Potsdam Institute for Climate Impact Research

Carbon management: What's the point of CCS, CCU, CCC?

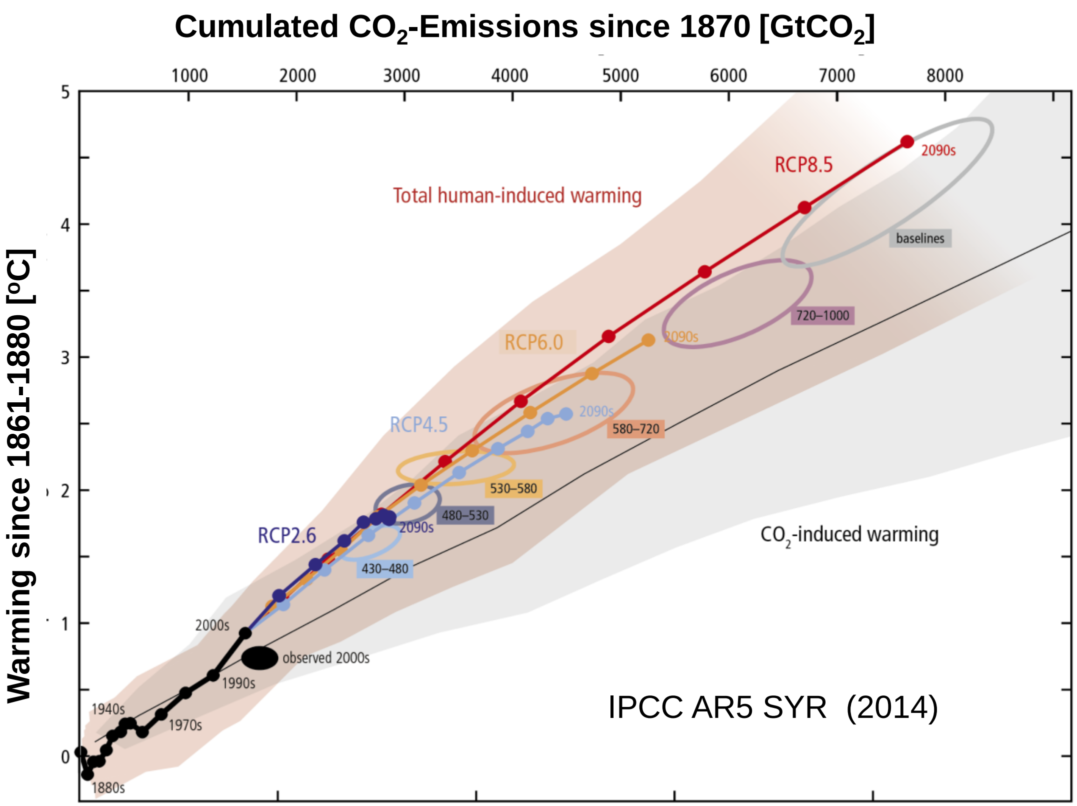
Gunnar Luderer and Falko Ueckerdt

Strommarkttreffen
Berlin, 29 June 2018

Leibniz Association

Energy Transition Hub – an Australian-German innovation partnership

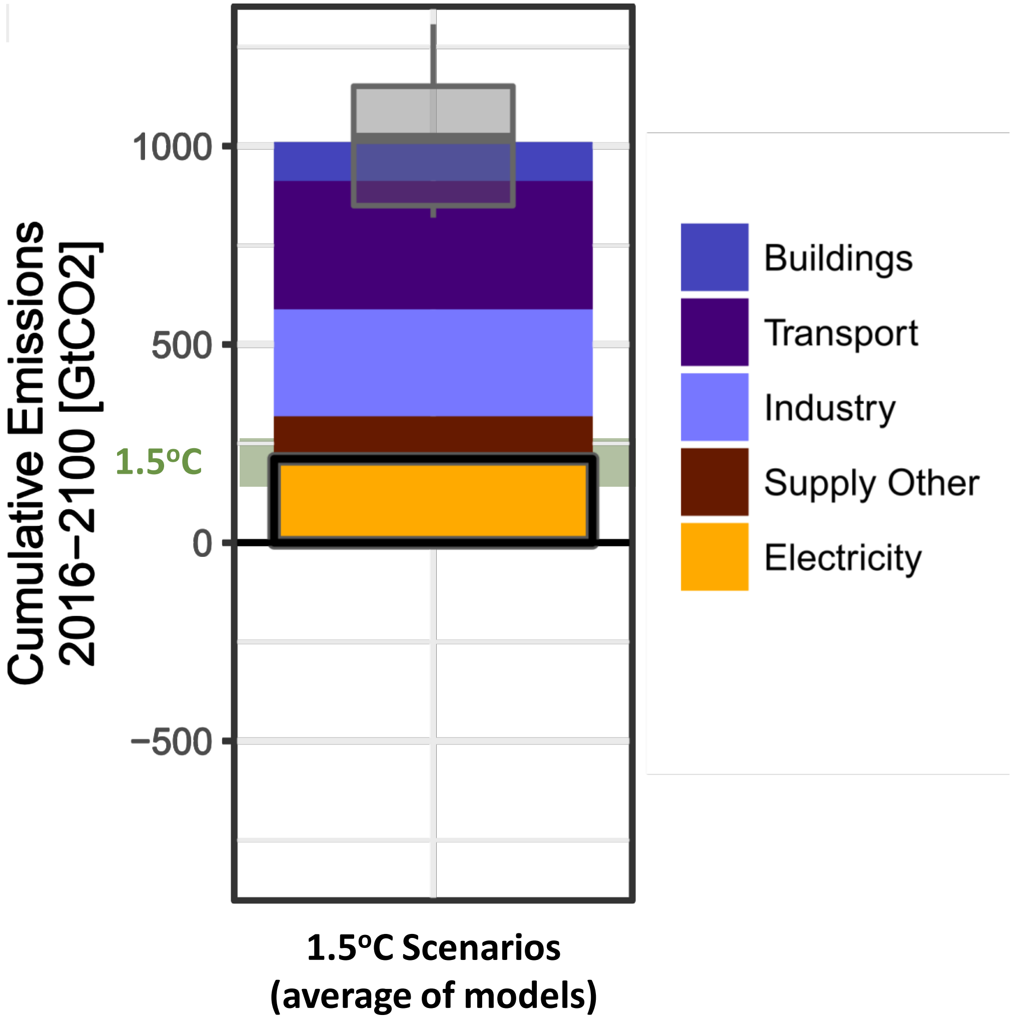
1.5 vs. 2°C: Warming is proportional to cumulative emissions



