POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Mitigation Pathways for 1.5°C

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1.5 Degrees Conference
Oxford, September 22, 2016

The Paris Agreement

Temperature and emissions goals

- Holding global mean temperature well below 2°C
- **Pursuing efforts to limit temperature increase to 1.5°C**
- Aiming to peak global GHG emissions as soon as possible
- Undertaking rapid reductions thereafter to **achieve balance between emissions sources and sinks in the 2nd half of the century**, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty

The Mitigation Challenge

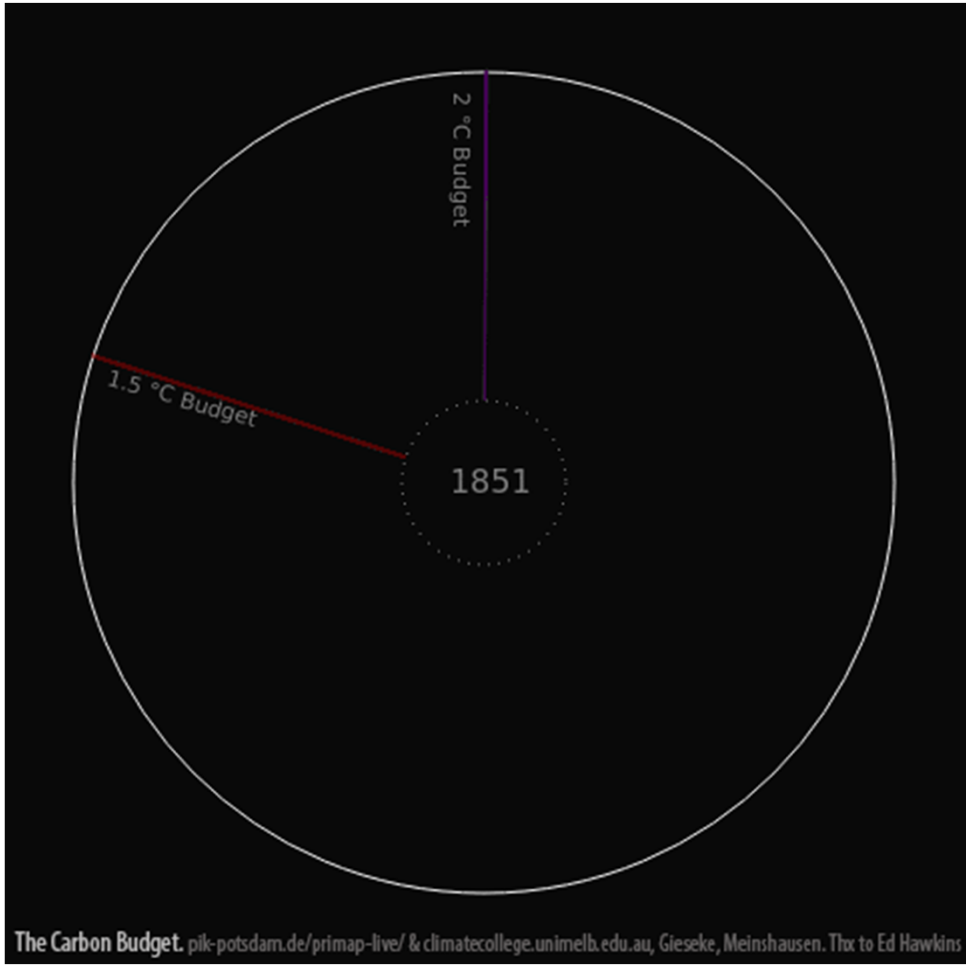
GHG Emissions accumulate in the atmosphere

➔ Net zero emissions needed to stop warming

➔ But first, current emissions growth need to be stopped & reversed („Peaking“)

➔ Followed by rapid emissions reduction

Can this happen fast enough for staying below 1.5°C?



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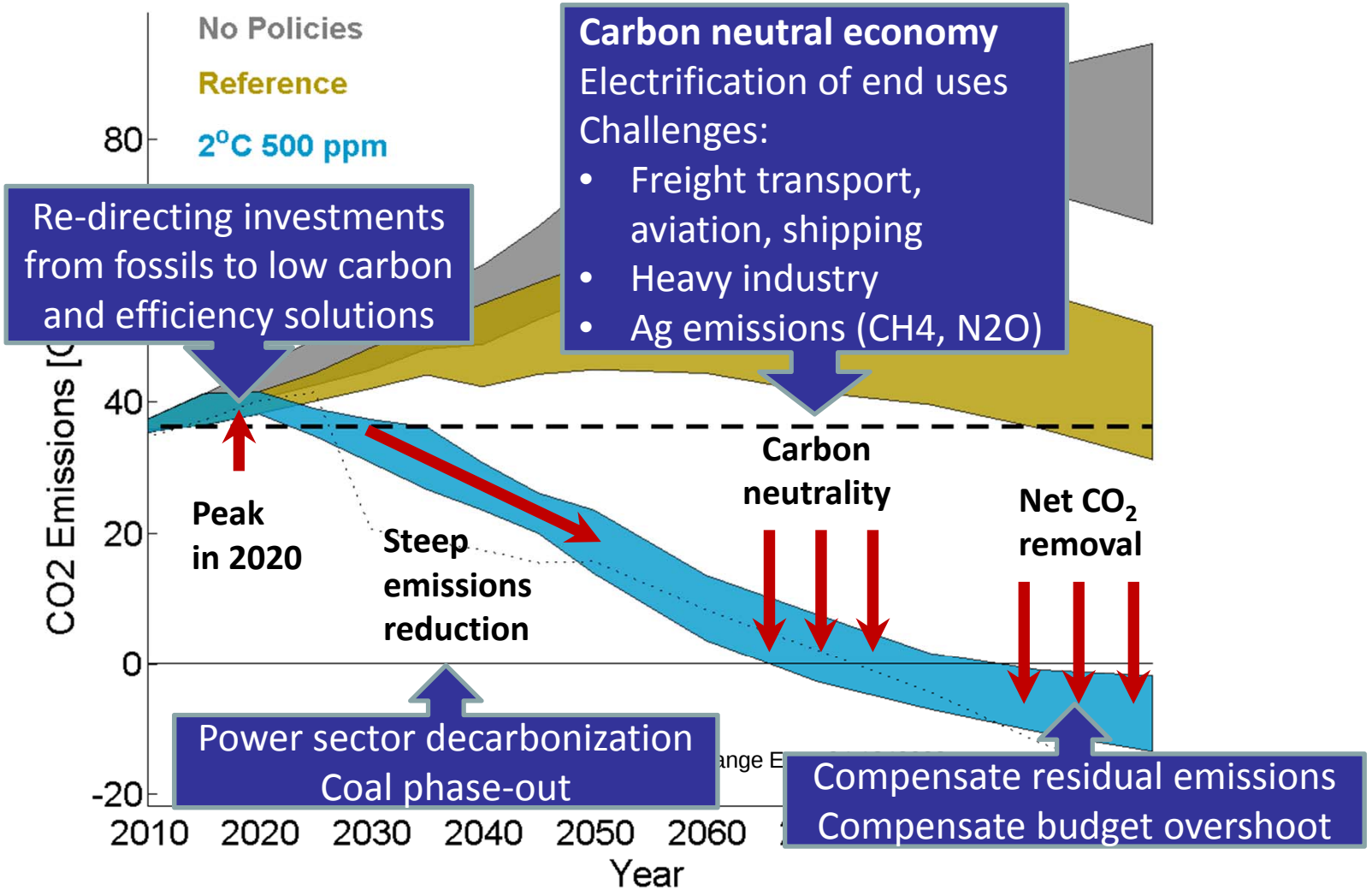
General Structure of Mitigation Pathways



