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science for global insight

Under what assumptions can the climate ambition of the Paris Agreement materialize?

IEA WB2DS Workshop
Paris, France

Joeri Rogelj – 20 June 2016

Outline

- Paris climate ambition
- Emission implications
- Scenario implications

Paris Agreement

"Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels"

The Long-Term Temperature Goal
Paris Agreement Article 2

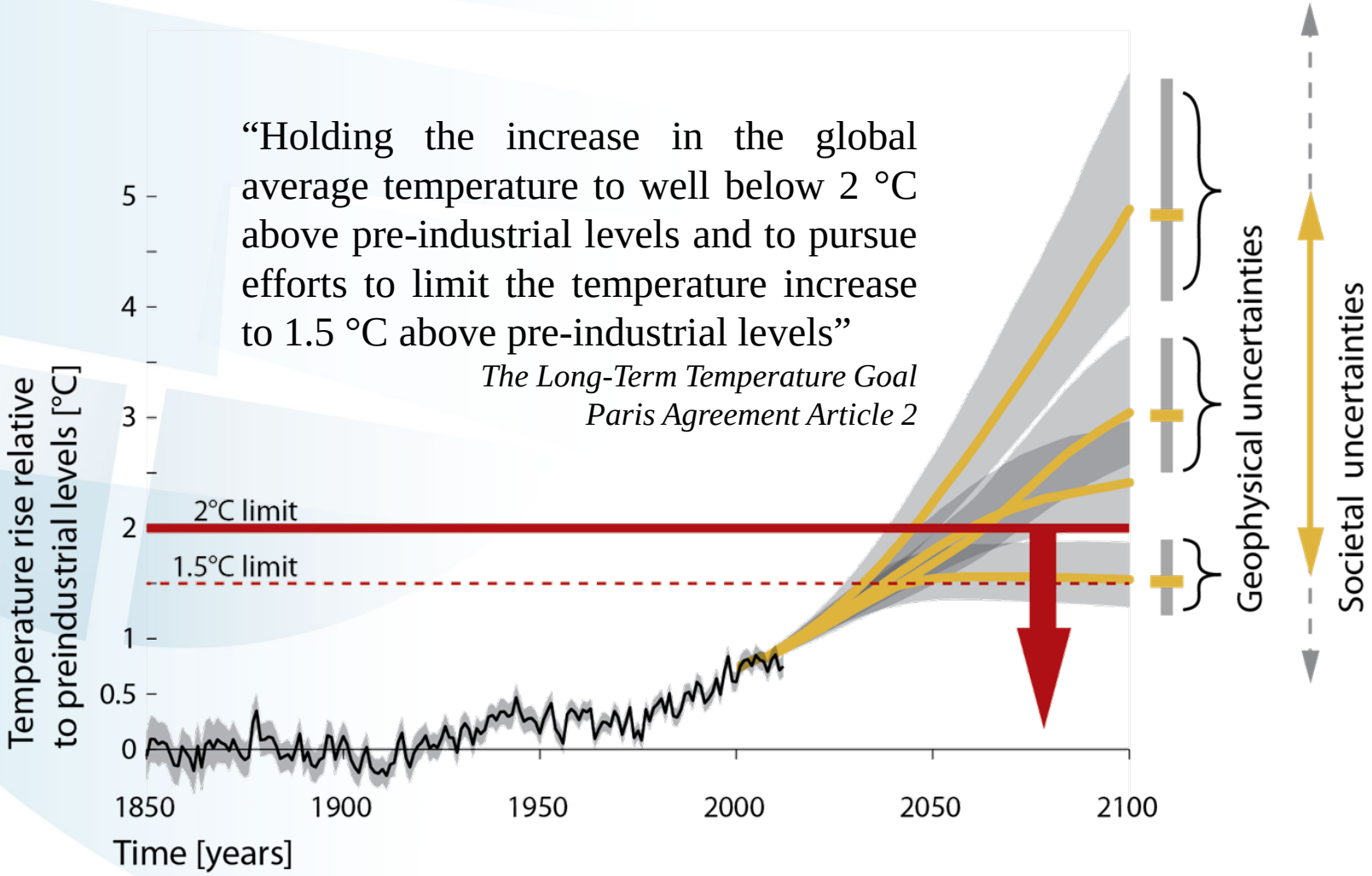


Image: Joeri Rogelj; History: HadCRUT4

Paris climate ambition

"Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels"

The Long-Term Temperature Goal, Paris Agreement Article 2

"In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach ***global peaking*** *of greenhouse gas emissions* ***as soon as possible*** *[…], and to undertake rapid reductions thereafter in accordance with best available science, so as to* ***achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century****"*

Paris Agreement Article 4

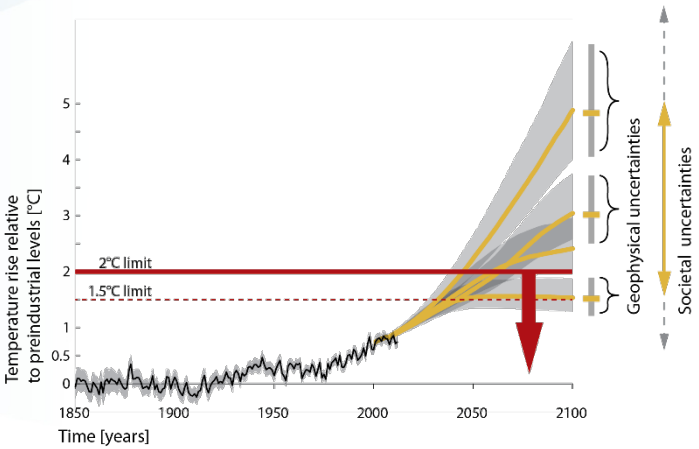
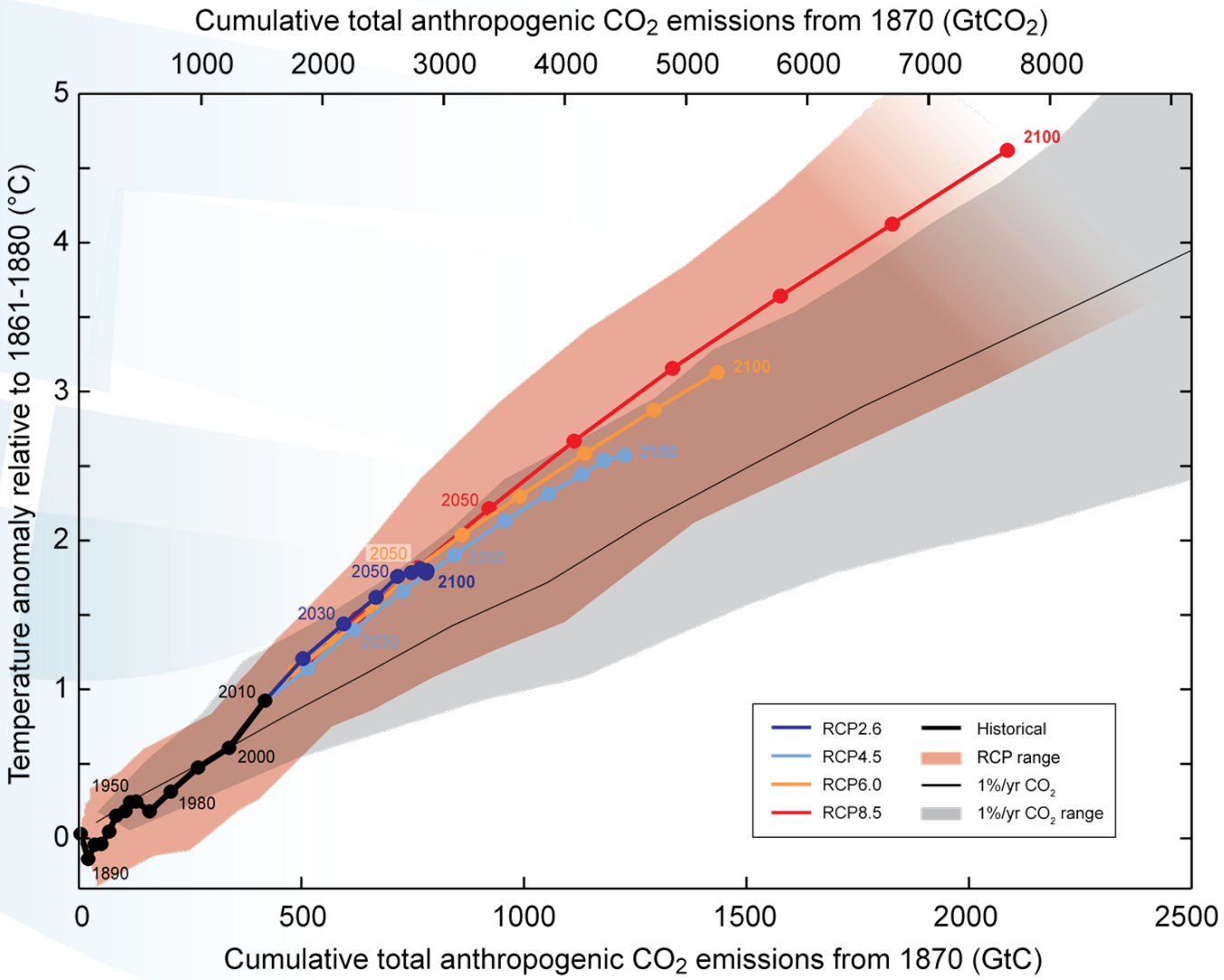