Global warming is roughly proportional to cumulative emissions

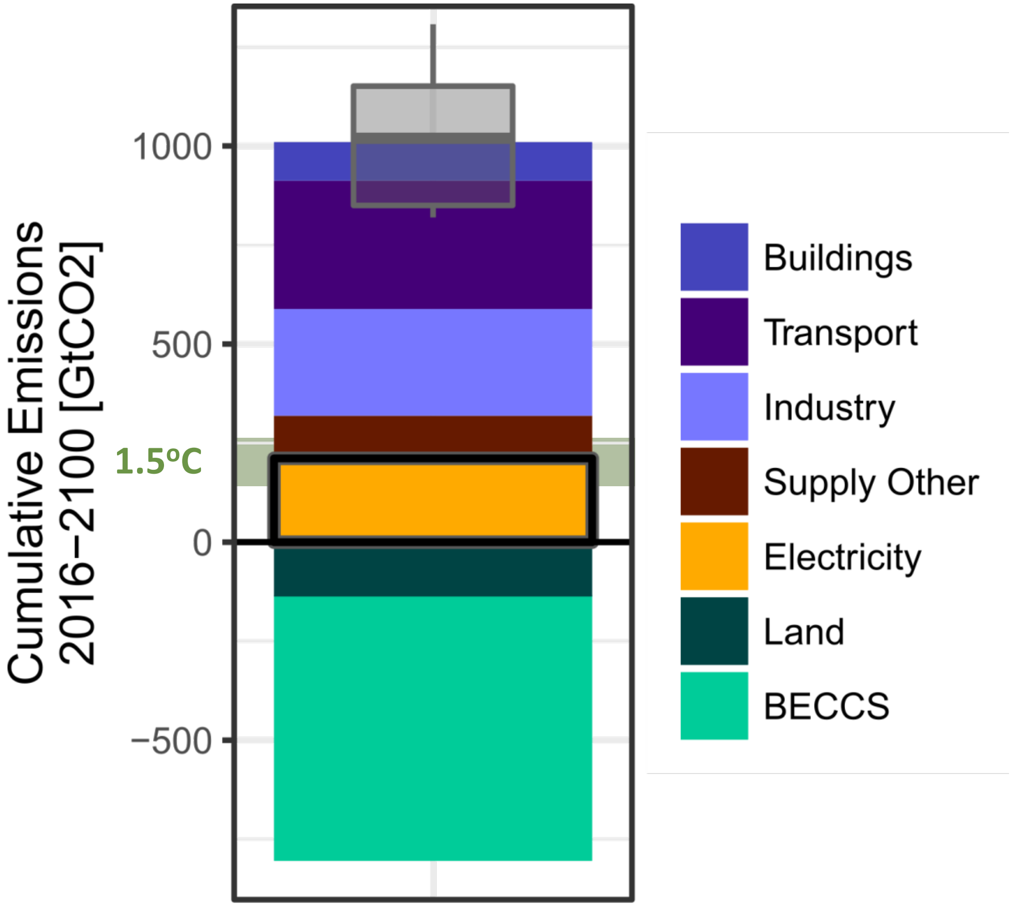
- There is a finite residual CO_2-budget ca. 800 $GtCO_2$ for well below 2°C, and ca. 200 $GtCO_2$ for 1.5°C
- Emissions have to be reduced to near-zero in the long-term

Sectoral breakdown



Luderer et al., NCC, (2018)

