

**About the 1.5°C warming IPCC Special Report :**

# **Global warming of 1.5°C**

**(...) in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty**

**Jean-Pascal van Ypersele**

**Former IPCC Vice-Chair (2008-2015)**

**Prof UCLouvain, Earth & Life Institute**

**Twitter: @JPvanYpersele,**

**High Scientific Council of the European Nuclear Society,  
Brussels, 6 November 2018**

Thanks to the Walloon government for supporting [www.platforme-wallonne-giec.be](http://www.platforme-wallonne-giec.be)  
and my team at UCLouvain (Université catholique de Louvain, Belgium)

# Why this report?

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

# Why this 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 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* »

# Global warming of 1.5°C

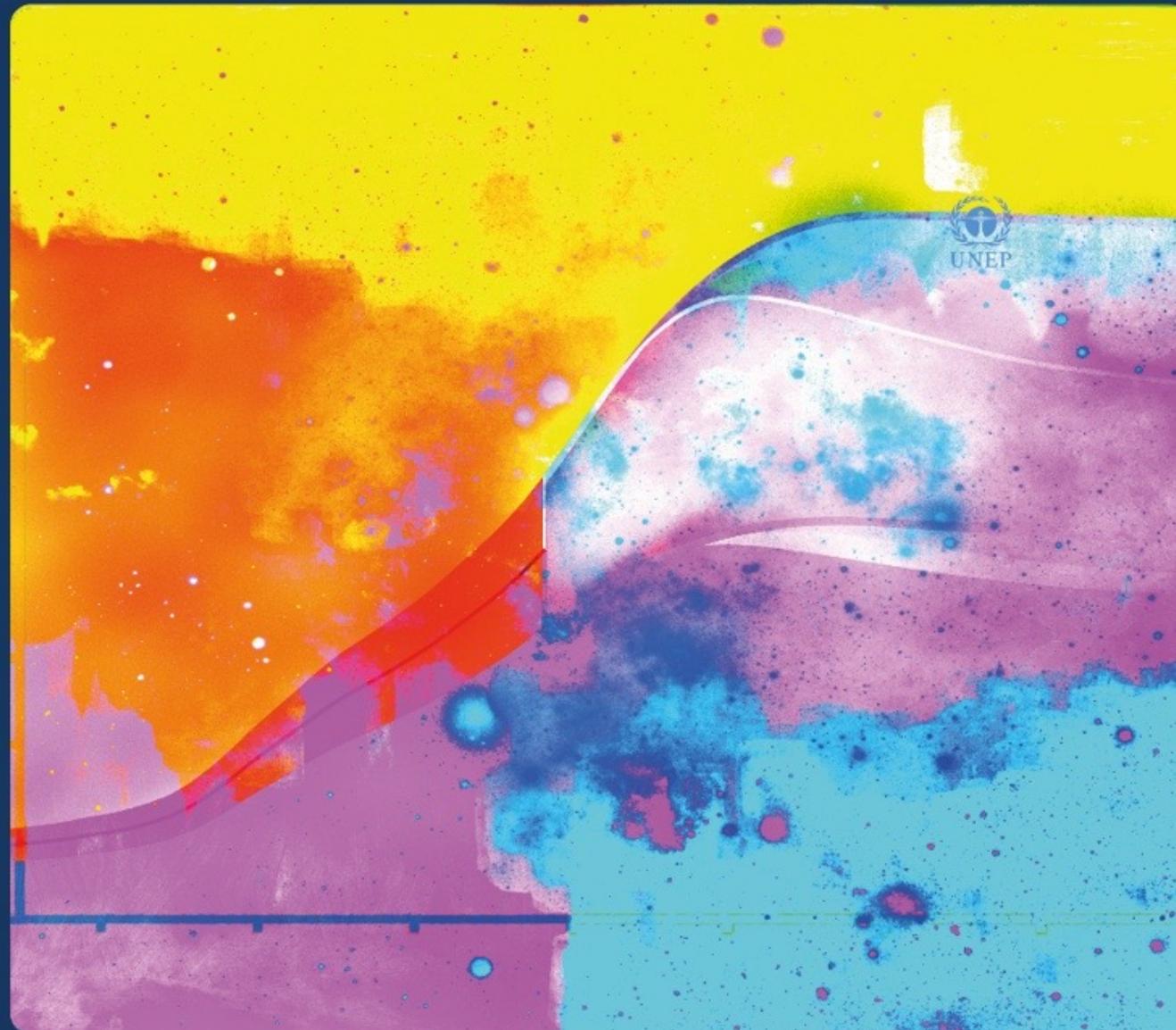
*A IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, **in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty***

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)