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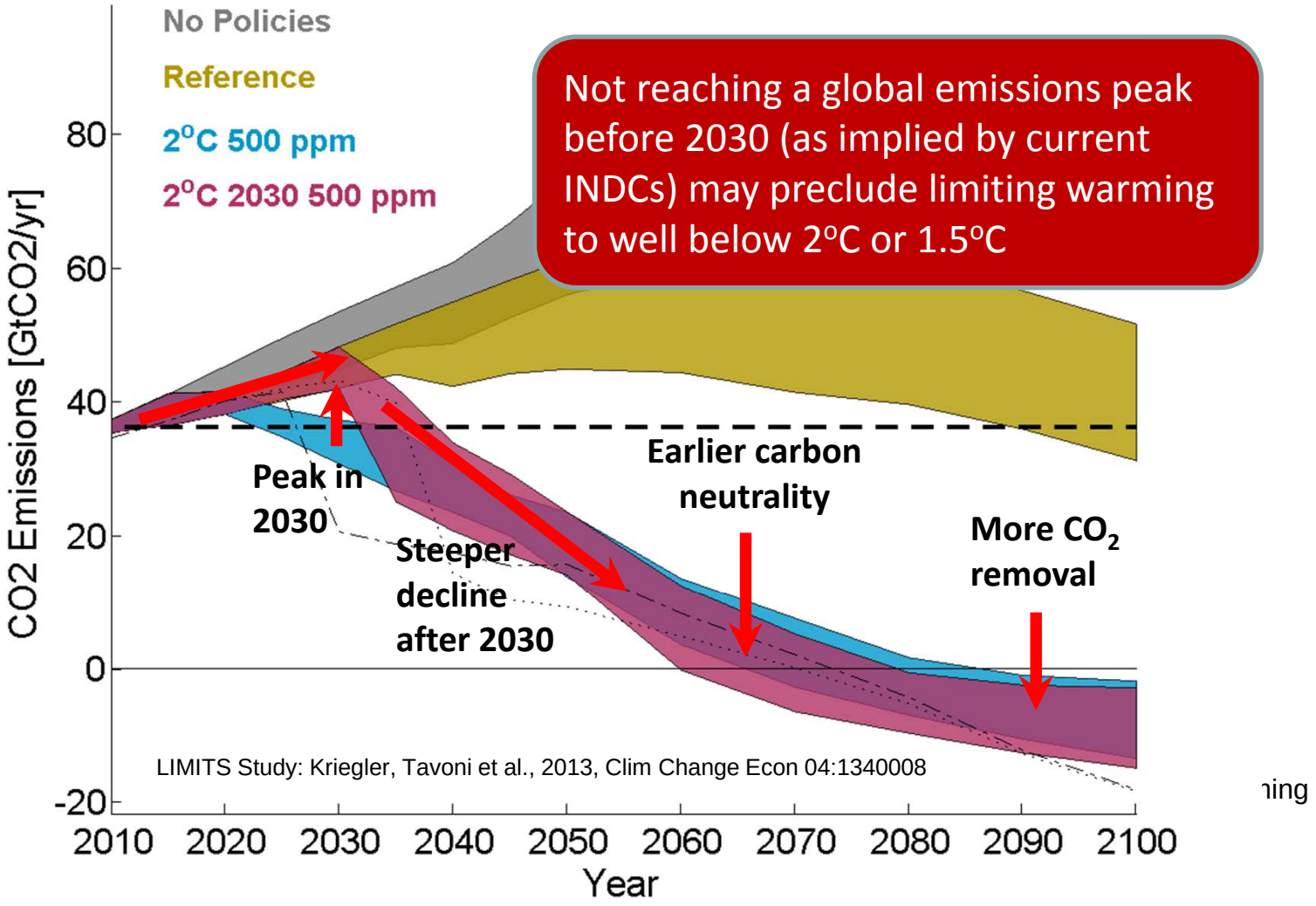
Consequences of Delay in Emissions Peaking



