The IPCC Special report on 1.5 degrees C warming, and some implications for Europe

Jean-Pascal van Ypersele

Former IPCC Vice-Chair (2008-2015)

Prof UCLouvain (Belgium), Earth & Life Institute

Twitter: @JPvanYpersele,

The Prince of Wales's Corporate Leaders Group meeting,
Brussels, 14 November 2018

Thanks to the Walloon government for supporting www.plateforme-wallonne-giec.be
and my team at UCLouvain (Université catholique de Louvain, Belgium)

Why this SR15 report?

- 1992: Article 2 of the UNFCCC: avoid « dangerous interference »
- 1996: EU Environment Council: for us, dangerous = <2°C
- 2009: COP15 (Copenhagen): dangerous = <2°C
- 2010: COP16 (Cancun): formalizes COP15
- 2015: COP21 (Paris): objective = « Well below 2°C » & « pursuing efforts to limit warming to 1.5°C»

The Paris Agreement (COP21, December 2015)

Vision

« …strengthen the **global response to the threat of climate change**, in the context of **sustainable development** and efforts to **eradicate poverty** »

Objectives

a) Holding the increase in the global average temperature:

- *« **to well below 2°C** above pre-industrial levels »*
- *« **pursuing efforts to limit the temperature increase to 1.5°C** above pre-industrial levels,*
  recognizing that this would significantly reduce the risks and impacts of climate change »

b) Adaptation and Mitigation

- *« **Increasing the ability to adapt** to the adverse impacts of climate change and **foster climate resilience** and*
- ***low greenhouse gas emissions development**, in a manner that does not threaten food production»*

c) Finances

- *« Making **finance flows consistent** with a pathway towards low greenhouse gas emissions and climate-resilient development. »*

Why this SR15 report?

COP21 decided to invite the IPCC « to provide a special report in 2018 on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways » (Article 21 of 1/CP21)

Why this SR15 report?

COP21 « Notes with concern that the estimated aggregate GHG emission levels in 2025 and 2030 resulting from the INDCs:

- do not fall within least-cost 2 ˚C scenarios but rather lead to a projected level of 55 gigatonnes in 2030,

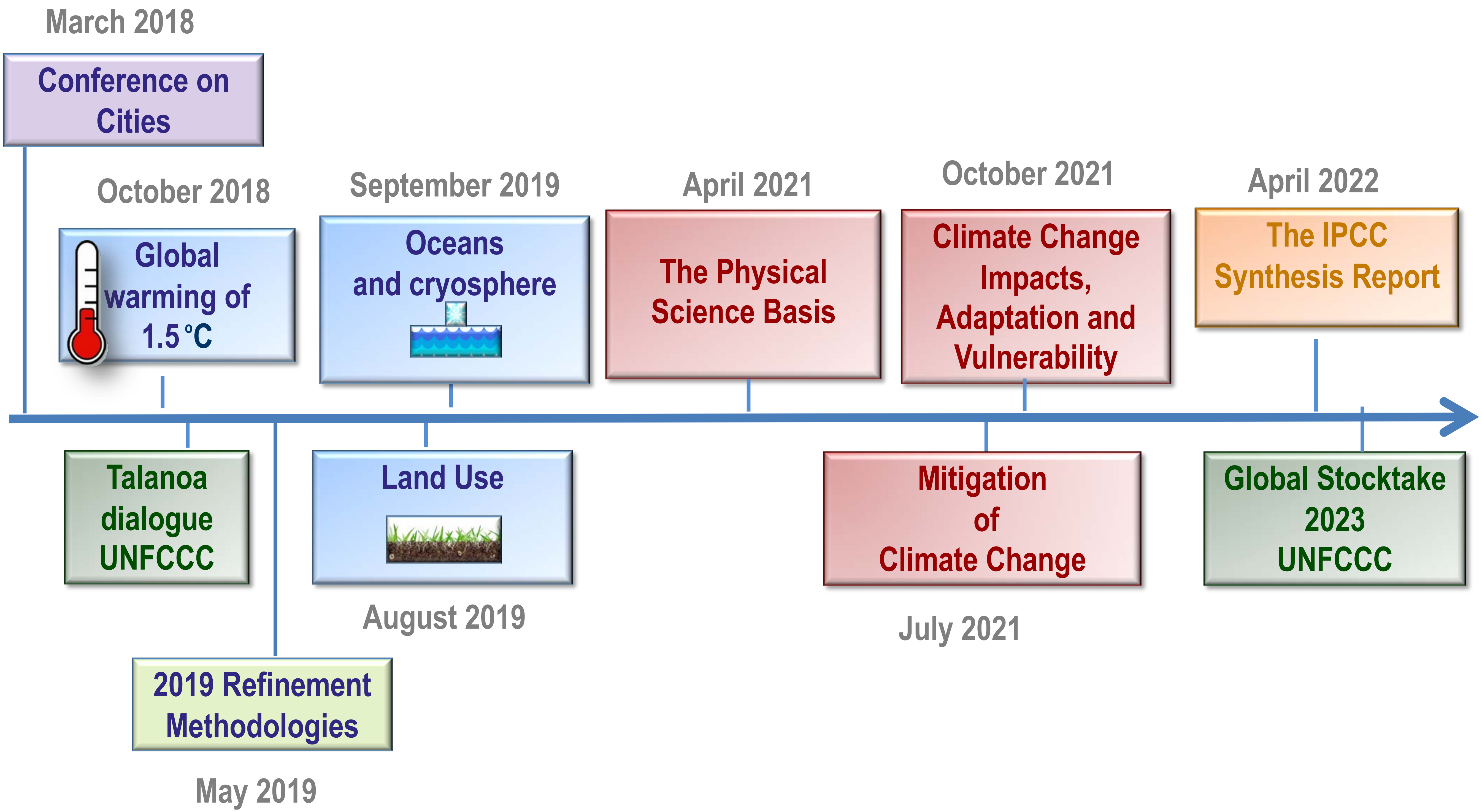
- and also notes that much greater emission reduction efforts will be required (…) in order to hold the increase in the global average temperature
-- to below 2 ˚C above pre-industrial levels by reducing emissions to 40 gigatonnes
-- or to 1.5 ˚C above pre-industrial levels by reducing to a ***level to be identified in the [IPCC] special report*** » (Article 17 of 1/CP21)

Why this SR15 report?

After a scoping process, the IPCC Plenary (Bangkok, October 2016) decided to accept the COP21 invitation and to produce:

« *An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, **in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*** »

Timeline for the forthcoming AR6 reports

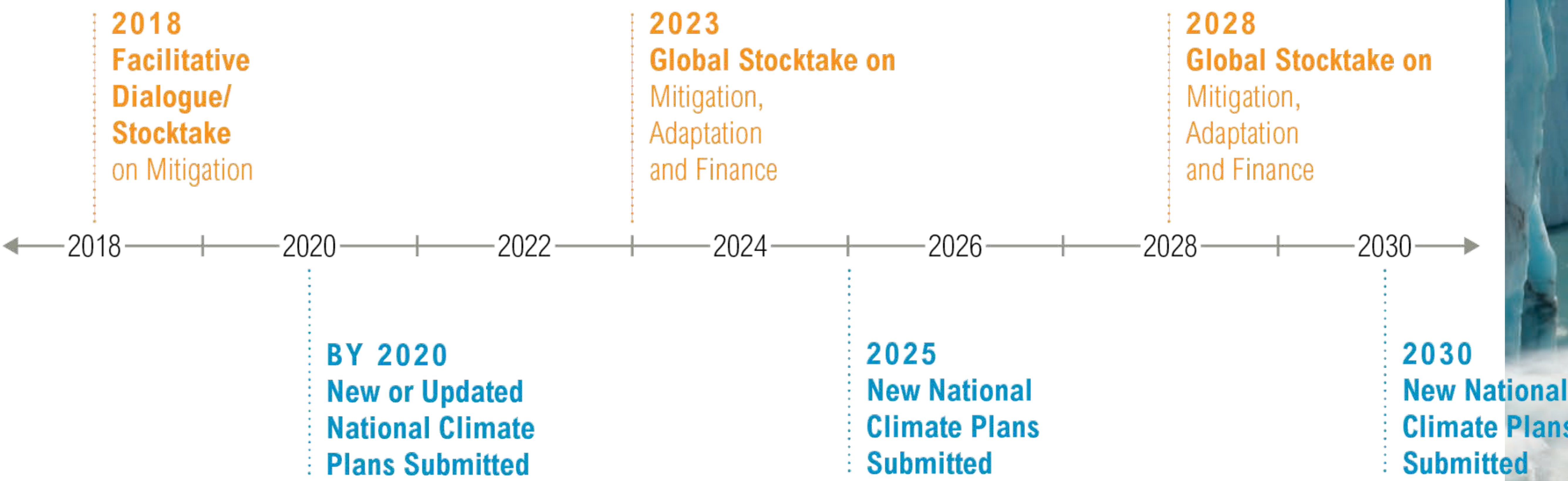


** Dates are subject to a change*

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Global stocktake : mitigation, adaptation and support

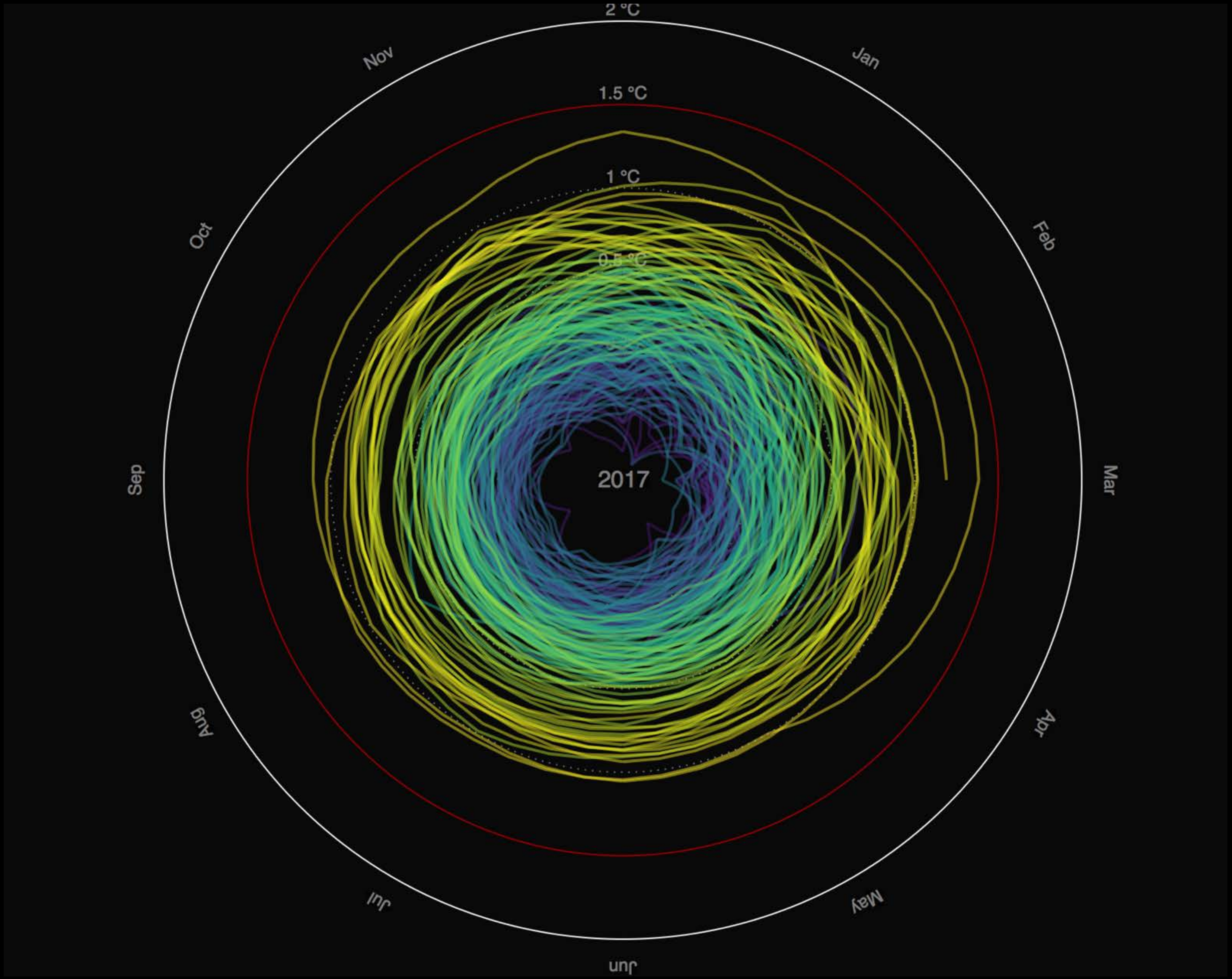
Ambition Mechanism in the Paris Agreement