# 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.





# The report in numbers

91 Authors from 40 Countries

133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments



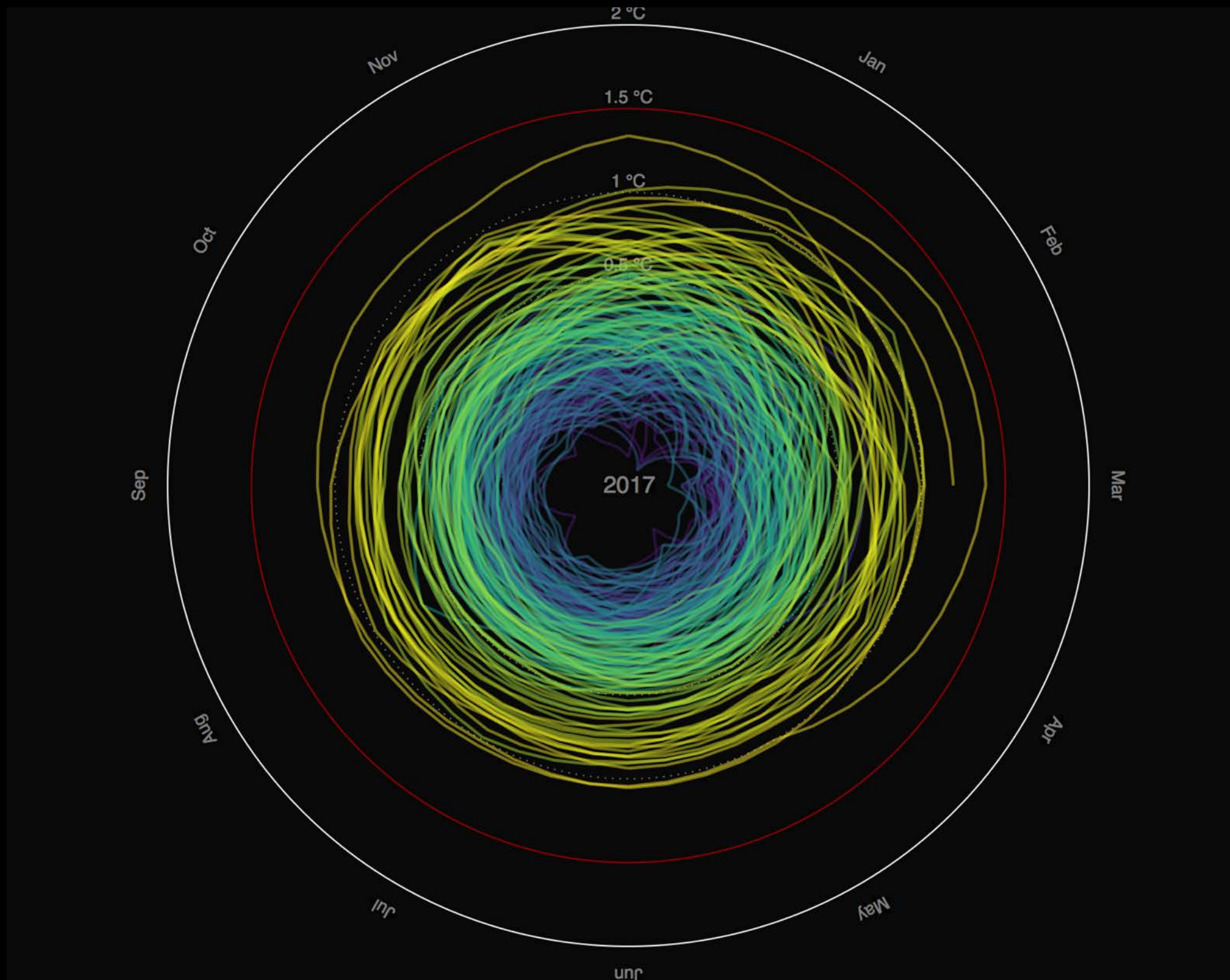
## Where are we now?

