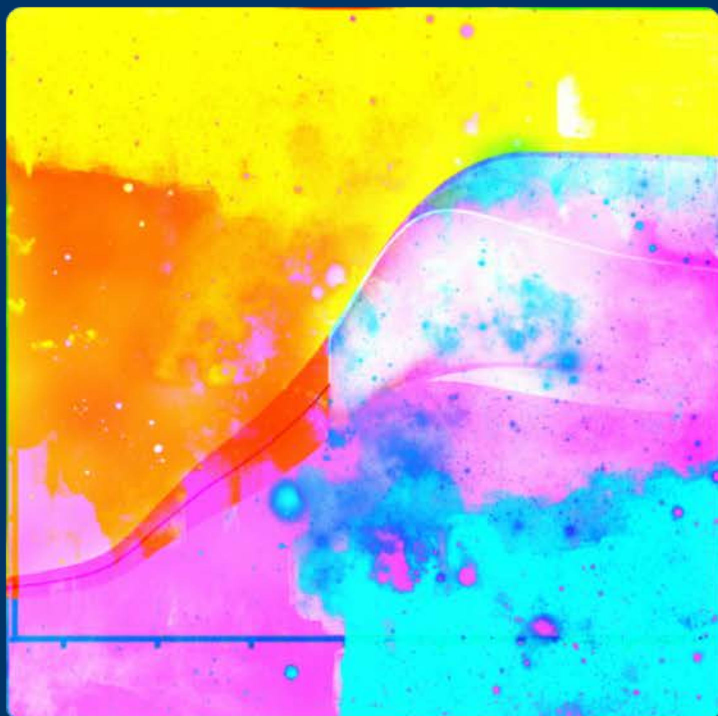


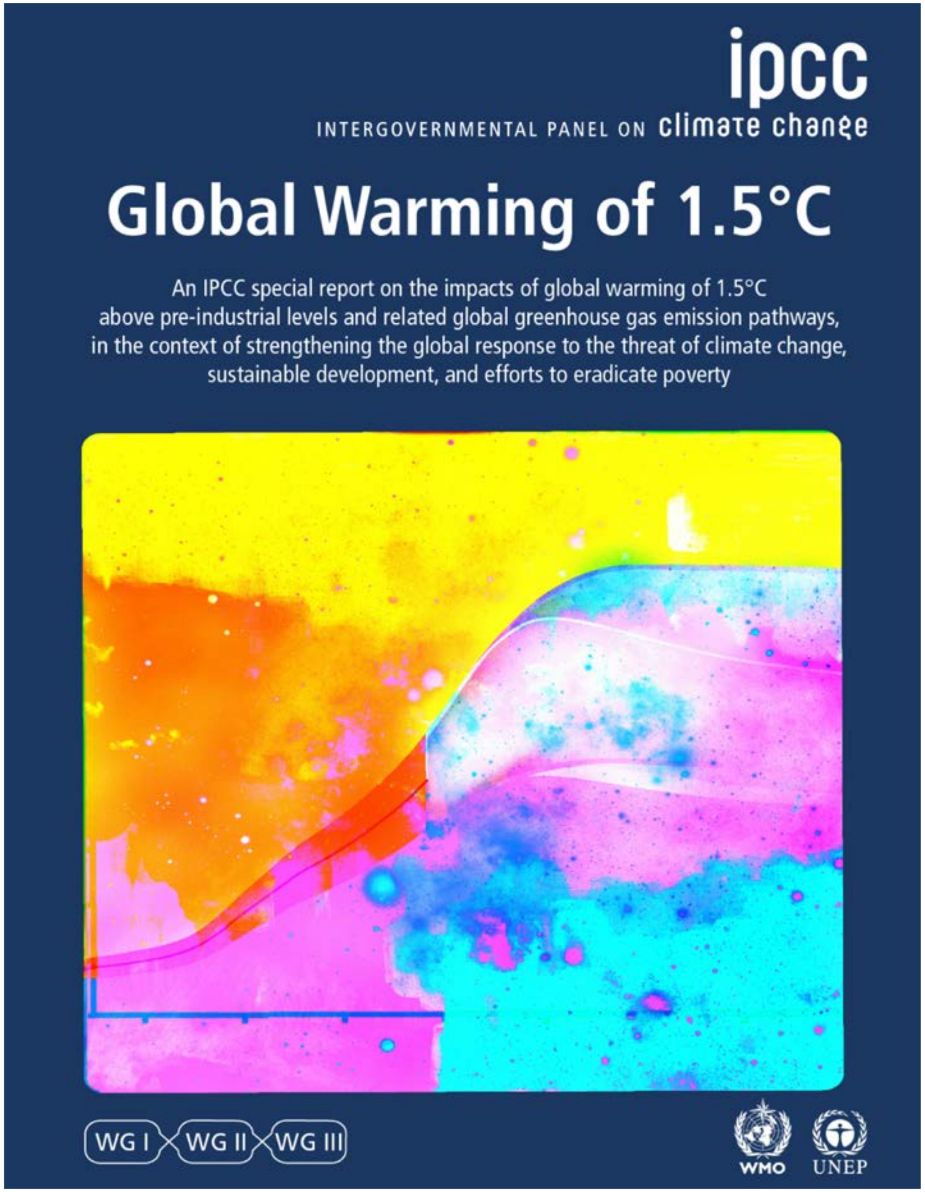
Natalie Mahowald

What is new in the Special Report on 1.5C

November 6, 2018

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.