http://ow.ly/VUfYe

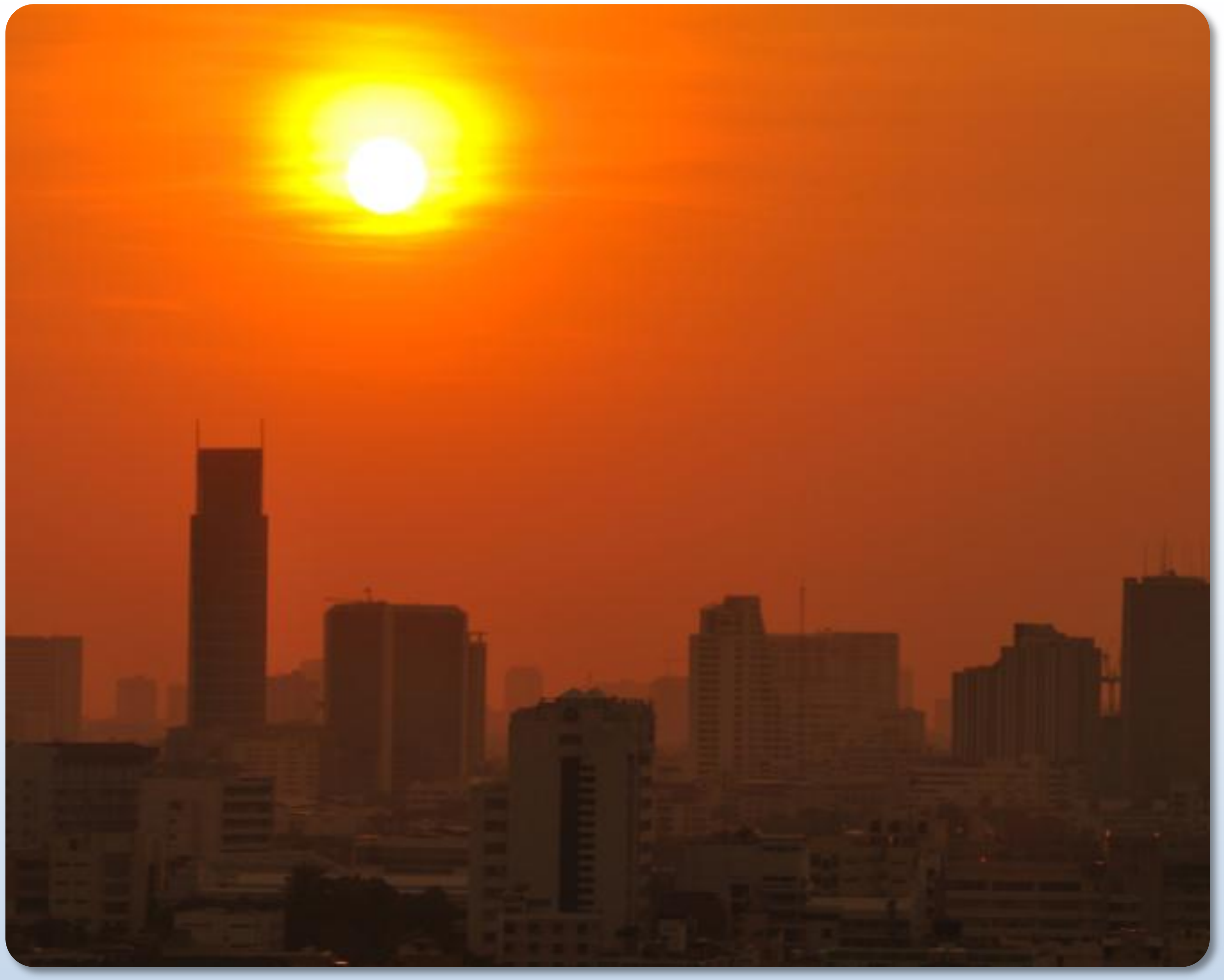
WORLD RESOURCES INSTITUTE

Temperature spiral



Global Mean Temperature in °C relative to 1850 – 1900
Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset
Animated version available on http://openclimatedata.net/climate-spirals/temperature

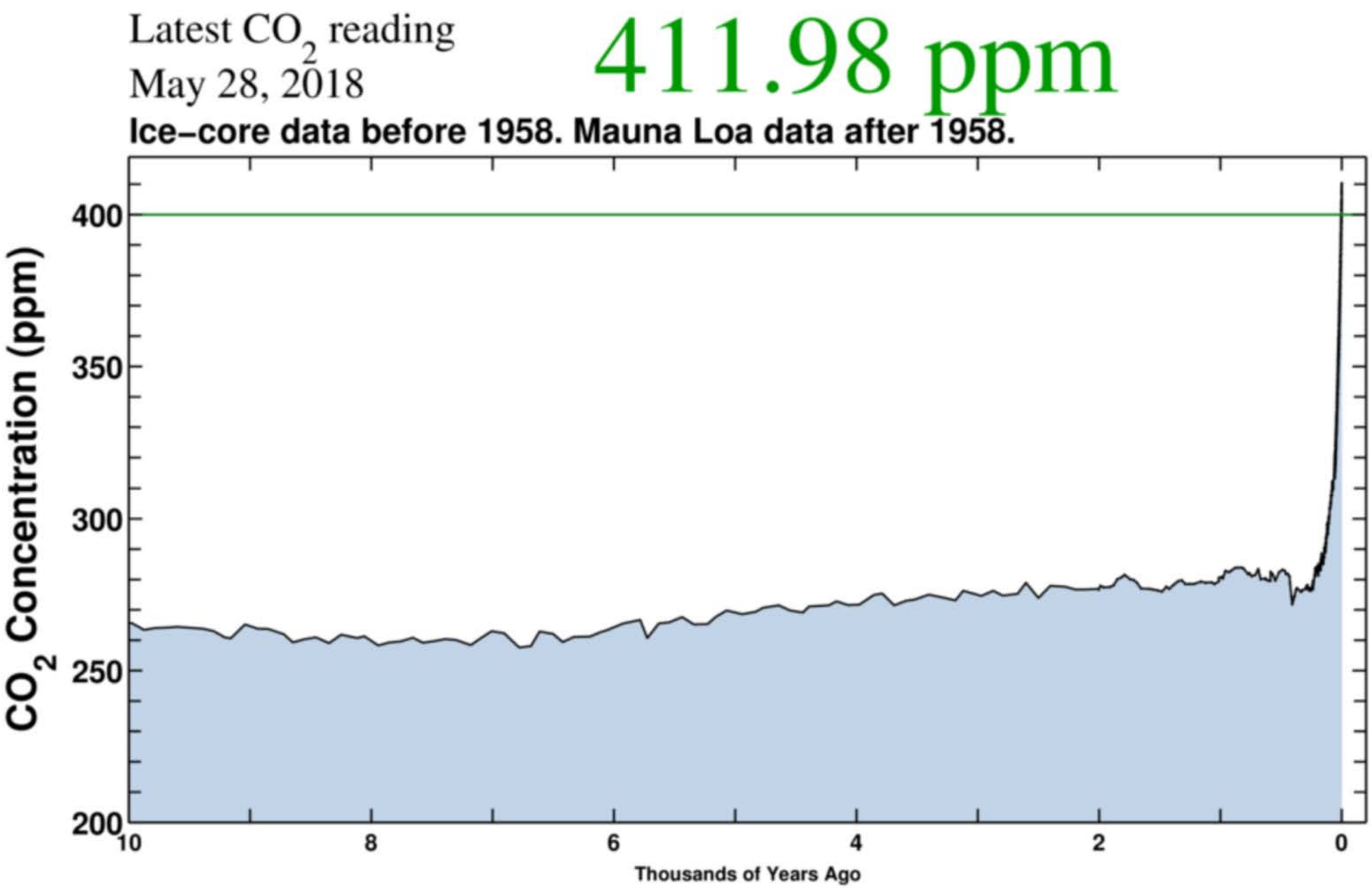
Since 1950, extreme hot days and heavy precipitation have become more common



There is evidence that anthropogenic influences, including increasing atmospheric greenhouse gas concentrations, have changed these extremes

More heavy precipitation and more droughts….

CO_2 Concentration, 28 May 2018 (Keeling curve)



Source: scripps.ucsd.edu/programs/keelingcurve/

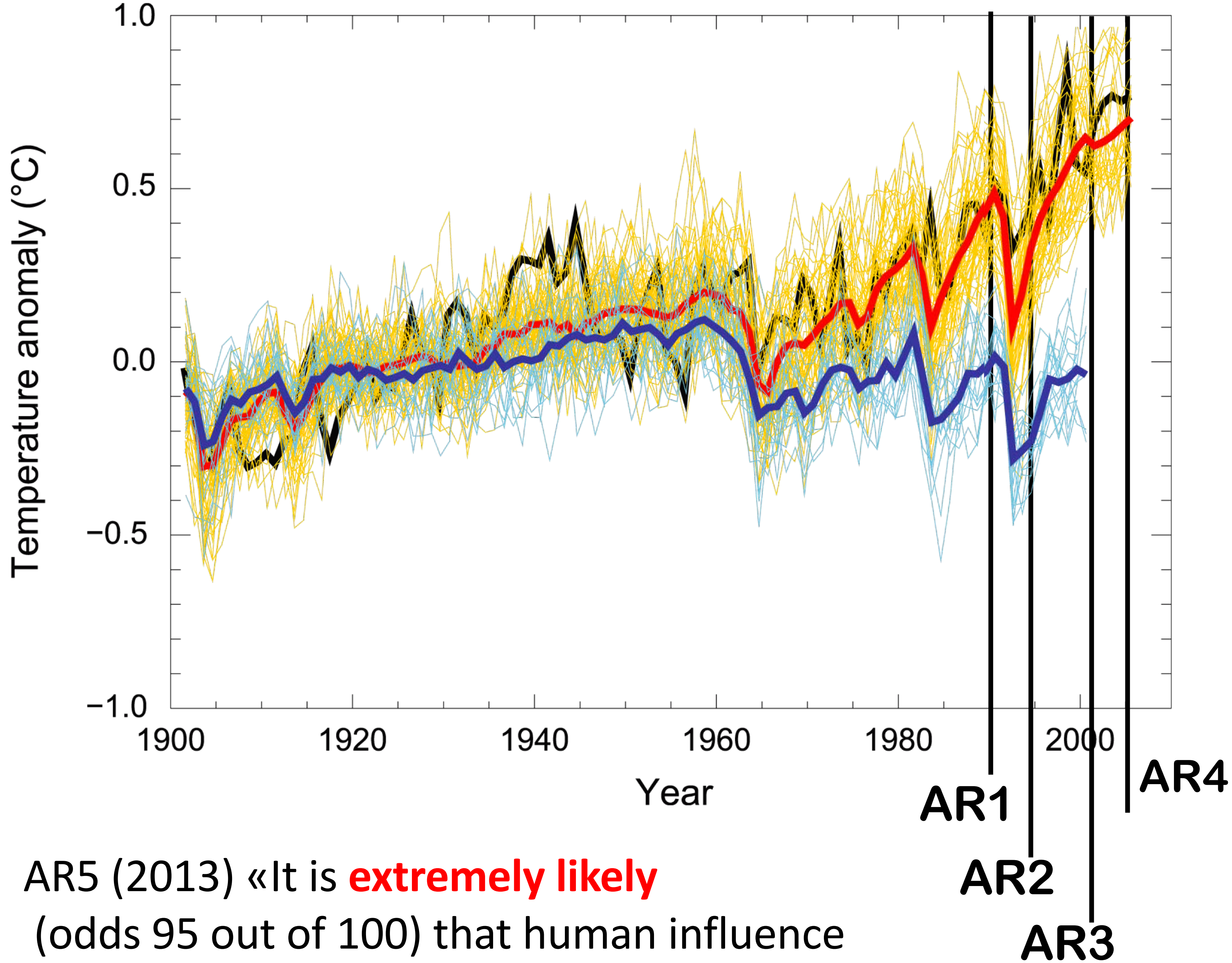
A Progression of Understanding: Greater and Greater Certainty in Attribution

AR1 (1990): "unequivocal detection not likely for a decade"

AR2 (1995): "balance of evidence suggests **discernible** human influence"

AR3 (2001): "most of the warming of the past 50 years is **likely** (odds 2 out of 3) due to human activities"

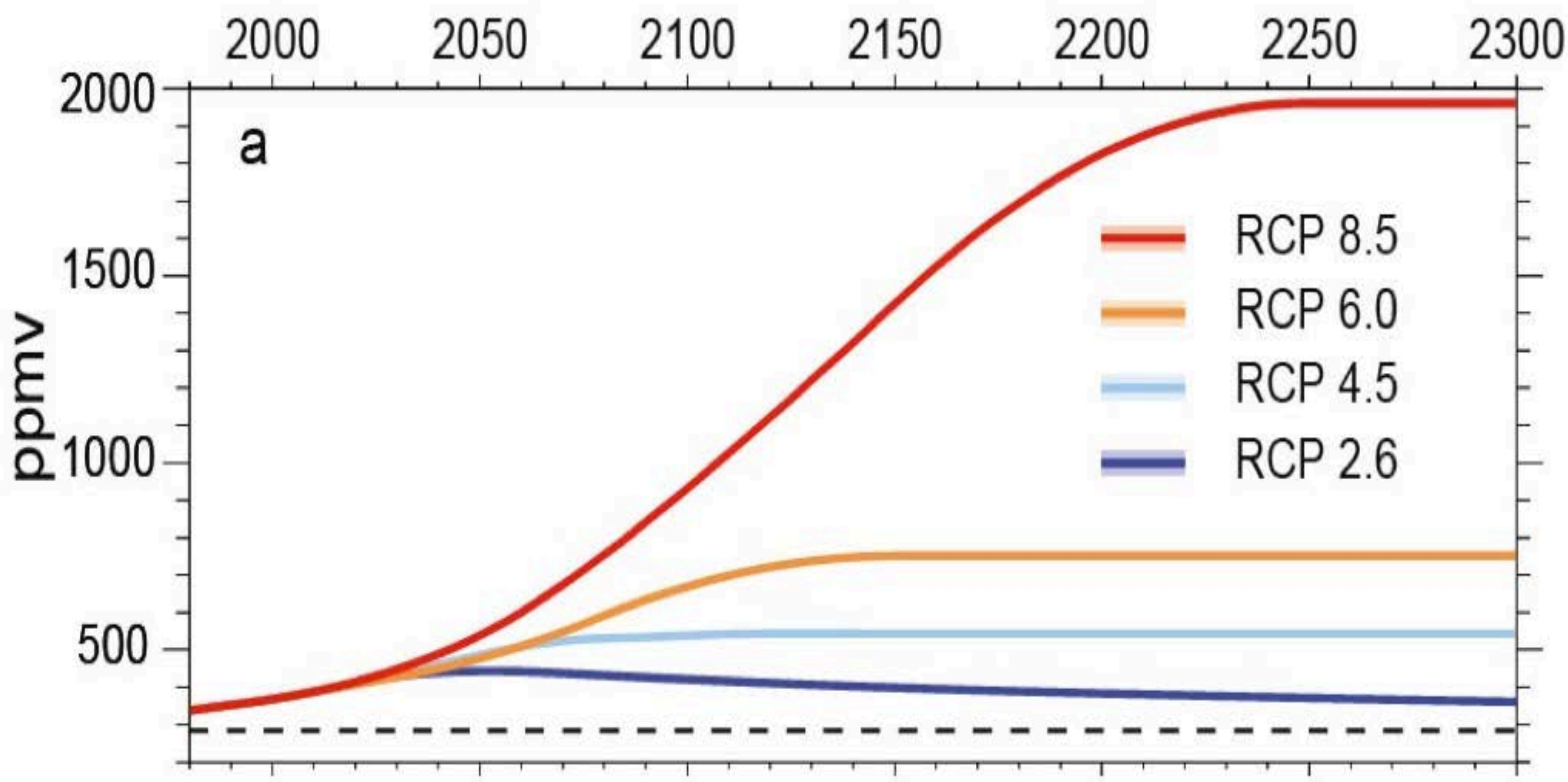
AR4 (2007): "most of the warming is **very likely** (odds 9 out of 10) due to greenhouse gases"