Sectoral breakdown

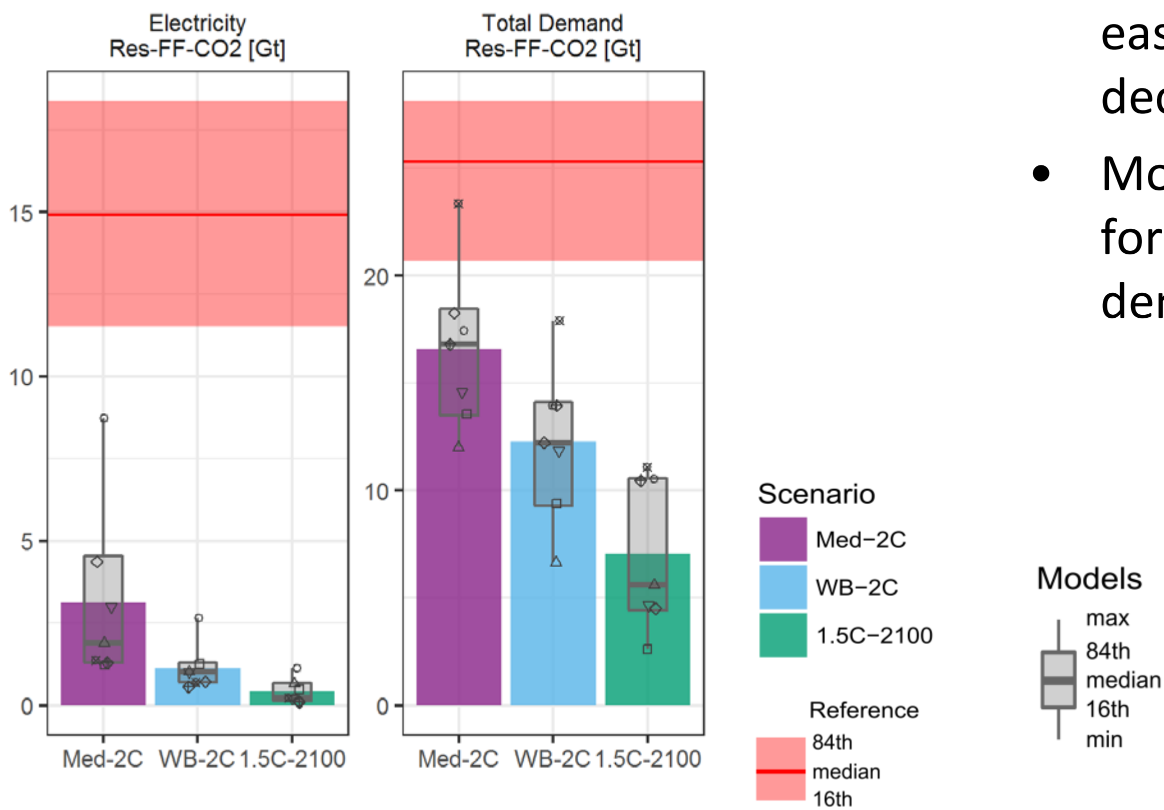


1.5°C Scenarios (average of models)

- Remaining fossil emissions of 1000 Gt CO_2, even with immediate and comprehensive climate action
- Major emissions from transport and industry
- Negative emissions required for 1.5° C limit

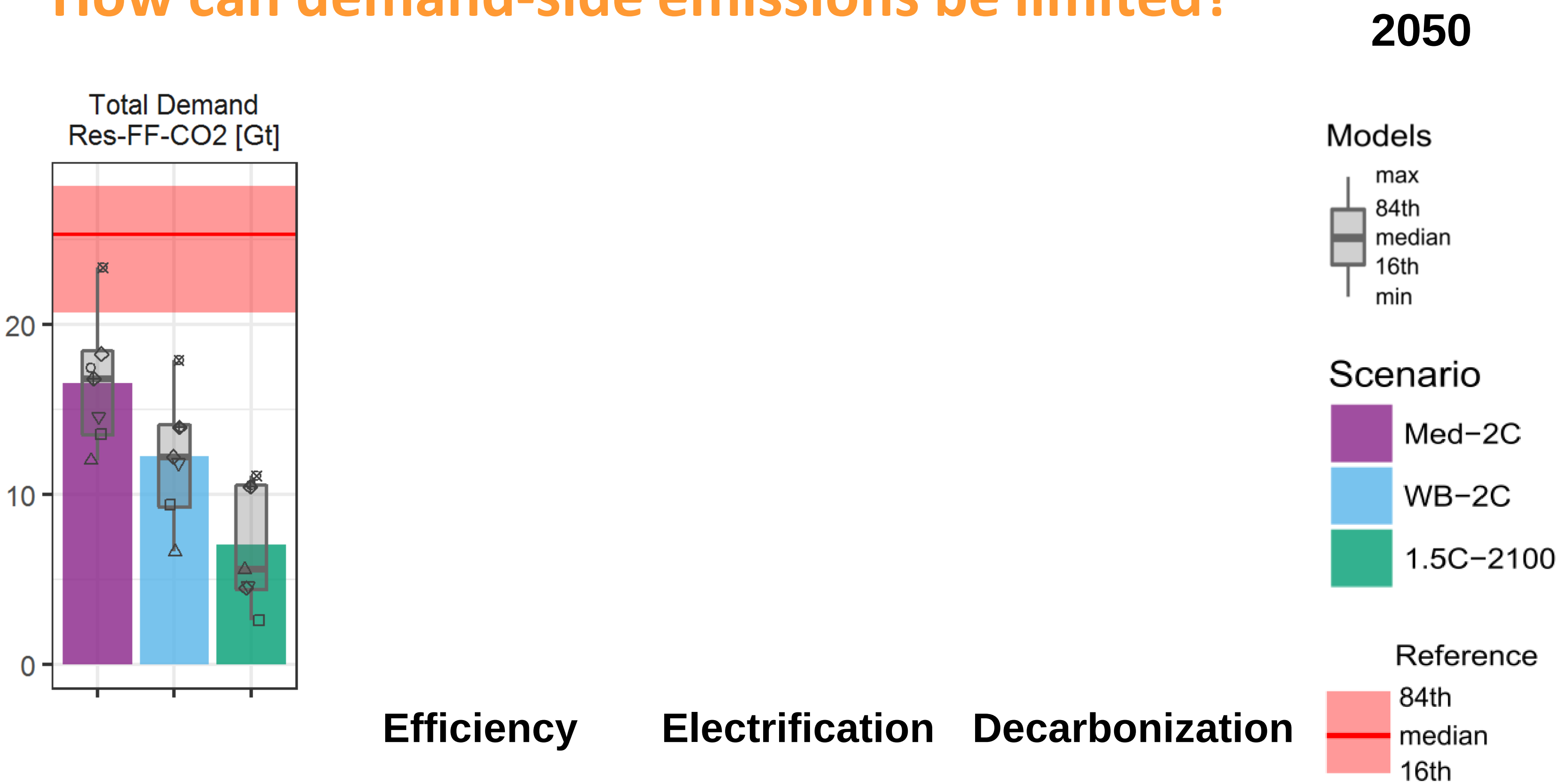
2050 emission reductions electricity vs. demand side