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



# 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

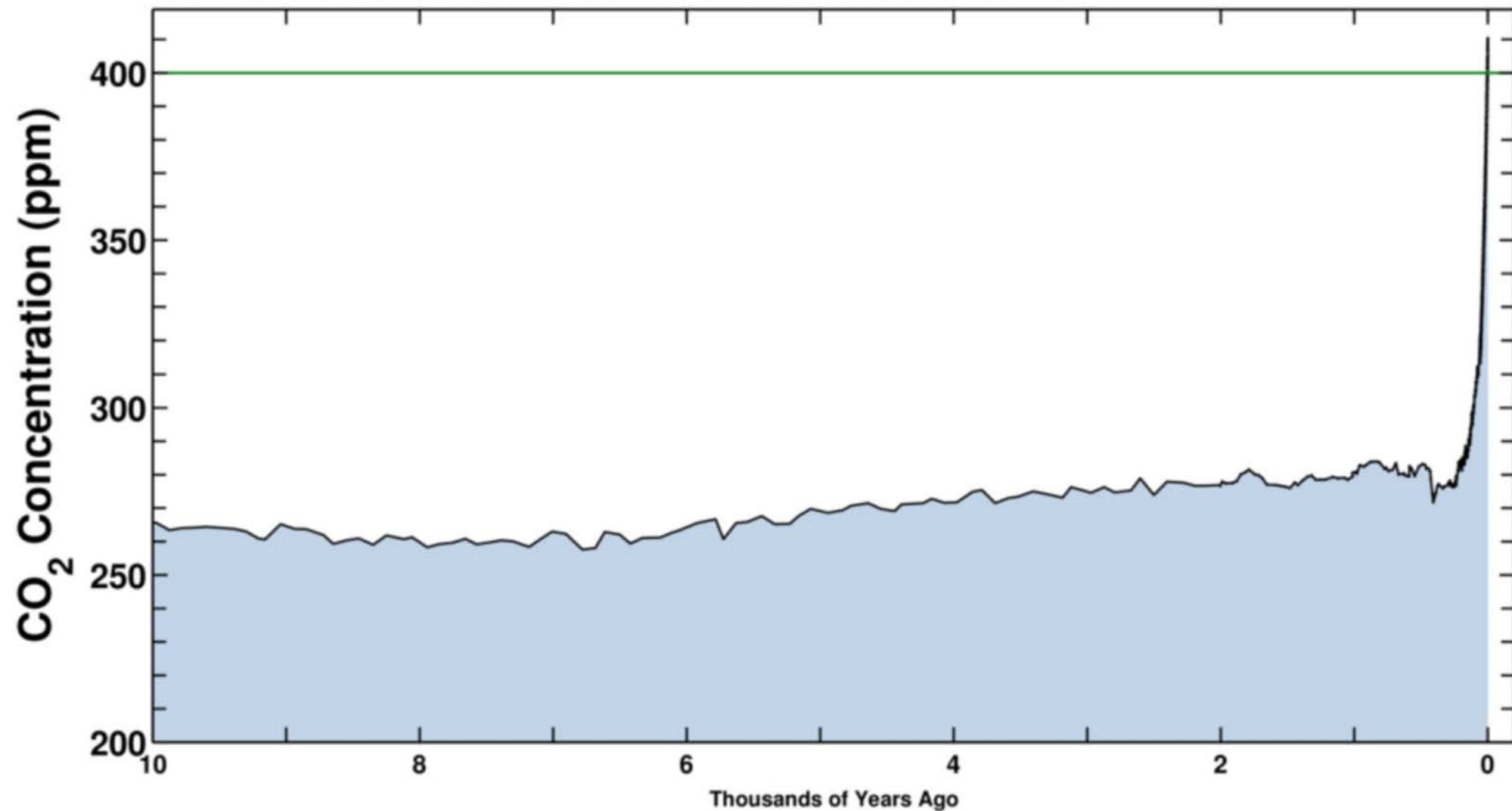


# CO<sub>2</sub> Concentration, 28 May 2018 (Keeling curve)

Latest CO<sub>2</sub> reading  
May 28, 2018

411.98 ppm

Ice-core data before 1958. Mauna Loa data after 1958.



Source: [scripps.ucsd.edu/programs/keelingcurve/](https://scripps.ucsd.edu/programs/keelingcurve/)



## 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:

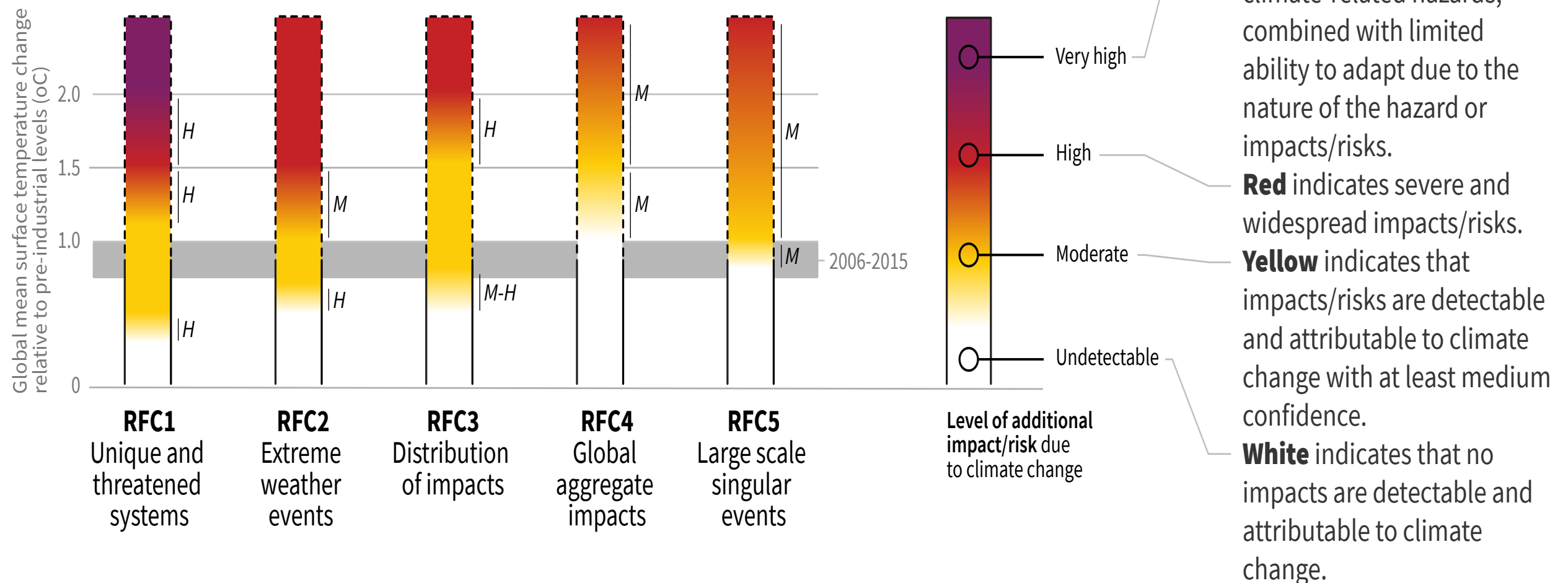
- Lower risk to fisheries & the livelihoods that depend on them
- Up to several hundred million fewer people exposed to climate-related risk and susceptible to poverty by 2050