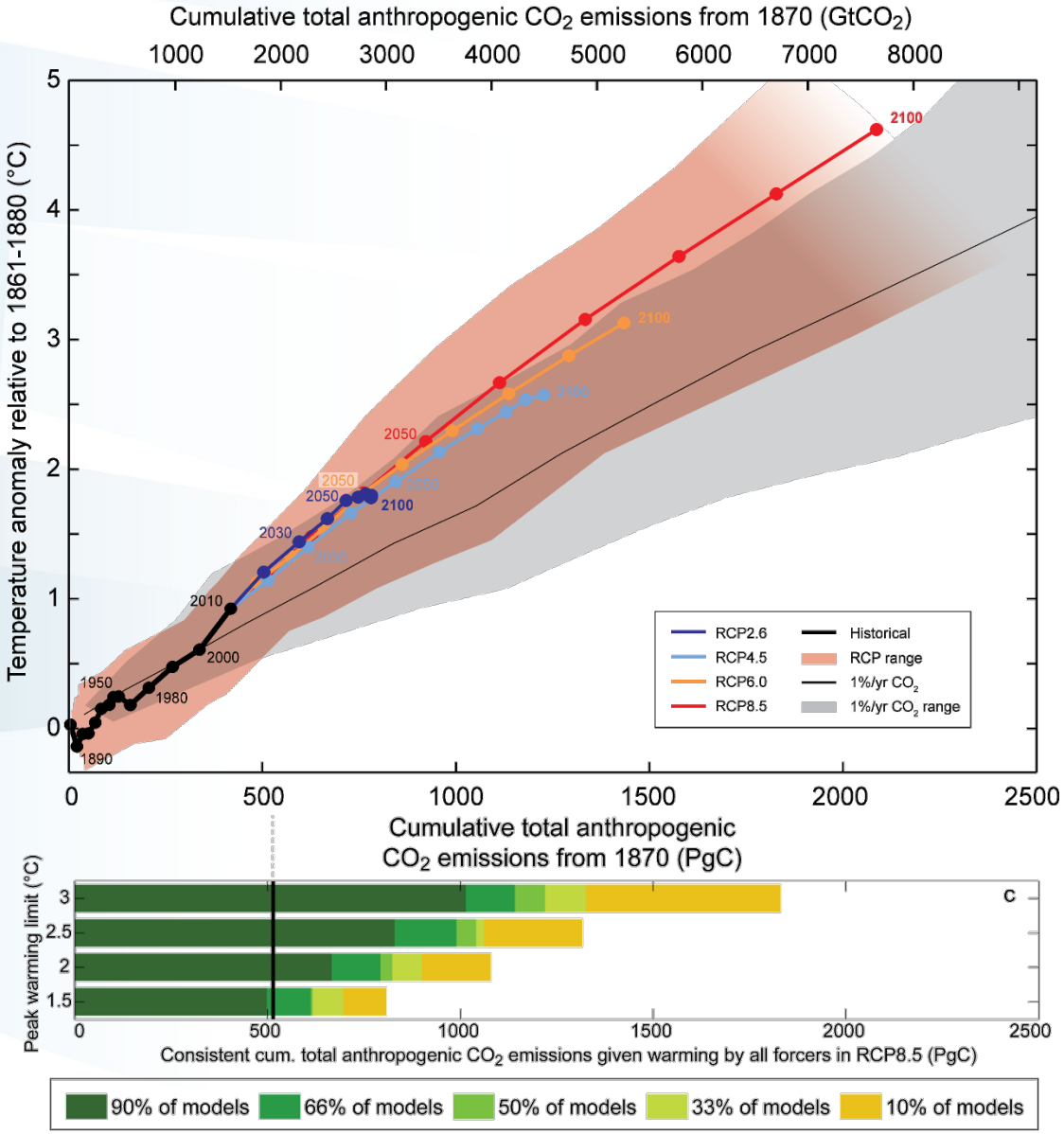
Image: Joeri Rogelj; History: HadCRUT4

Emissions implications



Emissions implications

carbon budgets



IPCC AR5 WGI TFE.8 Fig. 1

Emissions implications

How much remains for 1.5°C and 2°C?

For 2°C >66% (is this “well below”?)

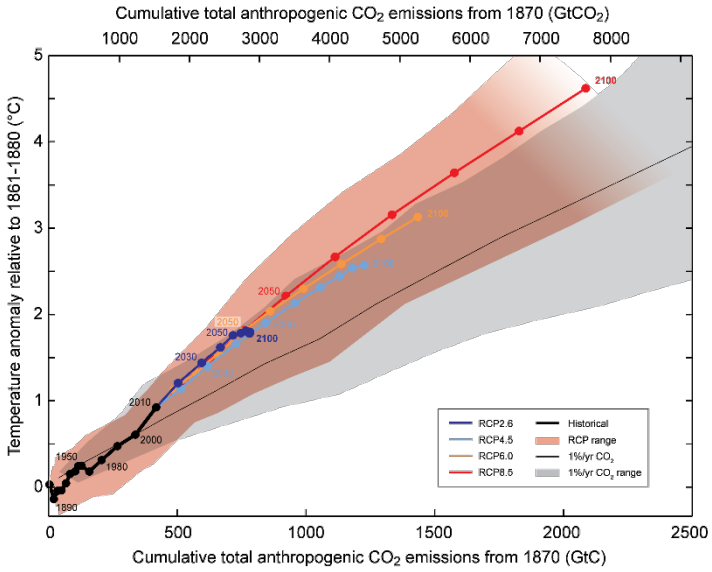
- About 1000 $GtCO_2$ after 2011 (IPCC AR5 SYR)
- 590–1240 $GtCO_2$ after 2015 (post-AR5 literature)

For 1.5°C

- 550 $GtCO_2$ after 2011 (IPCC AR5 SYR)
- 650 $GtCO_2$ since 2010-2020 average CMIP5 (present-day adjusted)

Context:

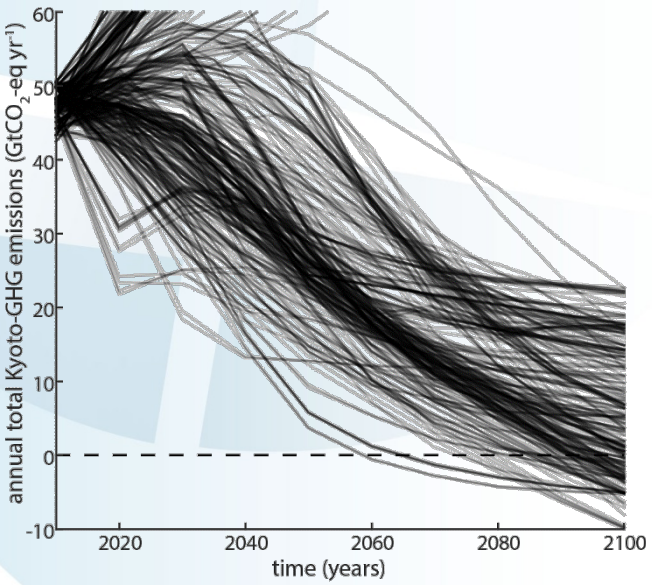
- Current annual emissions ~40 $GtCO_2$/yr
- Until 2011: about 1900 $GtCO_2$ emitted



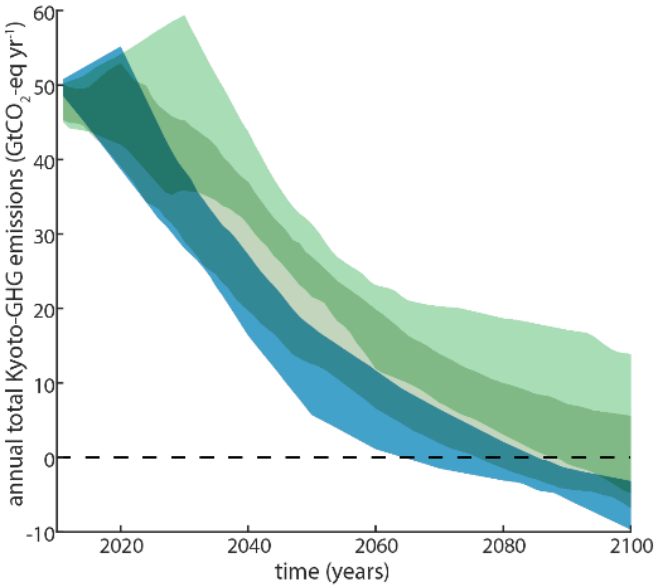
Scenario implications

Internal consistency Paris Agreement

IPCC AR5
Scenario Database



ex-post temperature
characterization



medium chance (50-66%) of limiting warming <2°C in 2100

likely chance (>66%) of limiting warming <2°C in 2100

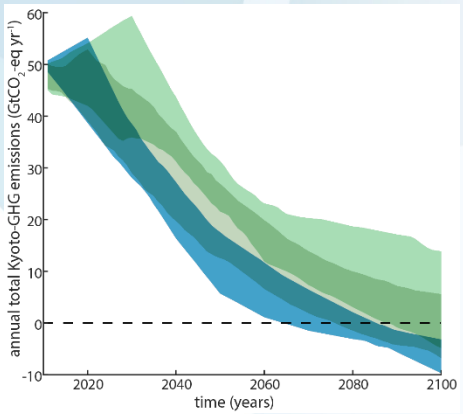
>50% chance of returning warming to below 1.5°C in 2100

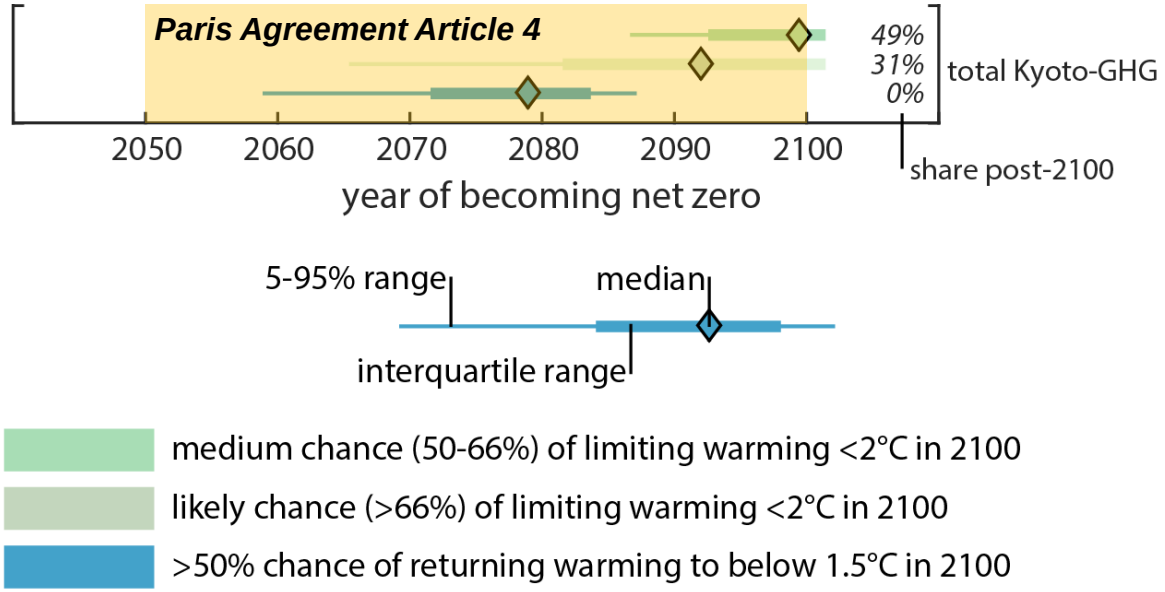
IPCC AR5 Scenario Database; Rogelj et al (2015) ERL