Fossil CO_2 emissions in 2050



- Electricity supply is much easier and faster to decarbonize
- Most of the incremental effort for 1.5°C over 2°C comes from demand side

How can demand-side emissions be limited?



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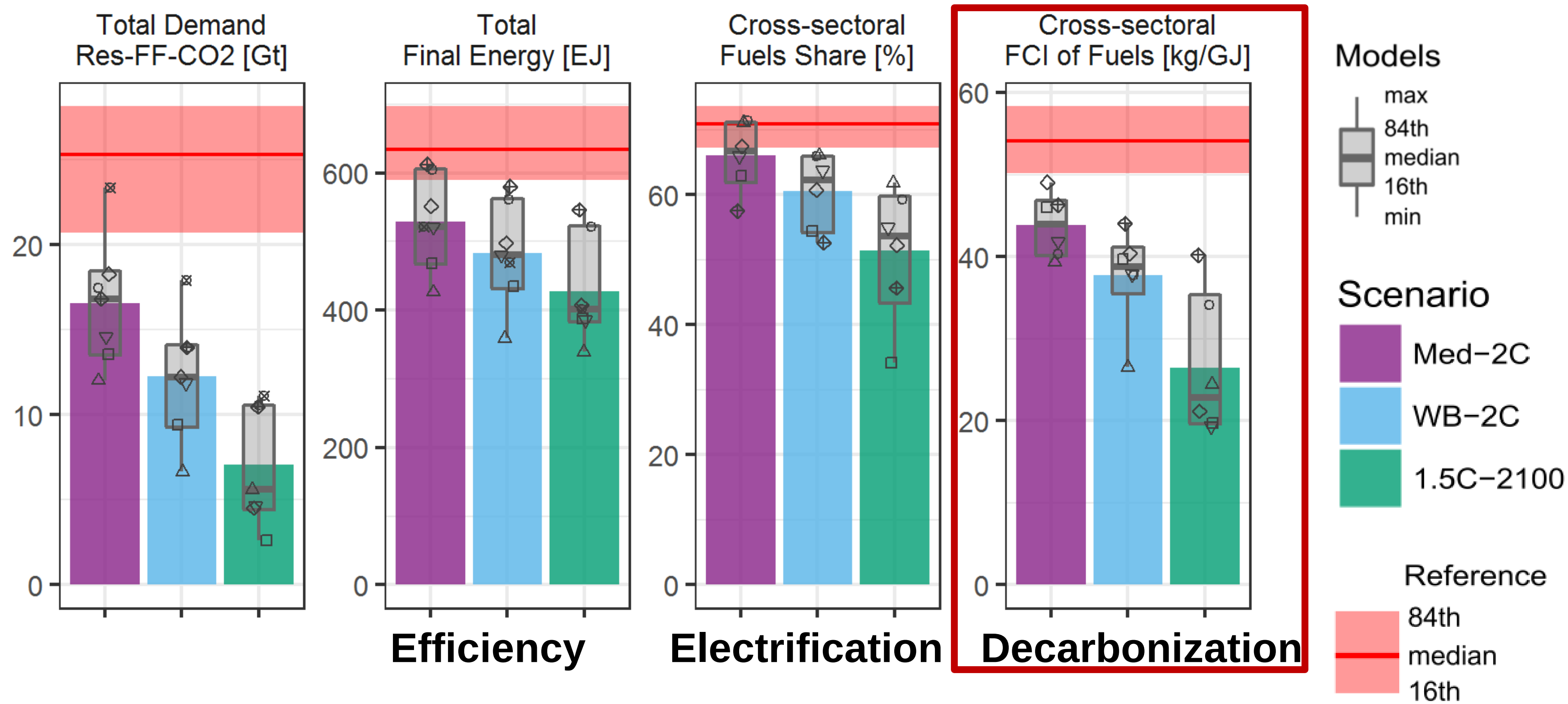
2050



