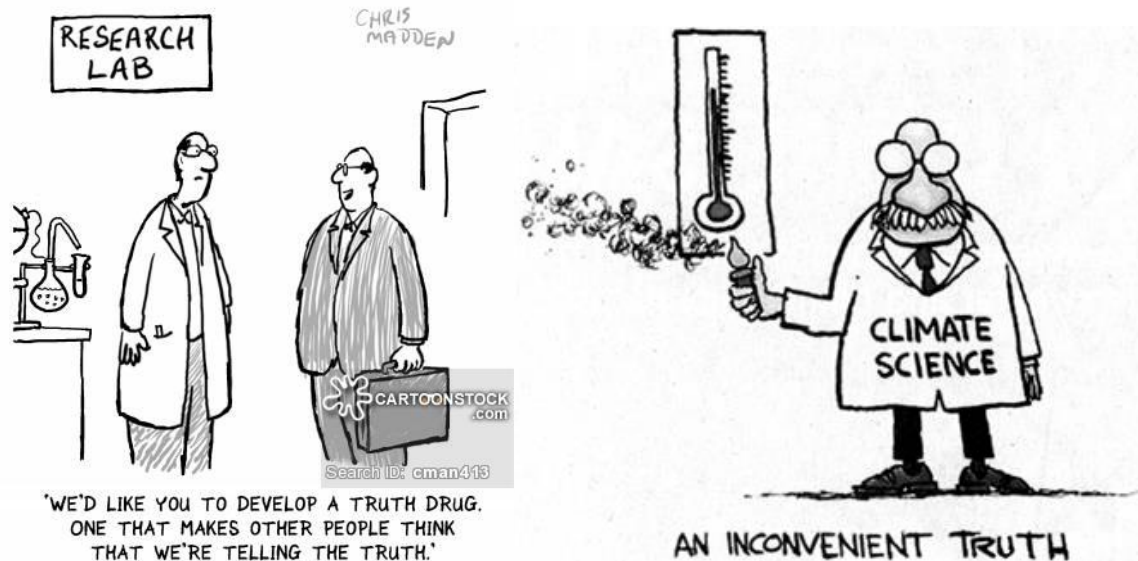


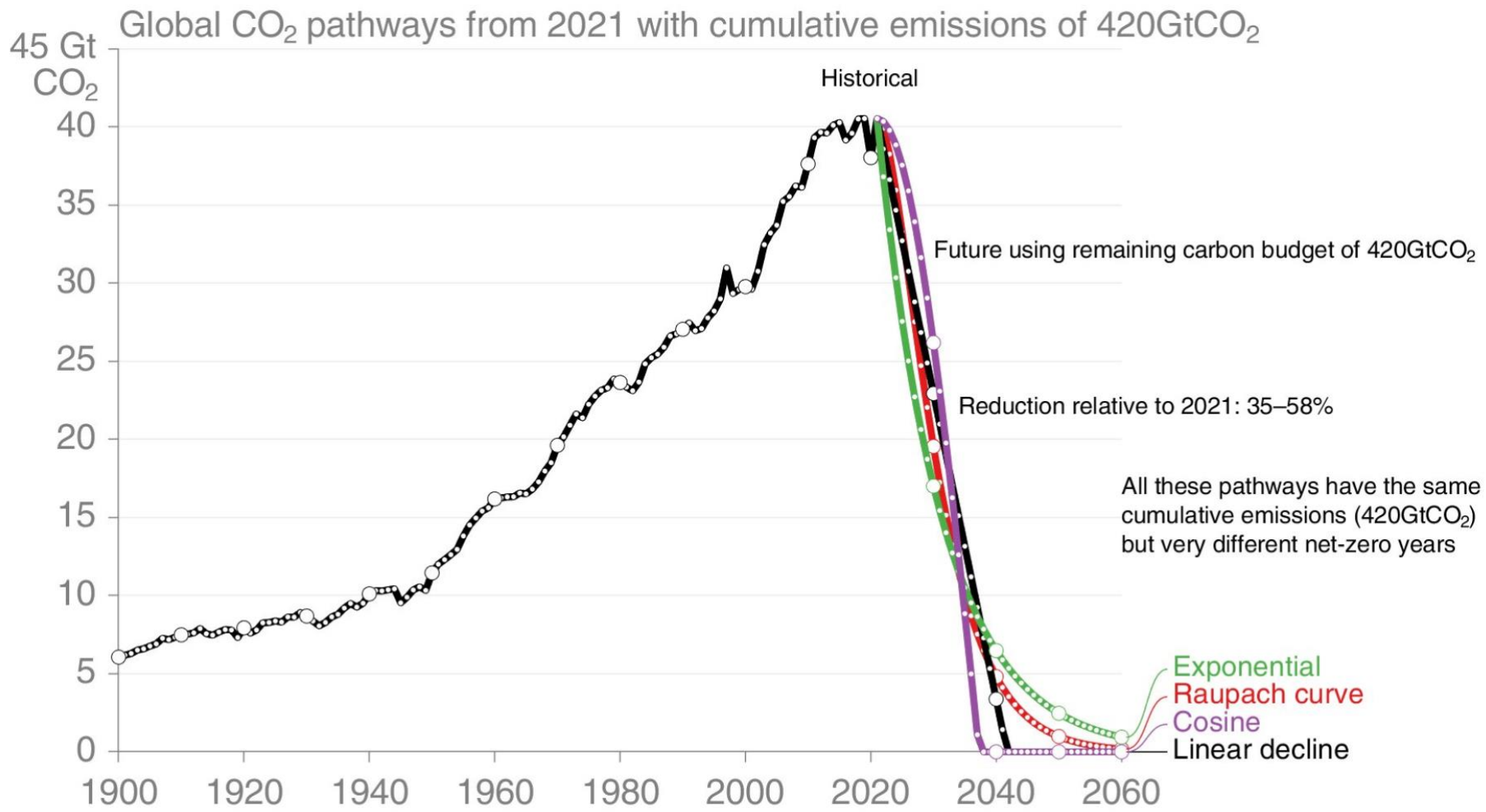


# Climate.now with built environment focus

## 5 credits

9.5.2023: Carbon spike and Whole Life Carbon

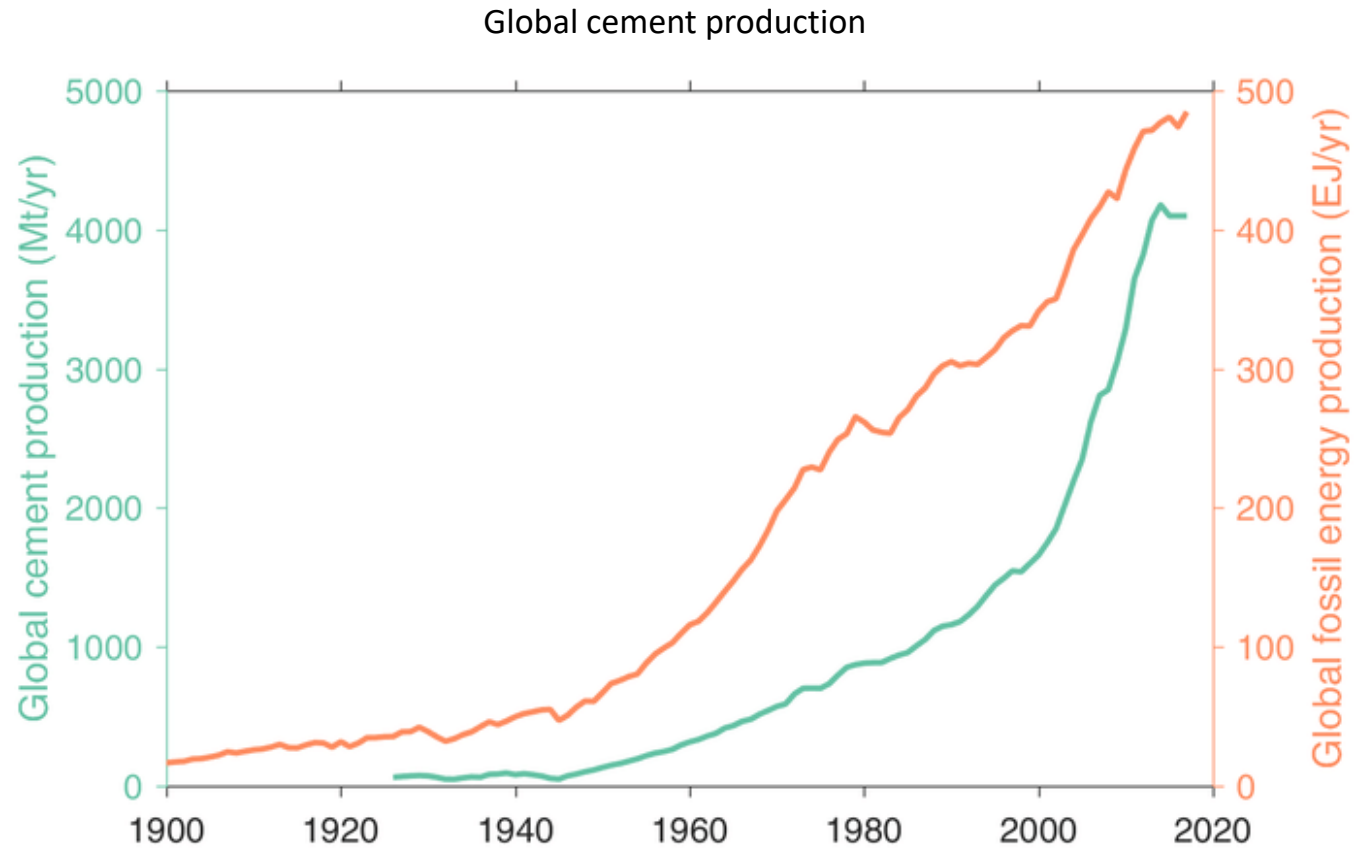




# Buildings

- 30-40% of global energy use and GHG emissions
- The majority during the use phase, but
  - The building stock renews slowly
  - Use phase emissions change along with the decarbonization of the energy sector