Scenario implications

Internal consistency Paris Agreement

Consistency between
Article 2 & Article 4

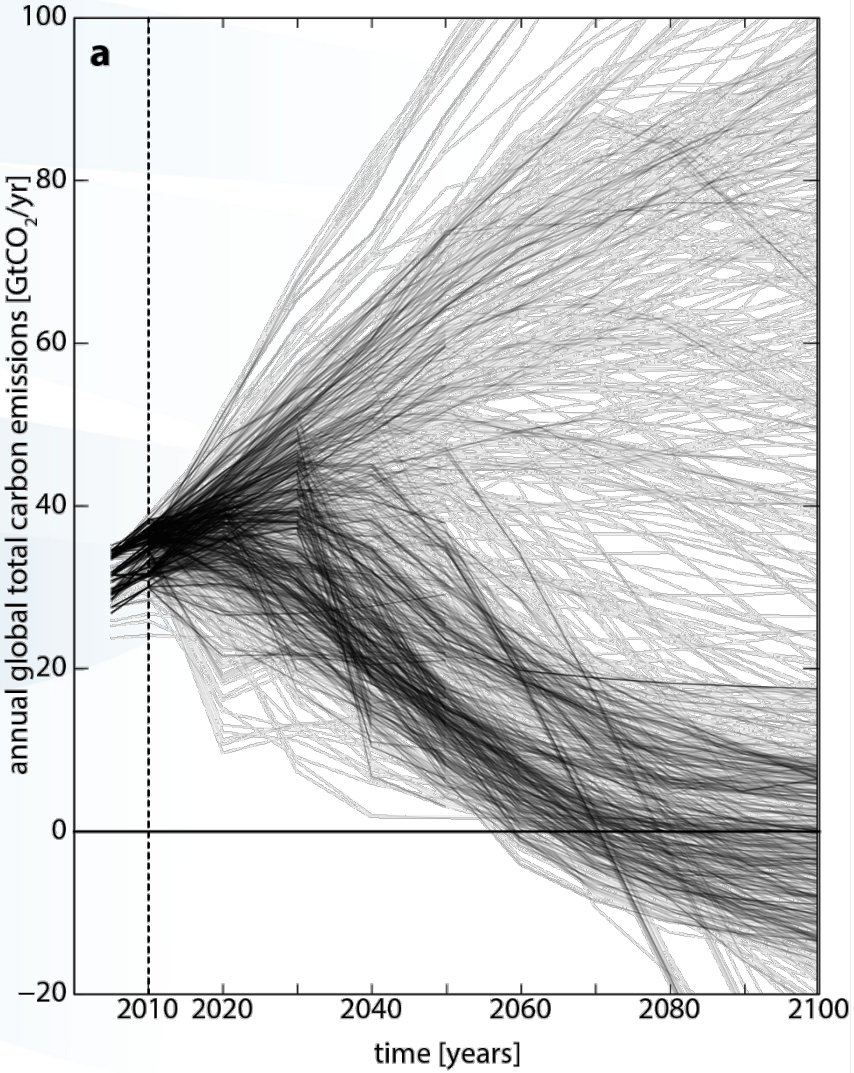




IPCC AR5 Scenario Database; Rogelj et al (2015) ERL

Scenario implications

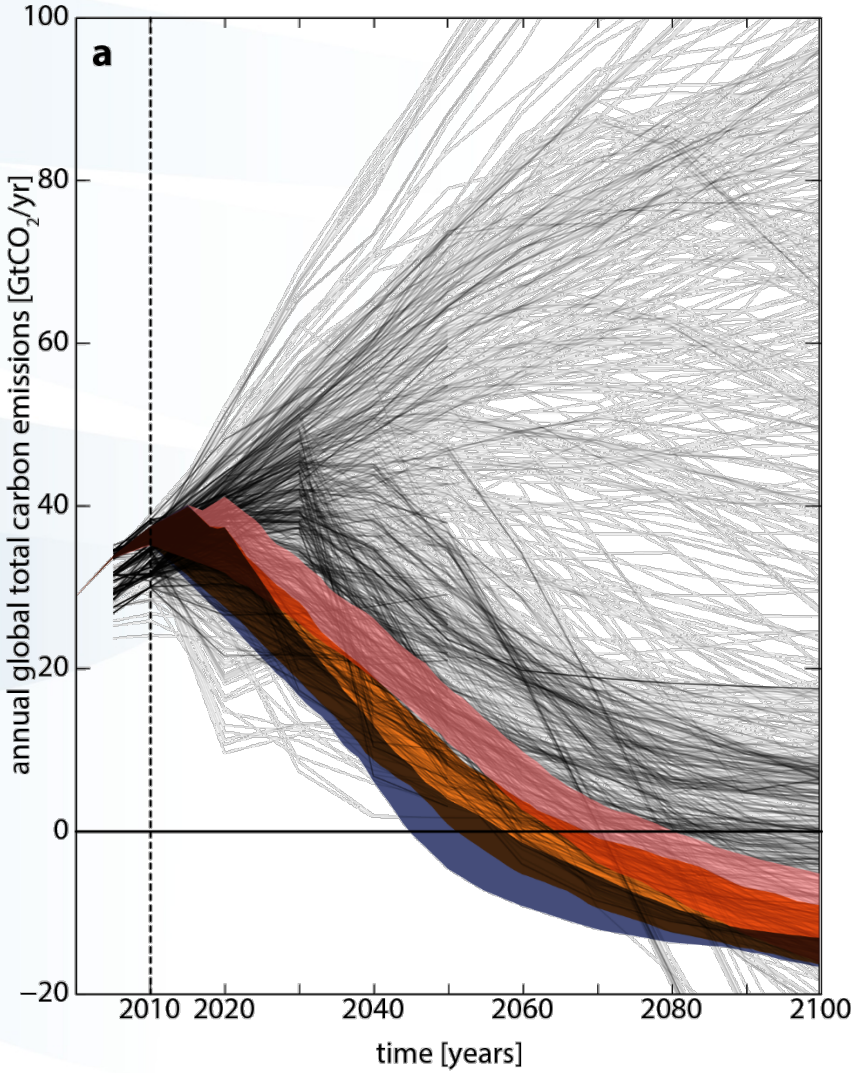
1.5°C & 2°C



Rogelj et al (2015) NCC

Scenario implications

1.5°C & 2°C



Rogelj et al (2015) NCC

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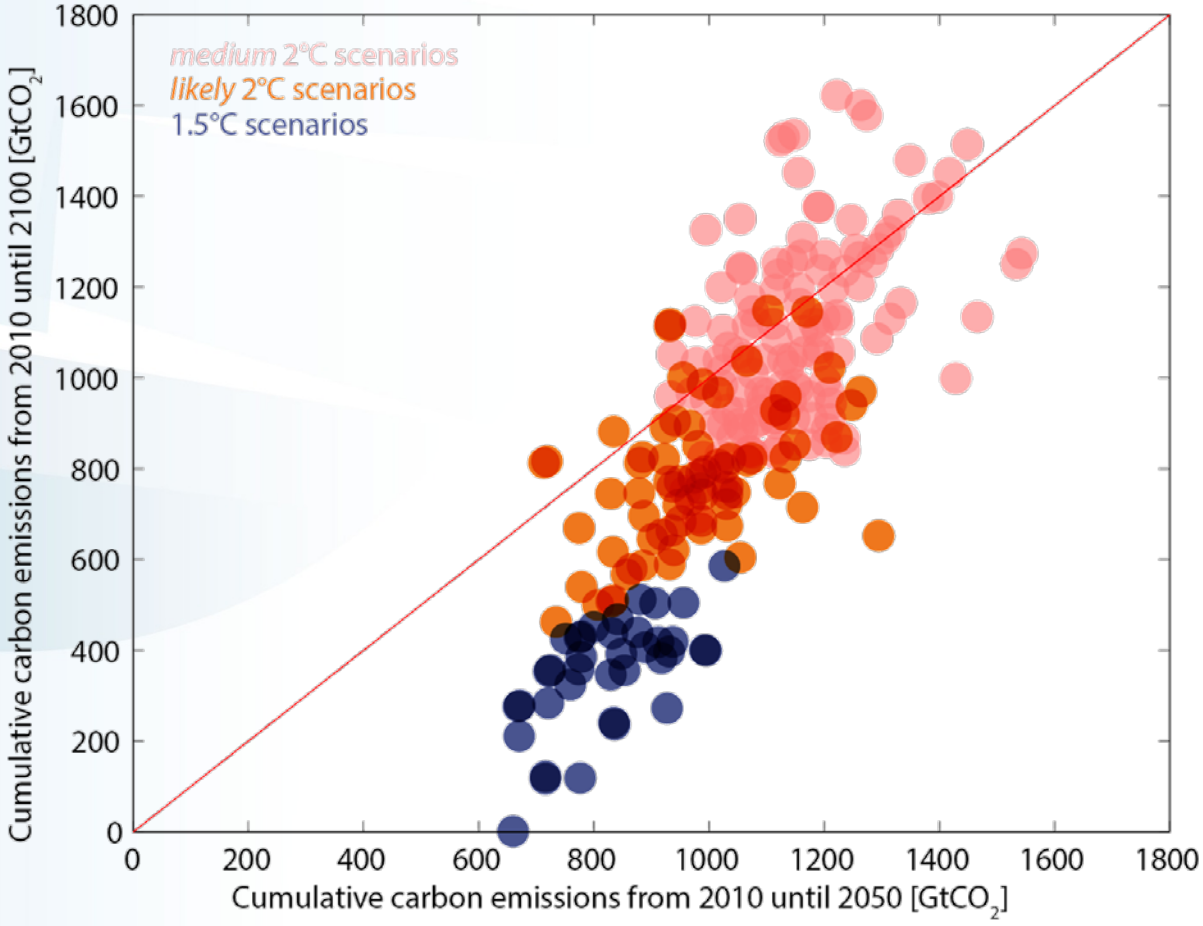
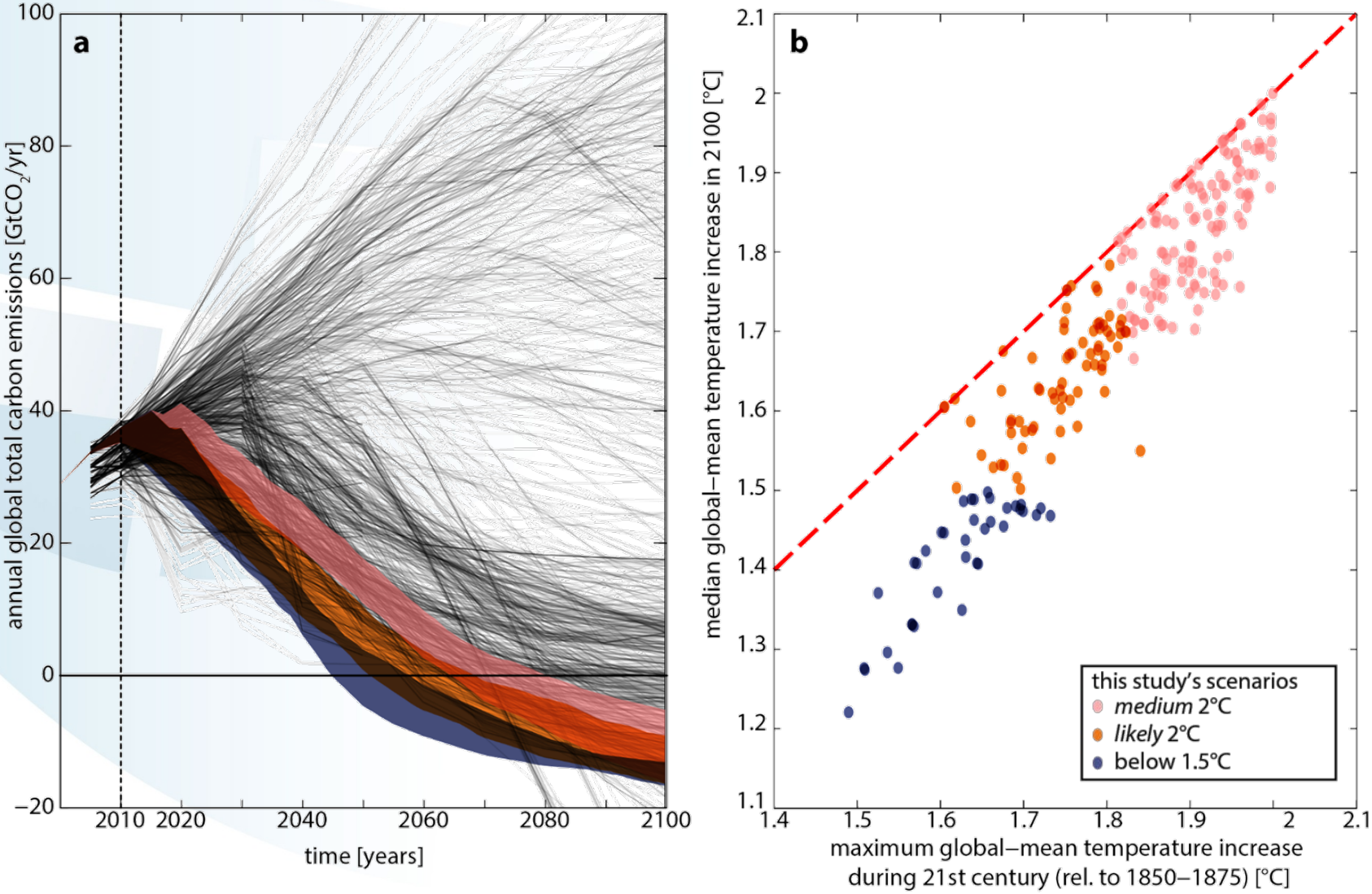