AR5 (2013) «It is **extremely likely** (odds 95 out of 100) that human influence has been the dominant cause… »

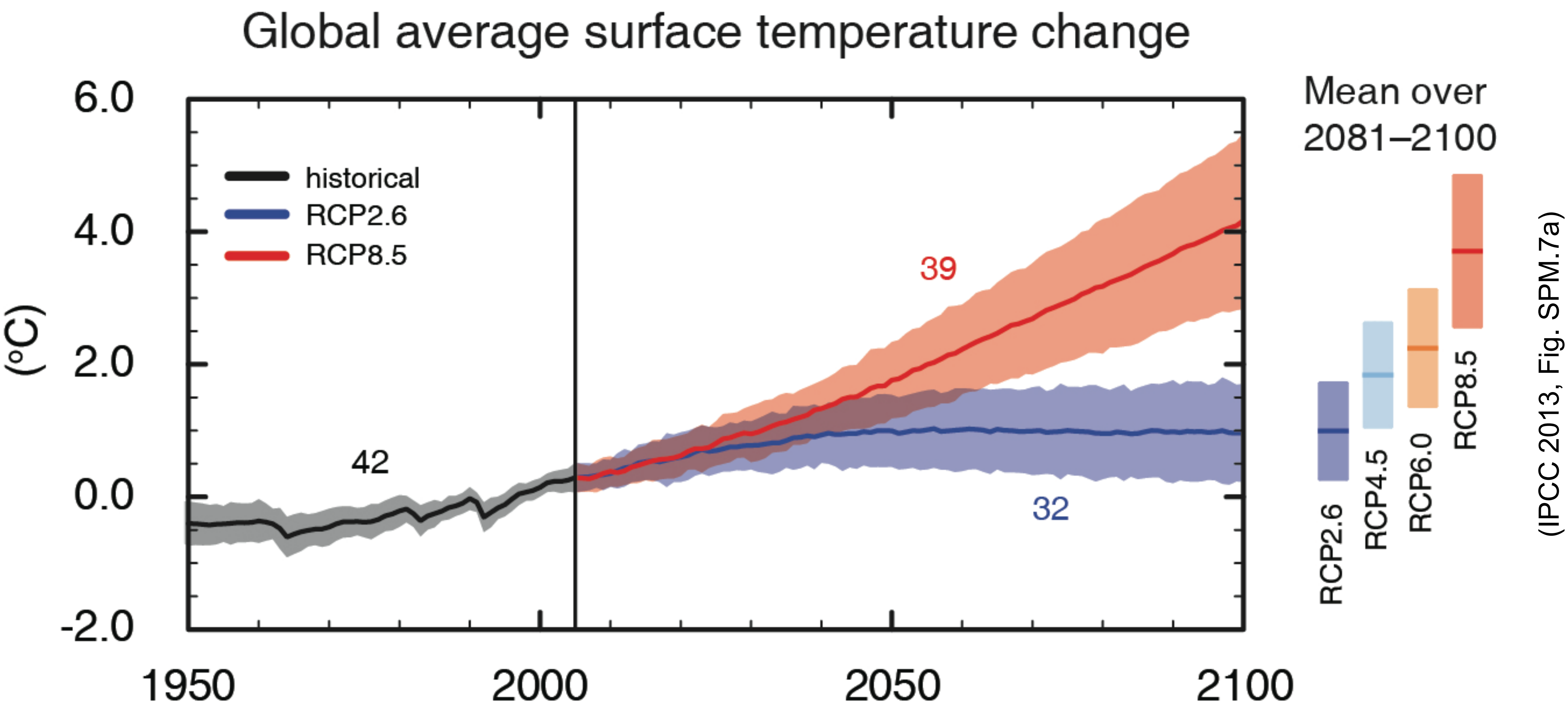
IPCC

RCP Scenarios: Atmospheric CO_2 concentration



Three stabilisation scenarios: RCP 2.6 to 6
One Business-as-usual scenario: RCP 8.5

AR5, chapter 12. WGI- Adopted version / subject to final copyedit



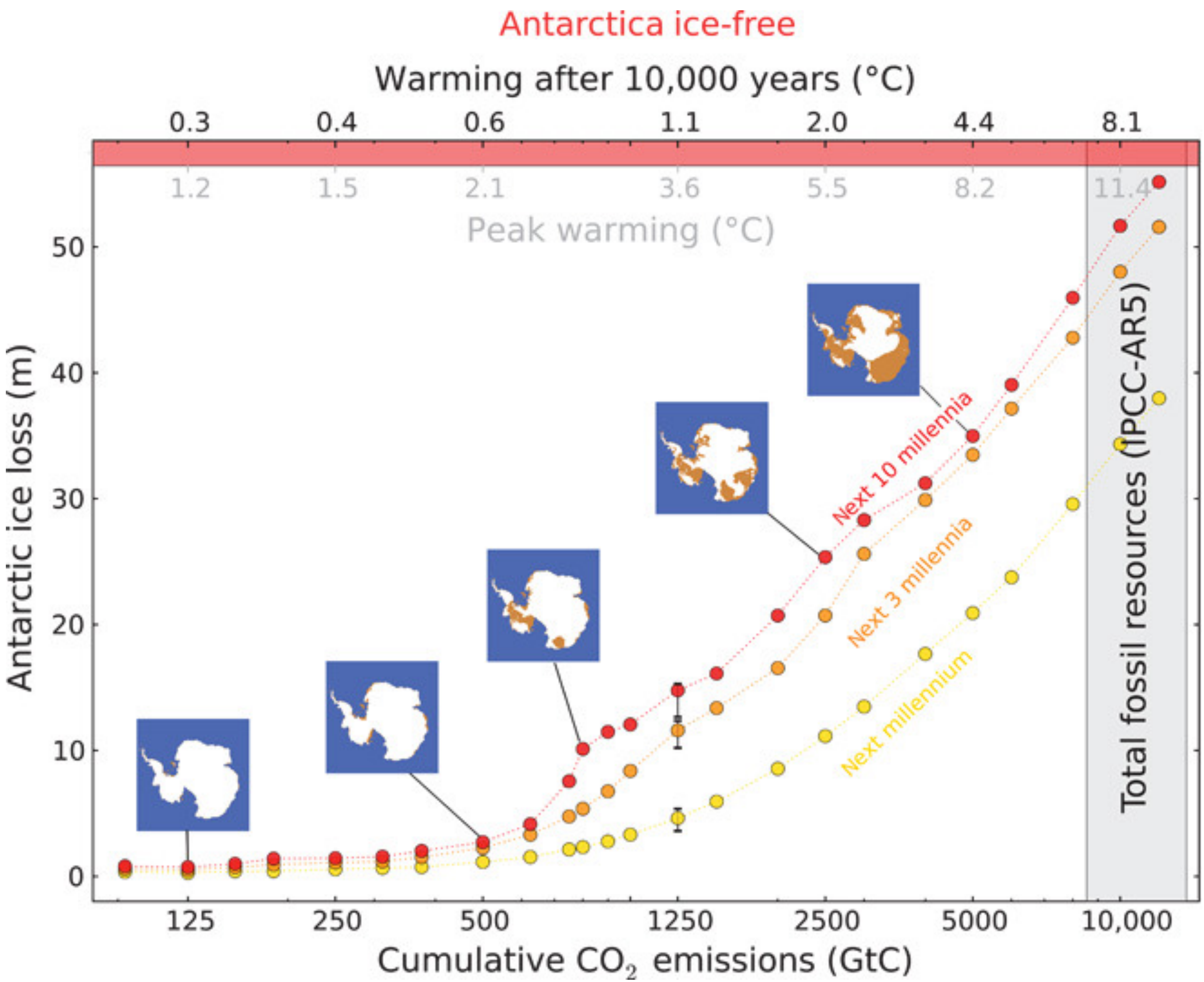
Only the lowest (RCP2.6) scenario maintains the global surface temperature increase above the pre-industrial level to less than 2° C with at least 66% probability

18-20000 years ago (Last Glacial Maximum)

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.

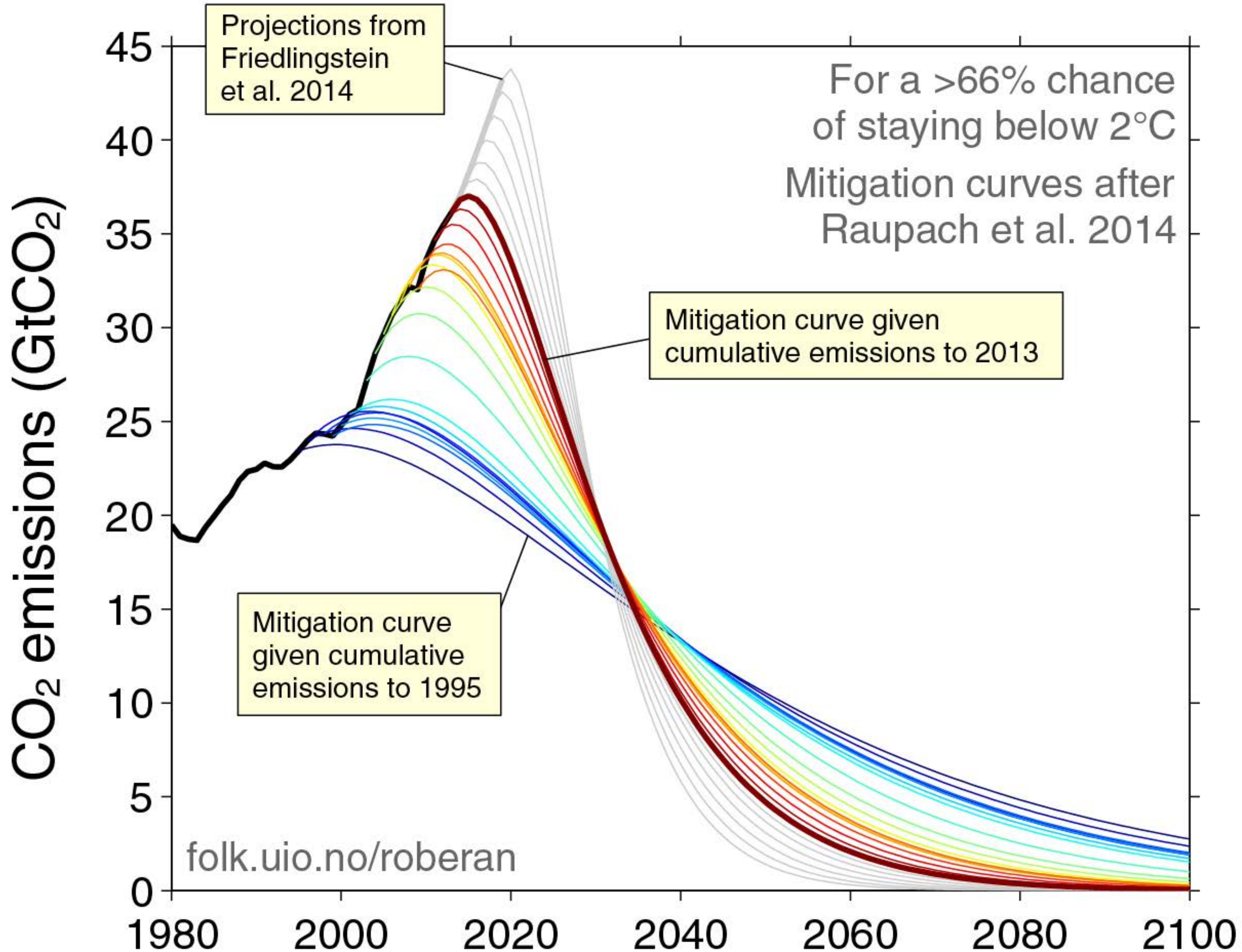
Today, with +4-5° C globally

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.