  - If we "invest" too much carbon in the pre-use phase, the result will never be a true low-carbon society
- It is somehow weird how we seem to think that something possibly happening far in the future justifies high-emission choices now

# Is there an ongoing green building transformation?







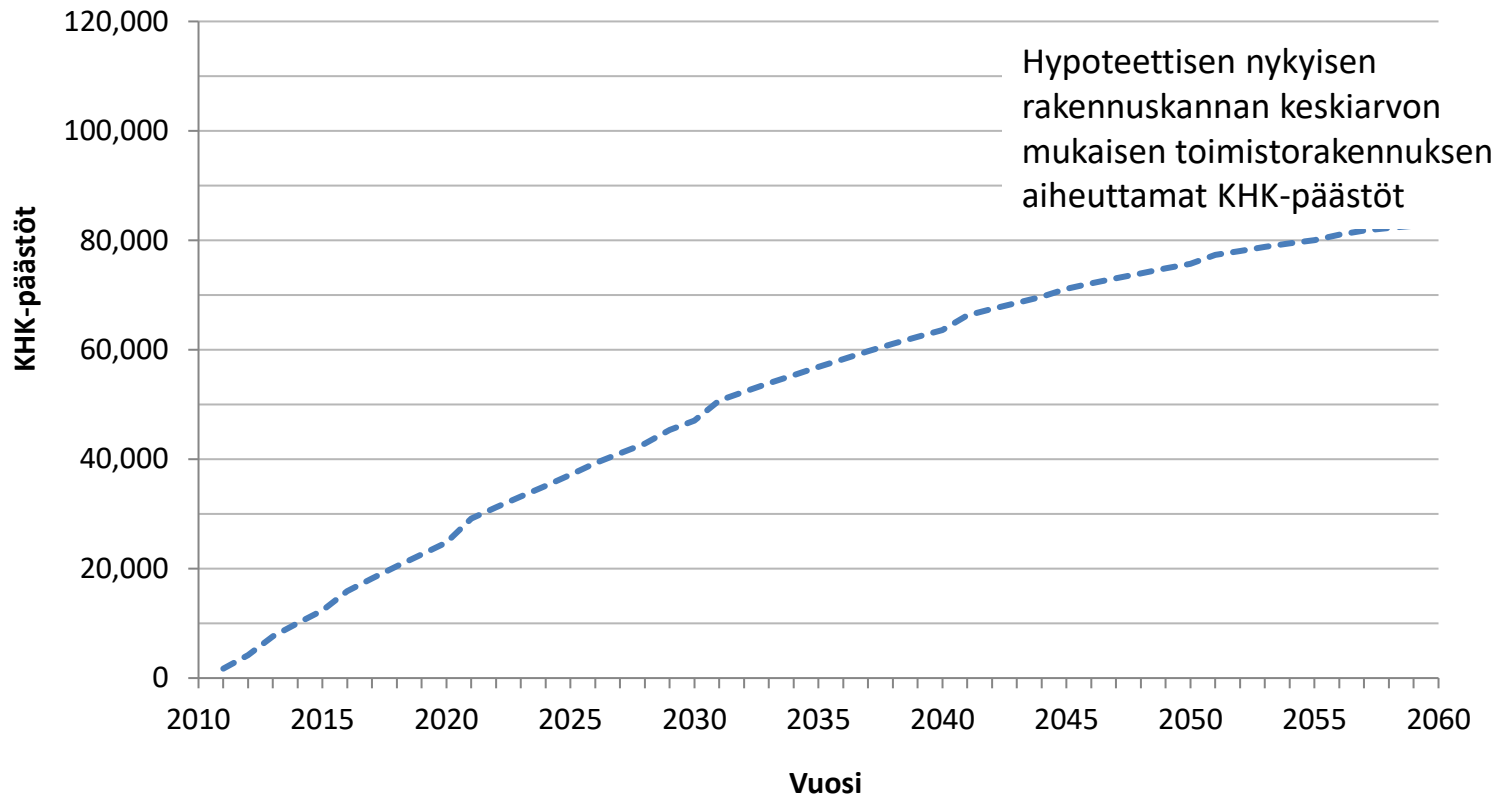
# Which one is a BREEAM building?

*“Vertical forest” building in Milan, Italy*



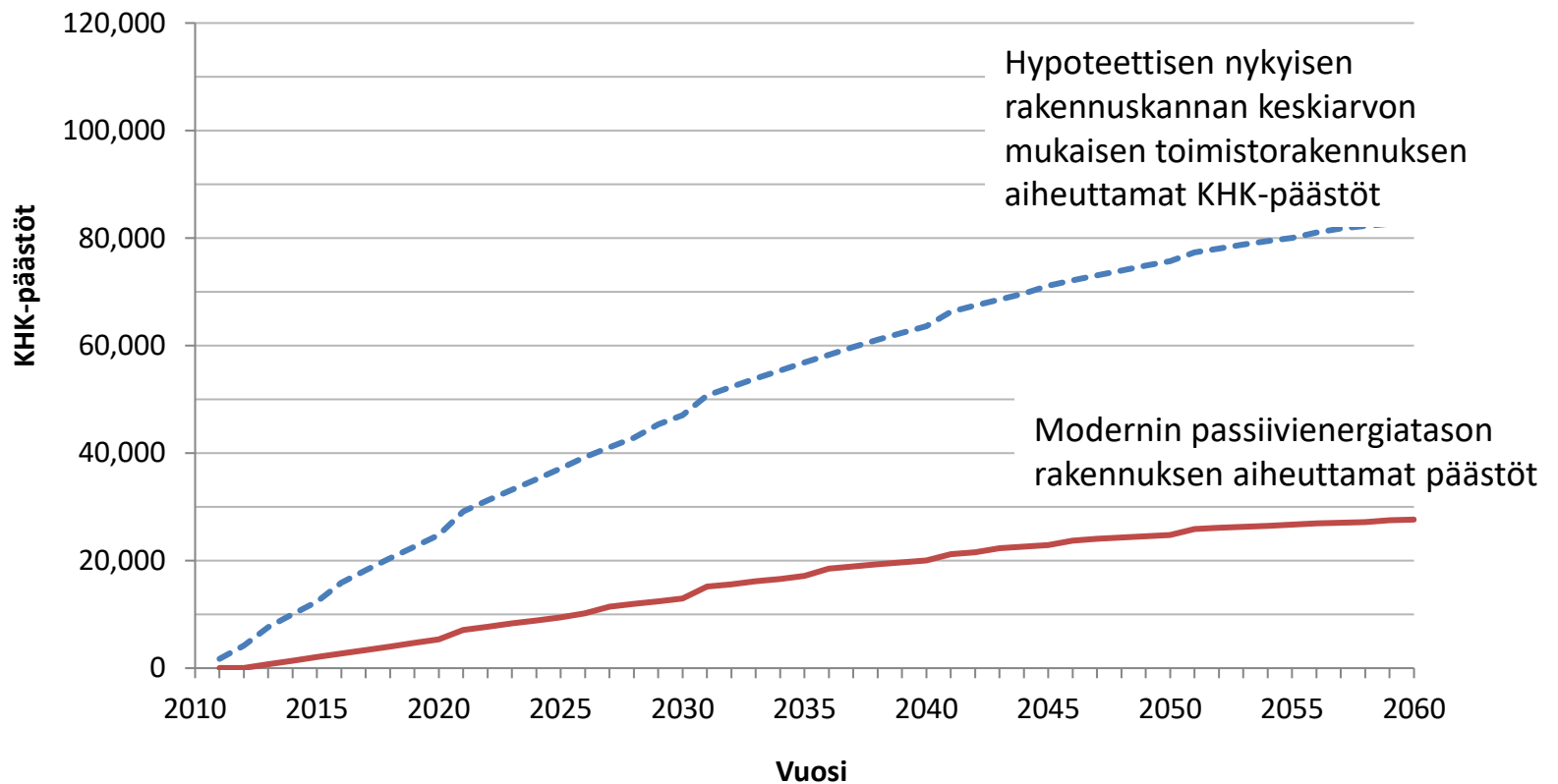
*“Veröld hus Vigdisar” building in Reykjavik, Iceland*