Biomass, hydrogen,
industry CCS,
power-to-X

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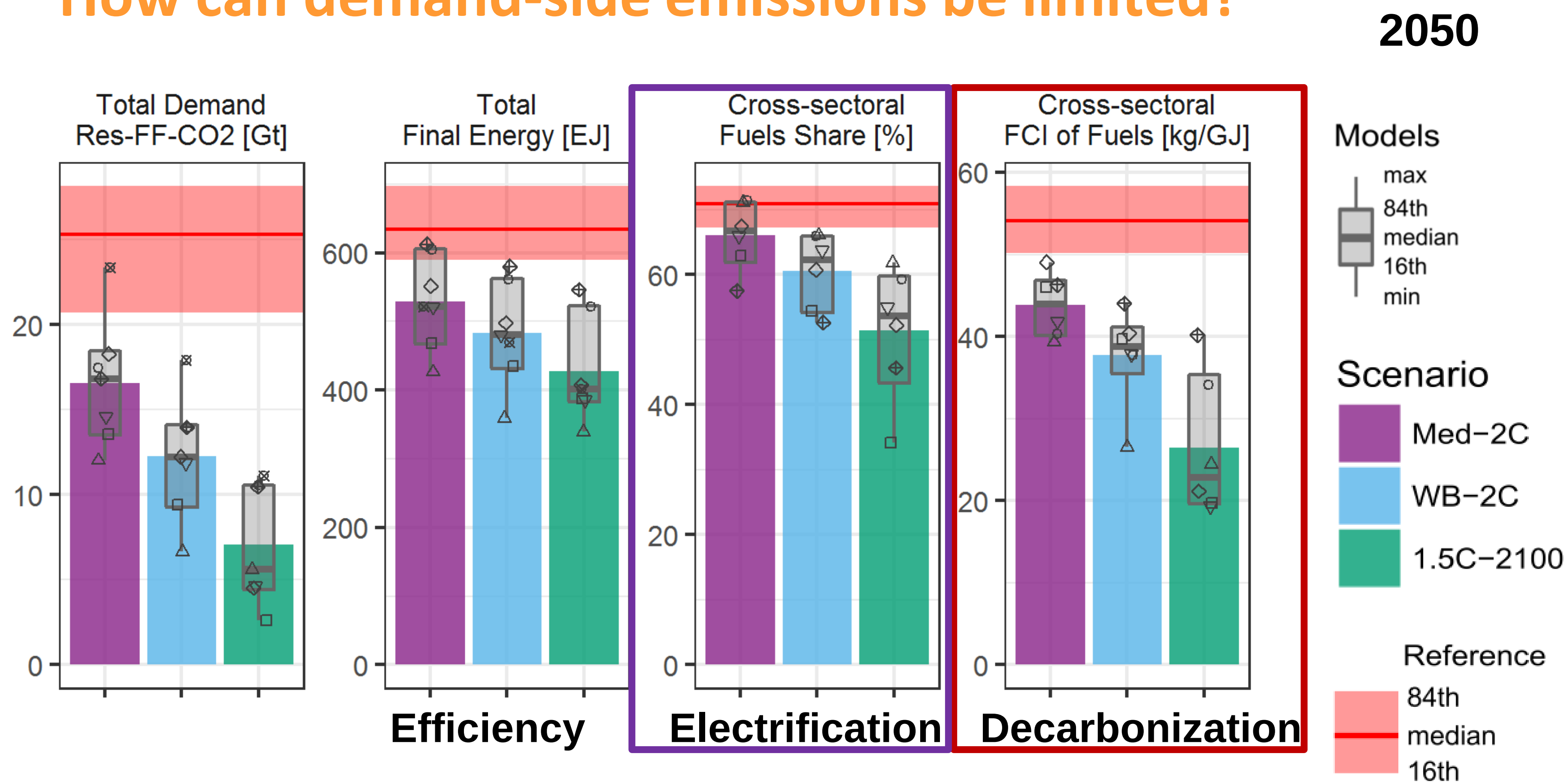

Direct electrification, e.g. freight transport, power-to-heat

vs.

Biomass, hydrogen, industry CCS, power-to-X

Concluding thoughts on CCU

- Most important use cases
  - storage / long-range transportation of renewable electricity
  - non-electrifyable end uses (aviation, freight, industrial processes)
  - combination with biofuel production
  - Material use, e.g. plastics, carbon fibres in building materials

- Key issues:
  - Not climate neutral unless carbon is renewable-based
  - Very high efficiency penalty
  - Need to consider economics and life-cycle impacts

Thanks!

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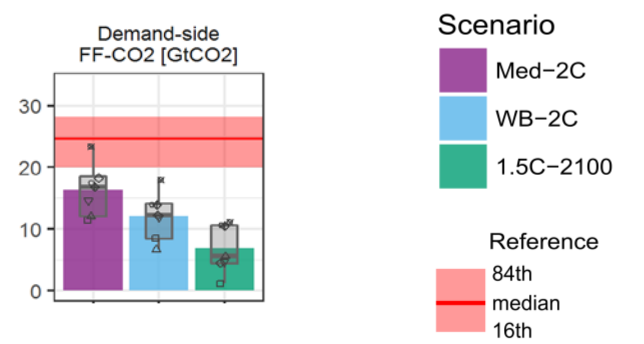
References:

Luderer, Vrontisi, et al. (2018): Residual fossil CO2 emissions in 1.5-2° C pathways. *Nature Climate Change* https://doi.org/10.1038/s41558-018-0198-6

Backup

How can demand-side emissions be limited?