Rogelj et al (2015) NCC

Scenario implications

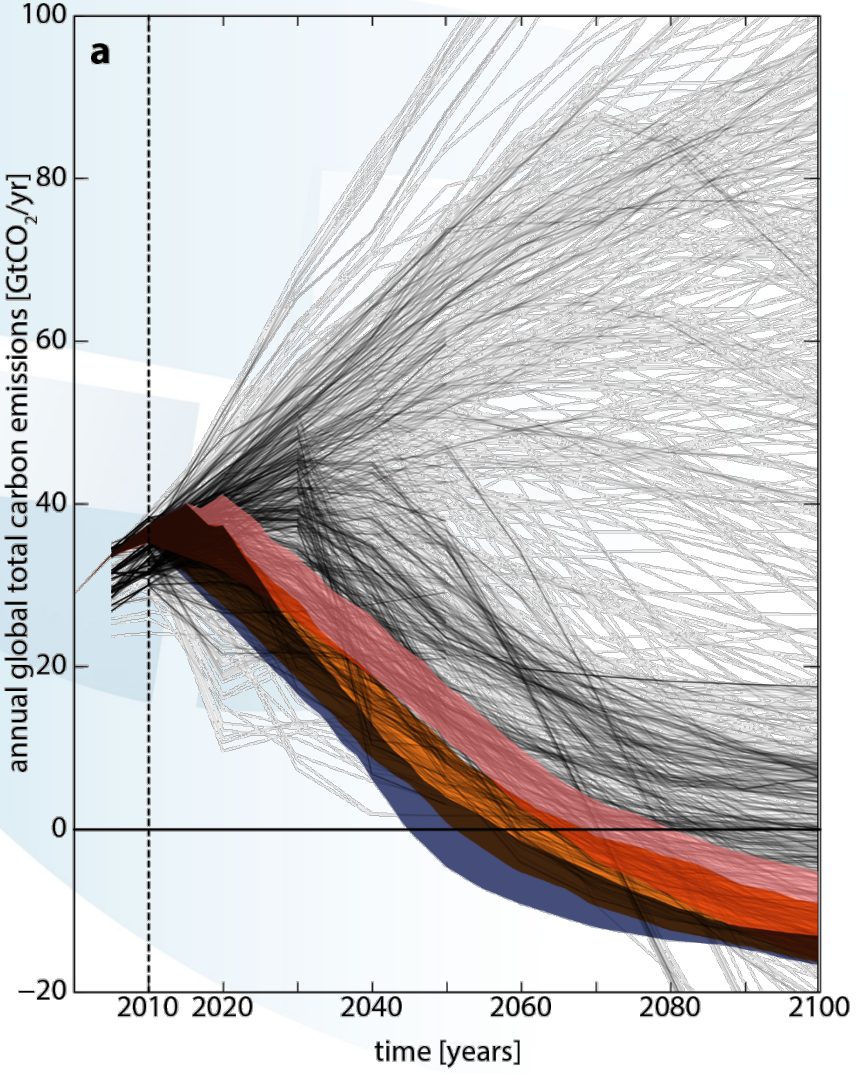
1.5°C & 2°C

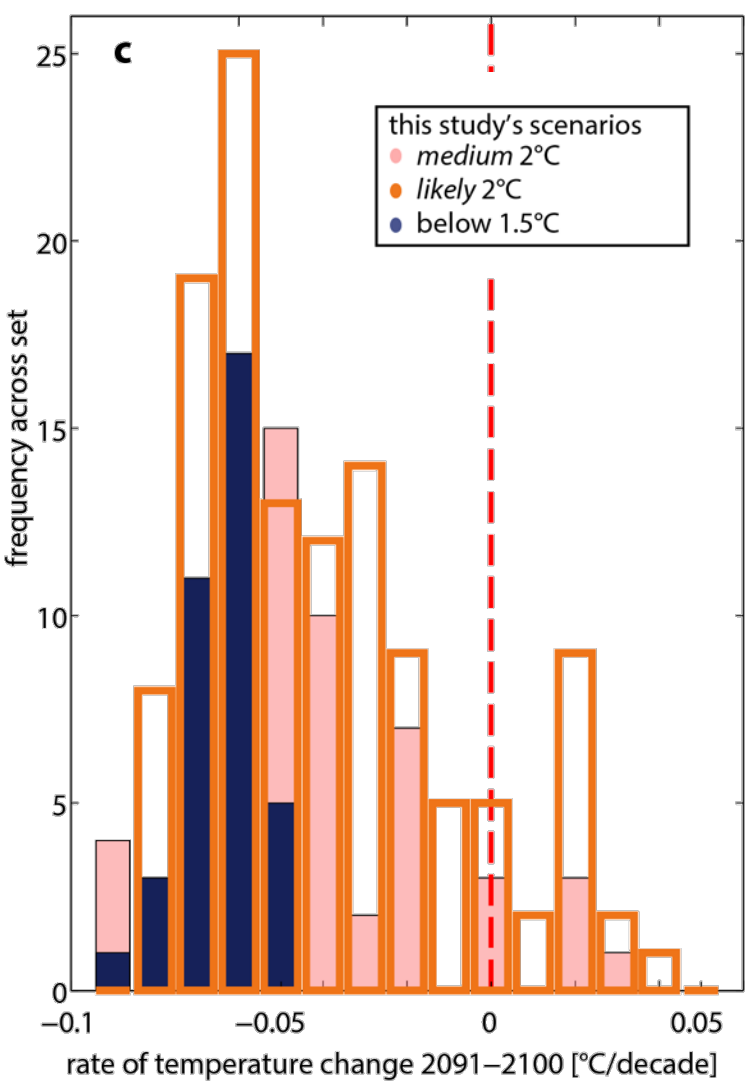


Rogelj et al (2015) NCC

Scenario implications

1.5°C & 2°C

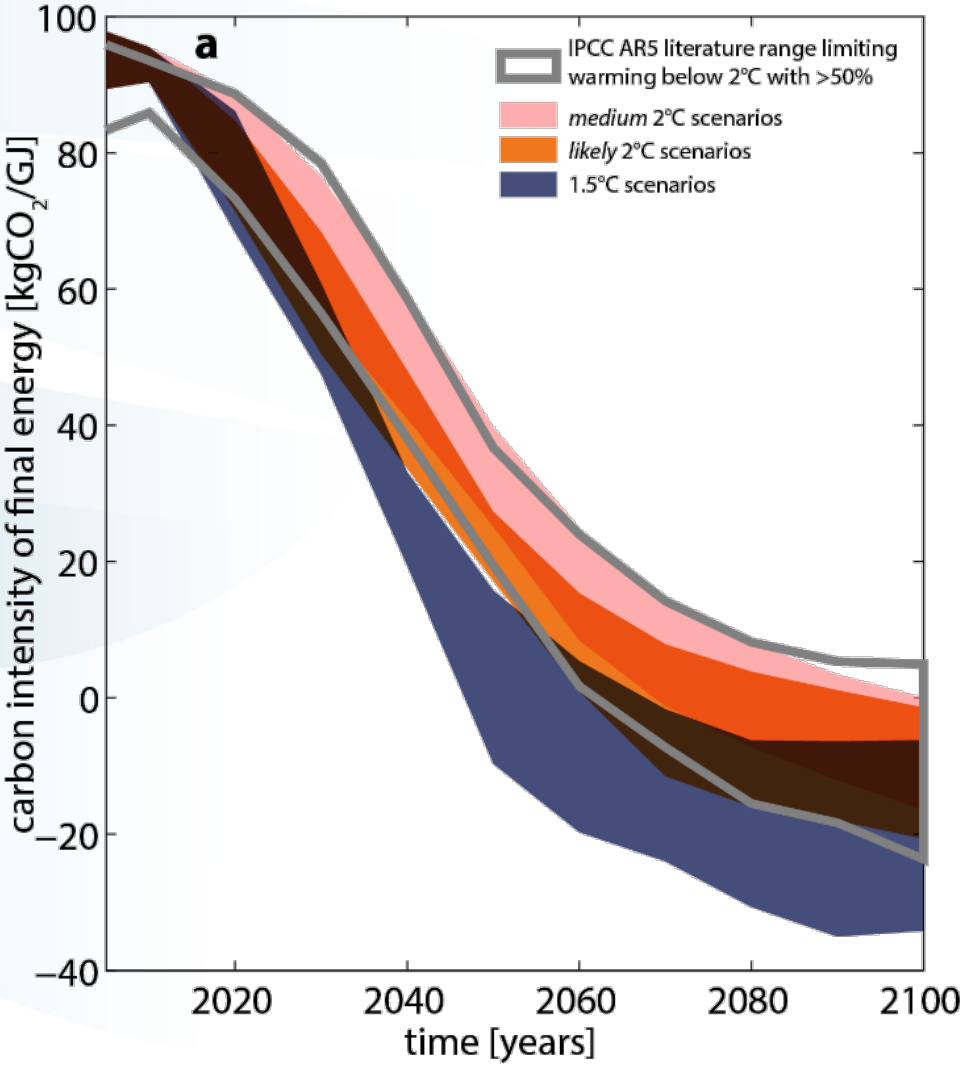




Rogelj et al (2015) NCC

What do 1.5°C scenarios look like?

Energy system characteristics