Nykyisen kaltainen rakentaminen on valtava ”hiili-investointi”, joka estää matalahiilisen yhteiskunnan saavuttamisen

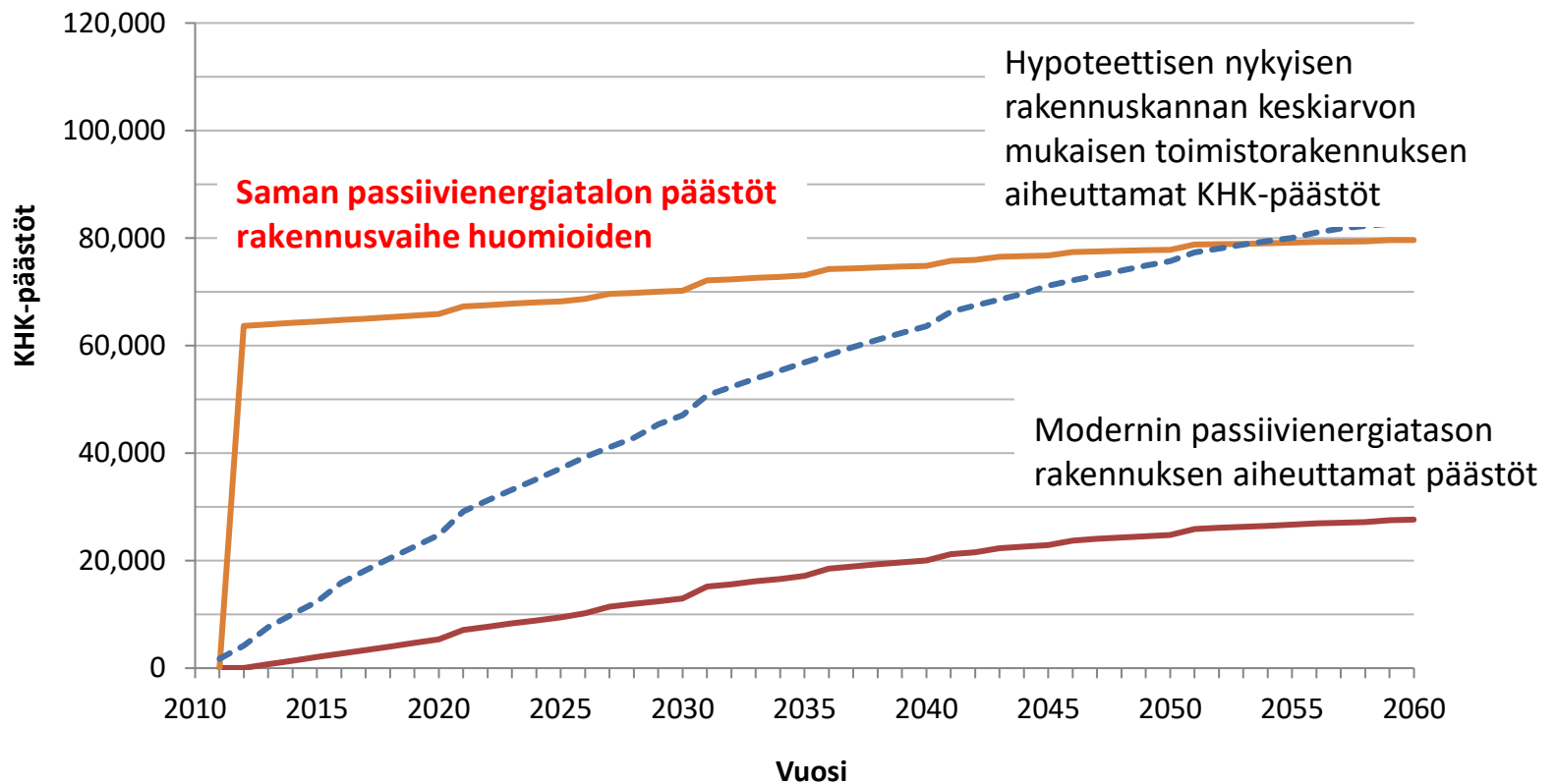




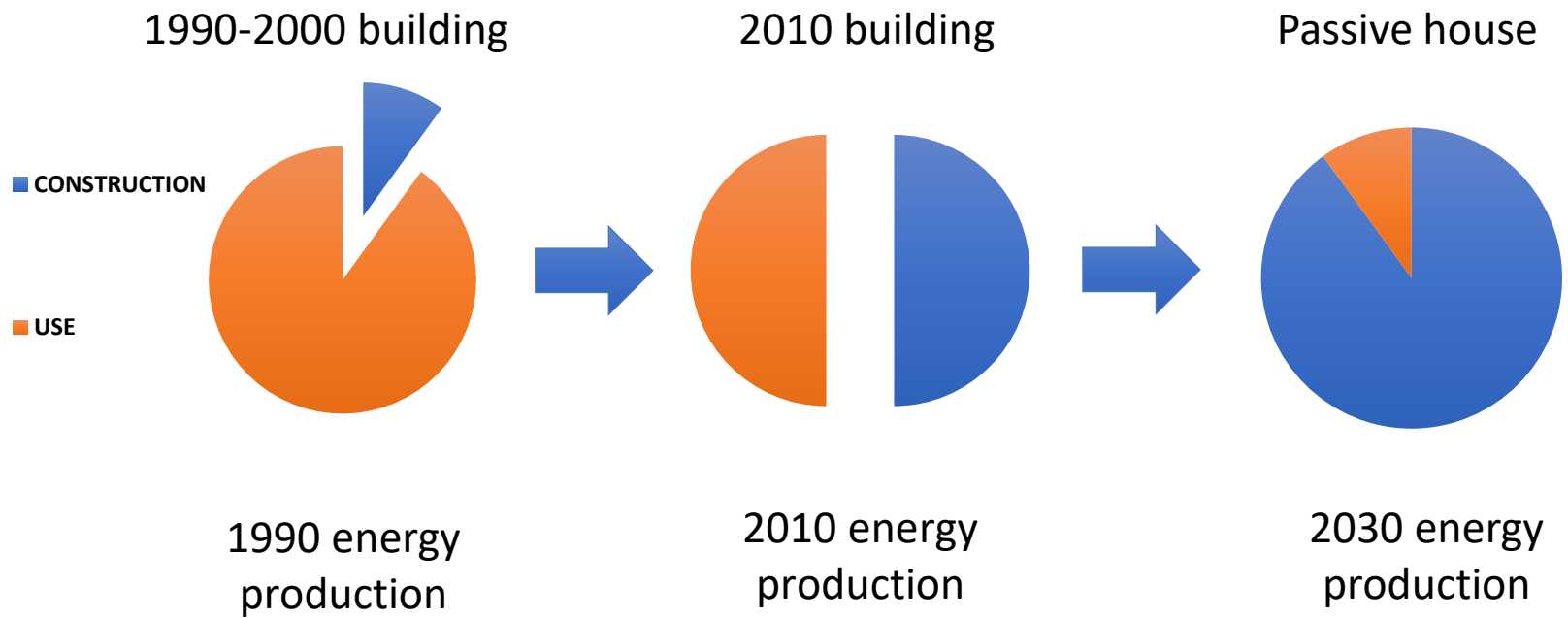
Nykyisen kaltainen rakentaminen on valtava ”hiili-investointi”, joka estää matalahiilisen yhteiskunnan saavuttamisen