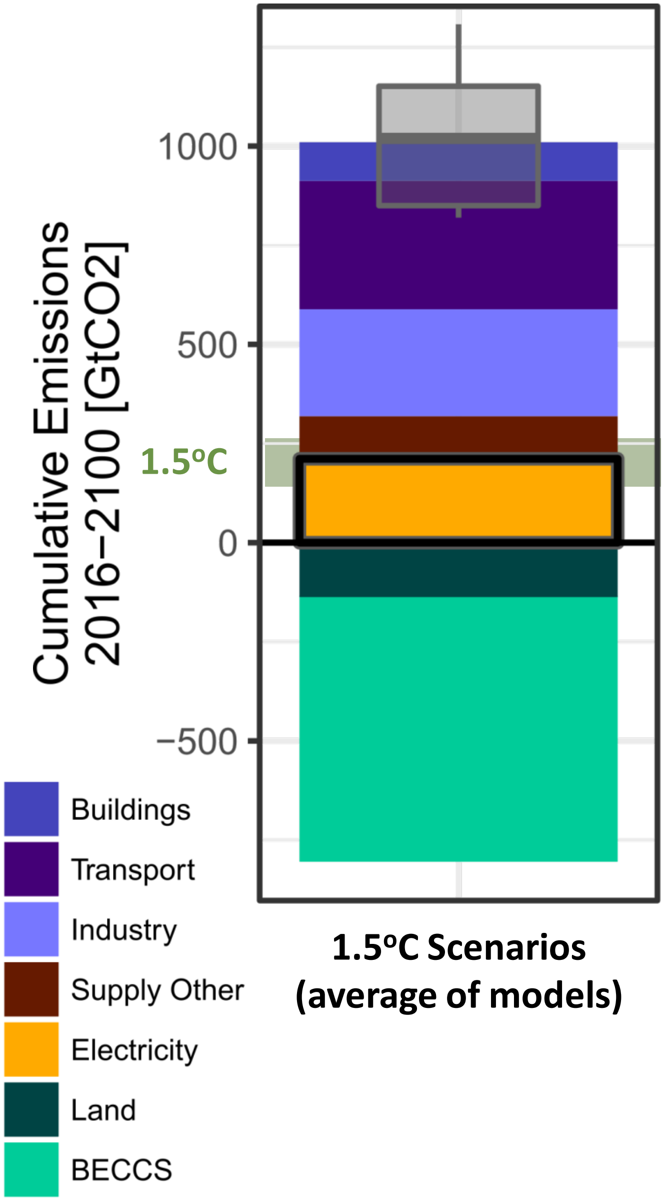
2050 indicators

I. Energy demand reductions (efficiency and sufficiency)

II. Reduction of combustible fuels (electrification)

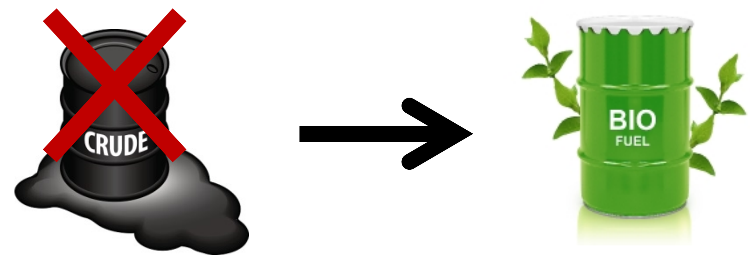
III. Decarbonization of fuels (mostly biomass, hydrogen)

The role of bioenergy for climate protection

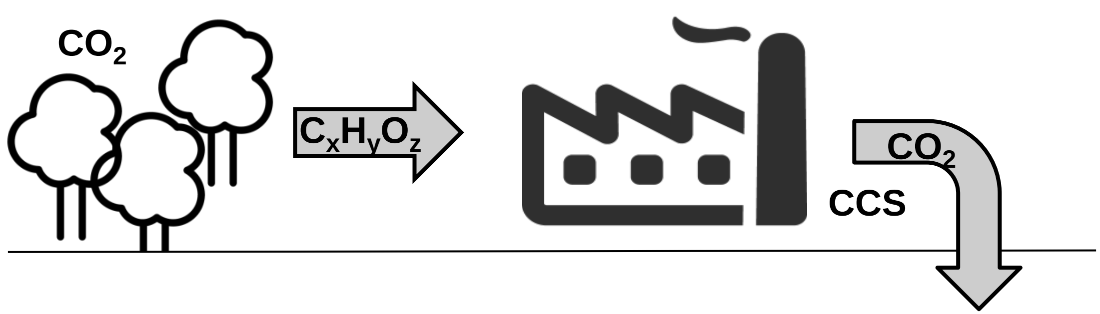


1.5ºC Scenarios
(average of models)

(1) Substitution of fossil energy



(2) Negative Emissions via combination with CCS (BECCS)