IPCC =Intergovernmental Panel on Climate Change

Jointly organized by UN Environmental Programme and World Meteorological organization

Scientists write the report, governments accept summary for policy makers, line by line.

The report in numbers

91 Authors from **40** Countries

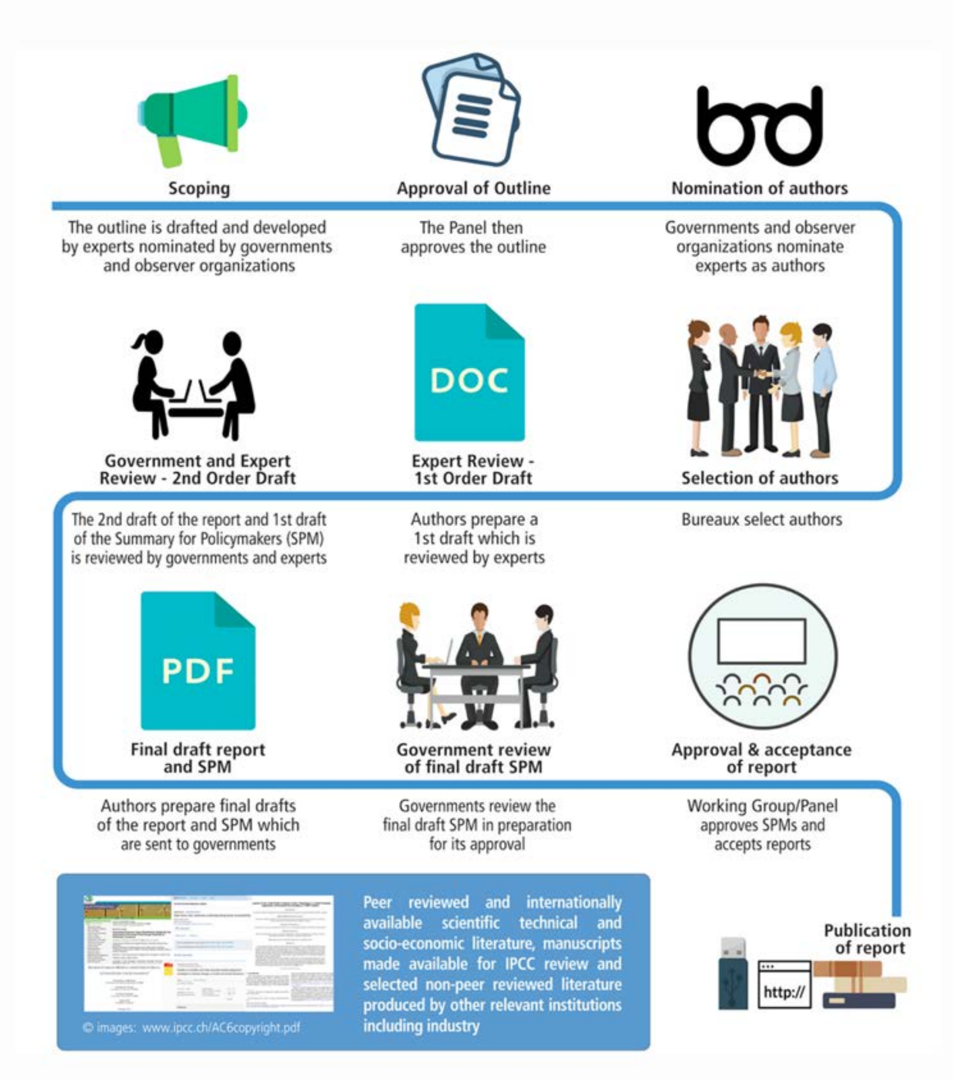
133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments

Process for IPCC reports.



Summary for policy makers approved line-by-line by IPCC Panel of governments.

Governments agree that the SPM represents the science assessed in the report correctly.

Approved by consensus

Work done Monday through Friday, October 1-5,2018

Supposed to be done Friday 7pm.

Sessions:
10am-1pm 3pm-7pm
Wednesday added evening session: 8:00-10:30pm
Thursday added night session: 11pm-2am
Friday went all night straight through to Saturday 3pm.

Co-chairs introduce session

Authors come up to front and describe/defend each bullet point sentence

Read the headline statements first, then approve the bullet points, and then come back and approve headline statements

Co-Chairs opened discussion of bullets and then sent them to 'huddles' (informal sessions with authors and governments) and (contact groups: format sessions chaired by governments.

Authors have final say on what text says, but governments have choice to approve or not approve. Need almost all governments to approve EVERY sentence.


Forty-Eighth Session of the IPCC and
First Joint Session of Working Groups I, II and III
제48차 기후변화에 관한 정부간 협의체(IPCC) 총회
1-5 October 2018 | Incheon, Republic of Korea
ipcc

Success!

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.