# 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)



# HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:













EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

	1.5°C	2°C	2°C IMPACTS
<b>EXTREME HEAT</b> Global population exposed to severe heat at least once every five years	14%	37%	2.6x WORSE
<b>SEA-ICE-FREE ARCTIC</b> Number of ice-free summers	AT LEAST 1 EVERY 100 YEARS	AT LEAST 1 EVERY 10 YEARS	10x WORSE
<b>SEA LEVEL RISE</b> Amount of sea level rise by 2100	0.40 METERS	0.46 METERS	.06M MORE
<b>SPECIES LOSS: VERTEBRATES</b> Vertebrates that lose at least half of their range	4%	8%	2x WORSE
<b>SPECIES LOSS: PLANTS</b> Plants that lose at least half of their range	8%	16%	2x WORSE
<b>SPECIES LOSS: INSECTS</b> Insects that lose at least half of their range	6%	18%	3x WORSE
<b>ECOSYSTEMS</b> Amount of Earth's land area where ecosystems will shift to a new biome	4%	13%	1.86x WORSE
<b>PERMAFROST</b> Amount of Arctic permafrost that will thaw	4.8 MILLION KM <sup>2</sup>	6.6 MILLION KM <sup>2</sup>	38% WORSE
<b>CROP YIELDS</b> Reduction in maize harvests in tropics	3%	7%	2.3x WORSE
<b>CORAL REEFS</b> Further decline in coral reefs	70-90%	99%	UP TO 29% WORSE
<b>FISHERIES</b> Decline in marine fisheries	1.5 MILLION TONNES	3 MILLION TONNES	2x WORSE

Responsibility for content: WRI

# HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

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Responsibility for content: WRI



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

# Greenhouse gas emissions pathways

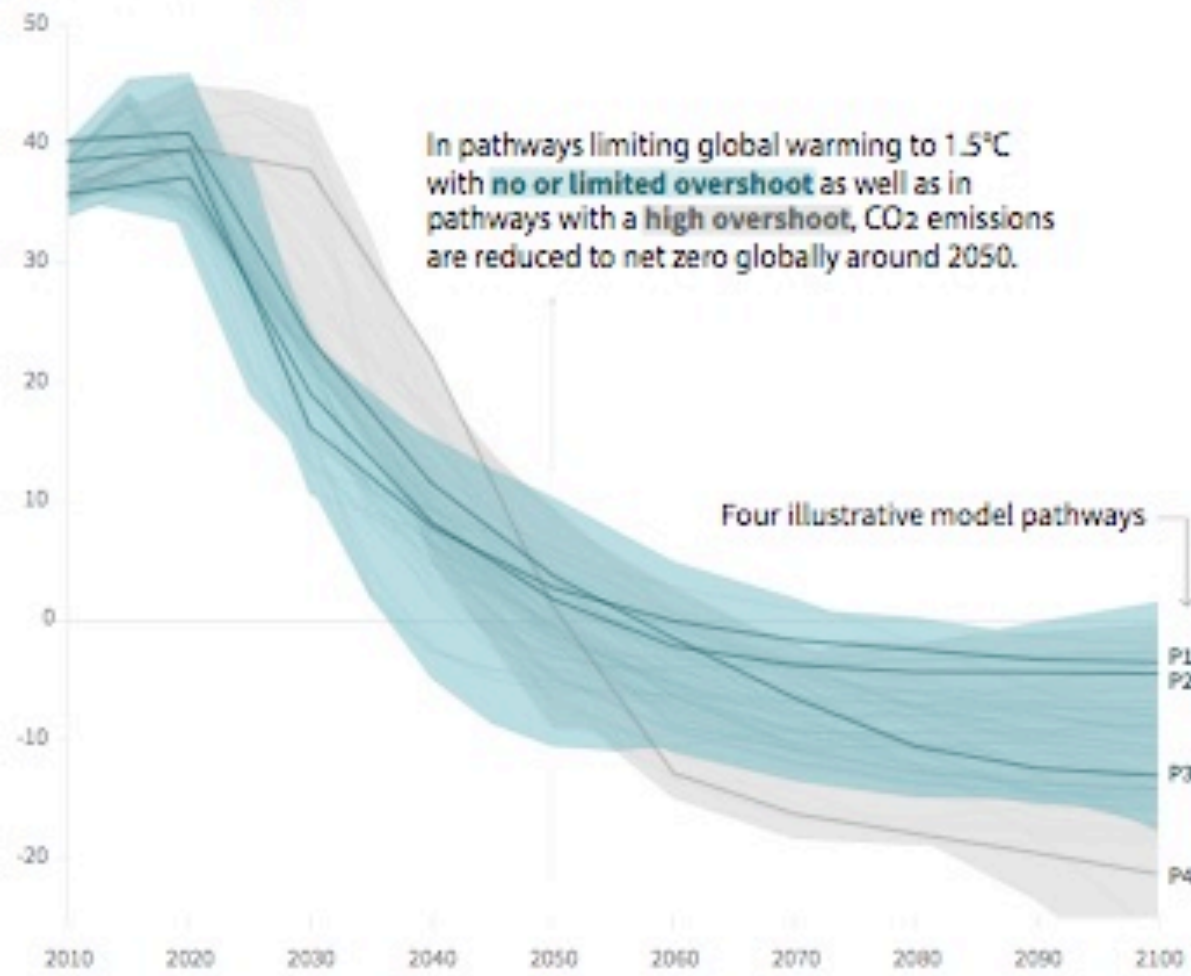
- To limit warming to 1.5° C, CO<sub>2</sub> emissions fall by about 45% by 2030 (from 2010 levels)
  - Compared to 20% for 2° C
- To limit warming to 1.5° C, CO<sub>2</sub> emissions would need to reach 'net zero' around 2050
  - Compared to around 2075 for 2° C
- Reducing non-CO<sub>2</sub> emissions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

## Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO<sub>2</sub>, 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.

### Global total net CO<sub>2</sub> emissions

Billion tonnes of CO<sub>2</sub>/yr



#### Timing of net zero CO<sub>2</sub>

Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios

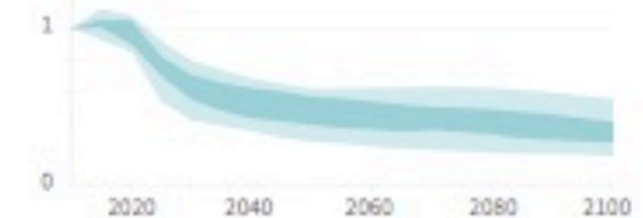


Source: IPCC Special Report on Global Warming of 1.5°C

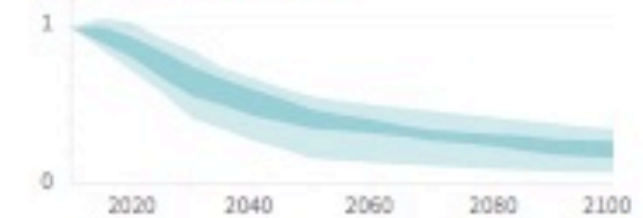
### Non-CO<sub>2</sub> emissions relative to 2010

Emissions of non-CO<sub>2</sub> forcers are also reduced or limited in pathways limiting global warming to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