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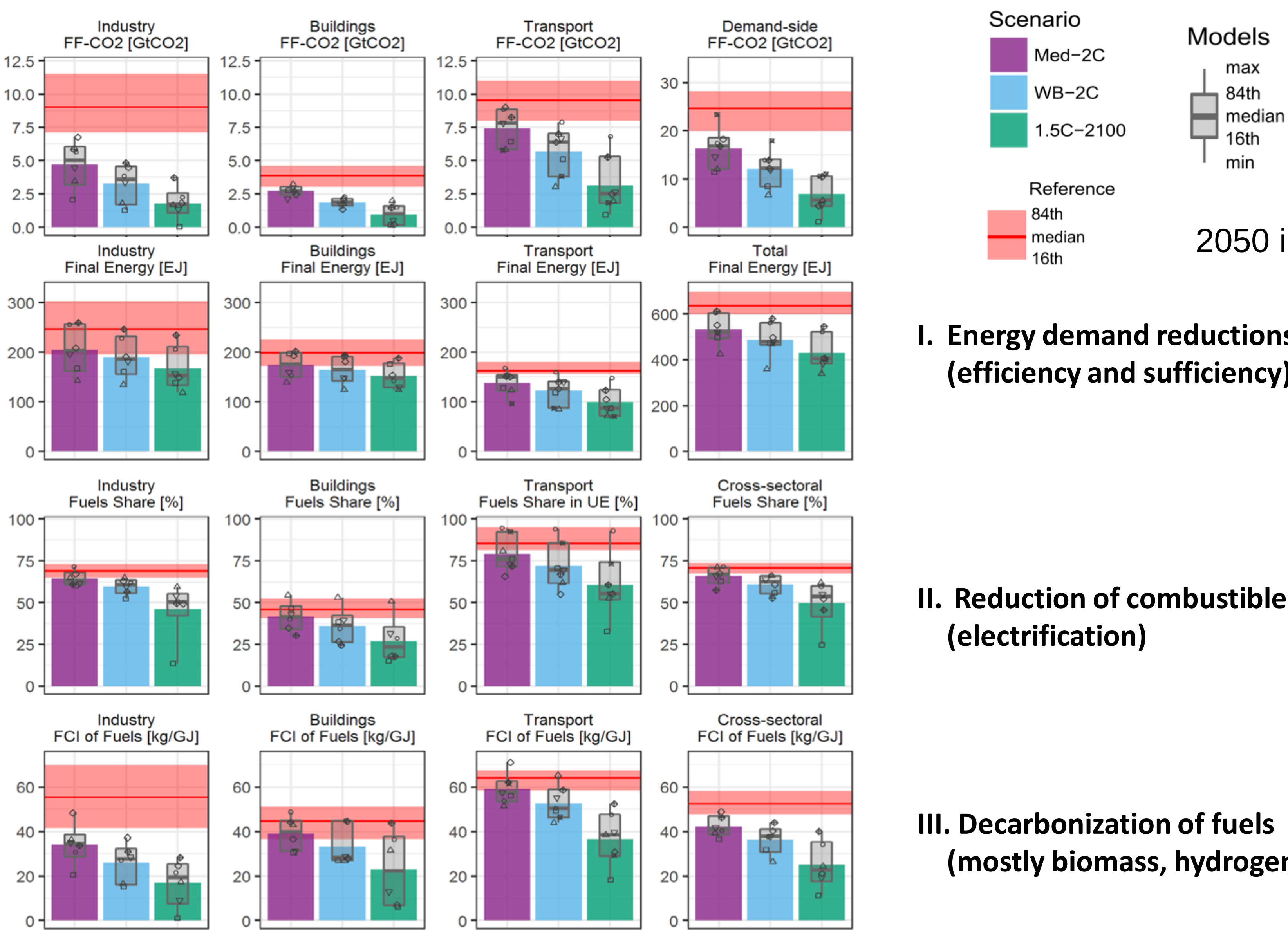

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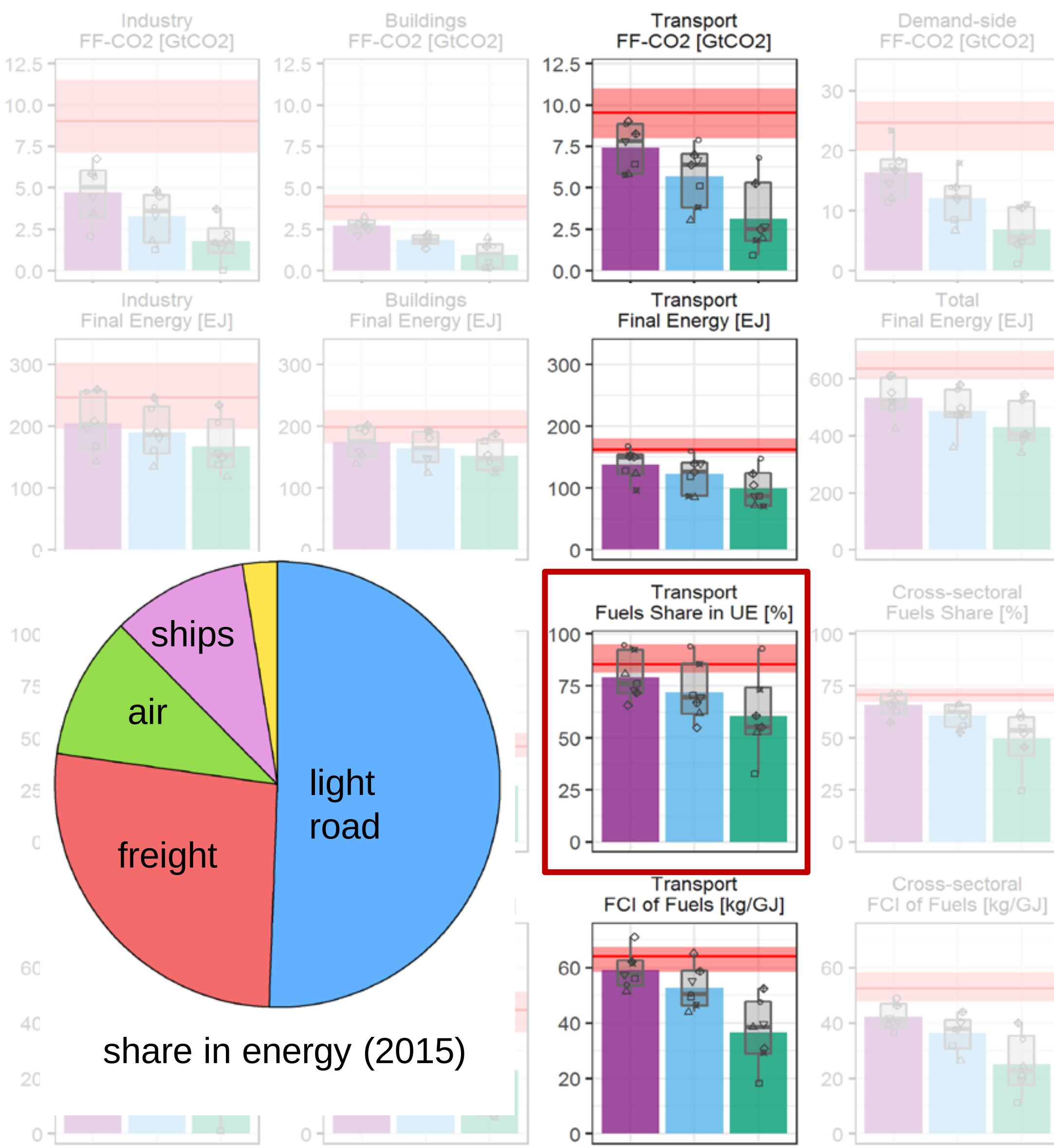