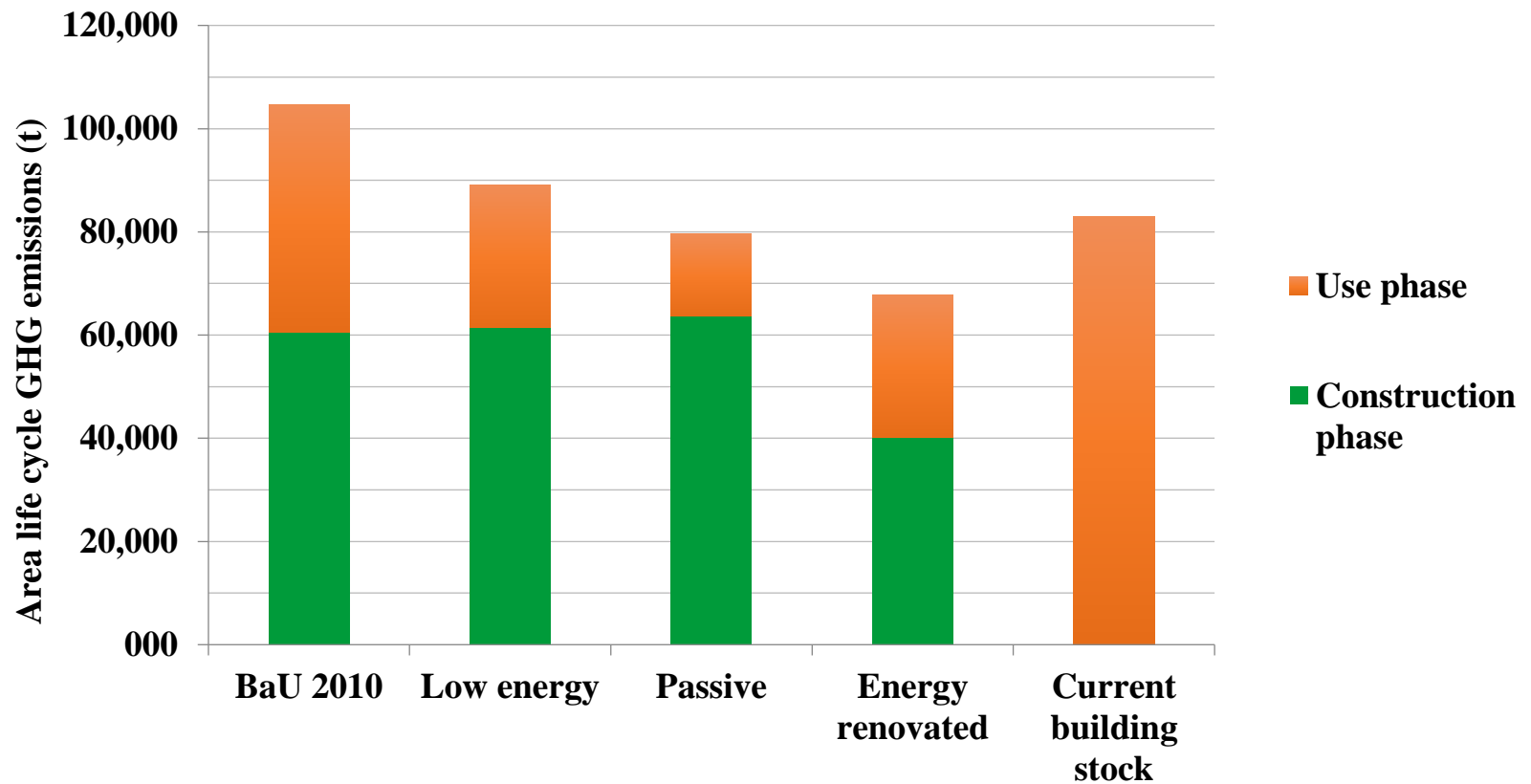
Nykyisen kaltainen rakentaminen on valtava ”hiili-investointi”, joka estää matalahiilisen yhteiskunnan saavuttamisen



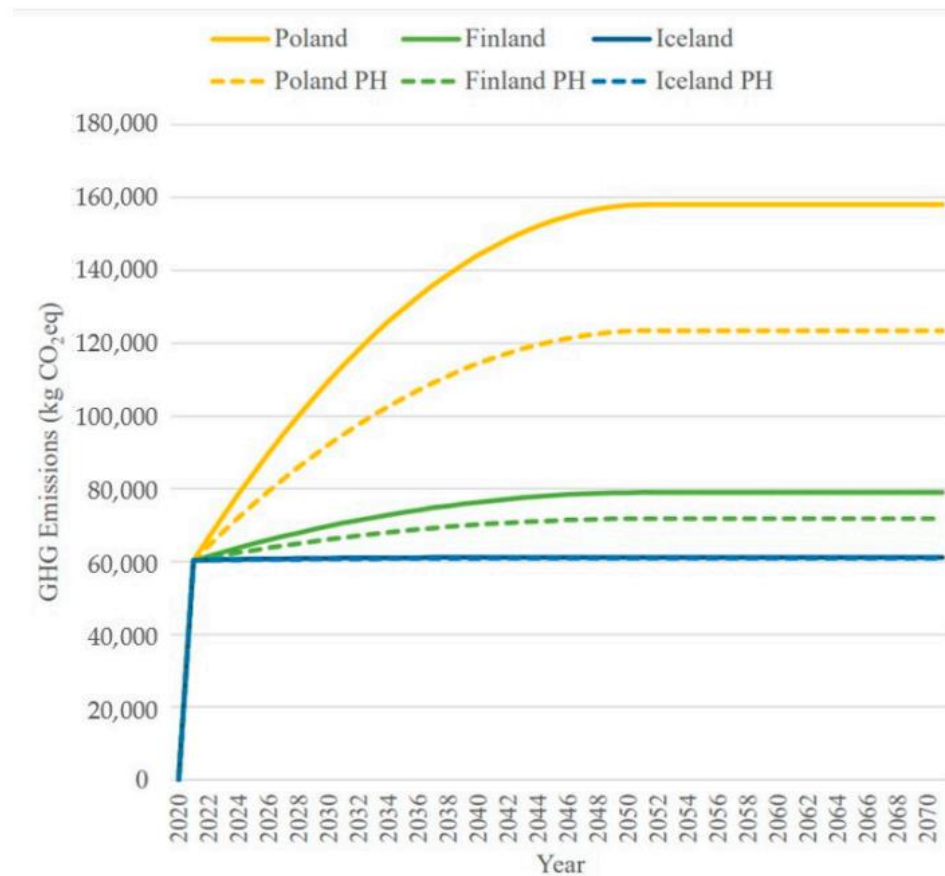
# Relative life cycle emissions of old and new buildings