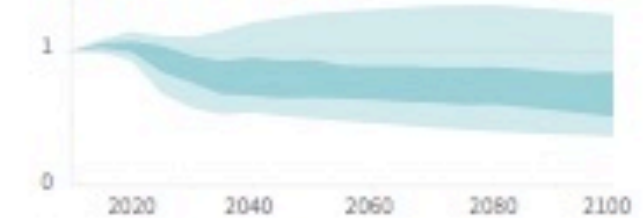
#### Methane emissions



#### Black carbon emissions



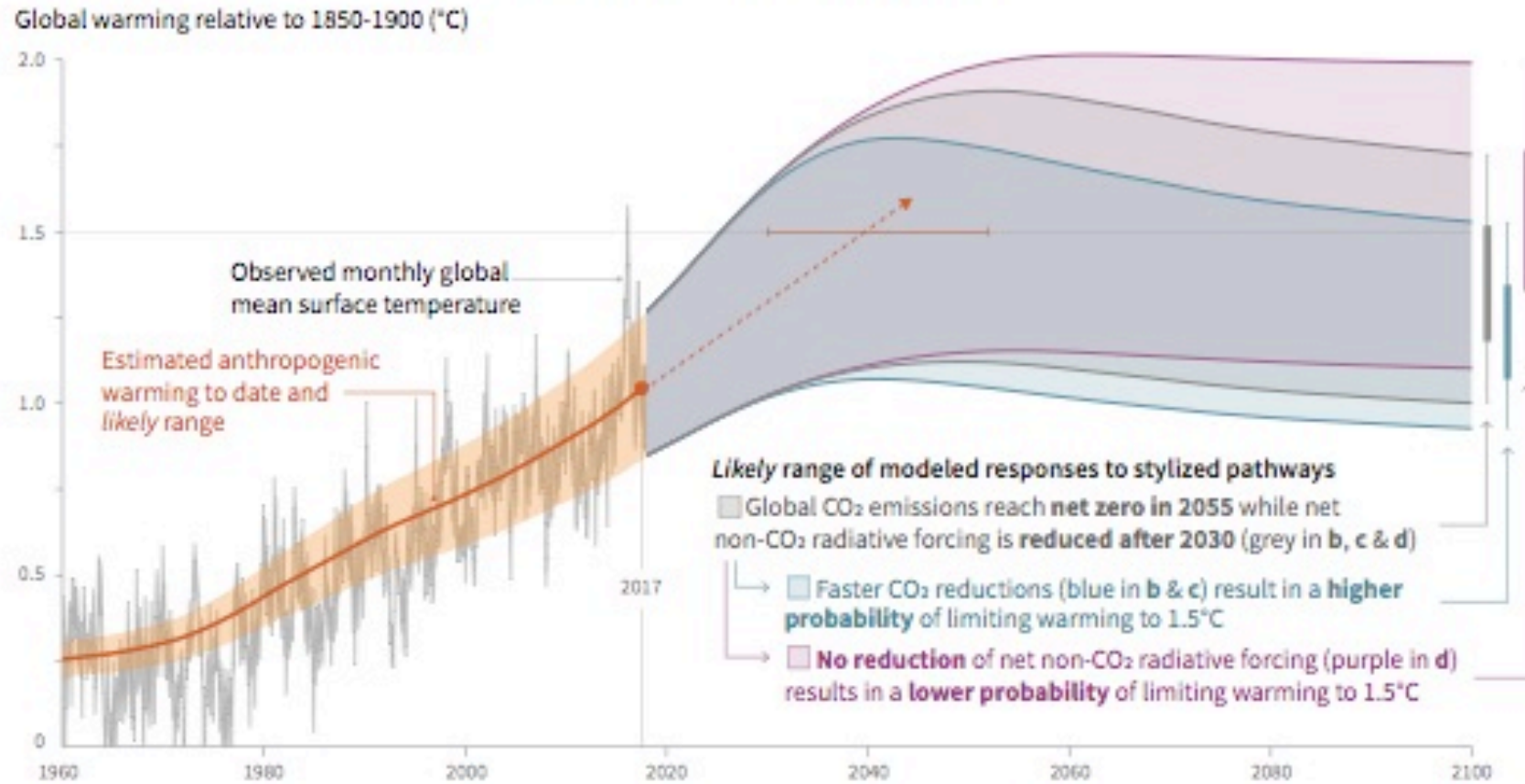
#### Nitrous oxide emissions



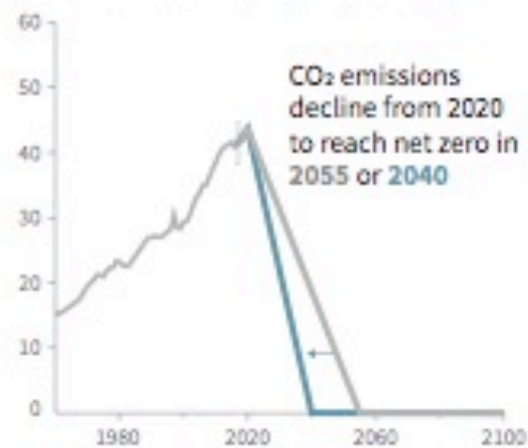


# Cumulative emissions of CO<sub>2</sub> and future non-CO<sub>2</sub> radiative forcing determine the probability of limiting warming to 1.5°C

## a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

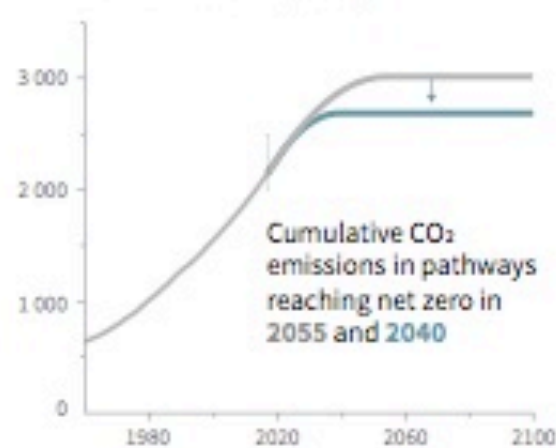


b) Stylized net global CO<sub>2</sub> emission pathways  
Billion tonnes CO<sub>2</sub> per year (GtCO<sub>2</sub>/yr)



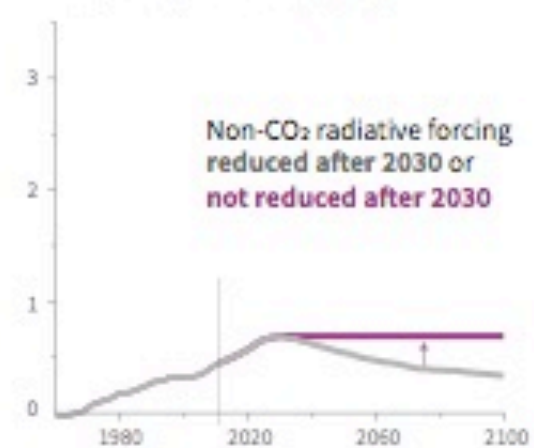
Faster immediate CO<sub>2</sub> emission reductions limit cumulative CO<sub>2</sub> emissions shown in panel (c).

c) Cumulative net CO<sub>2</sub> emissions  
Billion tonnes CO<sub>2</sub> (GtCO<sub>2</sub>)



Maximum temperature rise is determined by cumulative net CO<sub>2</sub> emissions and net non-CO<sub>2</sub> radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

d) Non-CO<sub>2</sub> radiative forcing pathways  
Watts per square metre (W/m<sup>2</sup>)