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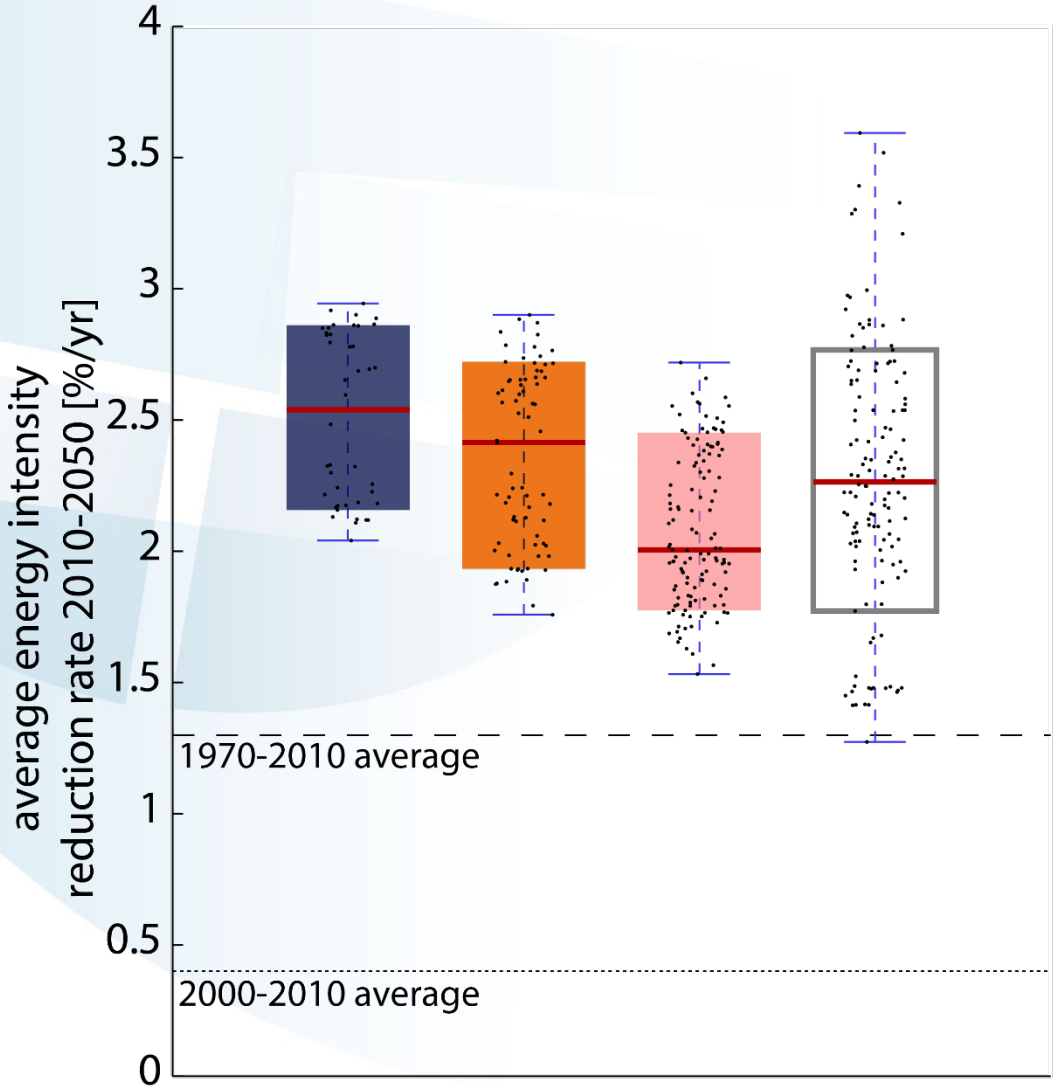


literature range limiting warming below 2°C with >50%

medium 2°C scenarios

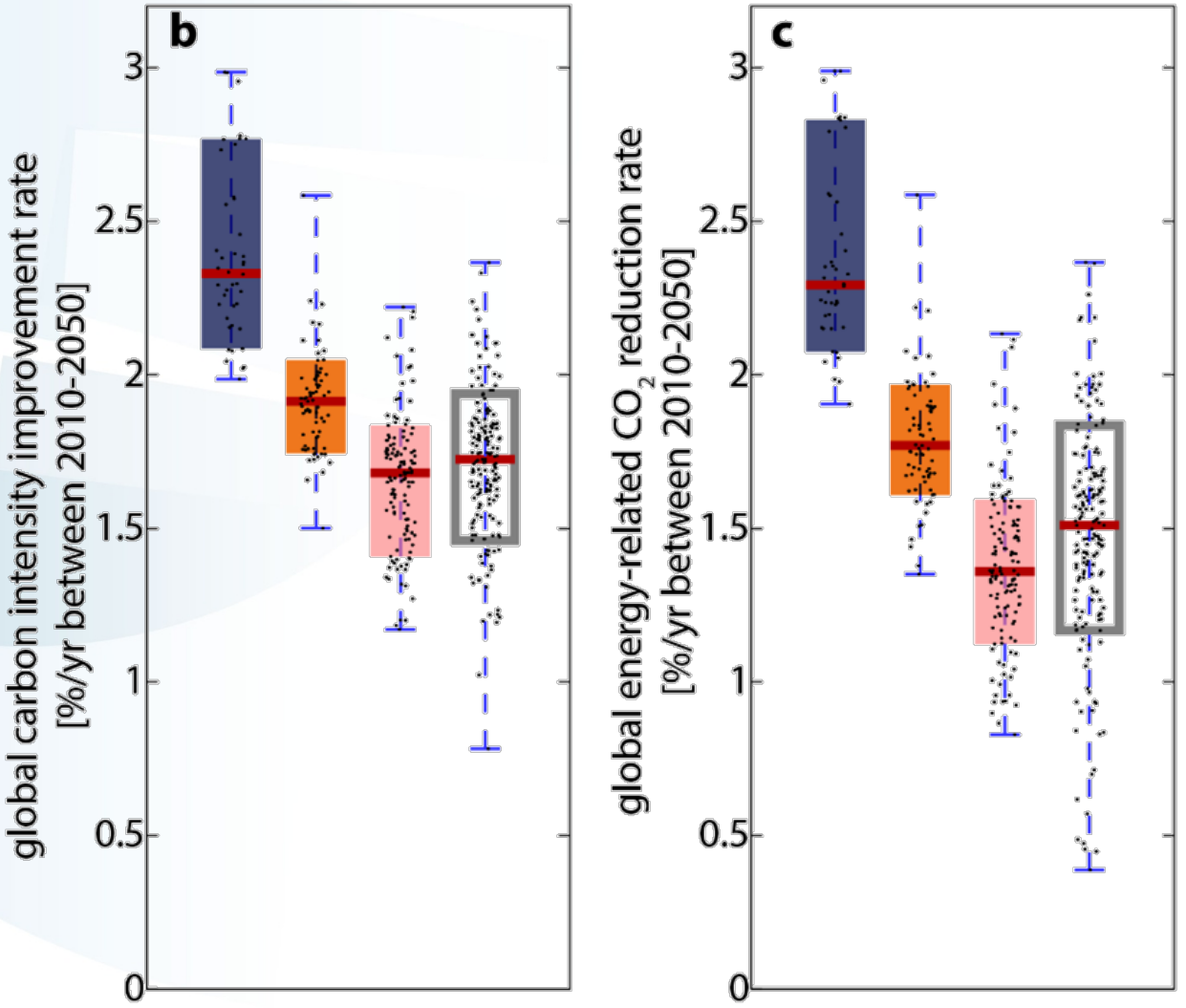
likely 2°C scenarios

1.5°C scenarios

Rogelj et al (2015) NCC

What do 1.5°C scenarios look like?