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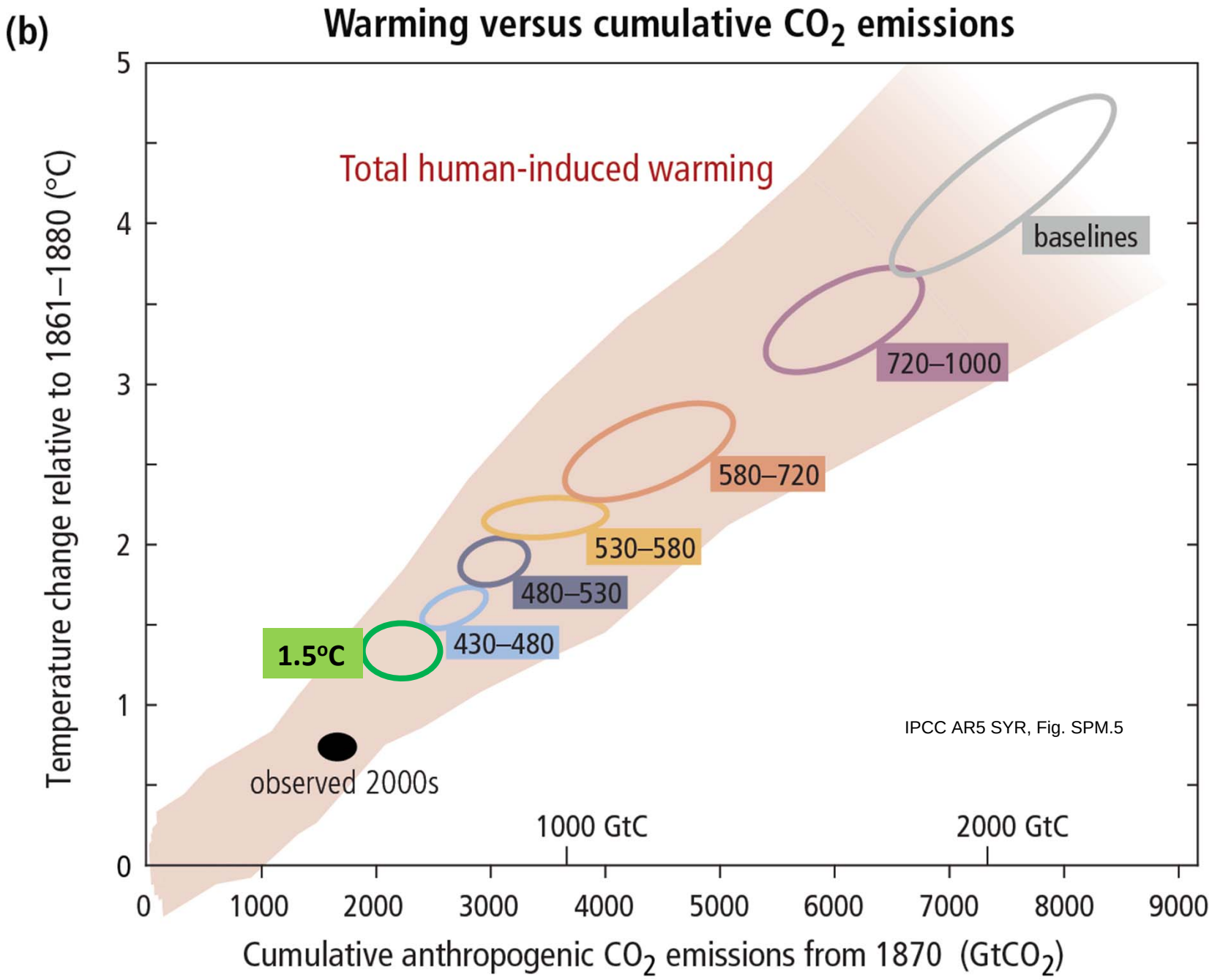
(b)
Warming versus cumulative CO_2 emissions
Total human-induced warming
baselines
720–1000
580–720
530–580
480–530
430–480
1.5°C
observed 2000s
IPCC AR5 SYR, Fig. SPM.5
1000 GtC
2000 GtC
Temperature change relative to 1861–1880 (°C)
Cumulative anthropogenic CO_2 emissions from 1870 ($GtCO_2$)
0
1
2
3
4
5
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

nature climate change

PERSPECTIVE

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Energy system transformations for limiting end-of-century warming to below 1.5 °C

Joeri Rogelj[1,2*], Gunnar Luderer[3*], Robert C. Pietzcker[3], Elmar Kriegler[3], Michiel Schaeffer[4,5], Volker Krey[1] and Keywan Riahi[1,6]

Many impacts projected for a global warming level of 2 °C relative to pre-industrial levels may exceed the coping capacities of particularly vulnerable countries. Therefore, many countries advocate limiting warming to below 1.5 °C. Here we analyse integrated energy–economy–environment scenarios that keep warming to below 1.5 °C by 2100. We find that in such scenarios, energy-system transformations are in many aspects similar to 2 °C-consistent scenarios, but show a faster scale-up of mitigation action in most sectors, leading to observable differences in emission reductions in 2030 and 2050. The move from a 2 °C- to a 1.5 °C-consistent world will be achieved mainly through additional reductions of CO_2. This implies an earlier transition to net zero carbon emissions worldwide, to be achieved between 2045 and 2060. Energy efficiency and stringent early reductions are key to retain a possibility for limiting warming to below 1.5 °C by 2100. The window for achieving this goal is small and rapidly closing.

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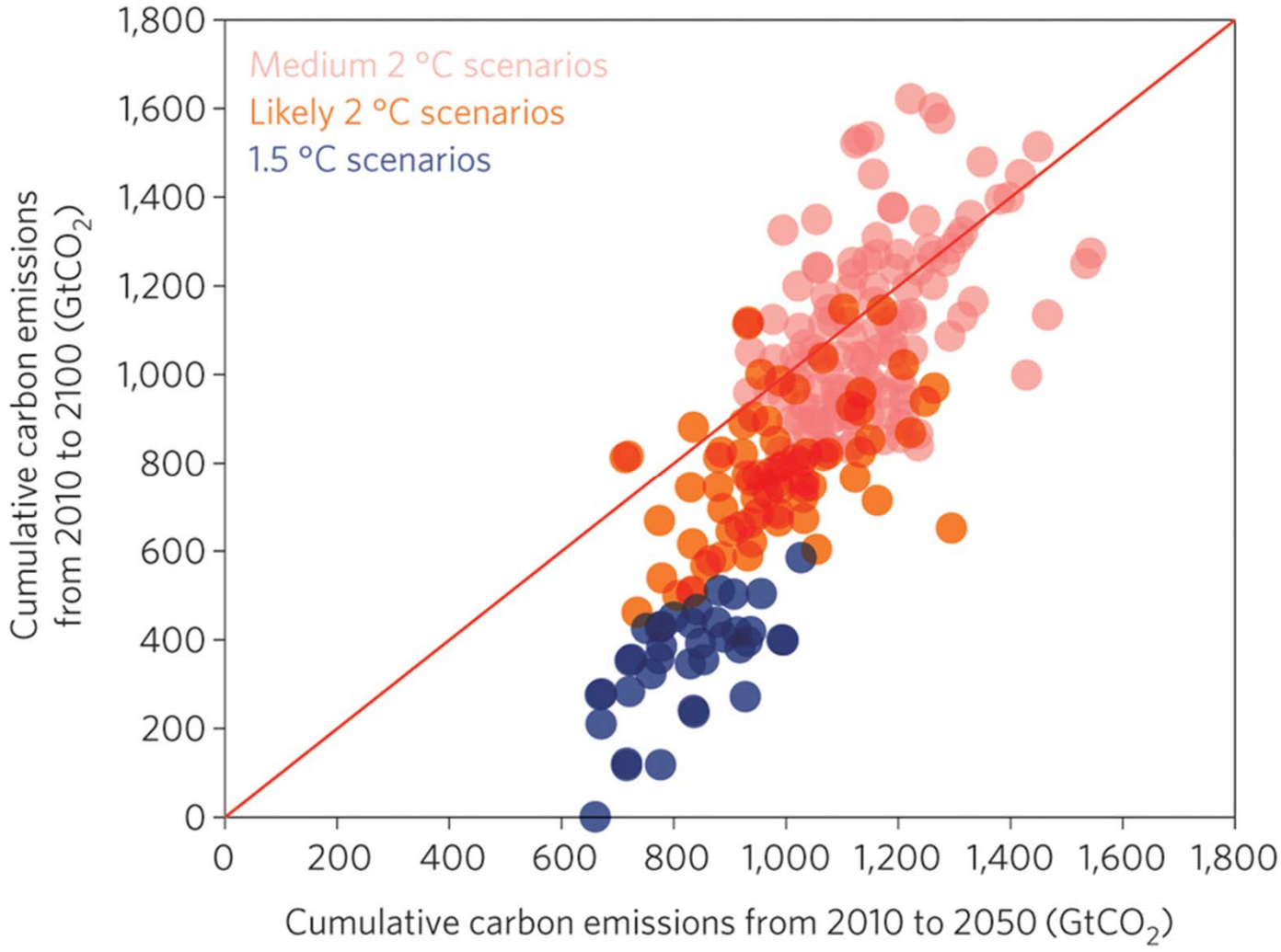
Carbon emission budgets