# 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

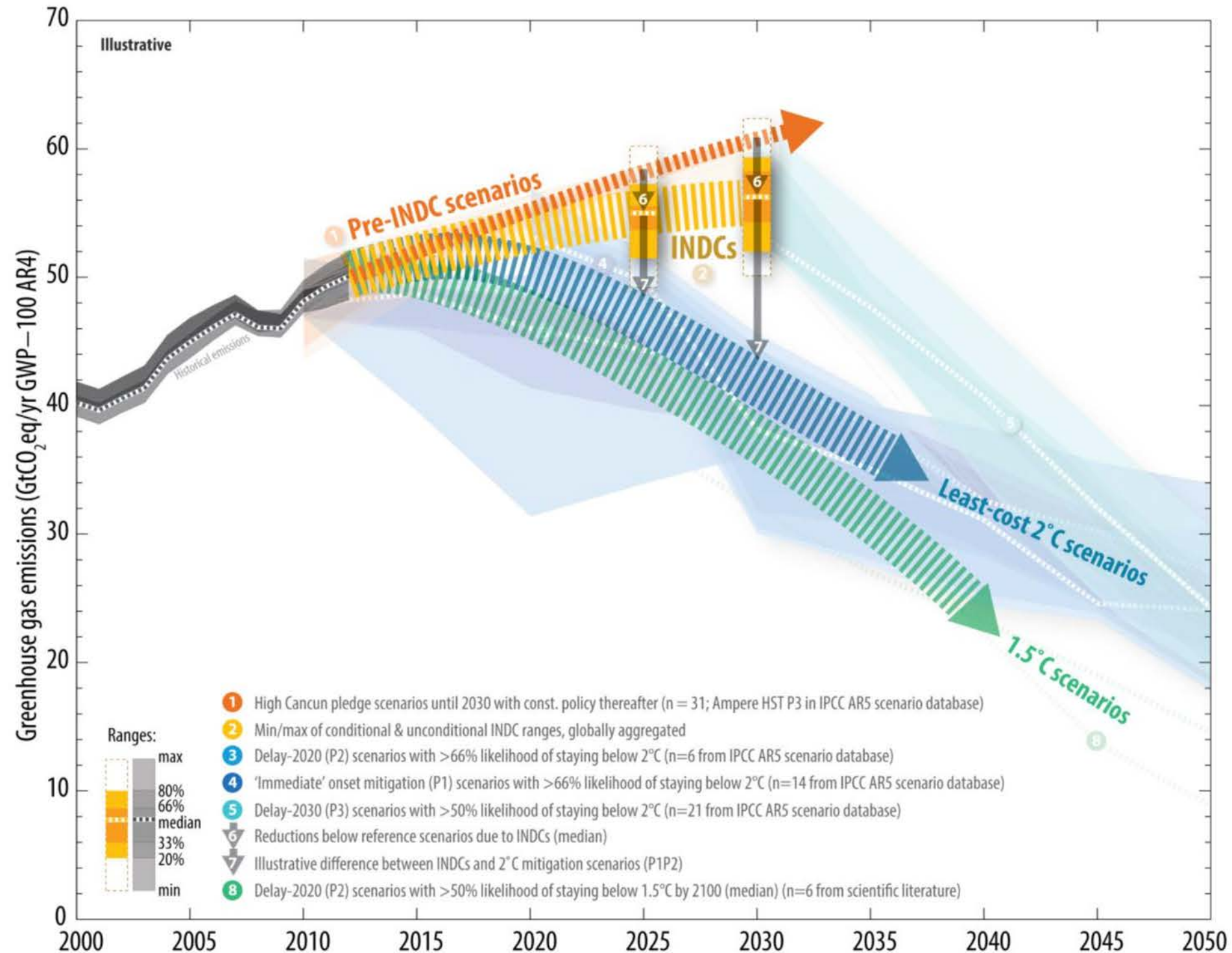
- Progress in renewables would need to mirrored in other sectors
- We would need to start taking carbon dioxide out of the atmosphere (Afforestation or other techniques)
- Implications for food security, ecosystems and biodiversity



# 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

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

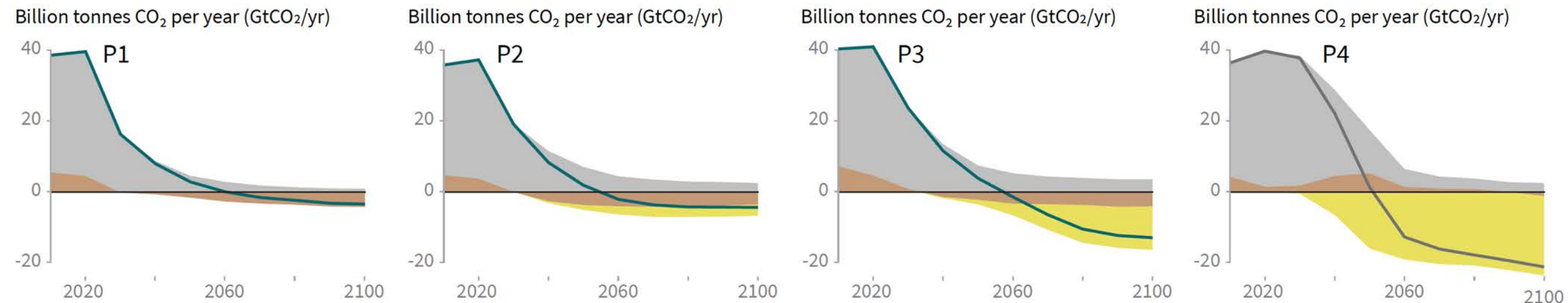




# Four illustrative model pathways in the IPCC SR15:

## Breakdown of contributions to global net CO<sub>2</sub> emissions in four illustrative model pathways

● Fossil fuel and industry ● AFOLU ● BECCS



**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 <sub>2</sub> 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 <sub>2</sub> )	0	348	687	1218	(550, 1017)
↳ of which BECCS (GtCO <sub>2</sub> )	0	151	414	1191	(364, 662)
Land area of bioenergy crops in 2050 (million hectare)	22	93	283	724	(151, 320)
Agricultural CH <sub>4</sub> 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 <sub>2</sub> O 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.