# Emissions of a residential area over a 50-year life cycle



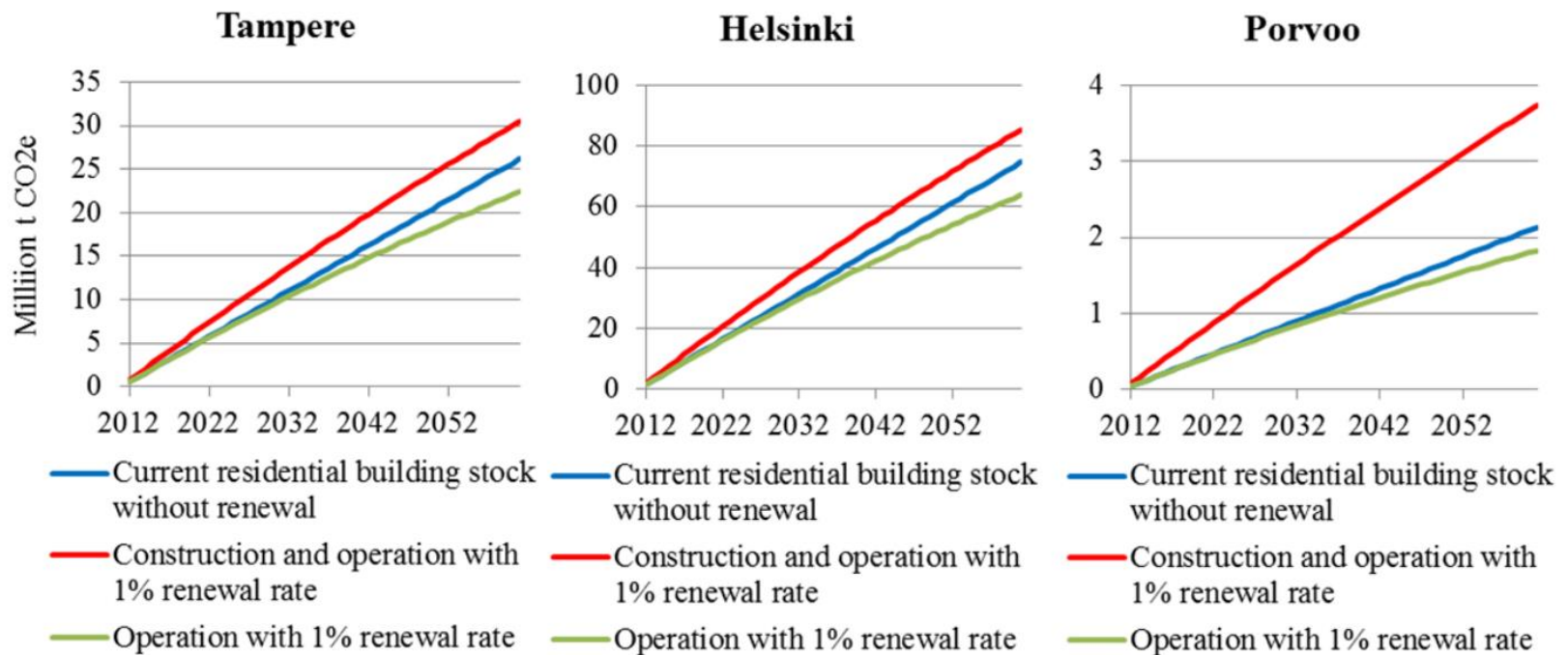
# The until end-of-life emissions of a detached house in three different locations



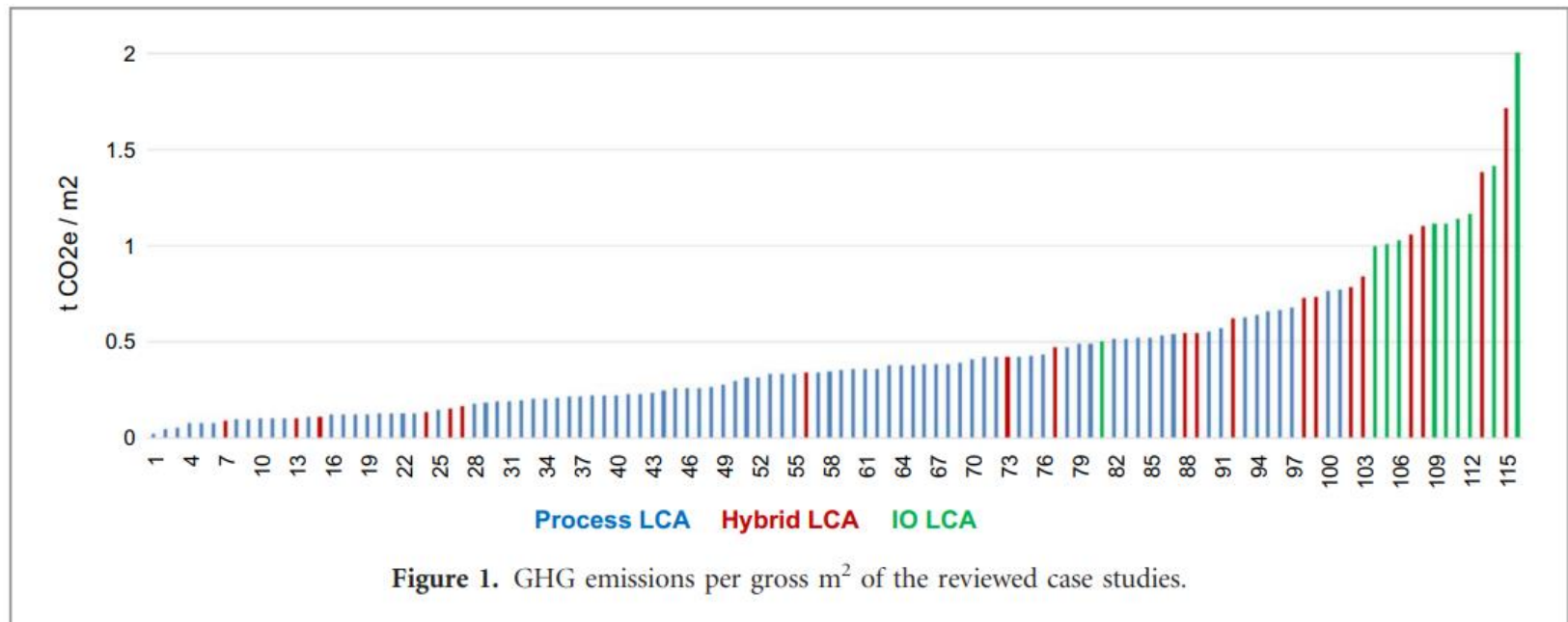
**Figure 8.** Lifetime GHG emissions over a 50-year timeframe in three geographic locations: Iceland, Poland, and Finland. Scenario 1, represented by the solid lines, utilizes current building standards for each respective country. Scenario 2, represented by dotted lines, reflects the Passive House standard.

# If we don't reduce the embodied carbon, there won't be a low-carbon future built environment

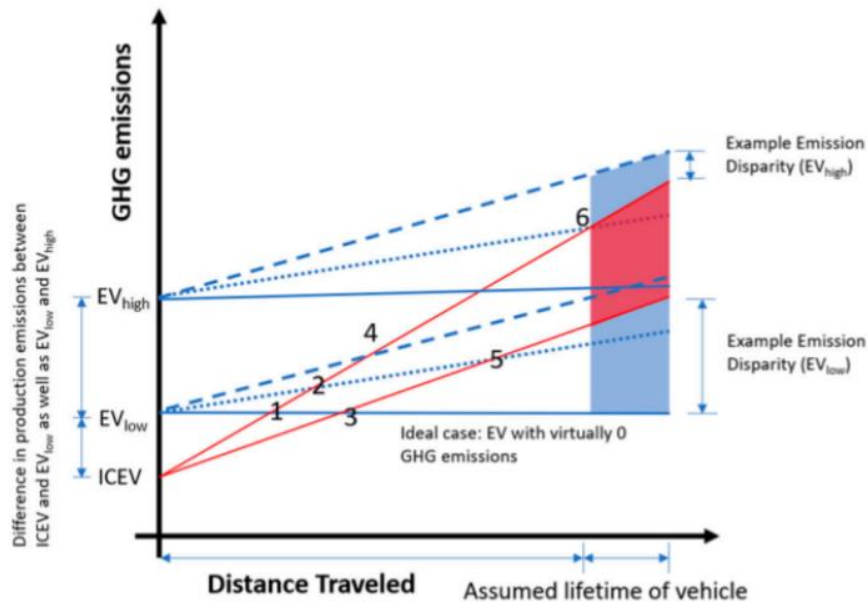
**Figure 2.** Impacts of construction phase emissions on the green house gases (GHGs) from the residential building stock in the case cities.