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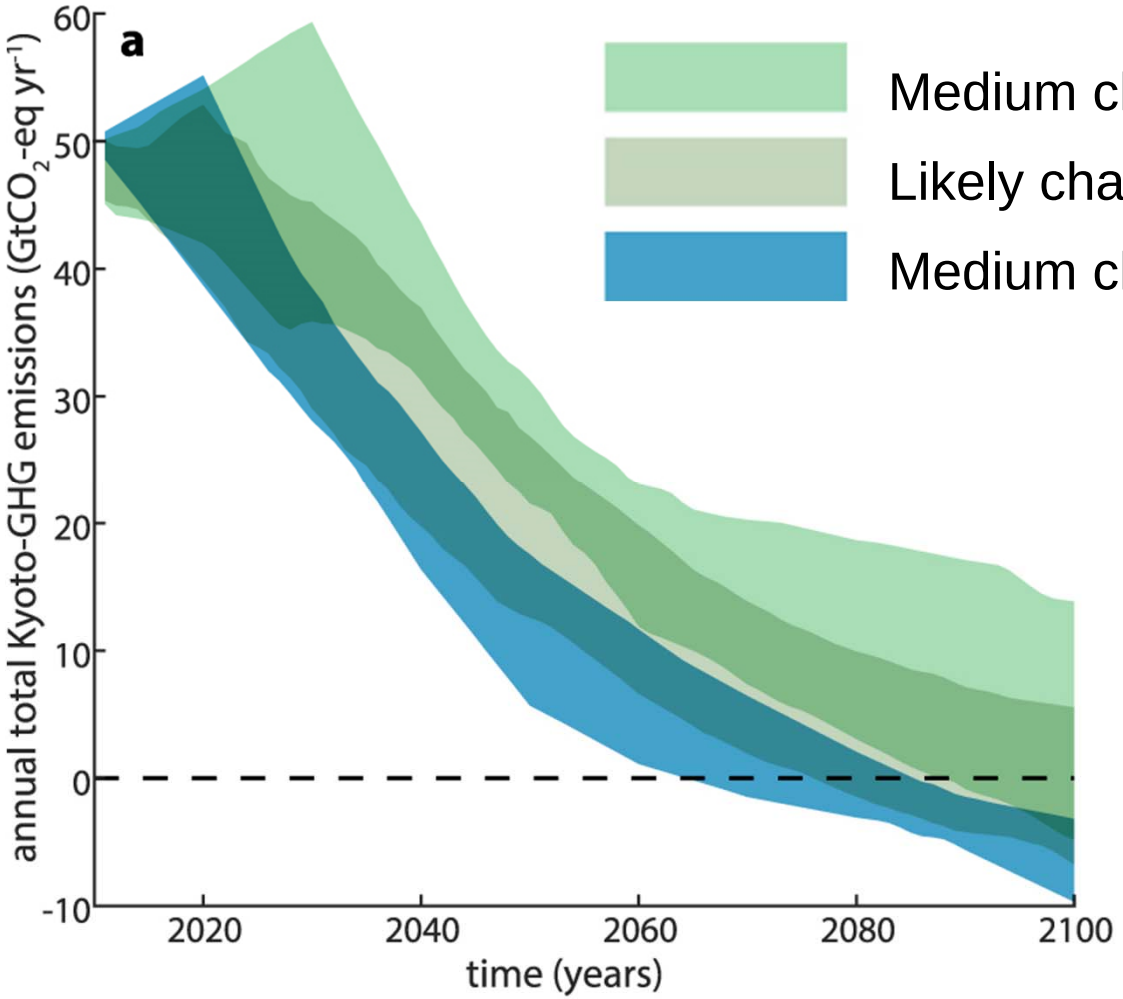
1.5°C vs. 2°C pathways