\* 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 <sub>2</sub> (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
Primary energy from nuclear (%rel to 2010) (2030/2050)	+59/+150	+83/+98	+98/+501

IPCC SR15  
Fig SPM 3b

# 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





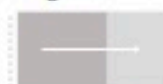
# SUSTAINABLE DEVELOPMENT GOALS



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

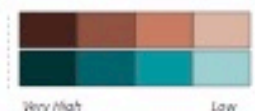
Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation 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.

Length shows strength of connection

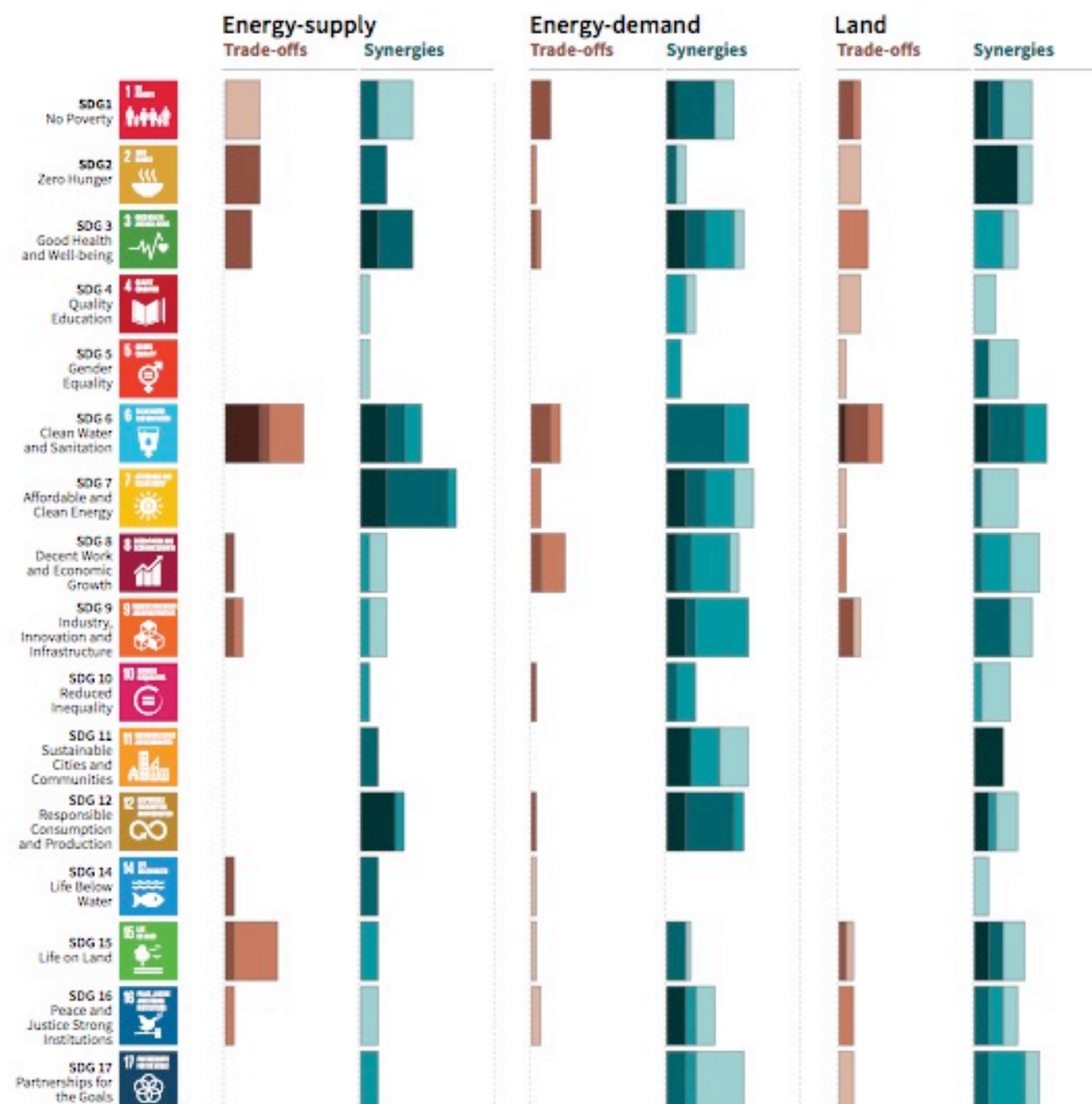


The overall size of the coloured bars depict the relative for synergies and trade-offs between the sectoral mitigation options and the SDGs.

Shades show level of confidence



The shades depict the level of confidence of the assessed potential for Trade-offs/Synergies.



# Tentative and personal conclusions

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**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

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**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 CO<sub>2</sub> 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**

# To go further :

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