# High variation in pre-use phase LCA results though



# A similar transport sector example

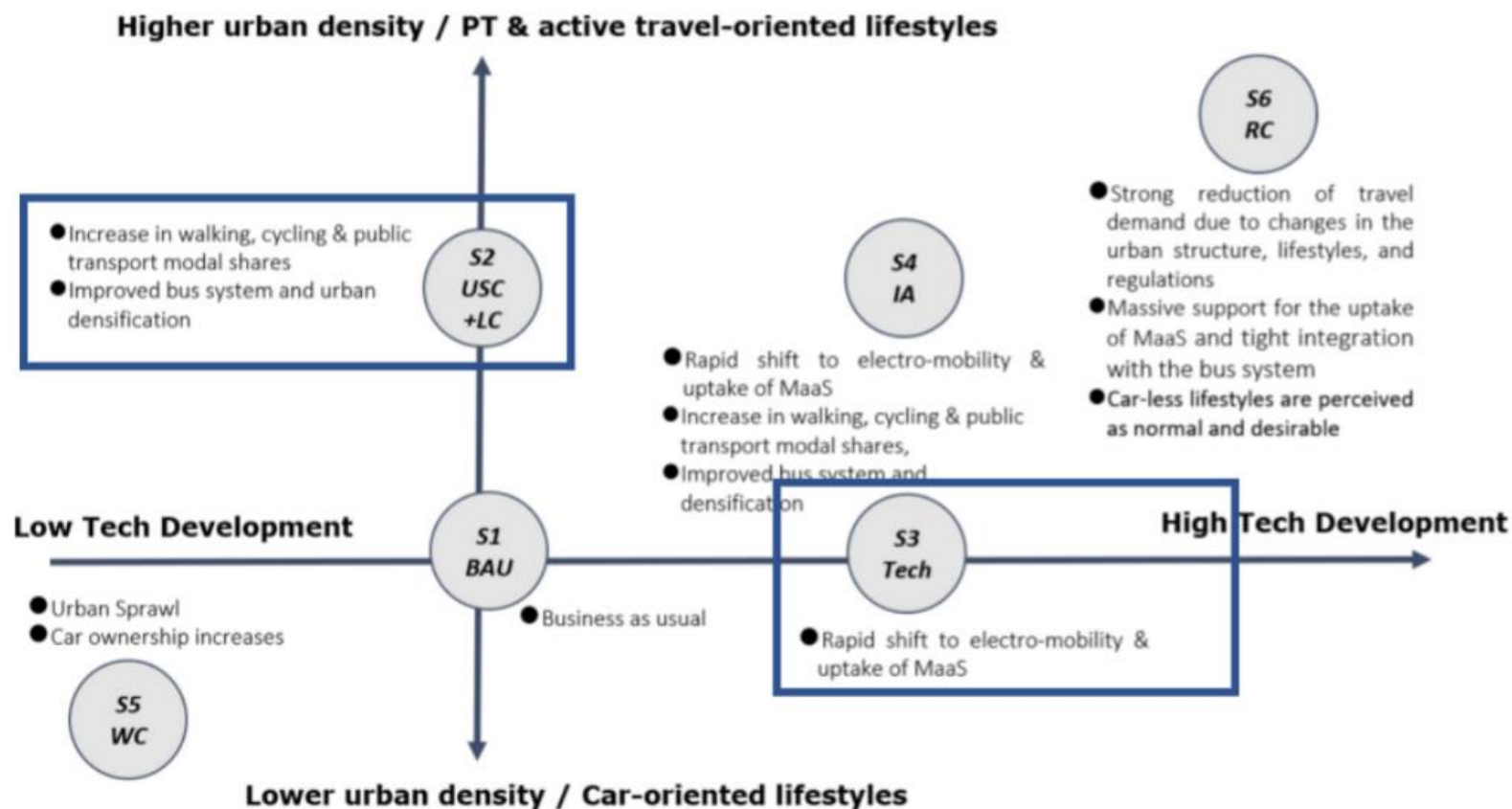


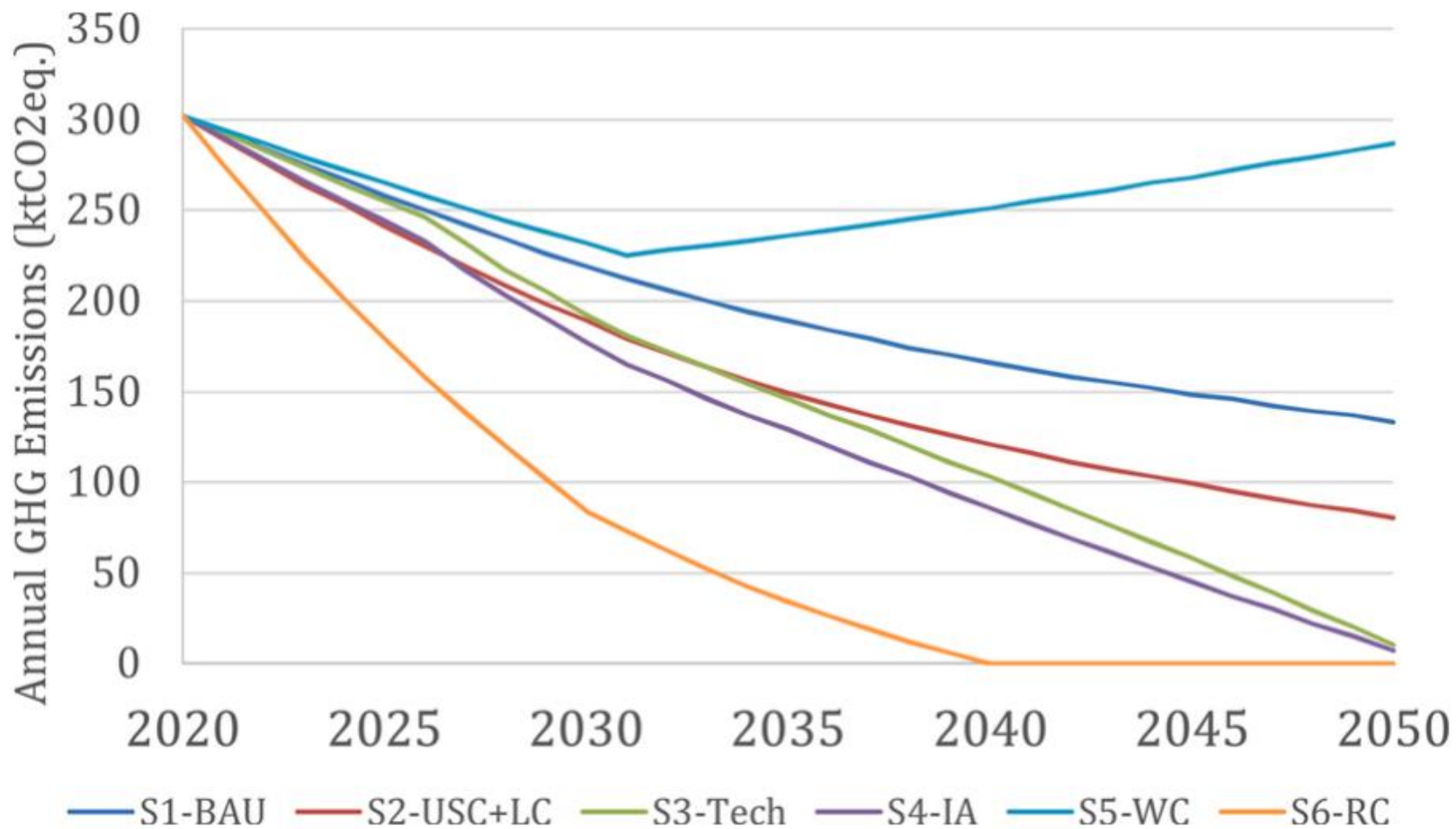
- Currently, EVs almost always have higher production emissions than a comparable combustion vehicle because of the embedded emissions in the battery pack
- It is in their operational phase where EVs generally see better environmental performance
- The breakeven point represents how far one would need to drive an EV in a certain grid context in order to have the same life cycle GHG emissions as a combustion vehicle

Potential distance of intersection points (DIP) of an internal combustion engine vehicle (ICEV), an electric vehicle (EV) with high production-phase emissions, and an EV with low production-phase emissions.