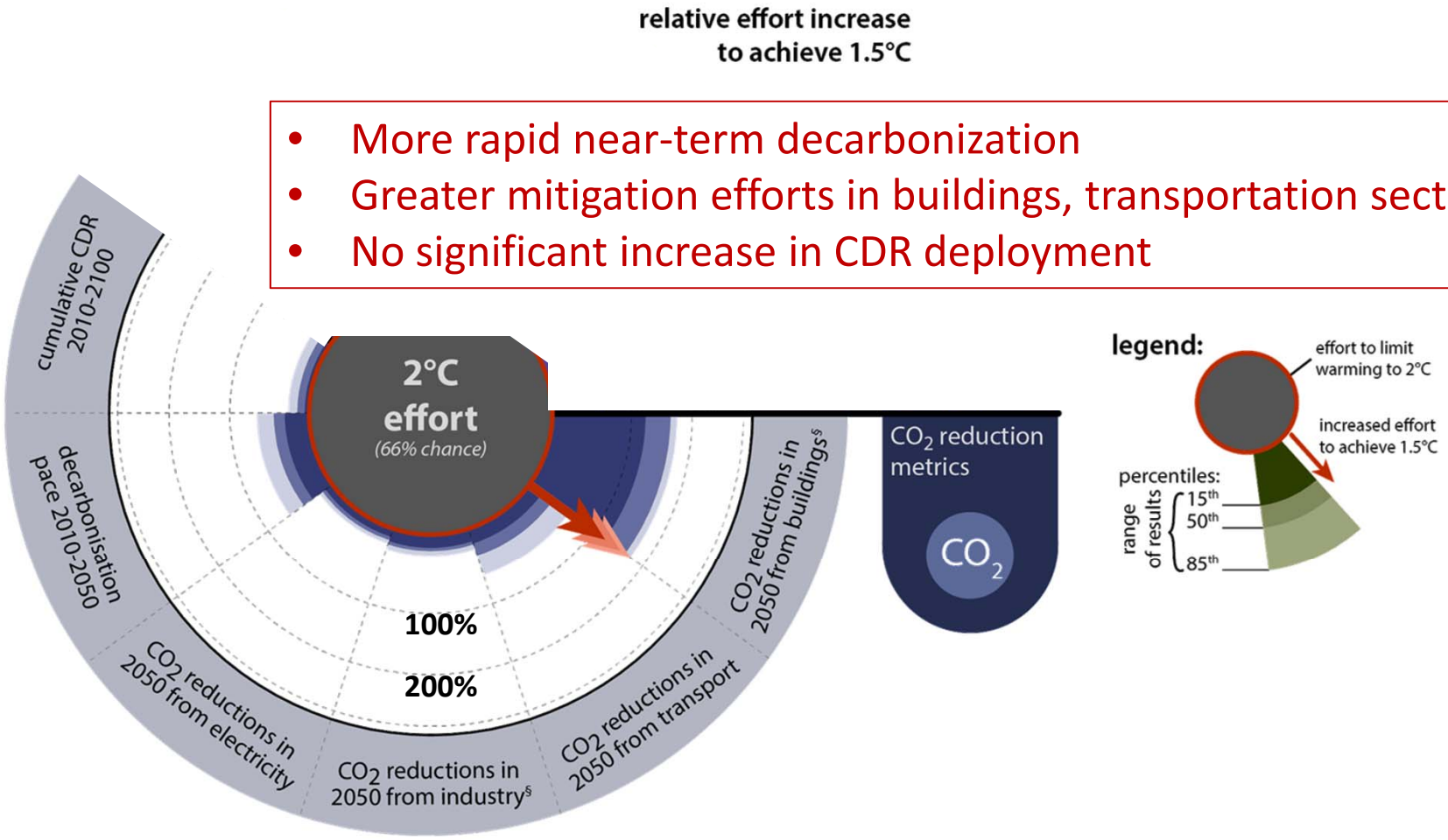


1.5°C pathways require earlier and deeper reduction (~ net zero CO2 emissions by 2050, 10-20 years earlier than in 2°C pathways)

Rogelj et al. (2015) Env Res Letters 10: 105007

1.5°C vs. 2°C – CO_2 reduction metrics

- More rapid near-term decarbonization
- Greater mitigation efforts in buildings, transportation sector
- No significant increase in CDR deployment



Rogelj, Luderer et al. (2015), NCC

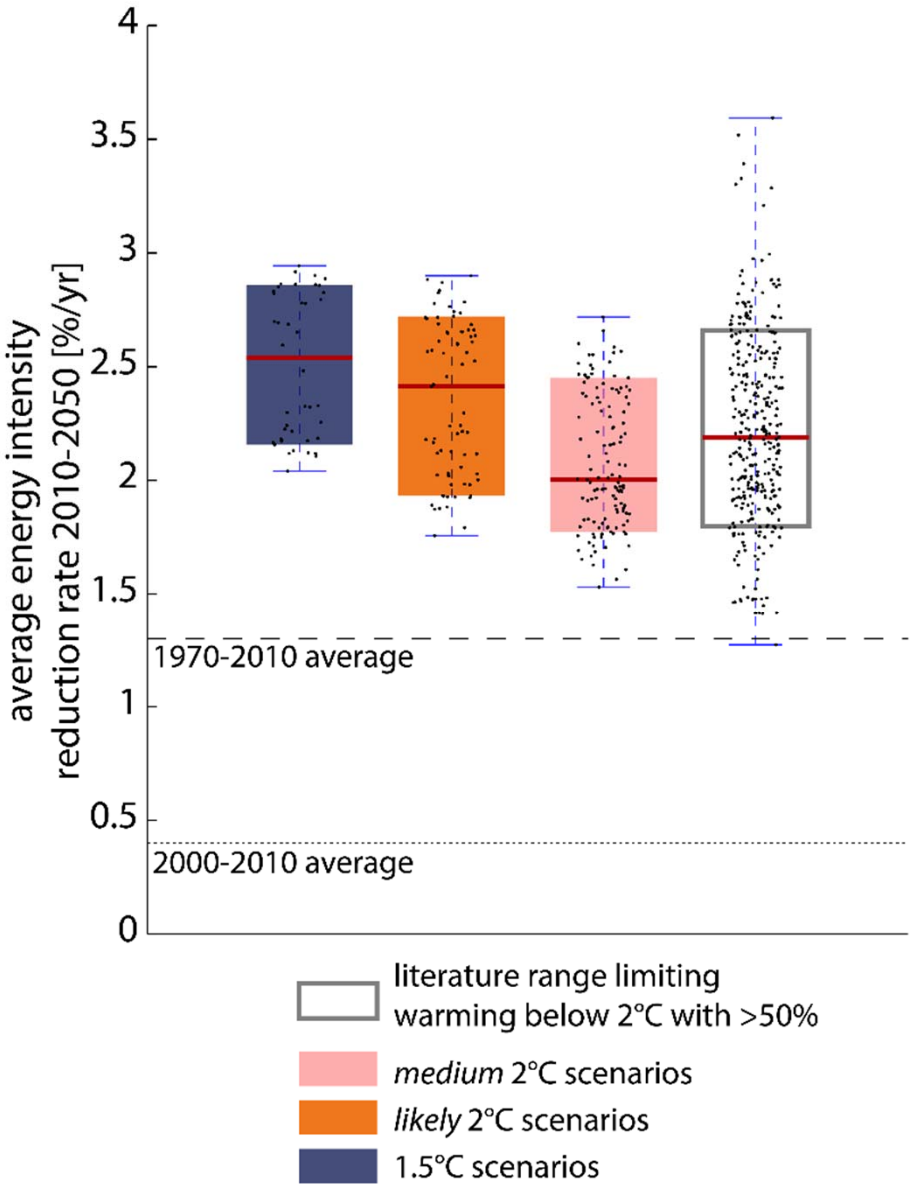
ADVANCE Study on Mitigation Pathways

Integrated analysis of

- implications of Paris outcomes and INDCs for energy transformation
- long-term pathways towards 1.5/2^{o}C stabilization with a focus on sectoral decarbonization bottlenecks.

This project is funded by the European Union.