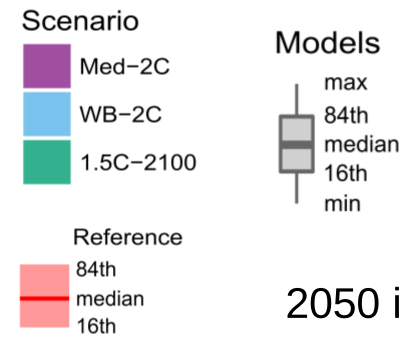

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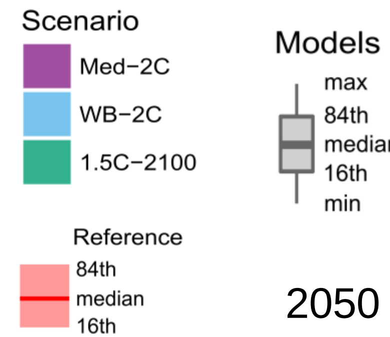

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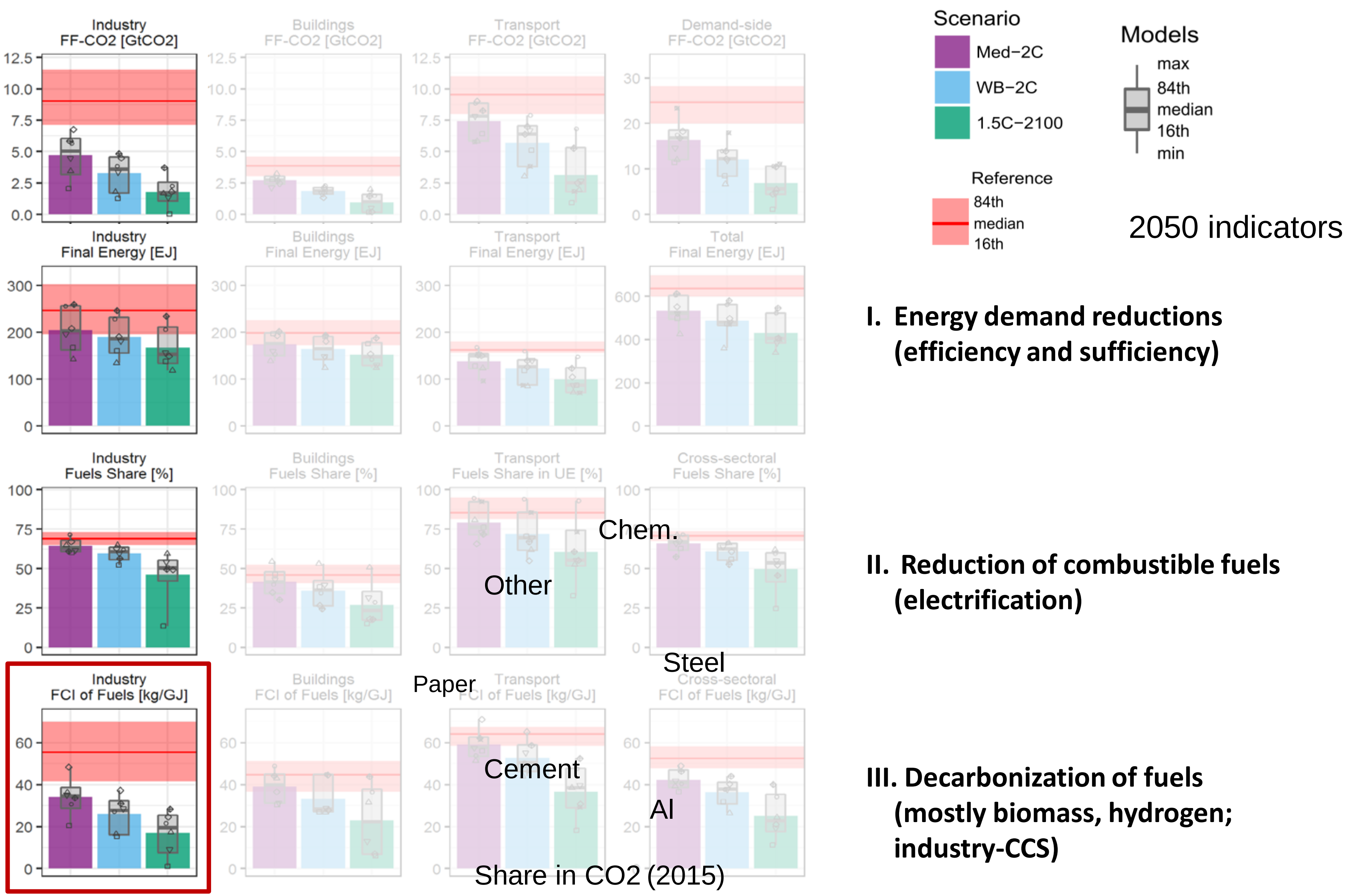

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