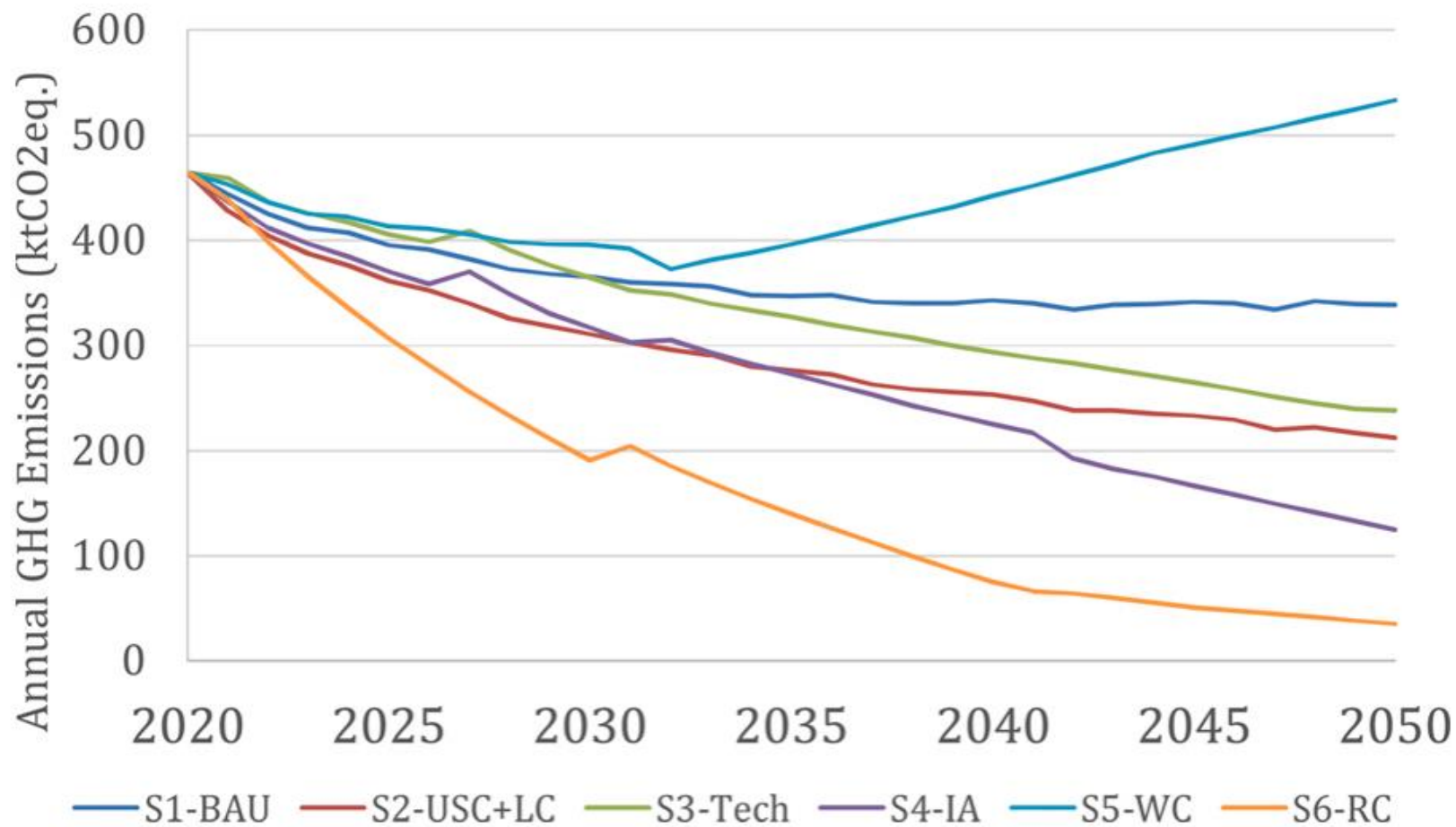


# Transport sector “carbon future”

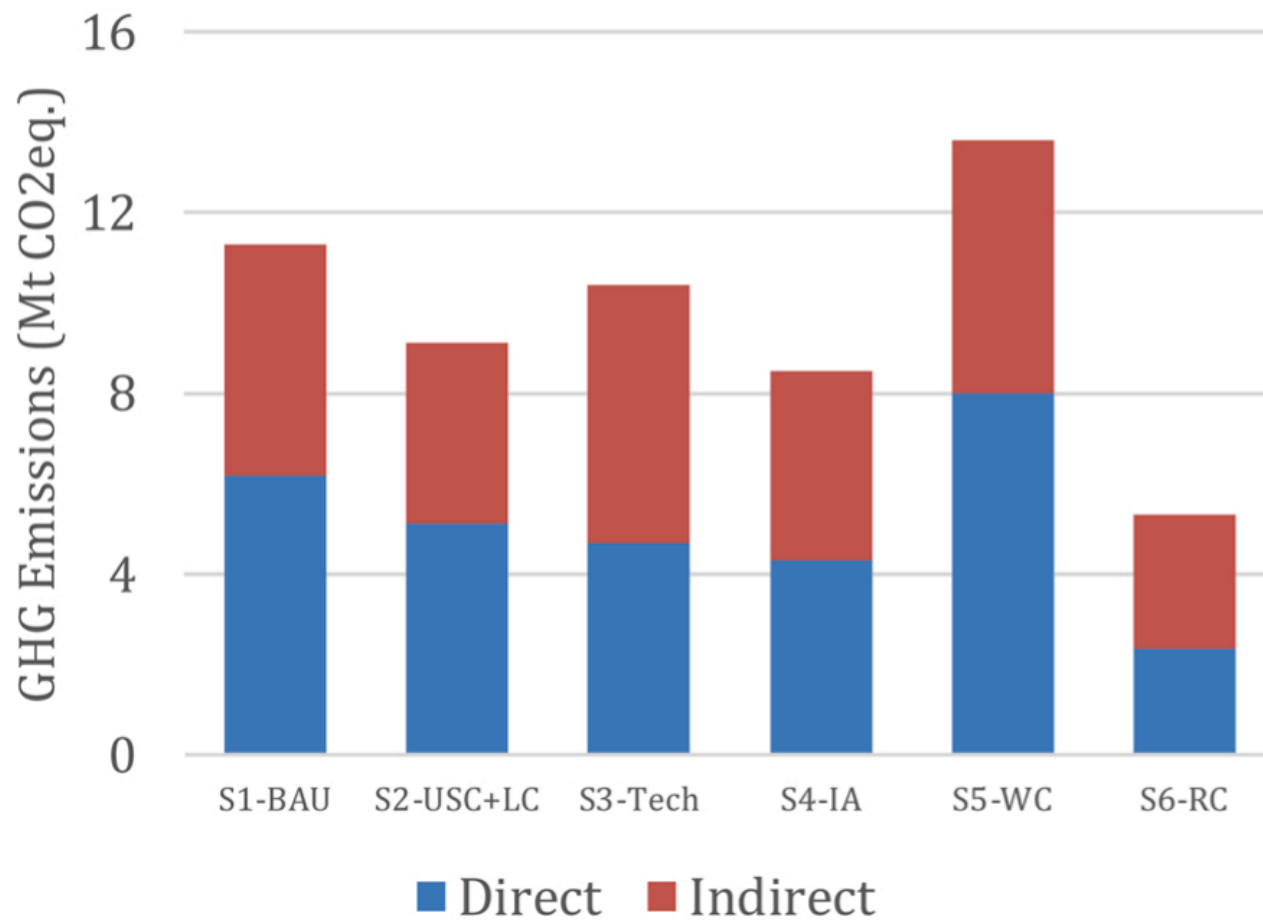




**Fig. 6.** Annual direct GHG emissions for all scenarios.



**Fig. 5.** Annual total GHG emissions for all scenarios.



**Fig. 8.** a) Cumulative GHG emissions from 2020-2050 for each scenario.

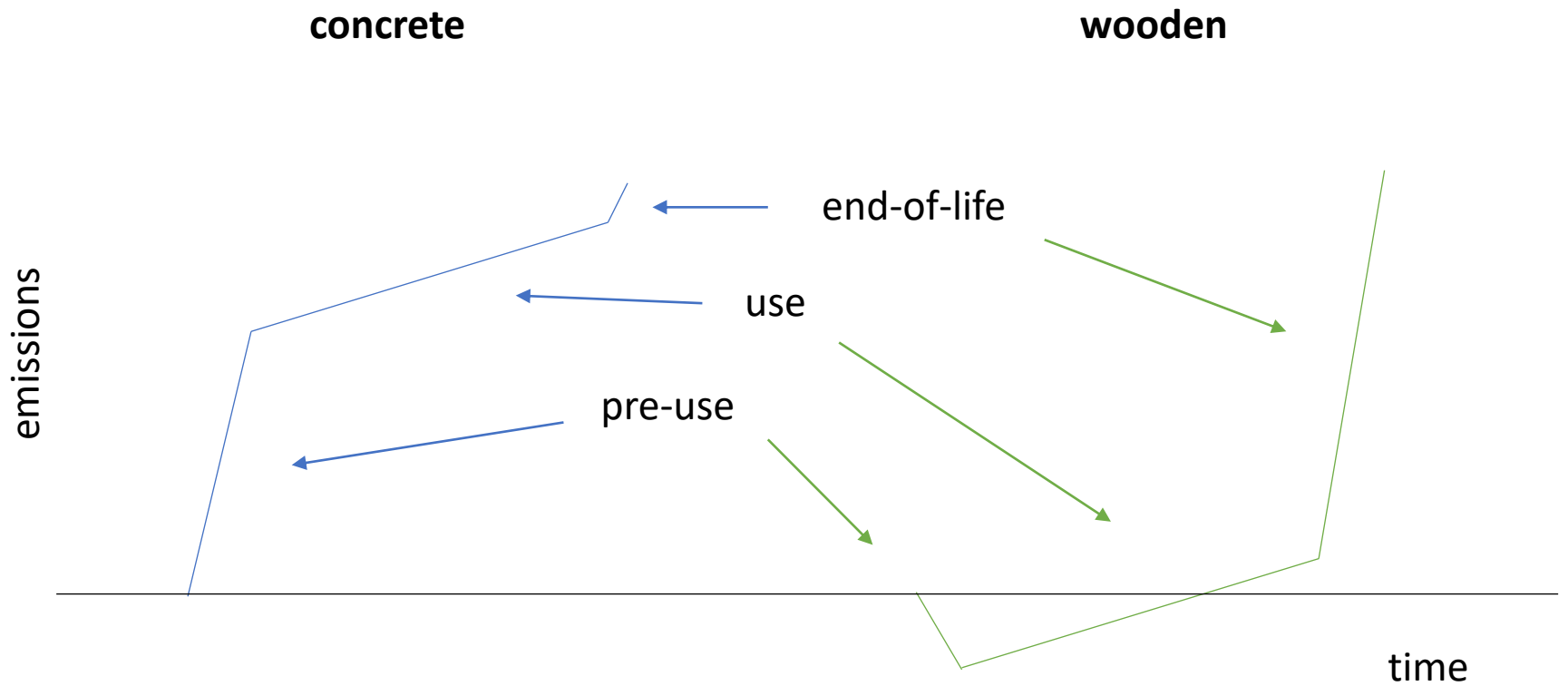
# Whole Life Carbon (WLC)

- Cradle to grave
- Currently no depreciation factors in use, but does it make sense?
  - When emissions should be dramatically reduced within 1-2 decades, is it a justified assumption that energy use will have the same impact in decades from now?
  - Or that end-of-life will have the same impact than now?
- Might lead to a very different decisions when making decisions about new buildings in terms of materials and energy efficiency

Life cycle stages	Product			Construction		Use stage							End-of-life				Benefits and loads beyond the system boundary	
	A1	A2	A3	A4	A5	Related to the building fabric					Related to the building operation		C1	C2	C3	C4	D	
						B1	B2	B3	B4	B5	B6	B7						
Modules	Raw material supply	Transport	Manufacturing	Transport	Construction	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal	Reuse / Recovery / Recycling potential	
	Scenarios																	