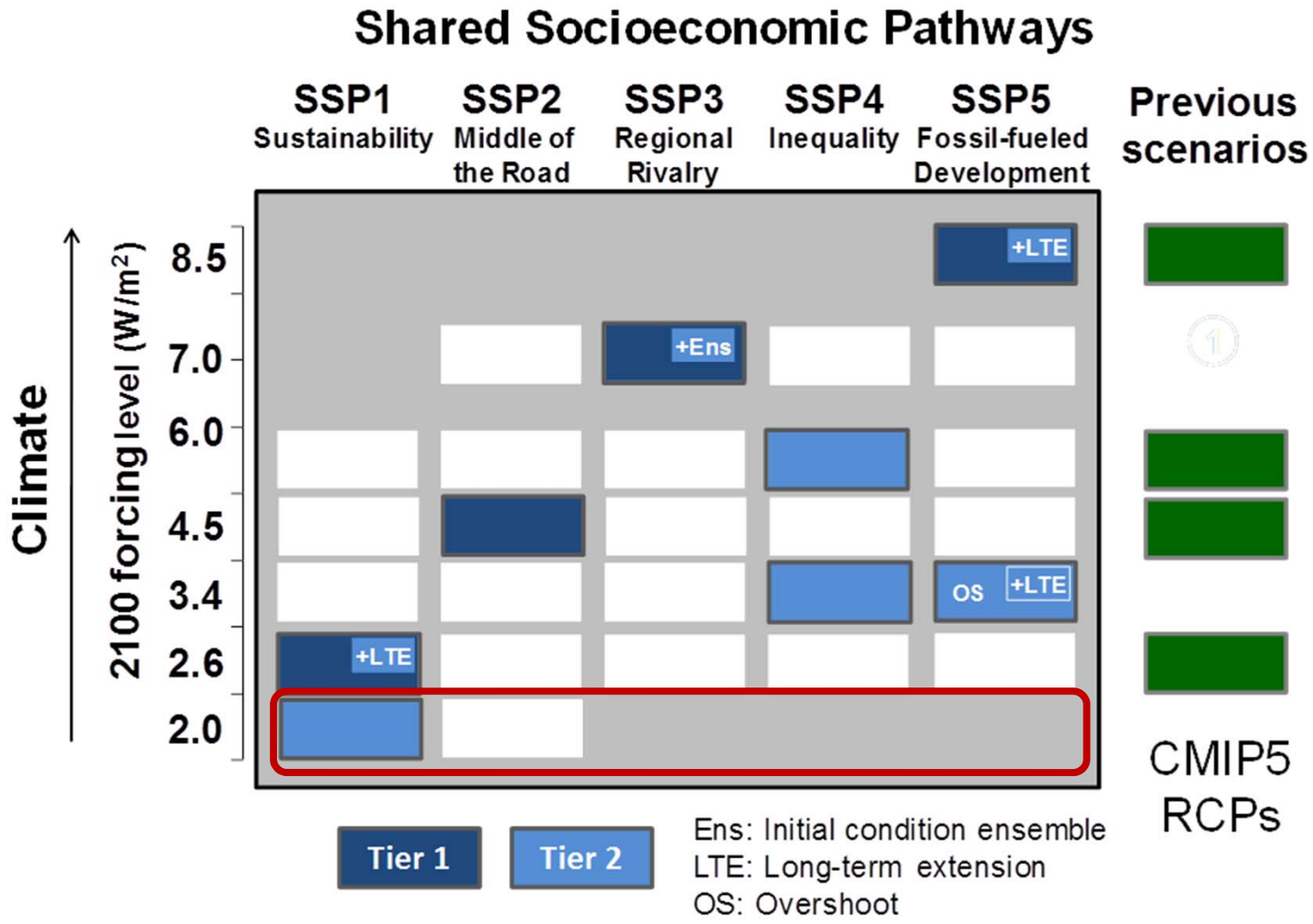
Important role of energy demand reductions