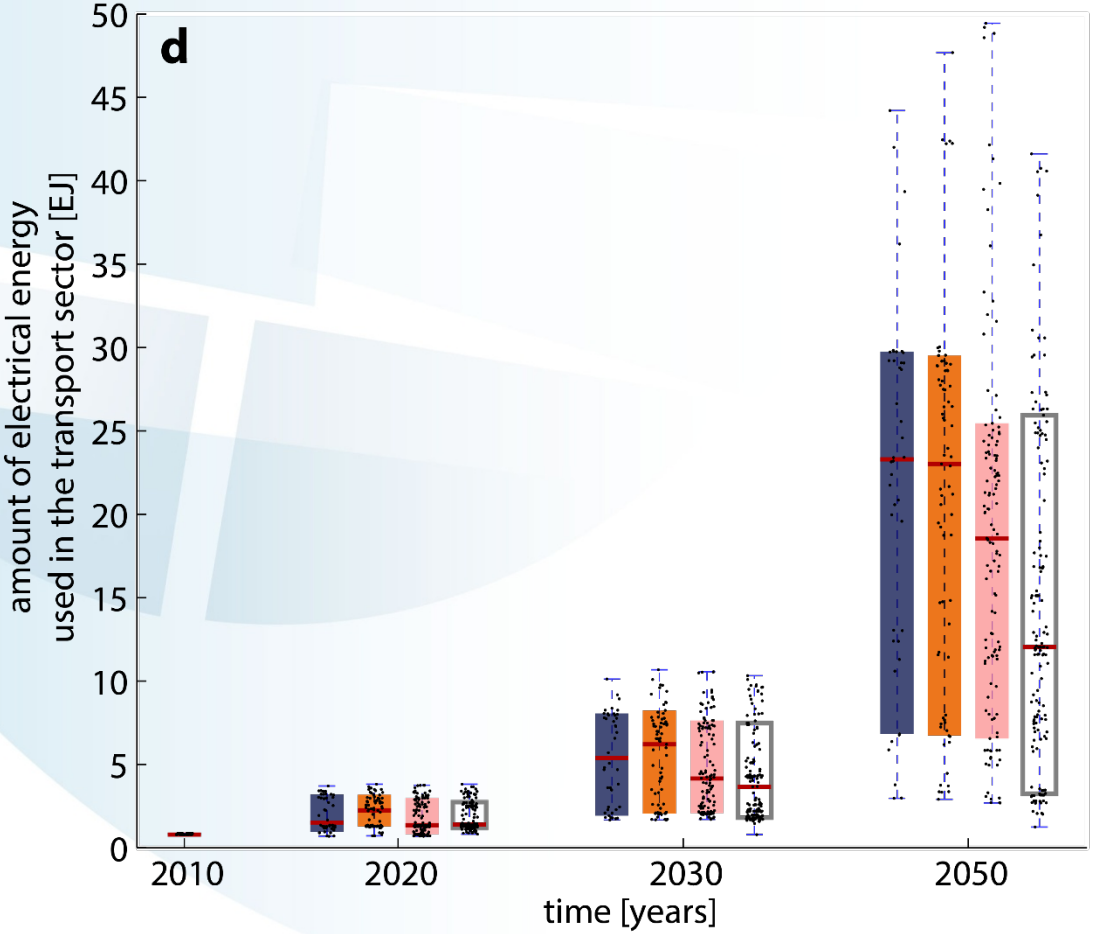
Energy system characteristics



Rogelj et al (2015) NCC

What do 1.5°C scenarios look like?

Energy supply characteristics – no differences



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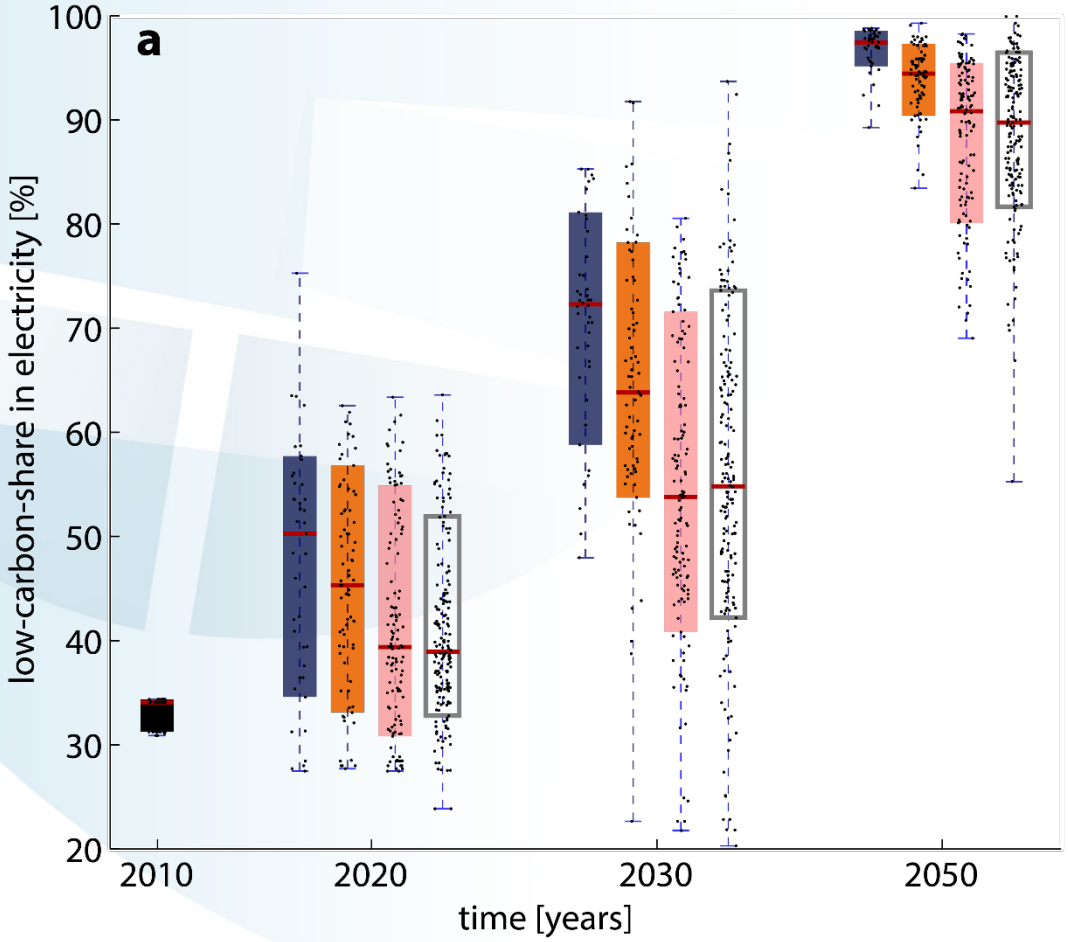
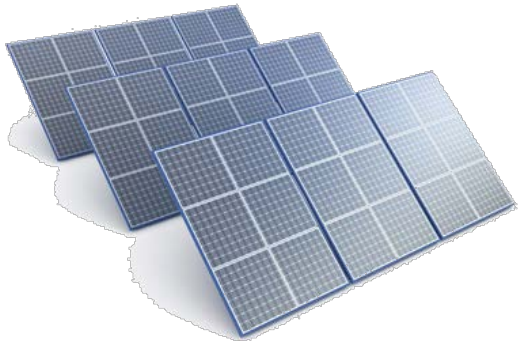
What do 1.5°C scenarios look like?