Two other special reports as well as AR6 underway

- Special report on climate change and oceans and the cryosphere (SROCC): September 2019
- Special report on climate change, desertification, land degradation, sustainable land management, food security and green house gas fluxes in terrestrial ecosystems (SR2): September 2019
- Working group 1: physical climate system
- Working group 2: impacts, vulnerability, adaptation and risks
- Working group 3: mitigation

Understanding Global Warming of 1.5°C

Ashley Cooper / Aurora Photos

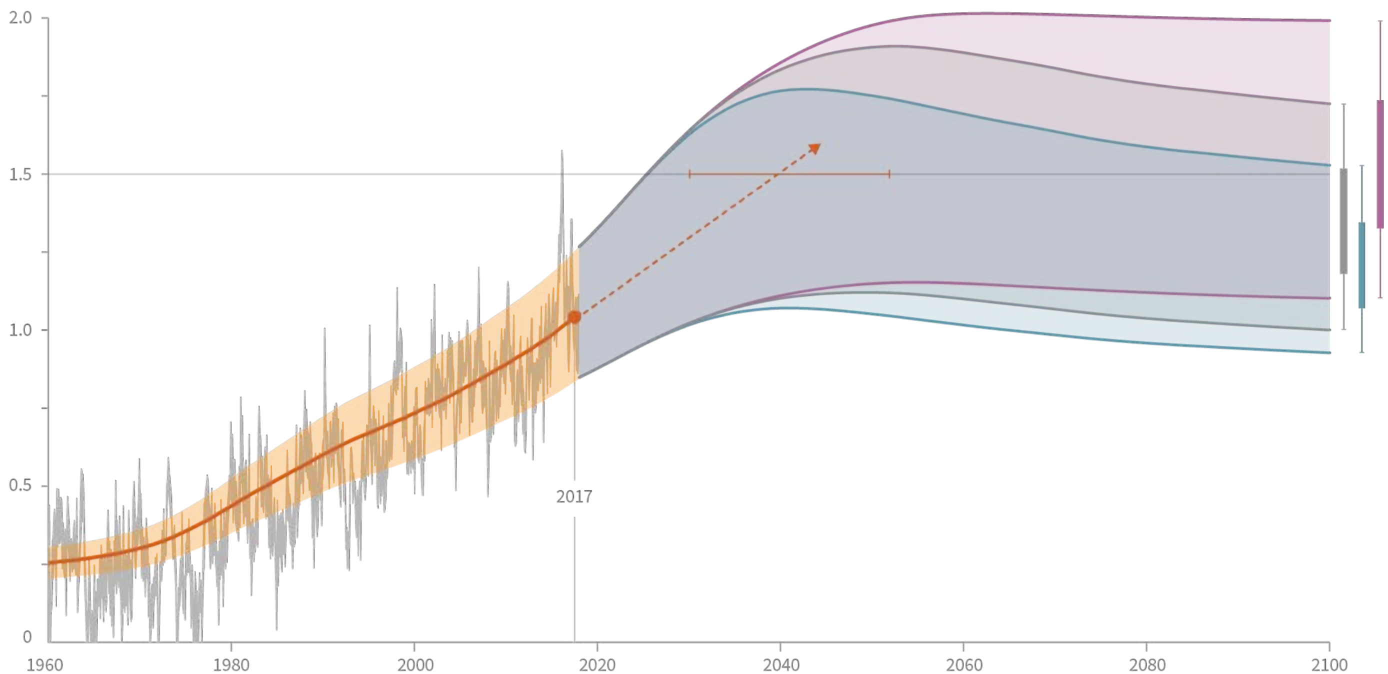
Where are we now?

Since pre-industrial times, human activities have caused approximately 1°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

SPM1 | Cumulative emissions of CO_2 and future non-CO_2 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



INTERGOVERNMENTAL PANEL ON climate change

SPM1 | Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

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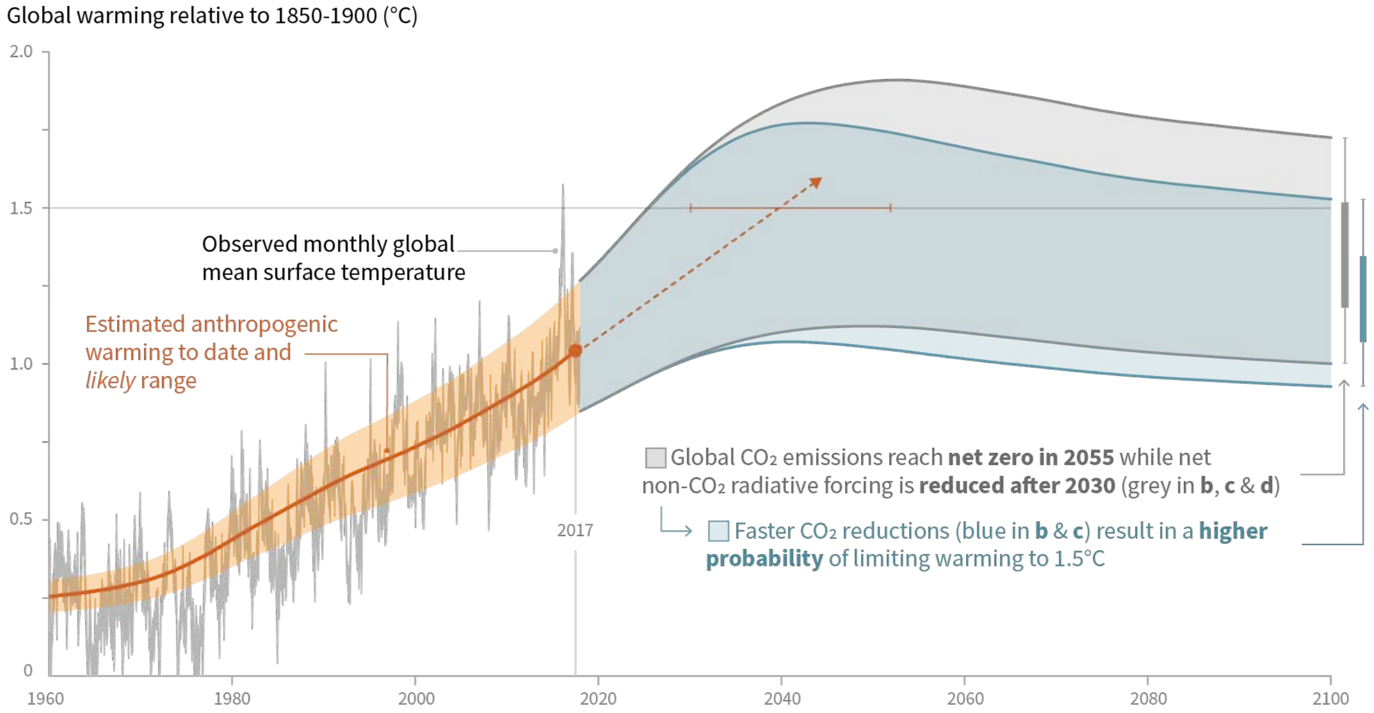