Winkelmann et al., (2015)

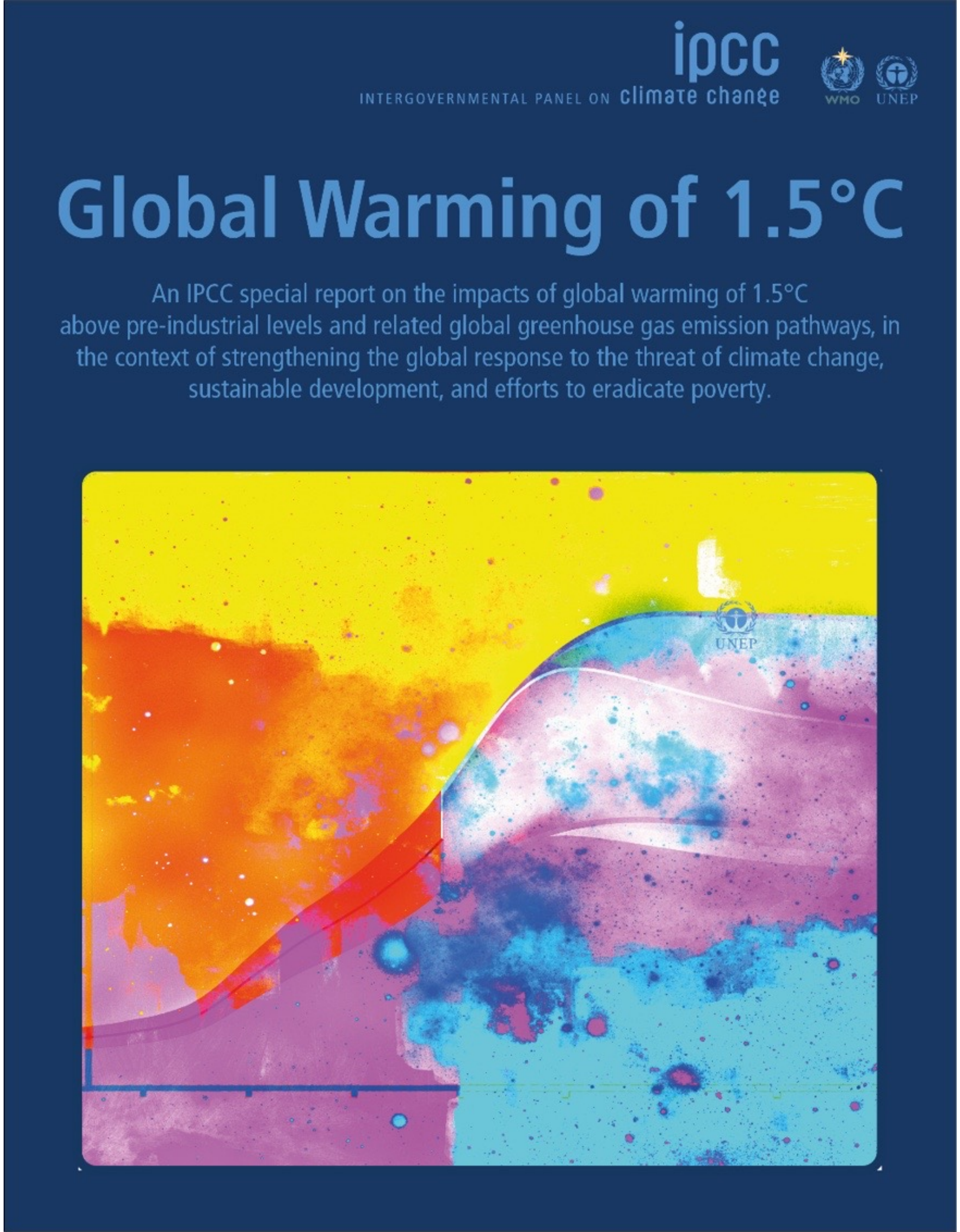
Limiting warming becomes much more difficult when the peak happens later



Source and details:

http://folk.uio.no/roberan/t/global_mitigation_curves.shtml

The SR15


ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP
Global Warming of 1.5°C
An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.
UNEP

Global warming of 1.5°C

*A IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, **in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty***

Proposed outline (as adopted in October 2016; report to be finalized in 2018) :

- Summary for policy makers *(max 10 pages)*
- Chapters :
  - 1. Framing and context
  - 2. Mitigation pathways compatible with 1.5°C in the context of sustainable development
  - 3. Impacts of 1.5°C global warming on natural and human systems
  - 4. Strengthening and implementing the global response to the threat of climate change
  - 5. Sustainable development, poverty eradication and reducing inequalities
- Boxes (integrated case studies/regional and cross-cutting themes),
- FAQs (10 pages)

The report in numbers

91 Authors from **40** Countries

133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments

Where are we now?

Since preindustrial times, human activities have caused approximately 1.0°C of global warming.

- Already seeing consequences for people, nature and livelihoods
- At current rate, would reach 1.5°C between 2030 and 2052
- Past emissions alone do not commit the world to 1.5°C

Impacts of global warming 1.5°C

At 1.5°C compared to 2°C:

- Less extreme weather where people live, including extreme heat and rainfall
- By 2100, global mean sea level rise will be around 10 cm lower
- 10 million fewer people exposed to risk of rising seas

Impacts of global warming 1.5°C

At 1.5°C compared to 2°C:

- Lower impact on biodiversity and species
- Smaller reductions in yields of maize, rice, wheat
- Global population exposed to water shortages up to 50% less

Impacts of global warming 1.5°C

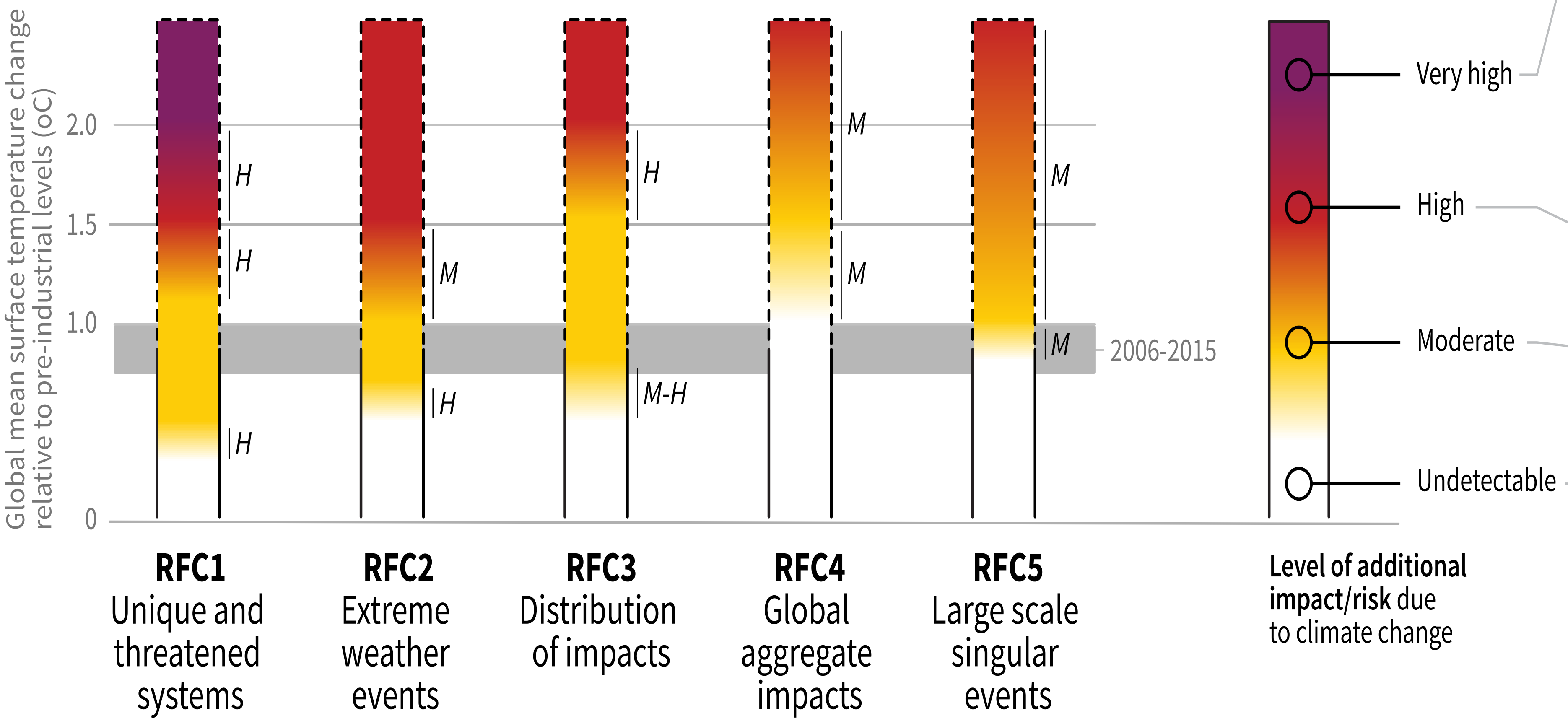
At 1.5°C compared to 2°C:

- Lower risk to fisheries & the livelihoods that depend on them
- Up to several hundred million fewer people exposed to climate-related risk and susceptible to poverty by 2050

How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)



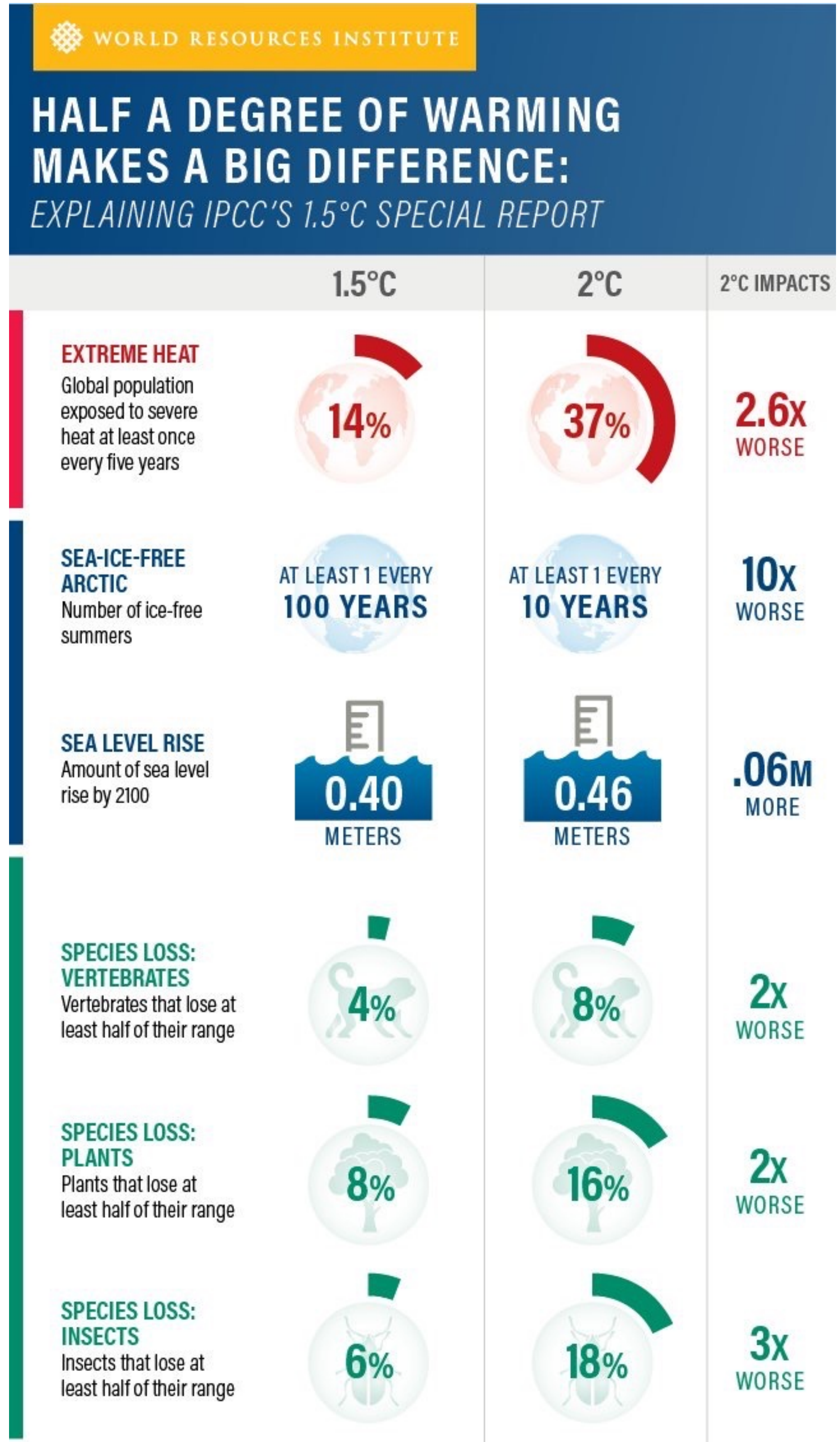
Purple indicates very high risks of severe impacts/risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.

Red indicates severe and widespread impacts/risks.

Yellow indicates that impacts/risks are detectable and attributable to climate change with at least medium confidence.

White indicates that no impacts are detectable and attributable to climate change.

Responsibility for content: WRI



Responsibility for content: WRI

IPCC SR15: Impacts on biodiversity

- B3.1 Of 105,000 species studied,

6% of insects, 8% of plants and 4% of vertebrates are projected **to lose over half** of their climatically determined geographic range for global warming of **1.5°C**,

compared with:

18% of insects, 16% of plants and 8% of vertebrates for global warming of **2°C** (medium confidence).