Energy supply characteristics – near-term differences





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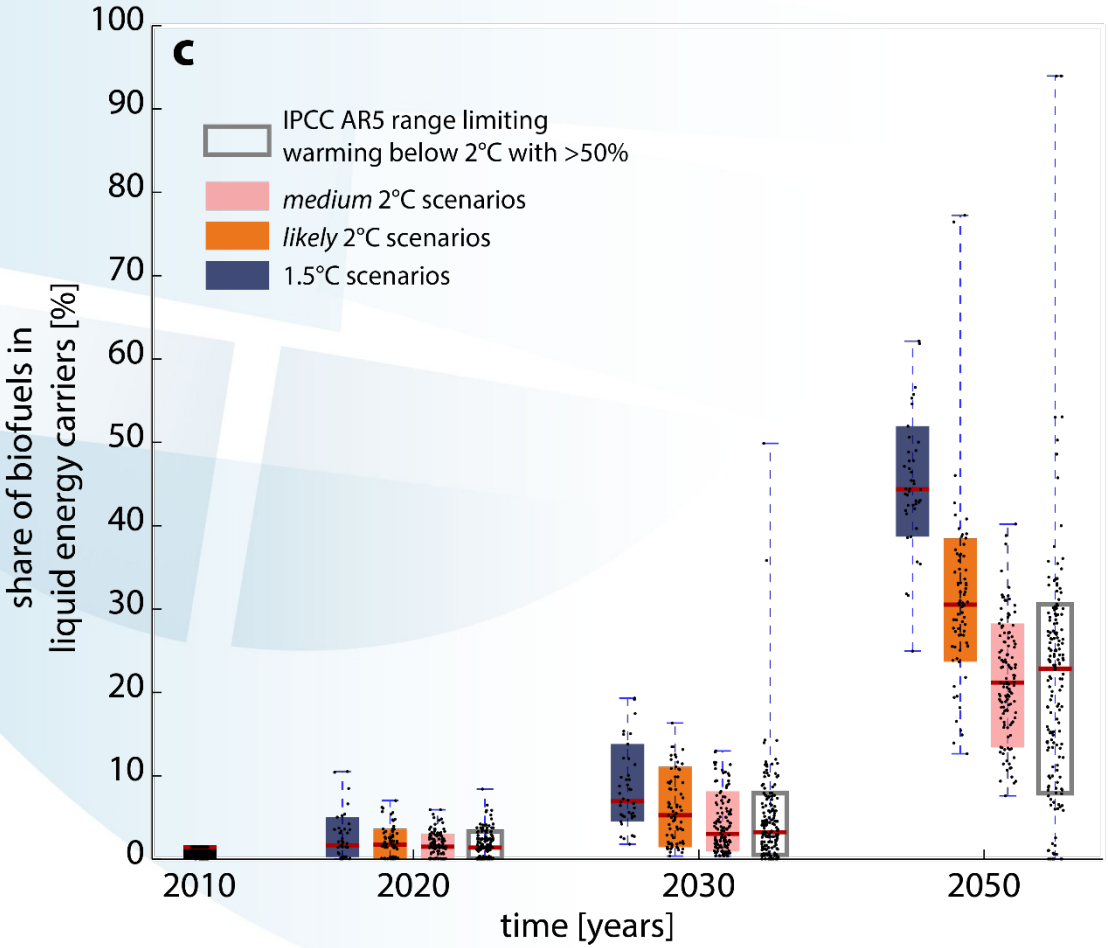
What do 1.5°C scenarios look like?

Energy supply characteristics – medium-term differences



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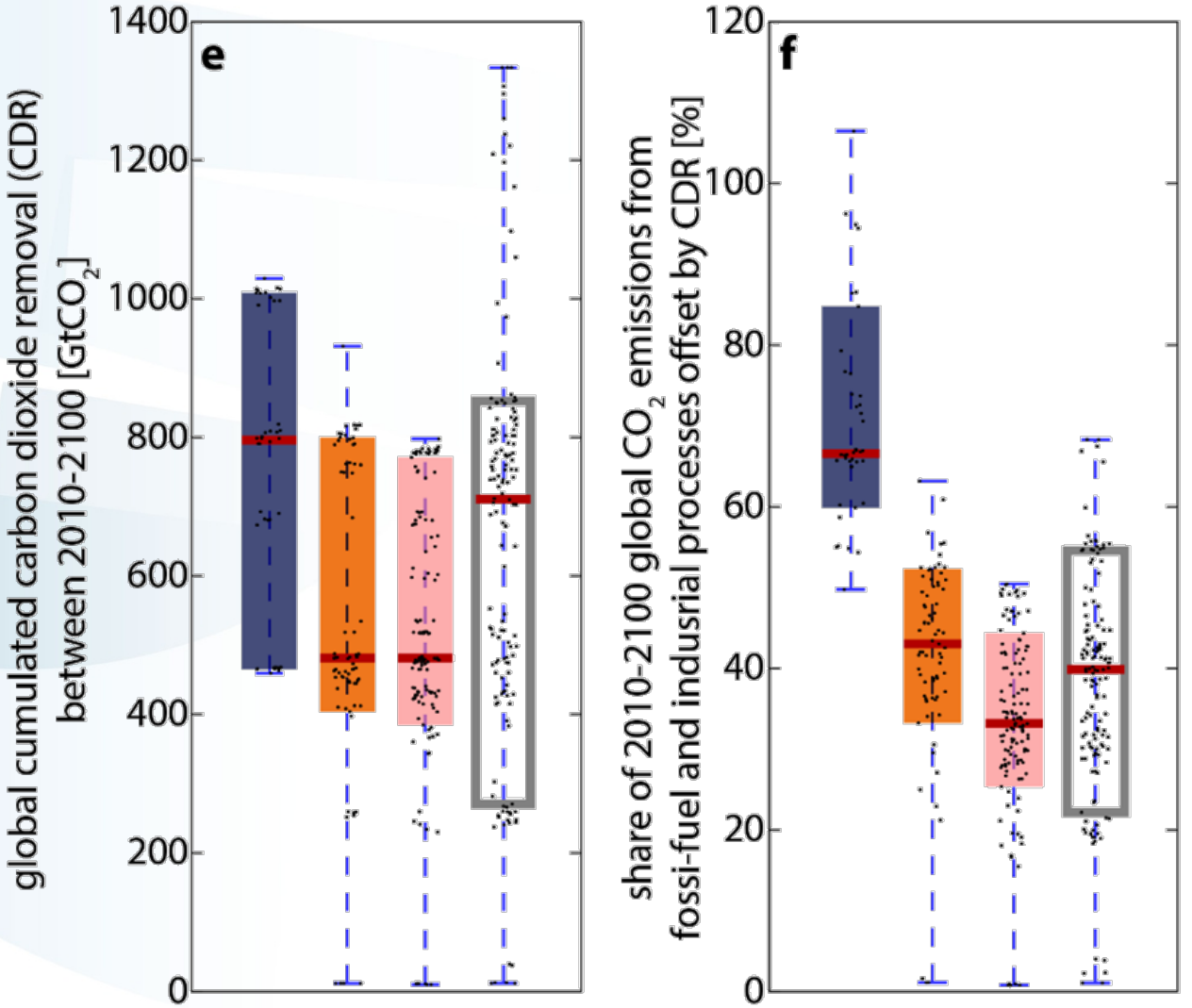
Key mitigation options

What do 1.5°C scenarios look like?

Negative emissions



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What do 1.5°C scenarios look like?

Like-with-like comparison

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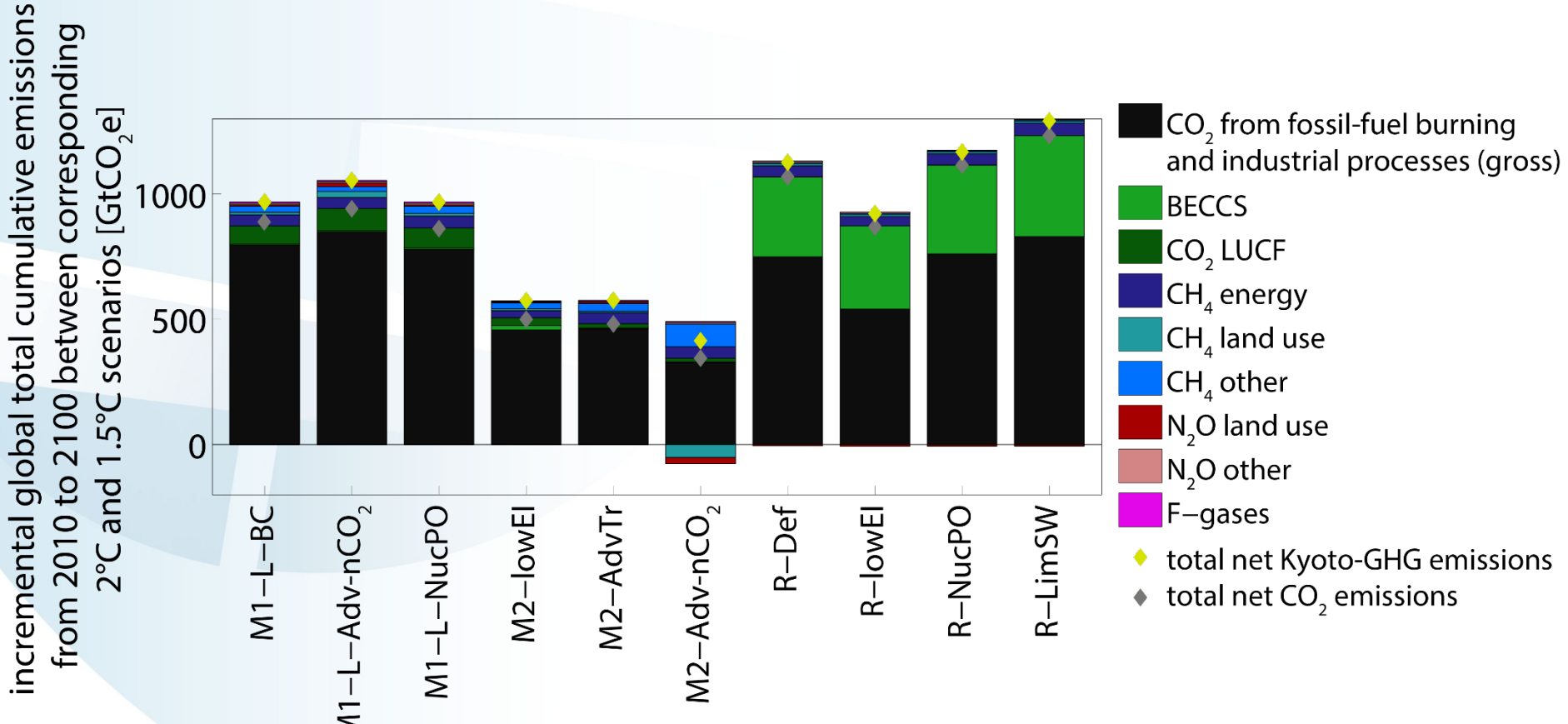
Like-with-like comparison