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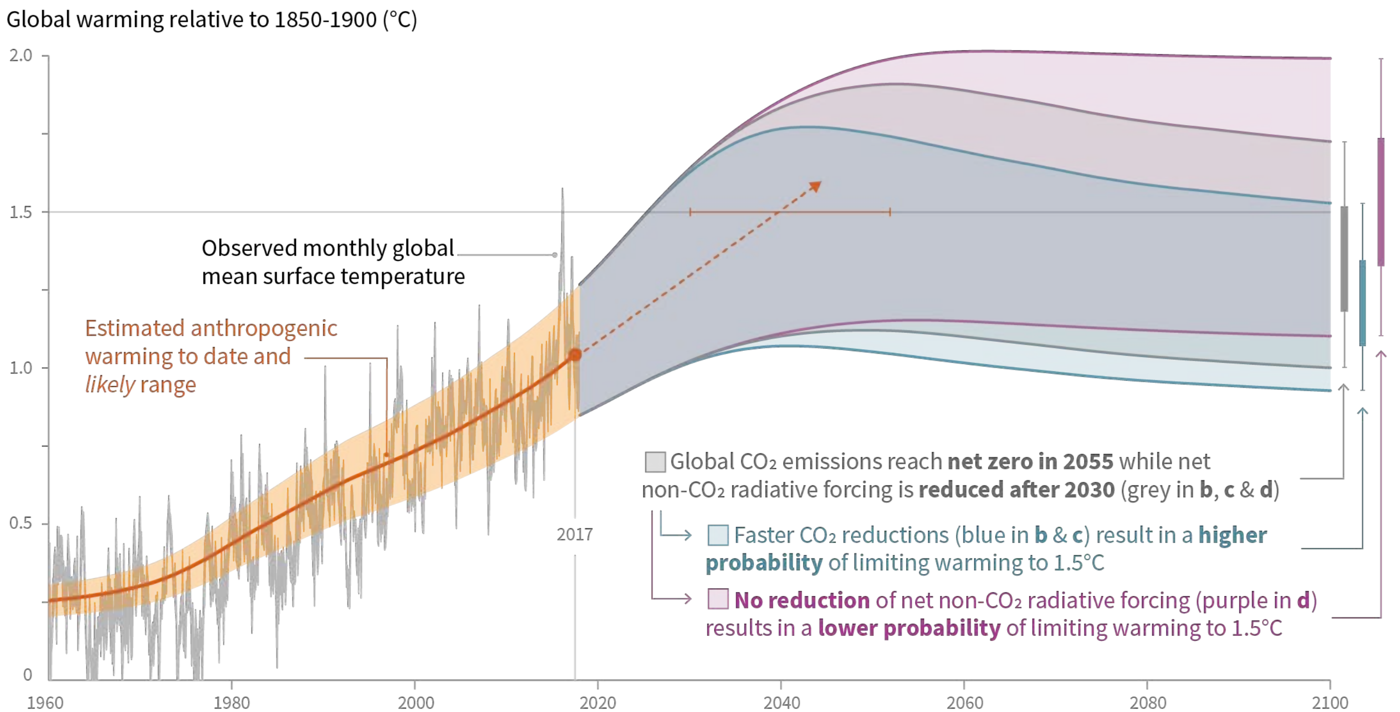
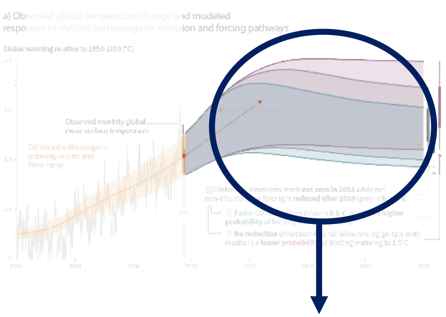


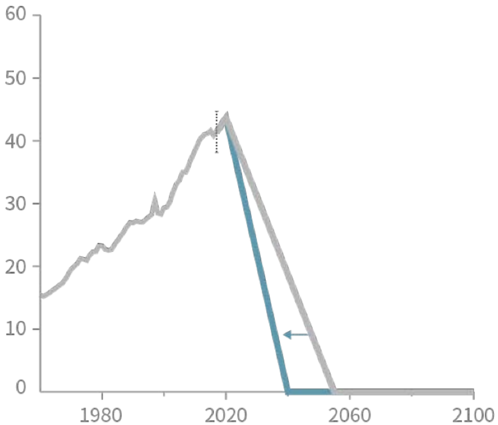
INTERGOVERNMENTAL PANEL ON climate change

SPM1 | Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

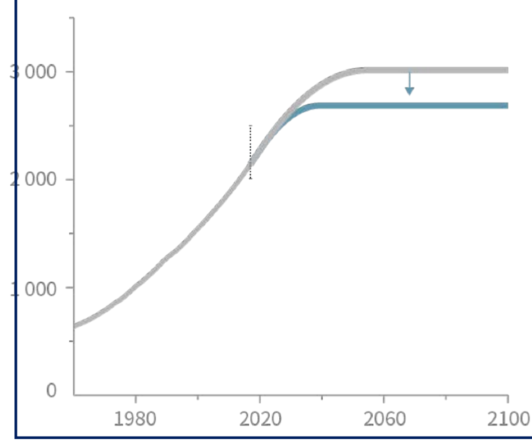


Maximum temperature rise is determined by cumulative net CO2 emissions and net non-CO2 radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents close to peak temperature.