Energy efficiency improvements a crucial enabling factor for 1.5°C

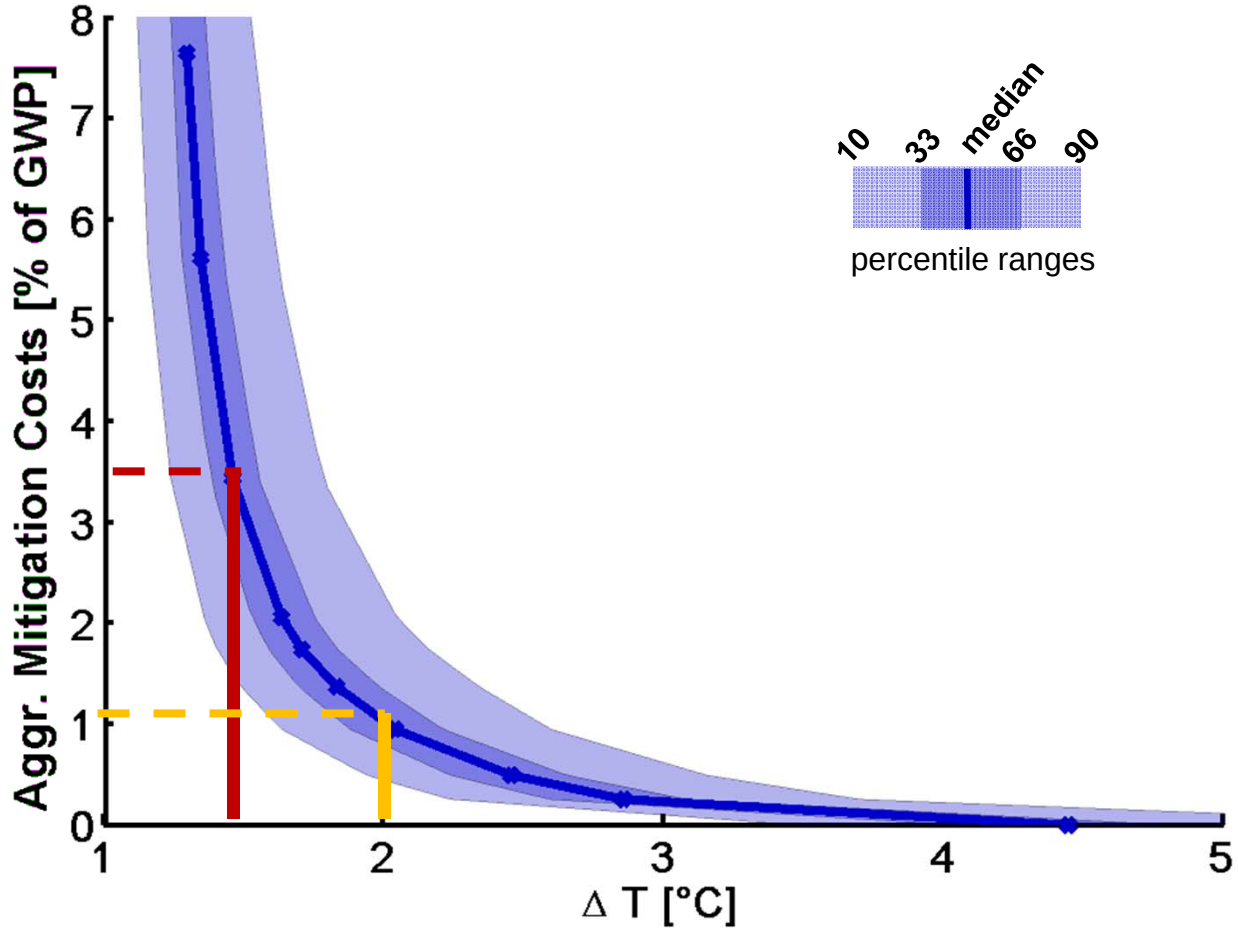
Rogelj, Luderer et al. (2015), NCC

Ongoing work on 1.5°C pathways: SSP-based 1.9 W/m² scenarios



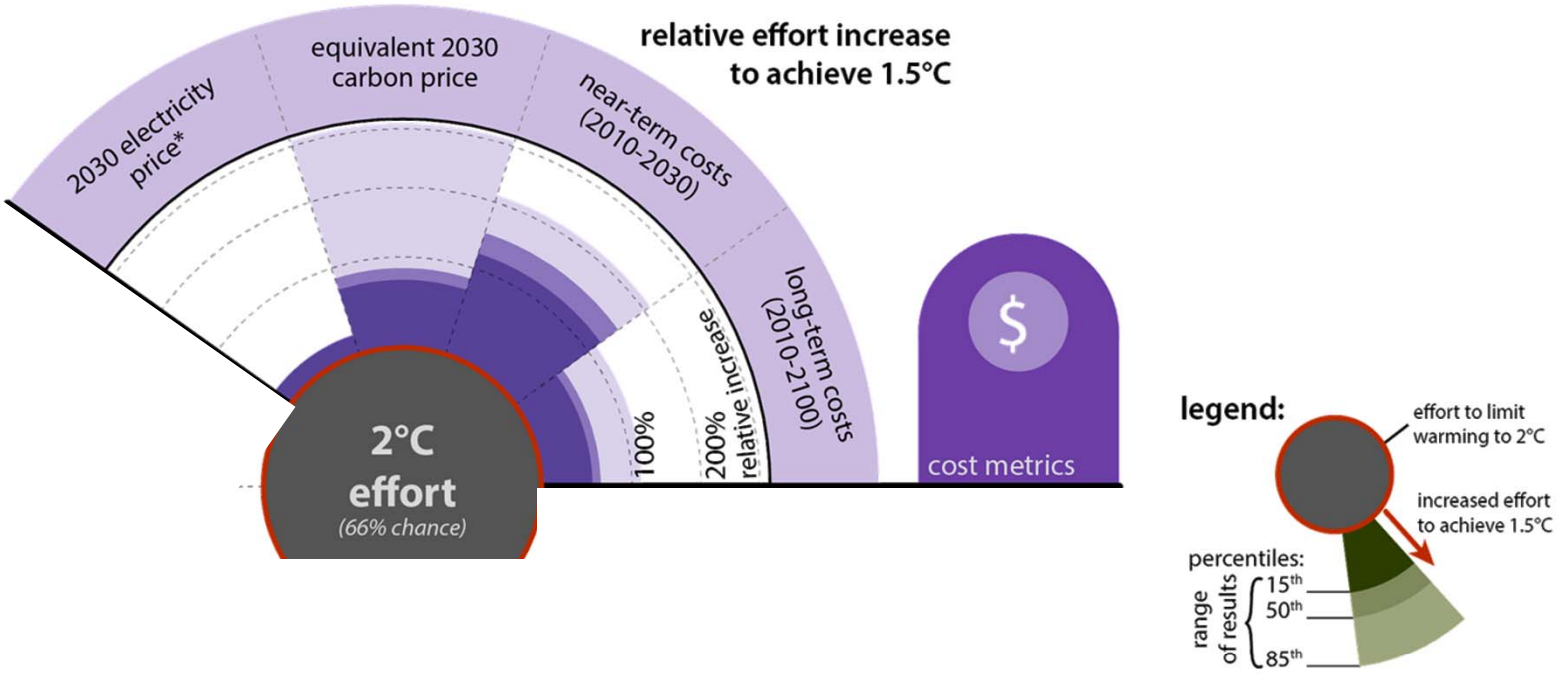
ScenarioMIP design, O'Neill et al. (2016)

Socio-economic implications of 1.5°C pathways: Narrow lense of direct mitigation costs



Luderer, G., Pietzcker, R., Bertram, C., Kriegler, E, Meinshause, M., Edenhofer, O. Economic mitigation challenges: How further delay closes the door for achieving climate targets. *ERL* (2013).