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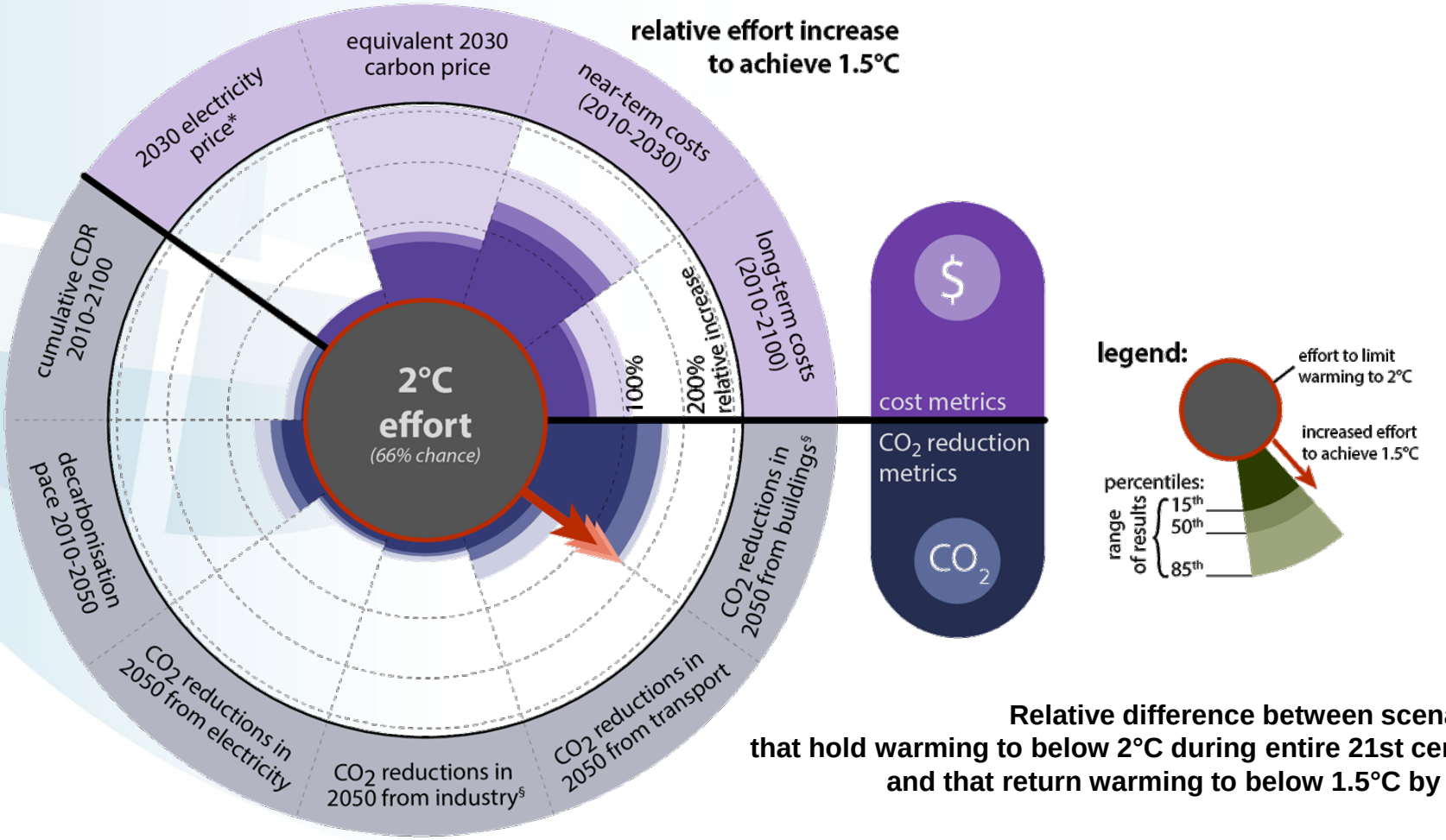
What do 1.5°C scenarios look like?

Like-with-like comparison



Relative difference between scenarios that hold warming to below 2°C during entire 21st century and that return warming to below 1.5°C by 2100

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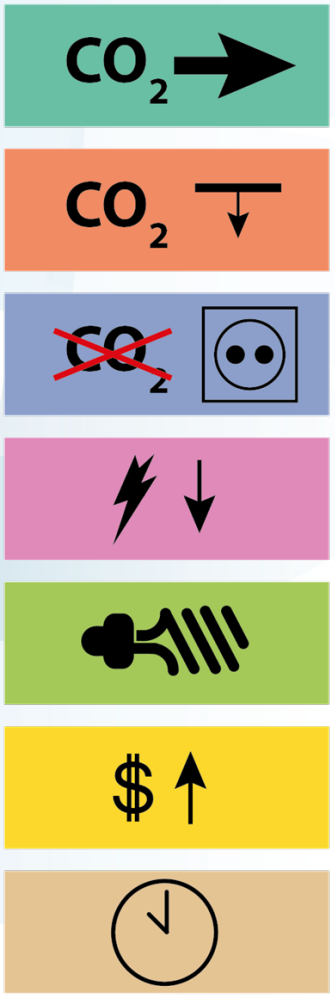
What do 1.5°C scenarios look like?

Key differences with 2°C scenarios



additional GHG reductions, mainly from CO2

CO2 reductions beyond net zero

rapid near-term decarbonisation of energy supply

greater demand side mitigation efforts

energy efficiency improvements are crucial

higher mitigation costs

comprehensive reductions in the coming decade

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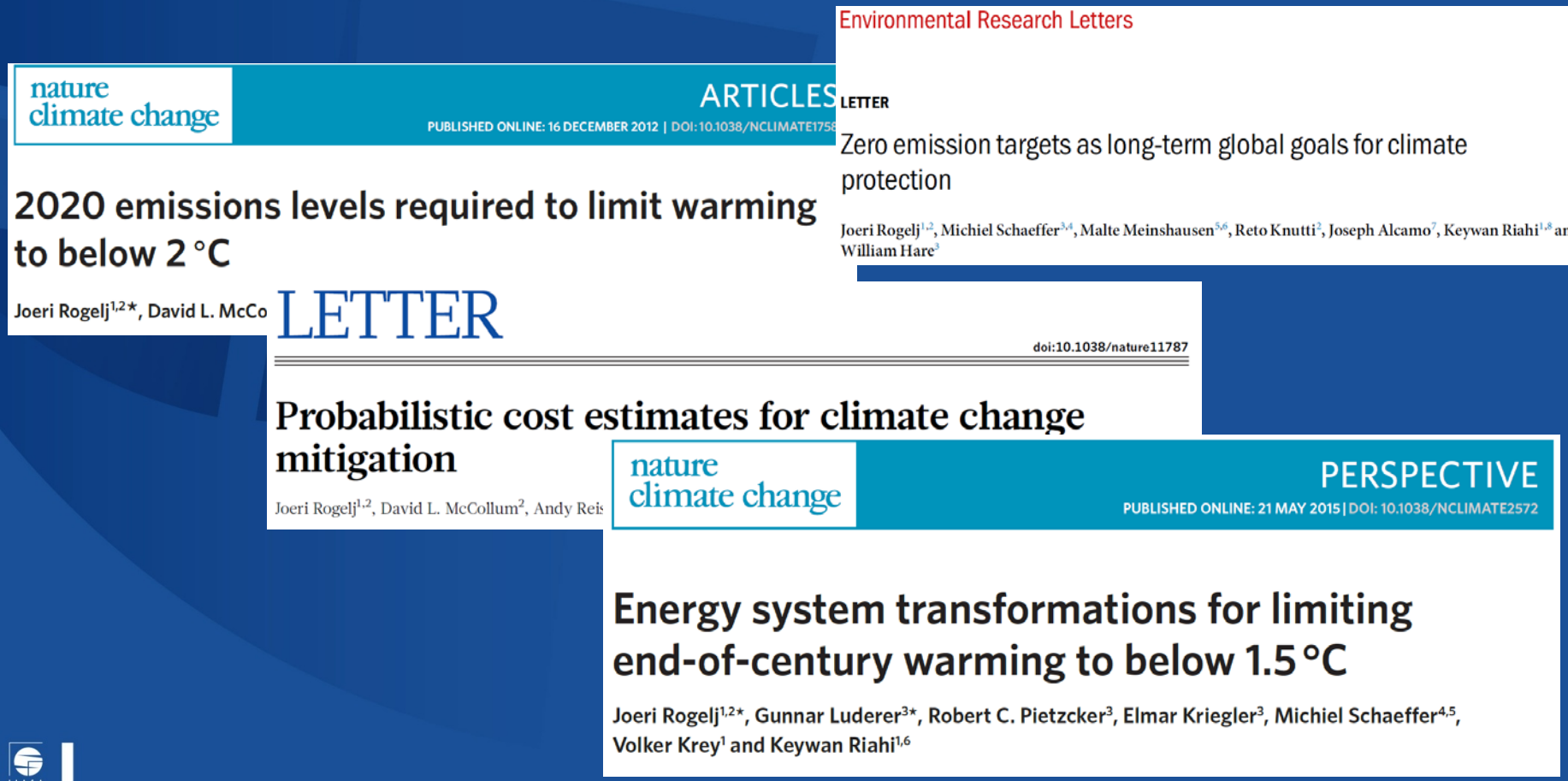
Half a decade of 1.5°C science at IIASA

Series of peer-reviewed publications:



nature climate change

ARTICLES

PUBLISHED ONLINE: 16 DECEMBER 2012 | DOI:10.1038/NCLIMATE175

2020 emissions levels required to limit warming to below 2 °C

Joeri Rogelj[1,2]*, David L. McCo

Environmental Research Letters

LETTER

Zero emission targets as long-term global goals for climate protection

Joeri Rogelj[1,2], Michiel Schaeffer[3,4], Malte Meinshausen[5,6], Reto Knutti[2], Joseph Alcamo[7], Keywan Riahi[1,8] and William Hare[3]

LETTER

doi:10.1038/nature11787

Probabilistic cost estimates for climate change mitigation

Joeri Rogelj[1,2], David L. McCollum[2], Andy Reis

nature climate change

PERSPECTIVE

PUBLISHED ONLINE: 21 MAY 2015 | DOI: 10.1038/NCLIMATE2572

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]

Thank you

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