IPCC SR15: Impacts on agriculture

- B5.3 Limiting warming to 1.5°C, compared with 2ºC, is projected to result in smaller net reductions in **yields of maize, rice, wheat,** and potentially other cereal crops, particularly in sub-Saharan Africa, Southeast Asia, and Central and South America; and in the CO2 dependent, and in the **nutritional quality of rice and wheat** (high confidence). **Reductions in projected food availability are larger at 2ºC** than at 1.5°C of global warming **in the Sahel, southern Africa, the Mediterranean, central Europe, and the Amazon** (medium confidence). **Livestock are projected to be adversely affected** with rising temperatures, depending on the extent of changes in feed quality, spread of diseases, and water resource availability (high confidence).

Emission Pathways and System Transitions Consistent with 1.5°C Global Warming

INTERGOVERNMENTAL PANEL ON climate change

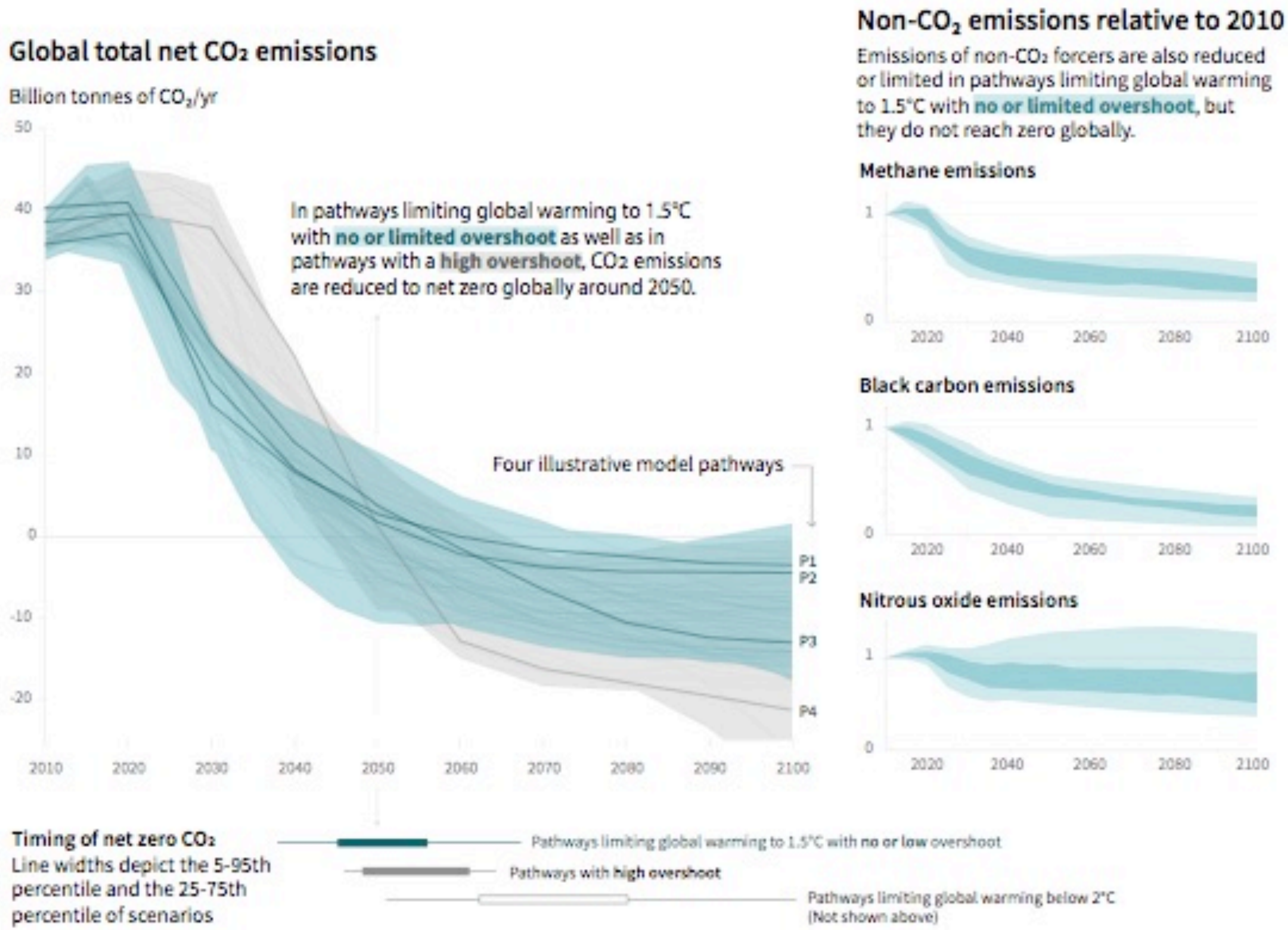
WMO UNEP

Greenhouse gas emissions pathways

- To limit warming to 1.5°C, CO_2 emissions fall by about 45% by 2030 (from 2010 levels)
  - Compared to 20% for 2°C
- To limit warming to 1.5°C, CO_2 emissions would need to reach 'net zero' around 2050
  - Compared to around 2075 for 2°C
- Reducing non-CO_2 emissions would have direct and immediate health benefits

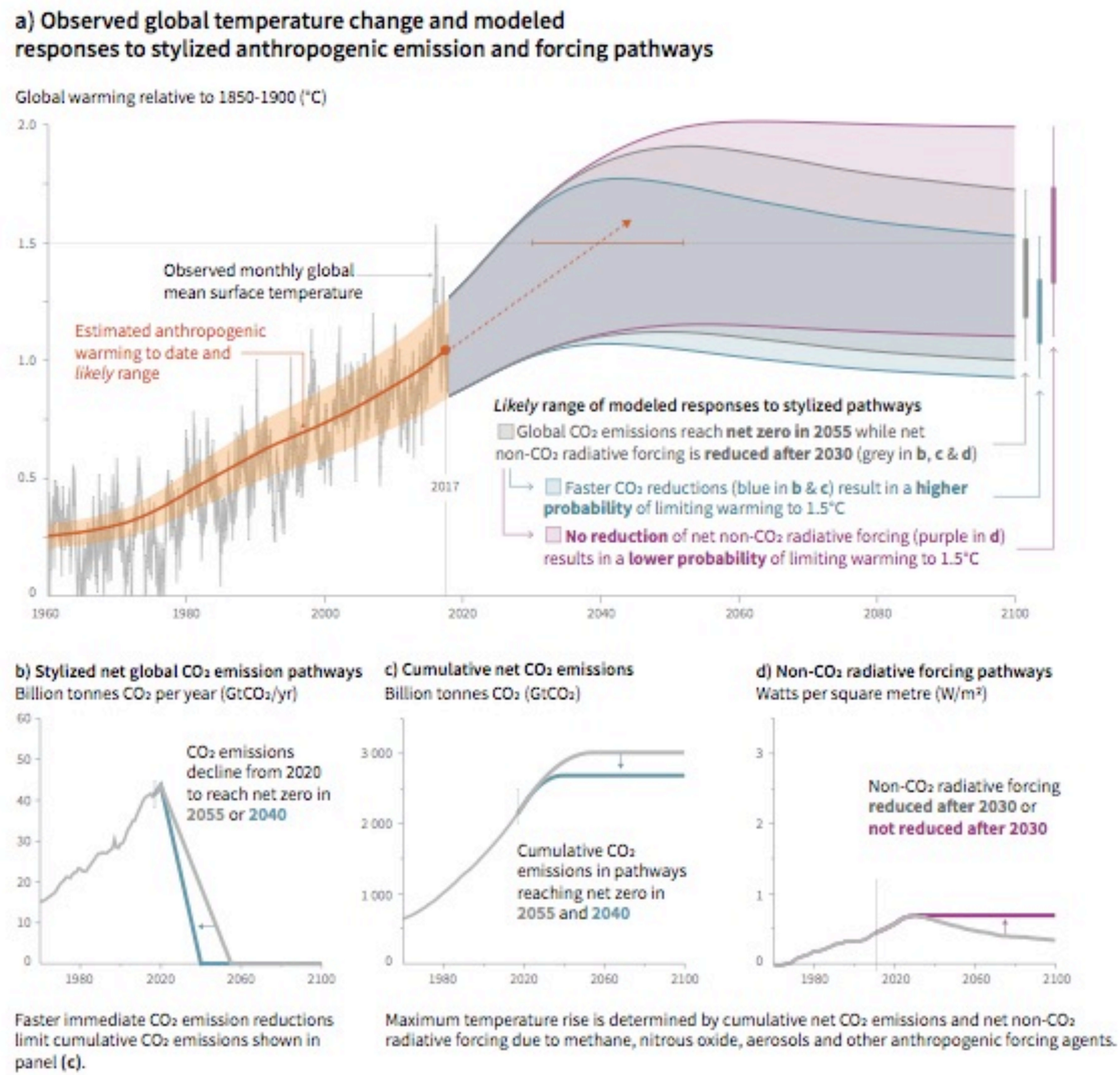
Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO_2, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM3B.



Source: IPCC Special Report on Global Warming of 1.5°C

Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C



Source: IPCC Special Report on Global Warming of 1.5°C

Greenhouse gas emissions pathways

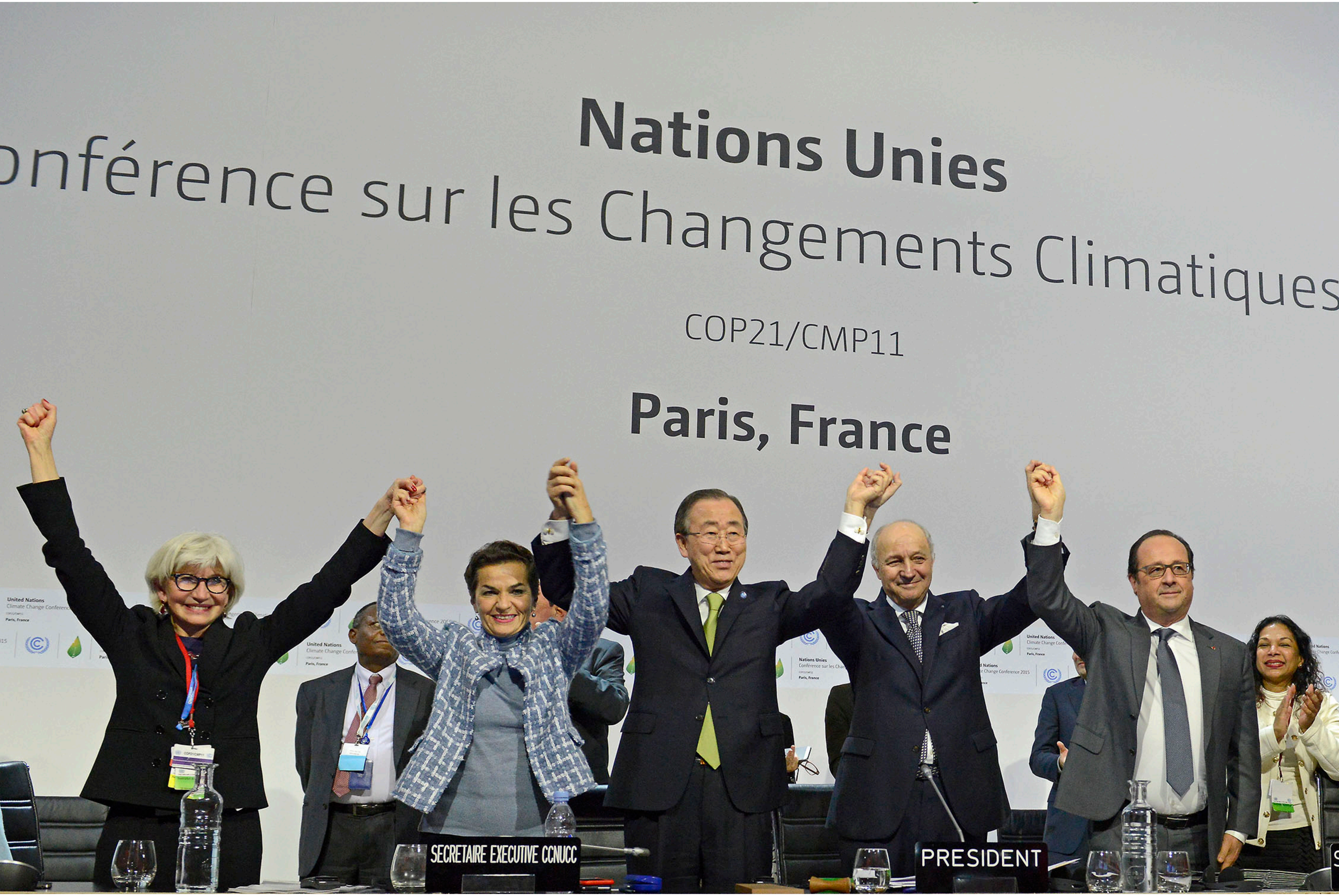
- Limiting warming to 1.5° C would require changes on an unprecedented scale
  - Deep emissions cuts in all sectors
  - A range of technologies
  - Behavioural changes
  - Increase investment in low carbon options