1.5°C vs. 2°C – Cost metrics



Rogelj, Luderer et al. (2015), NCC

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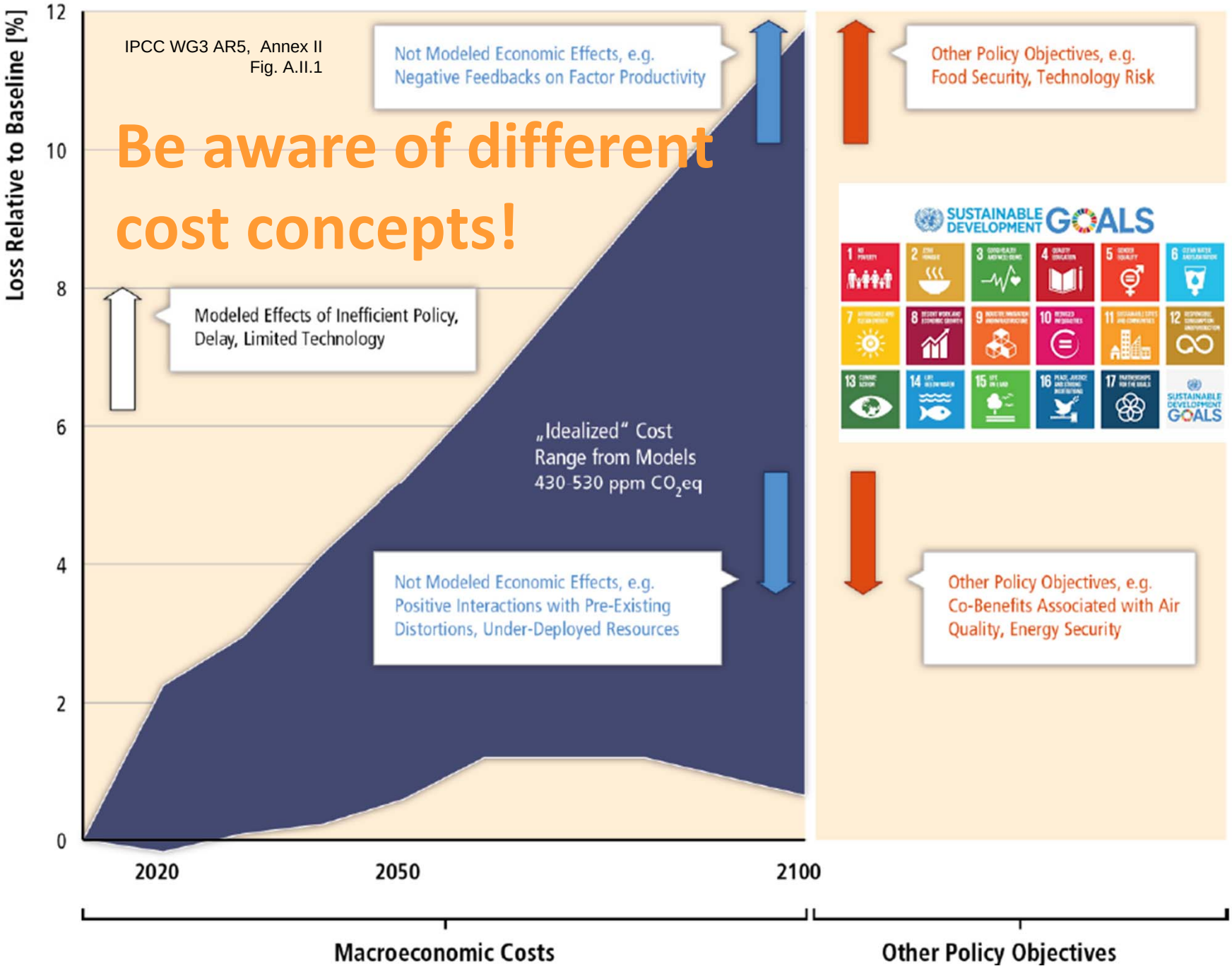
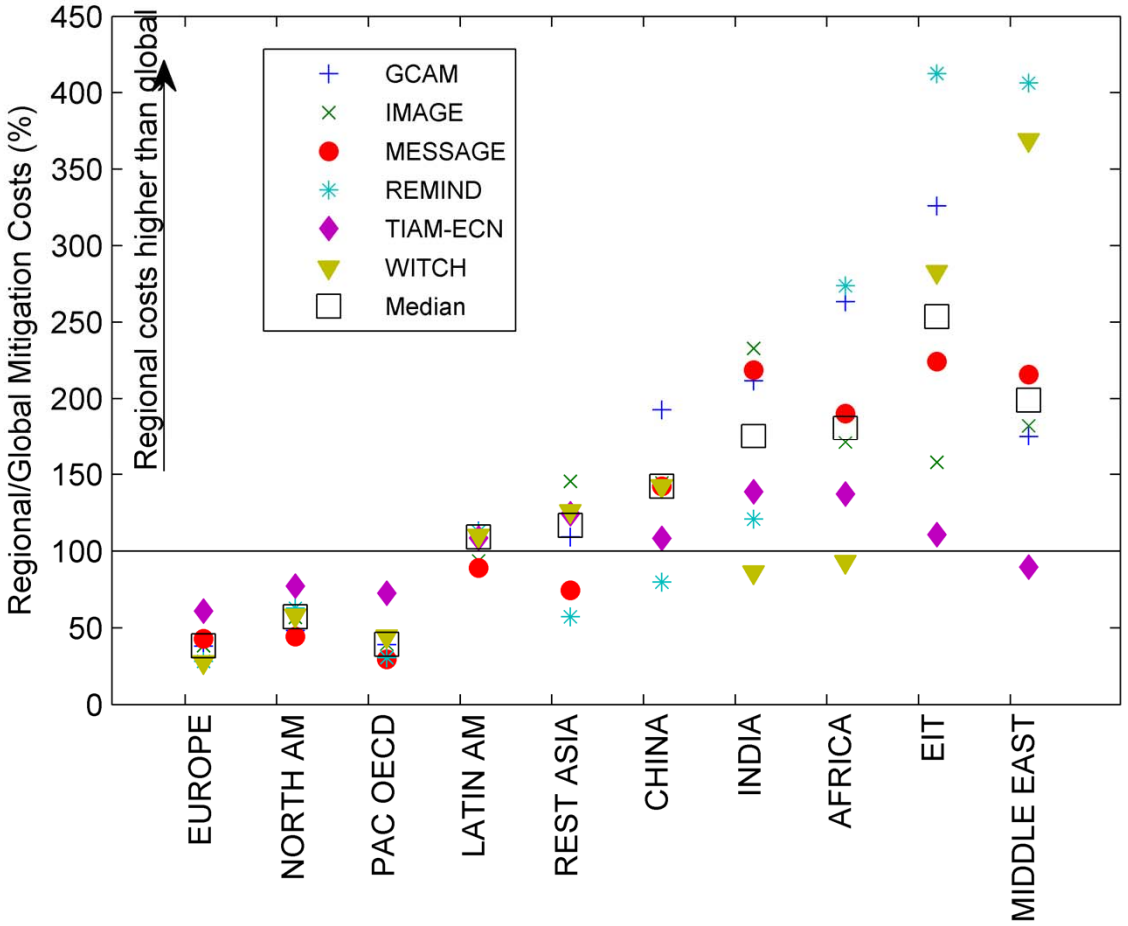

IPCC WG3 AR5, Annex II
Fig. A.II.1
Loss Relative to Baseline [%]
12
10
8
6
4
2
0
2020
2050
2100
Not Modeled Economic Effects, e.g.
Negative Feedbacks on Factor Productivity
Other Policy Objectives, e.g.
Food Security, Technology Risk
Be aware of different cost concepts!
Modeled Effects of Inefficient Policy,
Delay, Limited Technology
„Idealized" Cost
Range from Models
430-530 ppm CO_2eq
Not Modeled Economic Effects, e.g.
Positive Interactions with Pre-Existing
Distortions, Under-Deployed Resources
Other Policy Objectives, e.g.
Co-Benefits Associated with Air
Quality, Energy Security
SUSTAINABLE DEVELOPMENT GOALS
Macroeconomic Costs
Other Policy Objectives

Finding equitable solutions are key for 1.5 and 2°C

- Emissions need to be reduced collectively in all regions and sectors
- Burden sharing and transfers will be needed to realize collective emissions reduction potential

Regional mitigation costs in cost-efficient 2°C scenarios w/o transfers

LIMITS study on 2°C „Durban Platform Scenarios“:
Tavoni et al, 2013, Climate Change Economics 4(4)
Tavoni et al.,2015, NCC 5, 119-126



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