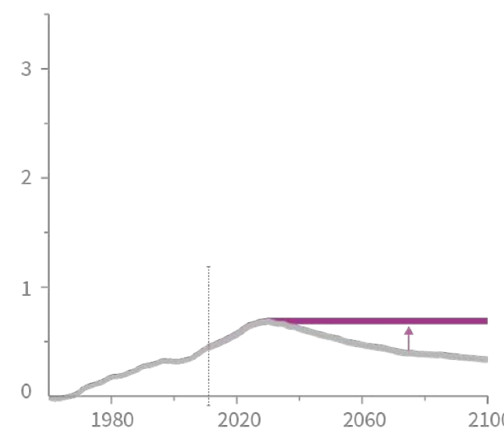
b) Stylized net global CO_2 emission pathways
Billion tonnes CO_2 per year ($GtCO_2$/yr)



c) Cumulative net CO_2 emissions
Billion tonnes CO_2 ($GtCO_2$)



d) Non-CO_2 radiative forcing pathways
Watts per square metre (W/m²)



Projected Climate Change, Potential Impacts and Associated Risks

Jason Florio / Aurora Photos

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 but may continue to rise for centuries
- 10 million fewer people exposed to risk of rising seas

Andre Seale / Aurora Photos

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 increased water shortages is up to 50% less

Natalie Behring / Aurora Photos

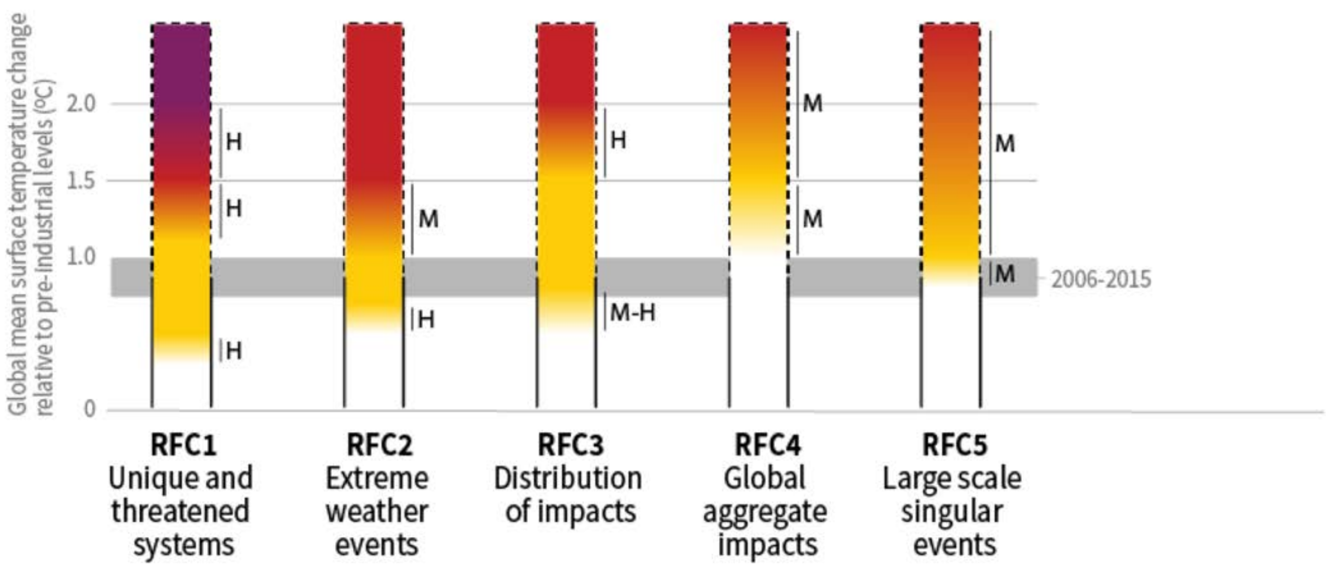
Impacts of global warming 1.5°C

At 1.5°C compared to 2°C:

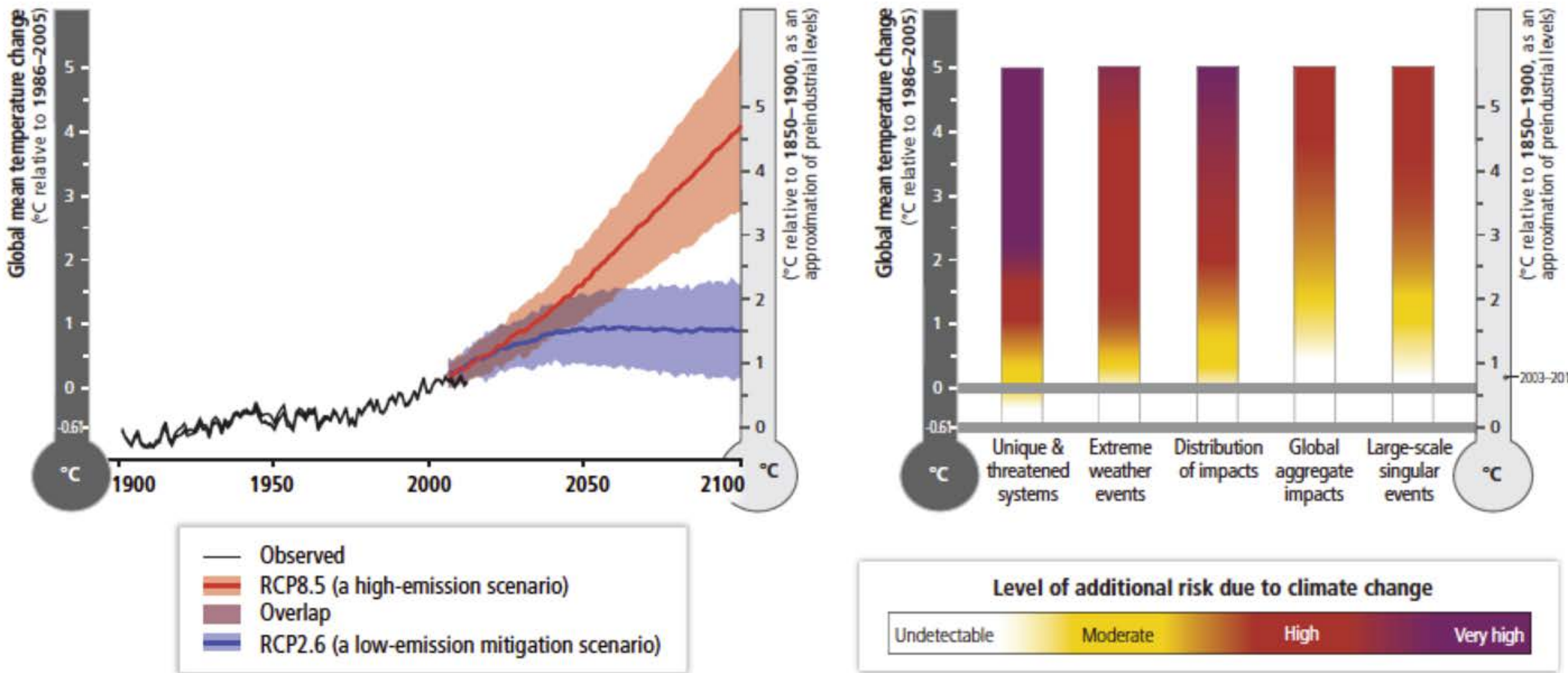
- Lower risk to fisheries and the livelihoods that depend on them
- Up to several hundred million fewer people exposed to climate-related risk and susceptible to poverty by 2050

SPM2 | 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

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

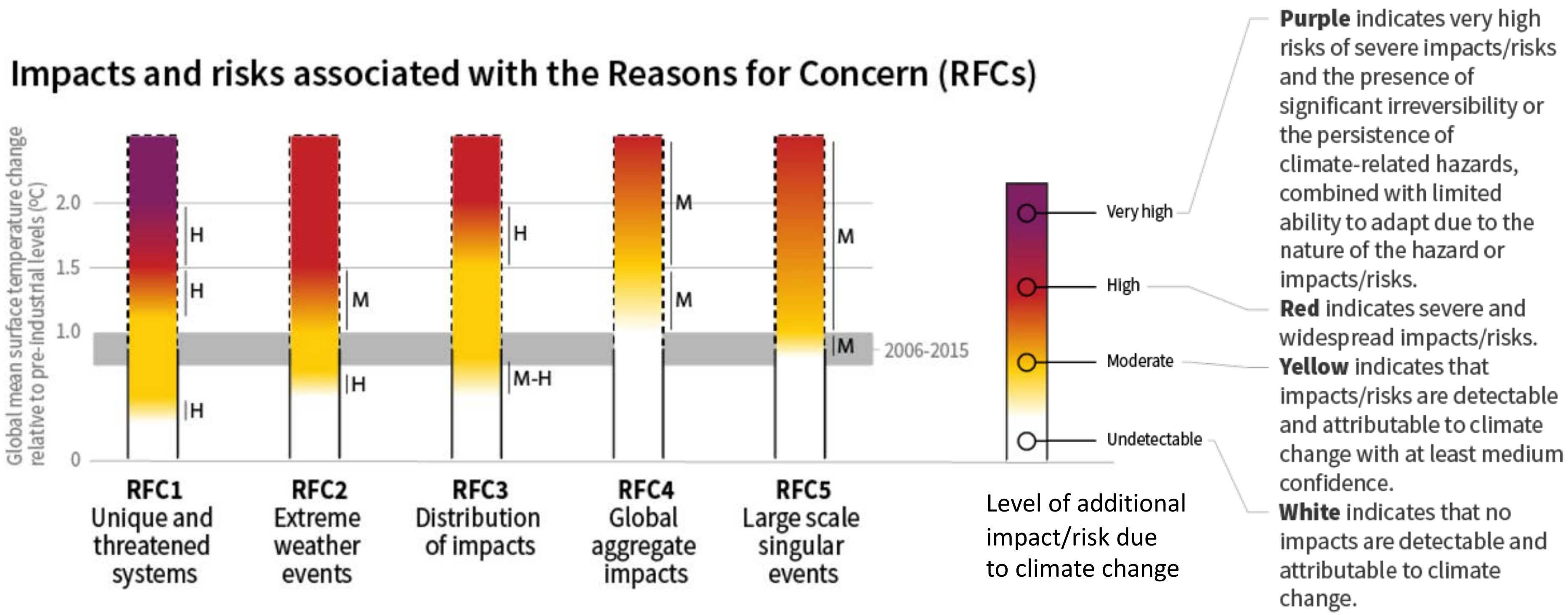


Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high



IPCC, 2014 (WG2)