Greenhouse gas emissions pathways

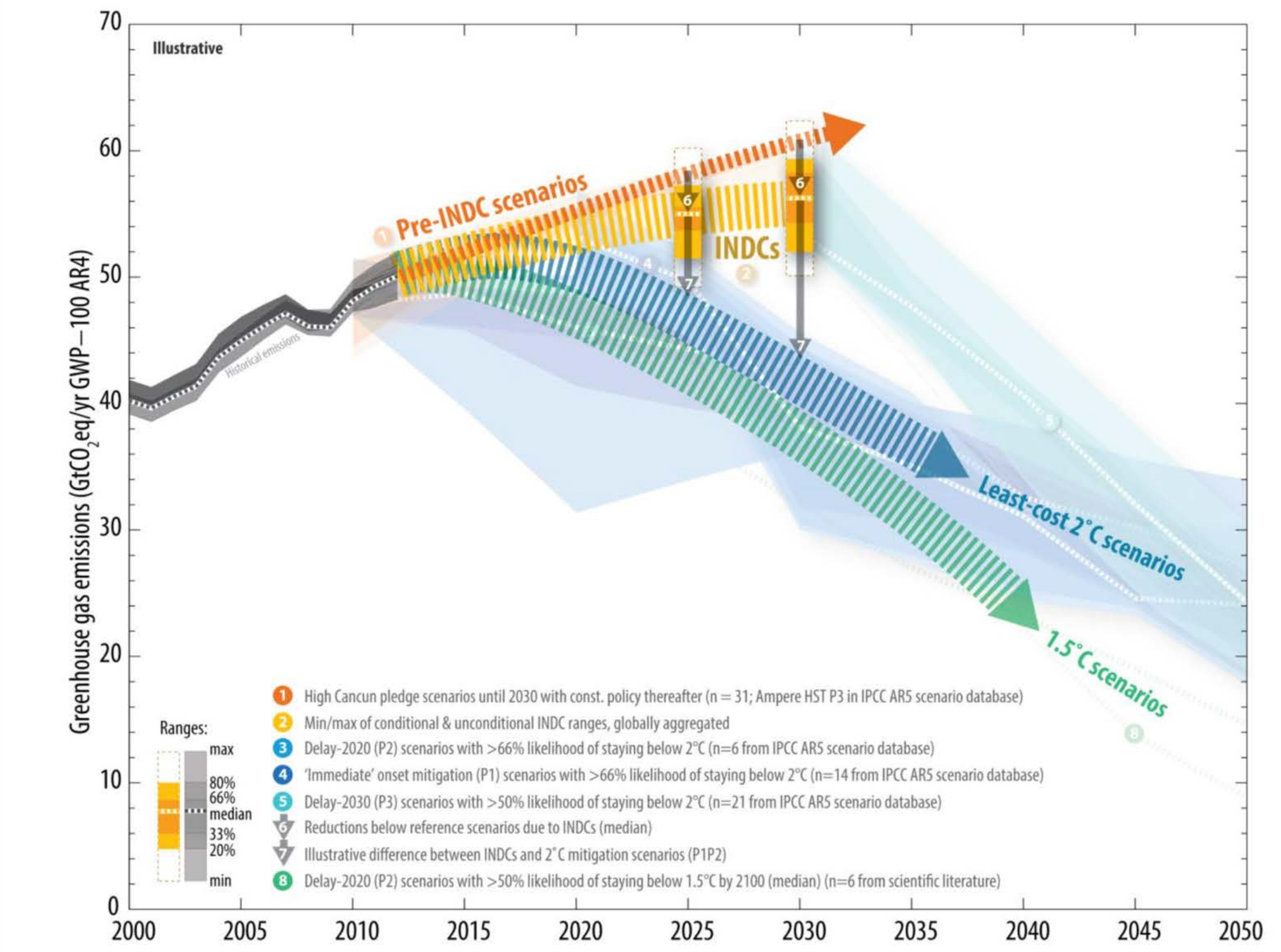
- Progress in renewables would need to mirrored in other sectors
- We would need to start taking carbon dioxide out of the atmosphere (Afforestation or other techniques)
- Implications for food security, ecosystems and biodiversity

Greenhouse gas emissions pathways

- National pledges are not enough to limit warming to 1.5° C
- Avoiding warming of more than 1.5° C would require carbon dioxide emissions to decline substantially before 2030


Nations Unies
onférence sur les Changements Climatiques
COP21/CMP11
Paris, France
SECRETAIRE EXECUTIVE CCNUCC
PRESIDENT

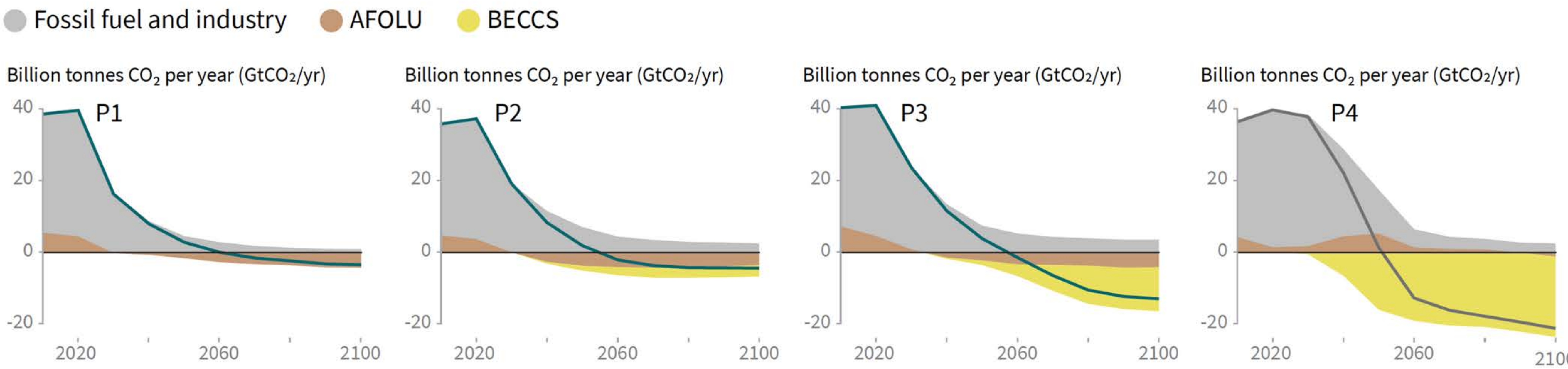
Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions



UNFCCC, Aggregate effect of the intended nationally determined contributions: an update
http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf

Four illustrative model pathways in the IPCC SR15:

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



P1: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Four illustrative model pathways in the IPCC SR15:

Global indicators	P1	P2	P3	P4	**Interquartile range**
Pathway classification	No or low overshoot	No or low overshoot	No or low overshoot	High overshoot	No or low overshoot
CO_2 emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-59,-40)
↳ in 2050 (% rel to 2010)	-93	-95	-91	-97	(-104,-91)
Kyoto-GHG emissions in 2030 (% rel to 2010)*	-50	-49	-35	-2	(-55,-38)
↳ in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)
*Final energy demand** in 2030 (% rel to 2010)*	-15	-5	17	39	(-12, 7)
↳ in 2050 (% rel to 2010)	-32	2	21	44	(-11, 22)
Renewable share in electricity in 2030 (%)	60	58	48	25	(47, 65)
↳ in 2050 (%)	77	81	63	70	(69, 87)
Primary energy from coal in 2030 (% rel to 2010)	-78	-61	-75	-59	(-78, -59)
↳ in 2050 (% rel to 2010)	-97	-77	-73	-97	(-95, -74)
from oil in 2030 (% rel to 2010)	-37	-13	-3	86	(-34,3)
↳ in 2050 (% rel to 2010)	-87	-50	-81	-32	(-78,-31)
from gas in 2030 (% rel to 2010)	-25	-20	33	37	(-26,21)
↳ in 2050 (% rel to 2010)	-74	-53	21	-48	(-56,6)
from nuclear in 2030 (% rel to 2010)	59	83	98	106	(44,102)
↳ in 2050 (% rel to 2010)	150	98	501	468	(91,190)
from biomass in 2030 (% rel to 2010)	-11	0	36	-1	(29,80)
↳ in 2050 (% rel to 2010)	-16	49	121	418	(123,261)
from non-biomass renewables in 2030 (% rel to 2010)	430	470	315	110	(243,438)
↳ in 2050 (% rel to 2010)	832	1327	878	1137	(575,1300)
Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218	(550, 1017)
↳ of which BECCS ($GtCO_2$)	0	151	414	1191	(364, 662)
Land area of bioenergy crops in 2050 (million hectare)	22	93	283	724	(151, 320)
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
in 2050 (% rel to 2010)	-33	-69	-23	2	(-46,-23)
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,4)
in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

Source: IPCC Special Report on Global Warming of 1.5°C

** Kyoto-gas emissions are based on SAR GWP-100*

*** Changes in energy demand are associated with improvements in energy efficiency and behaviour change*

For 3 illustrative model pathways that limit warming with no or limited overshoot

(%rel to 2010)	P1	P2	P3
CO_2 (2030/2050)	-58 / - 93	-47 / -95	-41 / -91
Final energy demand (2030/2050)	-15 / -32	-5 / +2	+17 / +21
Primary energy from coal (2030/2050)	-78/-97	-61/-77	-75/-73
Primary energy from non-biomass renewables (2030/2050)	+430/+832	+470/+1327	+315/+878

IPCC SR15
Fig SPM 3b

From SR15:

- C2.5 Model pathways that limit global warming to 1.5°C with no or limited overshoot project the **conversion** of **0.5–8 million km2 of pasture** and **0–5 million km2 of non-pasture agricultural land for food and feed crops into 1–7 million km2 for energy crops** and a 1 million km2 reduction **to 10 million km2 increase in forests by 2050 relative to 2010** (medium confidence).

An example from SR15:

- C3.5 **Some AFOLU-related CDR** (Carbon Dioxide Removal) measures such as restoration of natural ecosystems and soil carbon sequestration **could provide co-benefits** such as improved biodiversity, soil quality, and local **food security**.
- If deployed at large scale, they **would require governance systems** enabling sustainable land management to conserve and protect land carbon stocks and other ecosystem functions and services (medium confidence).

Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

Climate change and people

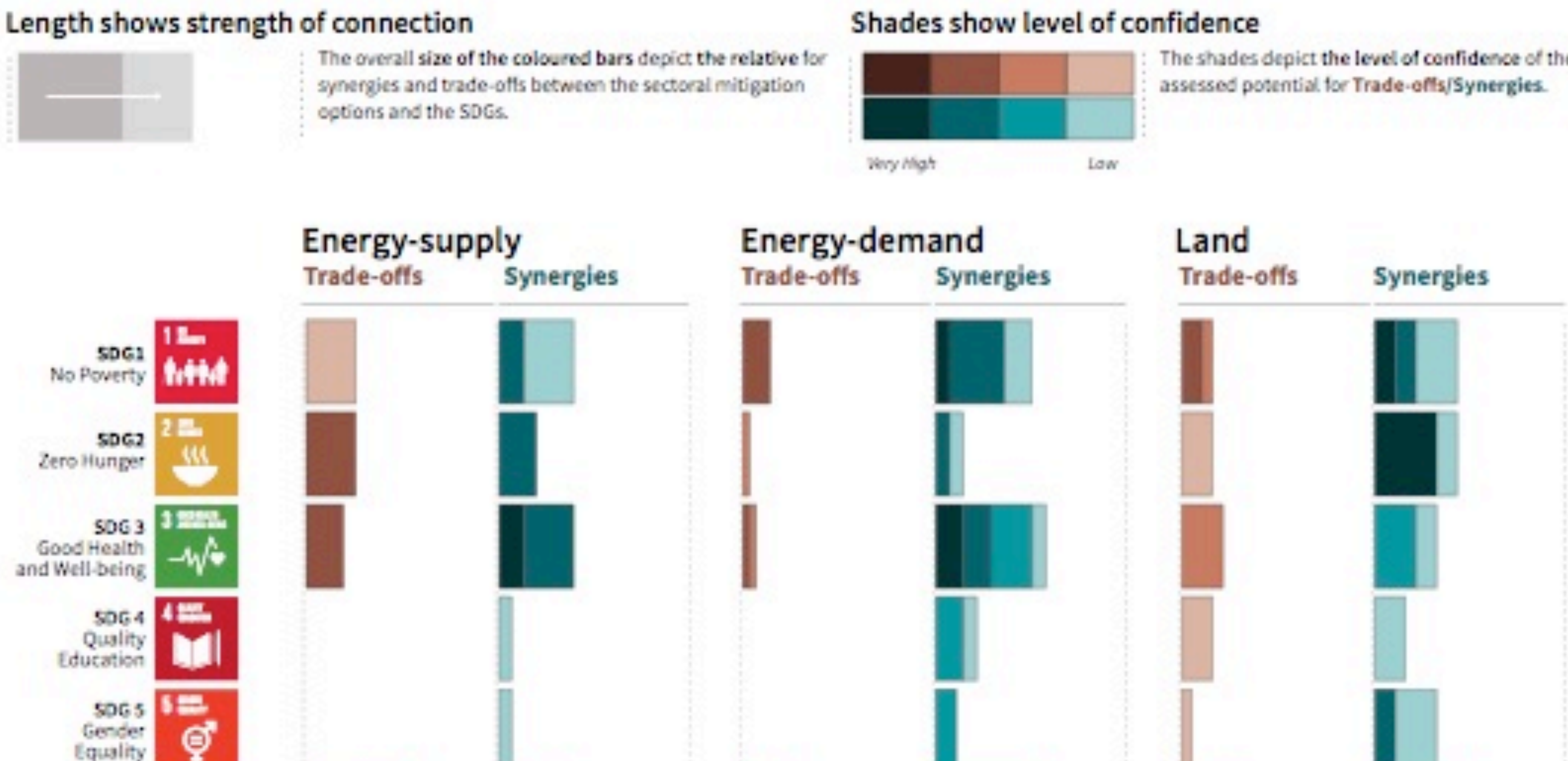
- Close links to United Nations Sustainable Development Goals (SDGs)
- Mix of measures to adapt to climate change and reduce emissions can have benefits for SDGs
- National and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support ambitious action
- International cooperation is a critical part of limiting warming to 1.5°C