Type of EPD	Cradle to Gate <sup>1</sup>	M	M	M														
	Cradle to Gate with option(s) <sup>2,4</sup>	M	M	M	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	Cradle to Grave <sup>3,4</sup>	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Key	M mandatory			O optional														
Notes	<sup>1</sup> for a declared unit																	
	<sup>2</sup> for a declared unit or functional unit																	
	<sup>3</sup> for a functional unit																	
	<sup>4</sup> Reference Service Life to be included only if all scenarios are included																	

**Figure 1.** Life cycle stages according to the standard EN 15804 and boundary setting of this study.

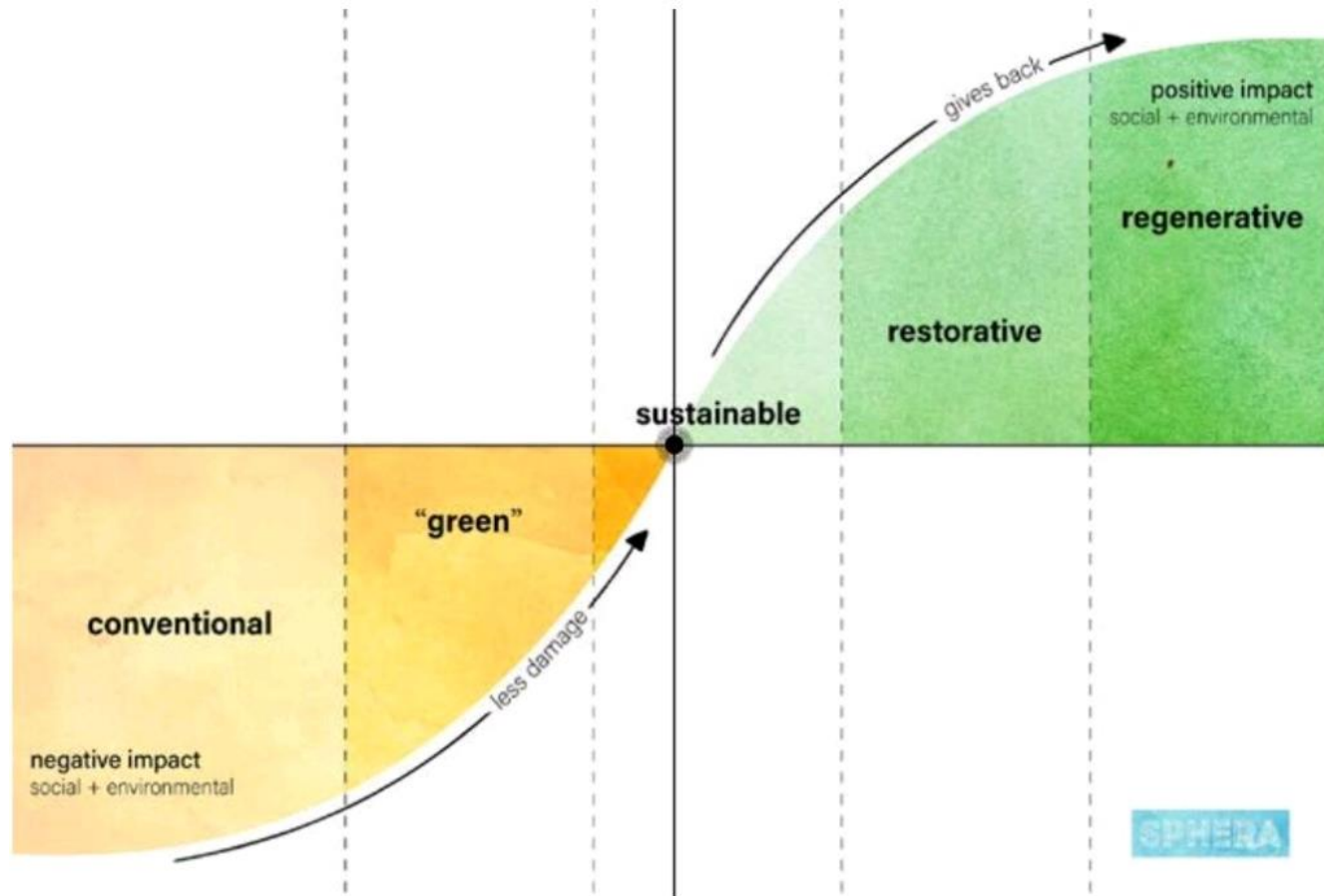
# Concrete vs. wooden, non-adjusted



Concrete vs. wooden, adjusted



# A paradigm shift is needed



# And the next lecture will be about this paradigm shift

- The built environment can store more carbon than is emitted during the production and operation combined
- It can be converted from a (big) part of the problem to a (major) solution
- Next week ONLINE at 14:15
  - "Carbon storing potential of the built environment"
  - Áróra Árnadóttir, CEO of the Green Building Council Iceland



The future is plant-based if it is to be sustainable



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