SPM2 | 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



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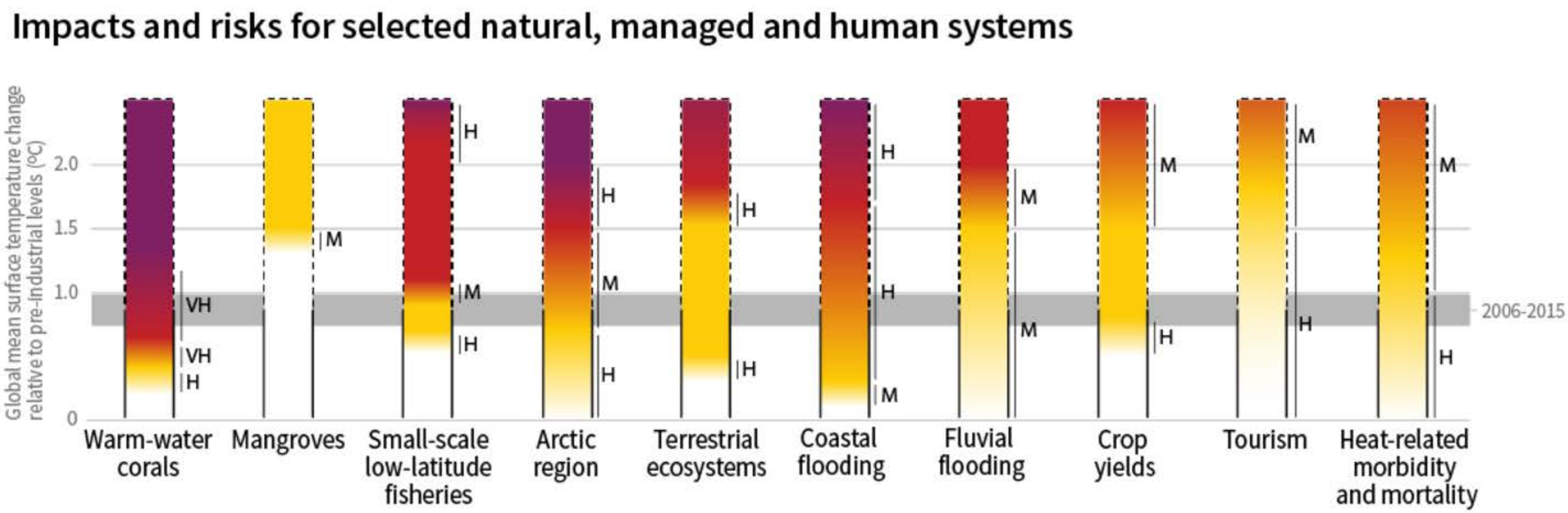


Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high

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

Robert van Waarden / Aurora Photos

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

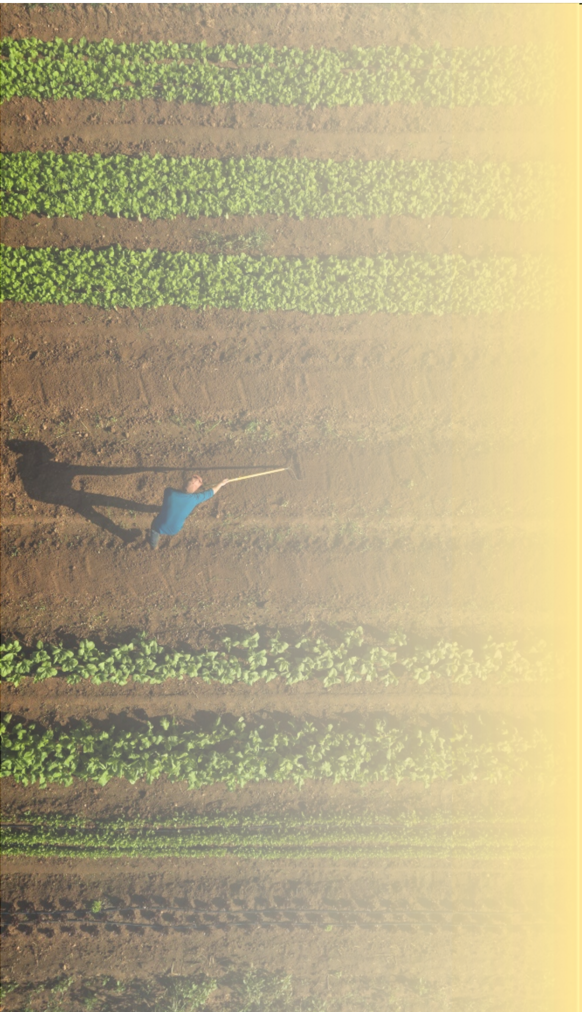
Neil Emmerson / Aurora Photos

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
    - → Increased investment in low carbon options