SUSTAINABLE DEVELOPMENT GOALS

IPCC SR15
Fig SPM 4

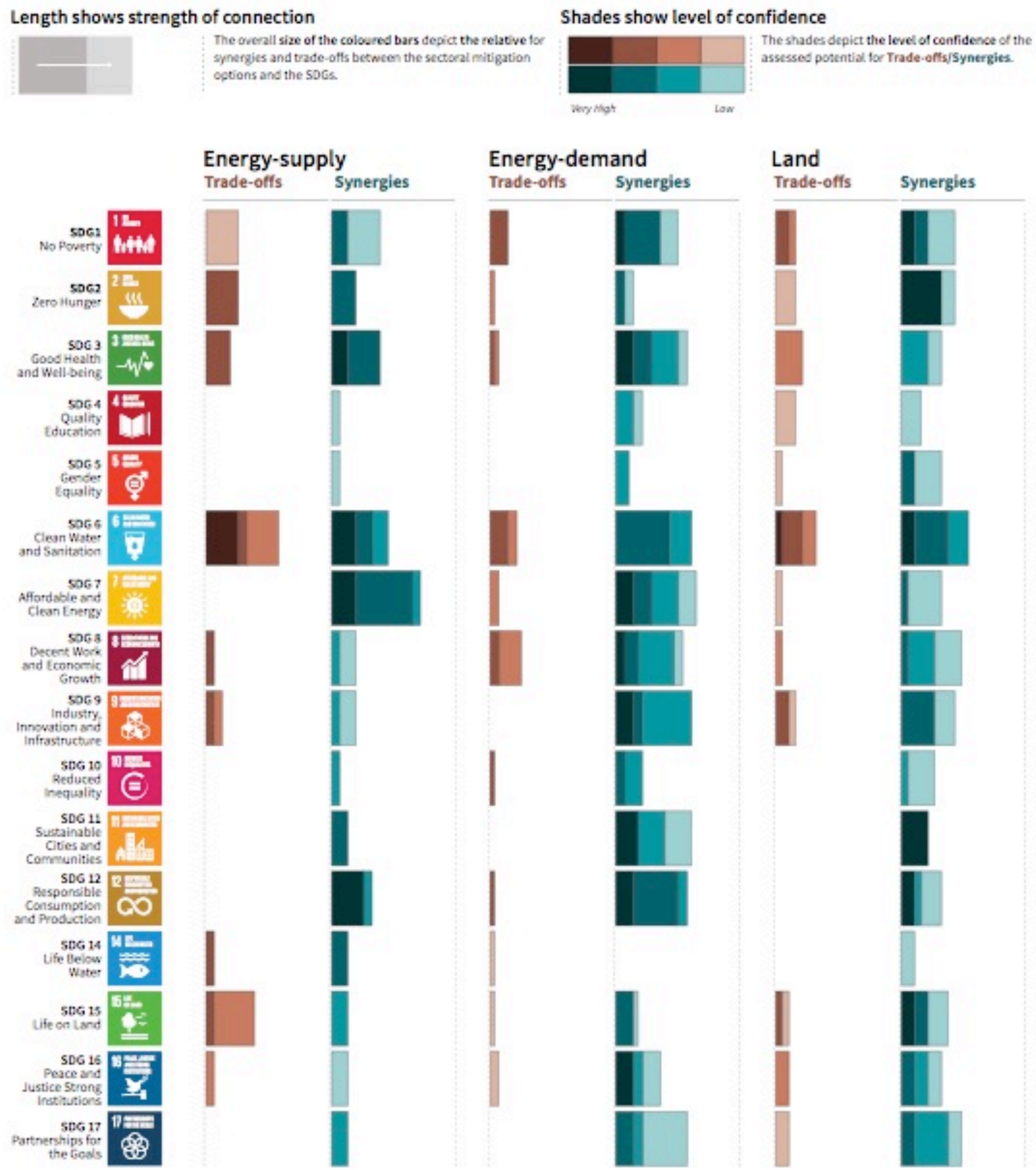
Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.



Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.



Source: IPCC Special Report on Global Warming of 1.5°C

IPCC SR15
Fig SPM 4

If well designed, measures to prevent climate change could offer so many opportunities:

- **Co-benefits in reduced pollution, health improvement, employment, gender equality, food security, reduced poverty, energy independence…**
- **Opportunities to shift the tax burden away from labour, incentivise, and fund sustainable development and just transitiona**

Synergies: Combustion of fossil fuels, wood, and biomass also cause air pollution, which kills 7 million people per year (including 500 000 in Europe)

(World Health Organization, 2018)

Opportunity: Addressing the causes of climate change can also improve air quality and wellbeing

@JPvanYpersele

Children are particularly sensitive to air pollution

Photo: Indiatoday.in, 6-12-2017

Just a few remarks about the EU

- Its climate leadership role needs work to be maintained, otherwise China…
- Example: the EU has not yet updated its 2014 plans (« NDCs ») to the new objectives of the Paris Agreement (« well below 2°C », not « below 2°C, and the 1.5°C objective…)

Personal remark: China is waking up to the climate and pollution challenge. It might become the world climate leader if the EU (5% of world population in 2050 ?) does not raise its ambition level in line with the Paris Agreement

The US economy will become less and less attractive, as it risks missing the decarbonizing trend. Hopefully, climate measures at the level of US cities and states can somewhat compensate federal actions

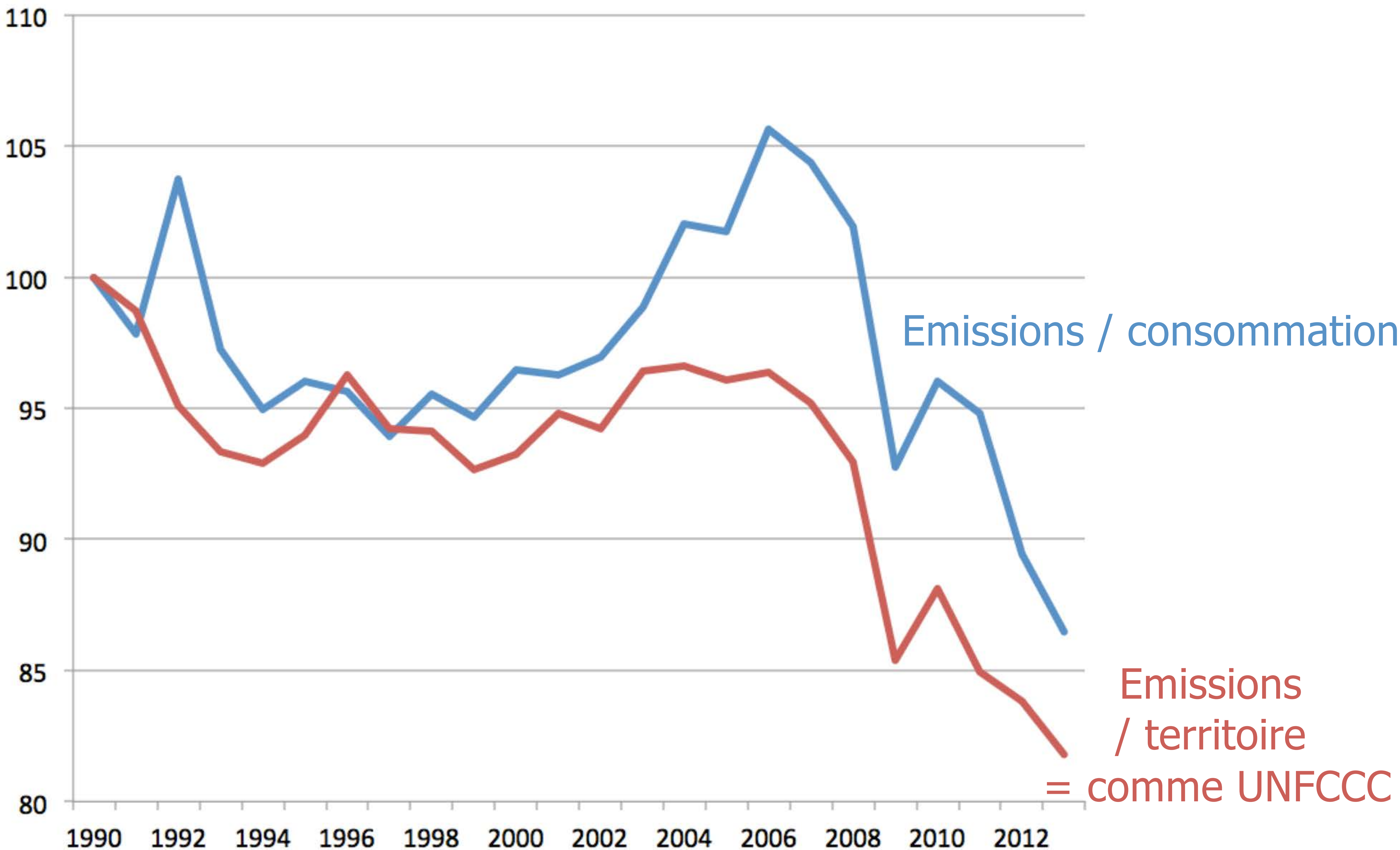
@JPvanYpersele

Just a few remarks about the EU (2)

- The Renewable Energy Directive considers wood as carbon neutral. That is fundamentally wrong (see letter signed by 800 scientists in December 2017, & article Searchinger et al.(2018, Nature Comm. https://rdcu.be/6ssN)
- Some of its emission reductions have been « externalised » (i.e. some goods are now imported, and lead to emissions increase elsewhere) (see next slide)

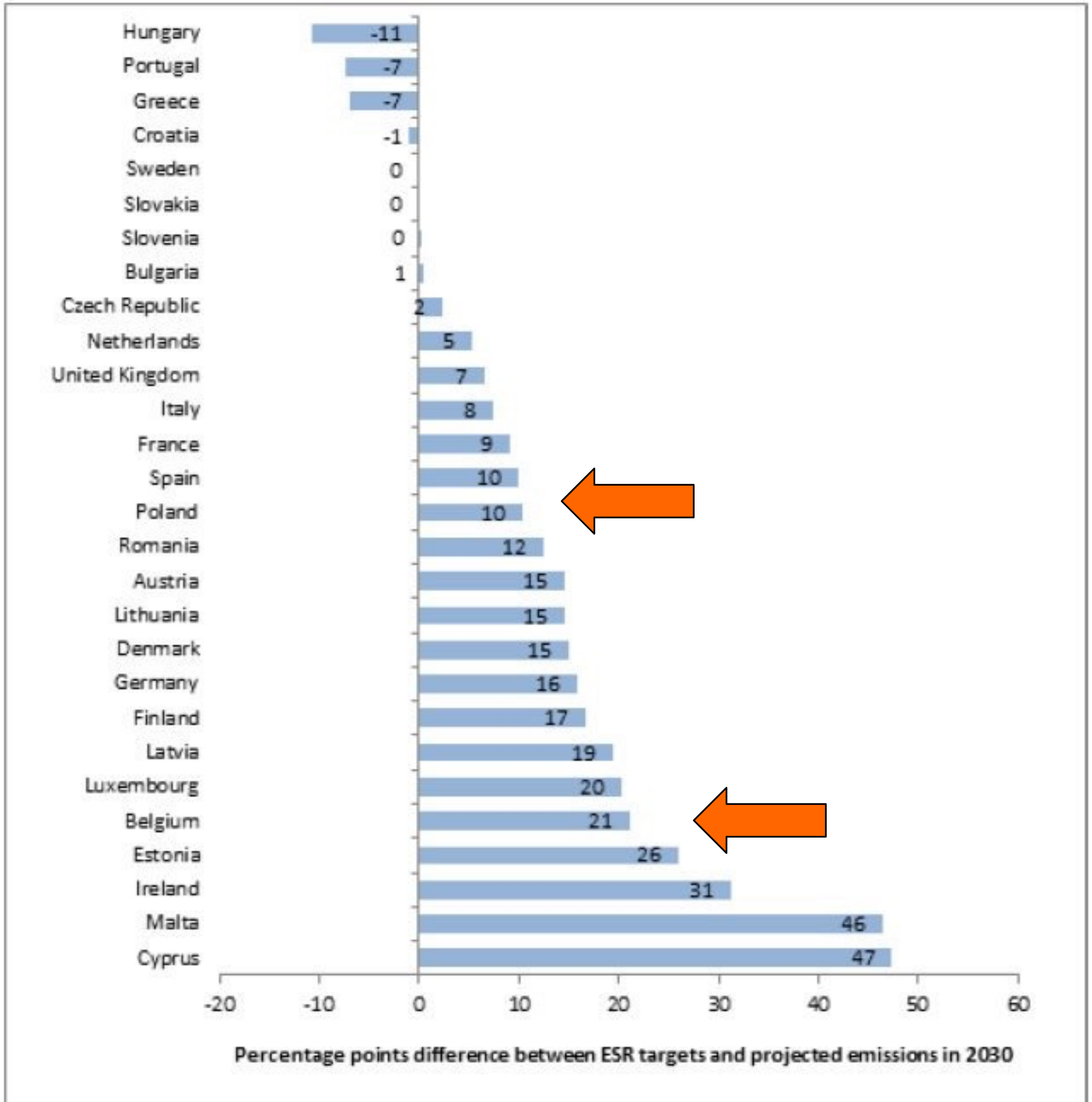
Europe : évolution des émissions depuis 1990

Attention à la production des objets importés…



Source : données de C Le Quéré et al, ESSD 2015

Percentage points difference between ESR targets and projected emissions in 2030

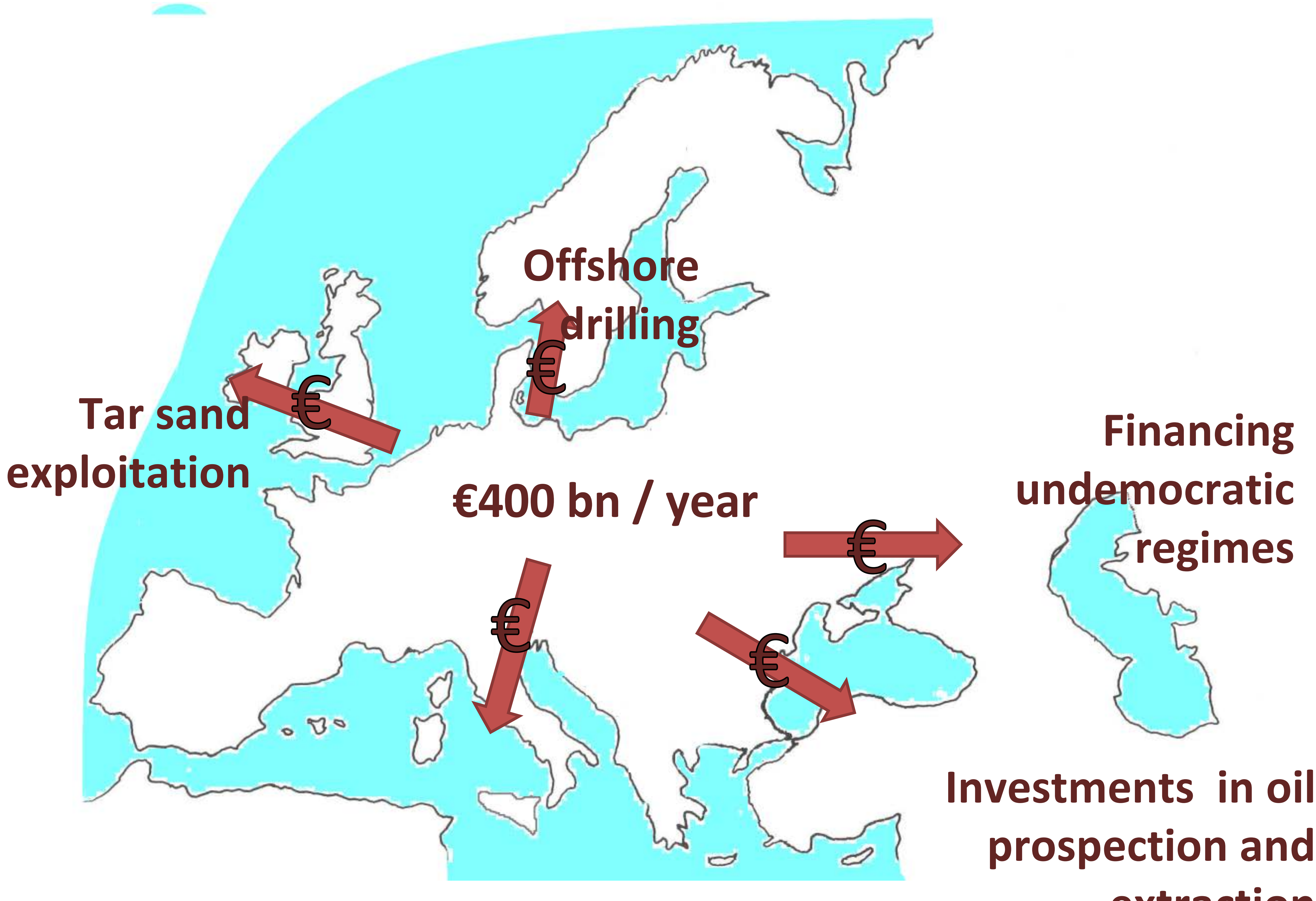


European Union loses at least 1 billion euros *per day* simply to buy fossil fuels outside its borders

True, decarbonizing the EU economy will cost, but not doing it could cost much more in impacts. Saving these 400 billions €/year could offer many opportunities

@JPvanYpersele

EU: annual cost of buying fossil fuels



Source: www.energycoalition.eu

- **Substantial reductions in emissions to stay under 2° C would require large changes in investment patterns e.g., from 2010 to 2029, in billions US dollars/year:** (mean numbers rounded, IPCC AR5 WGIII Fig SPM 9)
- **energy efficiency: +330**
- **renewables: + 90**
- **power plants w/ CCS: + 40**
- **nuclear: + 40**
- **power plants w/o CCS: - 60**
- **fossil fuel extraction: - 120**

Trying to practice what I « preach »:

- Energy audit before renovation
- Strong external insulation (wood fiber)
- Super-efficient windows
- Air tightiness + heat recovery ventilation system
- Ground-water heat pump replacing oil furnace
- Solar PV covering all consumption
- No tropical wood
- Small, used electric car
- Electric bicycles

Trying to practice what I « preach »

Trying to practice what I « preach »

RCP2.6 RCP8.5

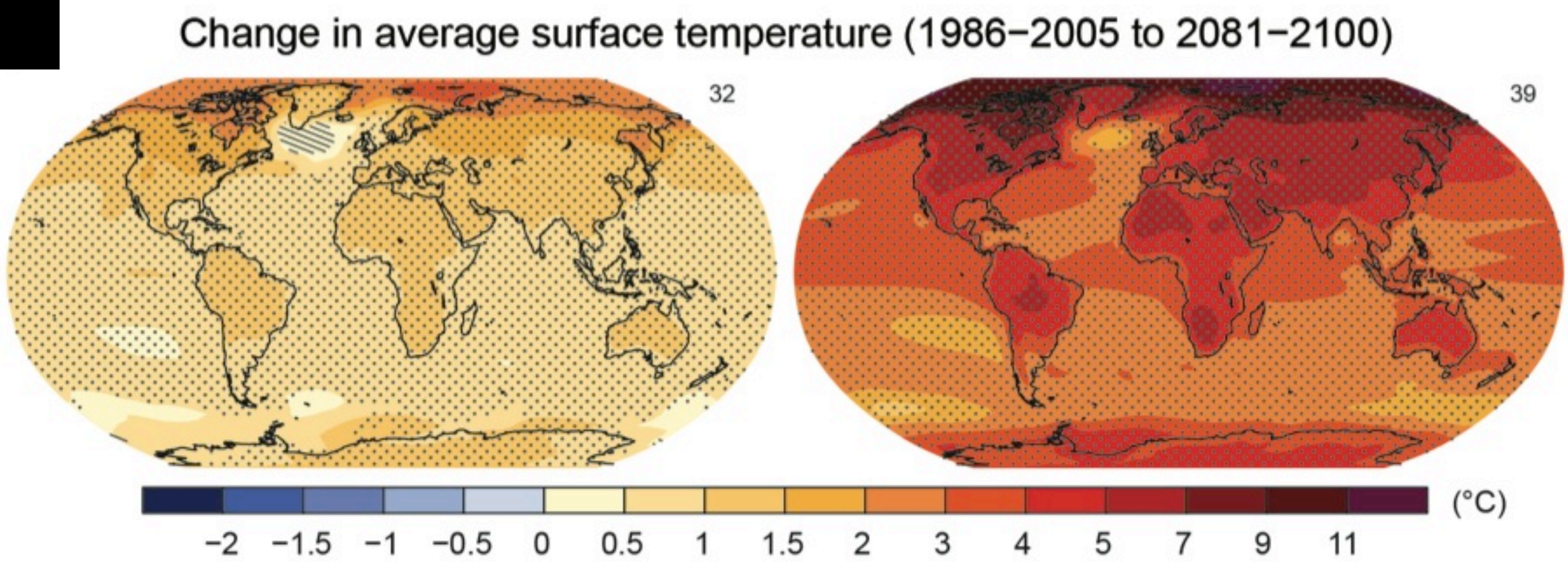


Fig. SPM.8

Humanity has the choice

SUSTAINABLE DEVELOPMENT GOALS

Tentative and personal conclusions

1.5°C matters: reducing the warming, even by tenths of a °C, can make large differences for impacts, as many of these are non-linear, that is they worsen faster with warming than the warming itself.

The probability of extremes (heat waves, drought, floods, extreme sea level) is significantly lower in a 1.5°C world than in a 2°C world

1.5°C is much safer than 2°C in terms of long-term sea-level rise associated to ice-sheet processes, particularly for low-lying regions

Tentative and personal conclusions

1.5°C lower impacts will make adaptation less costly than in 2°C world, even if there is a temporary overshoot above 1.5°C

It is very ambitious to reduce net CO2 emissions fast enough (i.e 2050) to ZERO for a 1.5°C long-term average temperature above pre-industrial objective

There are many possible co-benefits in fighting climate change, and they would help to achieve several SDGs

What is needed is the political, economic, citizen's will!

The slower radical changes in emission patterns take place, the more we may need uncertain or risky technologies, such as large use of carbon dioxide removal from the atmosphere (possibly at the expense of food security and biodiversity)

"Yes, we can!", says the IPCC

Yes, the planet got destroyed. But for a beautiful moment in time we created value for shareholders

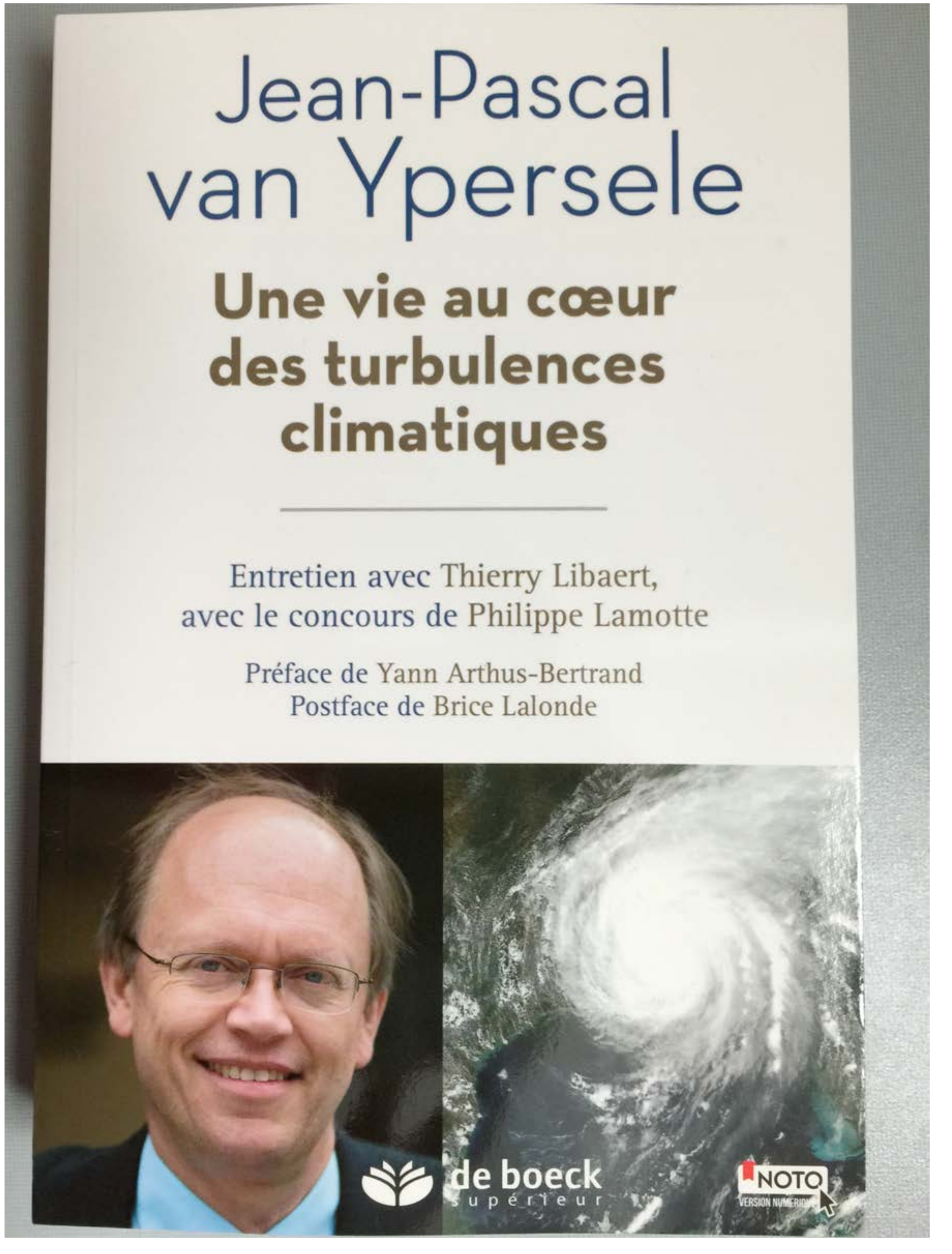
"Yes, the planet got destroyed. But for a beautiful moment in time we created a lot of value for shareholders."

http://www.newyorker.com/humor/issuecartoons/2012/11/26/cartoons_20121119#slide=6

Pour en savoir plus:

Lisez mon livre, où j'aborde tous ces sujets

Publié chez De Boeck supérieur



Bij EPO (2018)

Voorwoord:
Jill Peeters

To go further :

- www.climate.be/vanyp : my slides (under « conferences)
- www.ipcc.ch : IPCC
- www.realclimate.org : answers to the merchants of doubt arguments
- www.skepticalscience.com : same
- www.plateforme-wallonne-giec.be : IPCC-related in French, Newsletter, latest on SR15
- **Twitter: @JPvanYpersele & @IPCC_CH**