INTERGOVERNMENTAL PANEL ON climate change

Greenhouse gas emissions pathways



Peter Essick / Aurora Photos

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

Gerhard Zwerger-Schoner / Aurora Photos

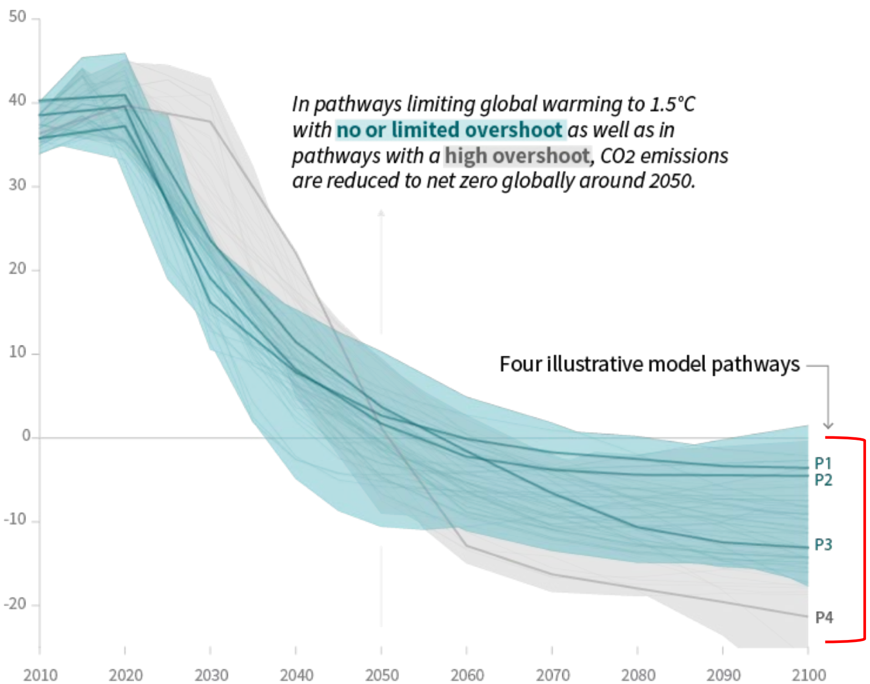
Greenhouse gas emissions pathways

- National pledges are not enough to limit warming to 1.5°C → consistent with 3C rise.
- Avoiding warming of more than 1.5°C would require CO_2 emissions to decline substantially before 2030

SPM3a | Global emissions pathway characteristics

Global total net CO_2 emissions

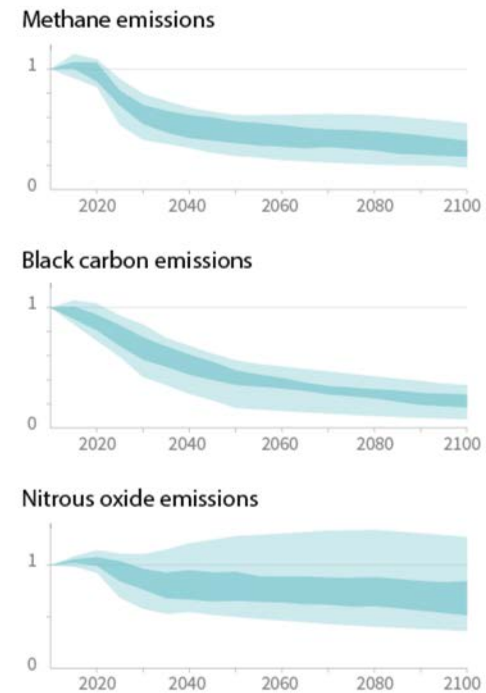
Billion tonnes of CO_2/yr



Timing of net zero CO_2
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios

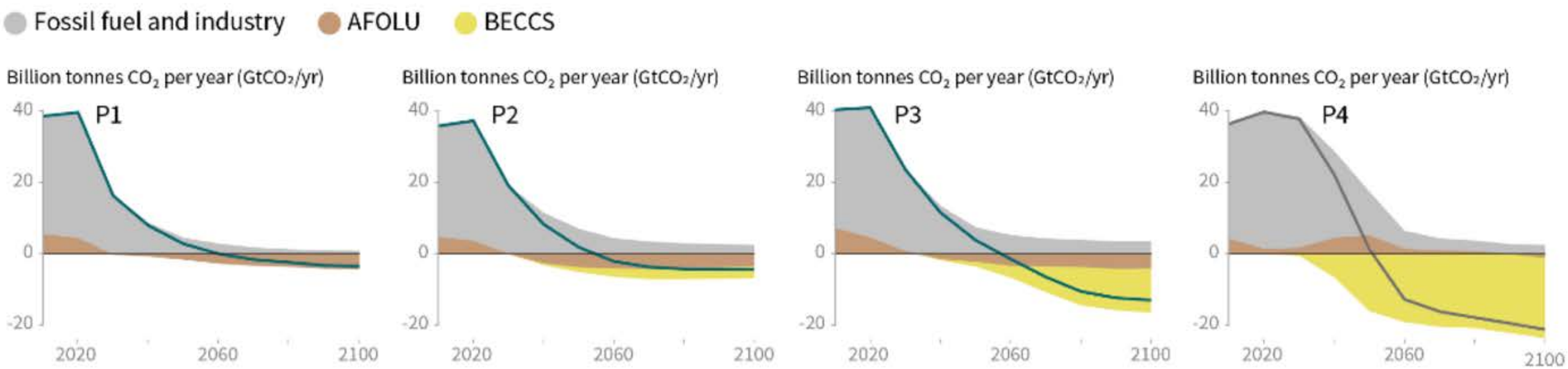
Non-CO_2 emissions relative to 2010

Emissions of non-CO_2 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.



SPM3b | Characteristics of four illustrative model pathways

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 downsized energy system enables rapid decarbonization 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.

SPM3b | Characteristics of four illustrative model pathways

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)

Temperature and emissions

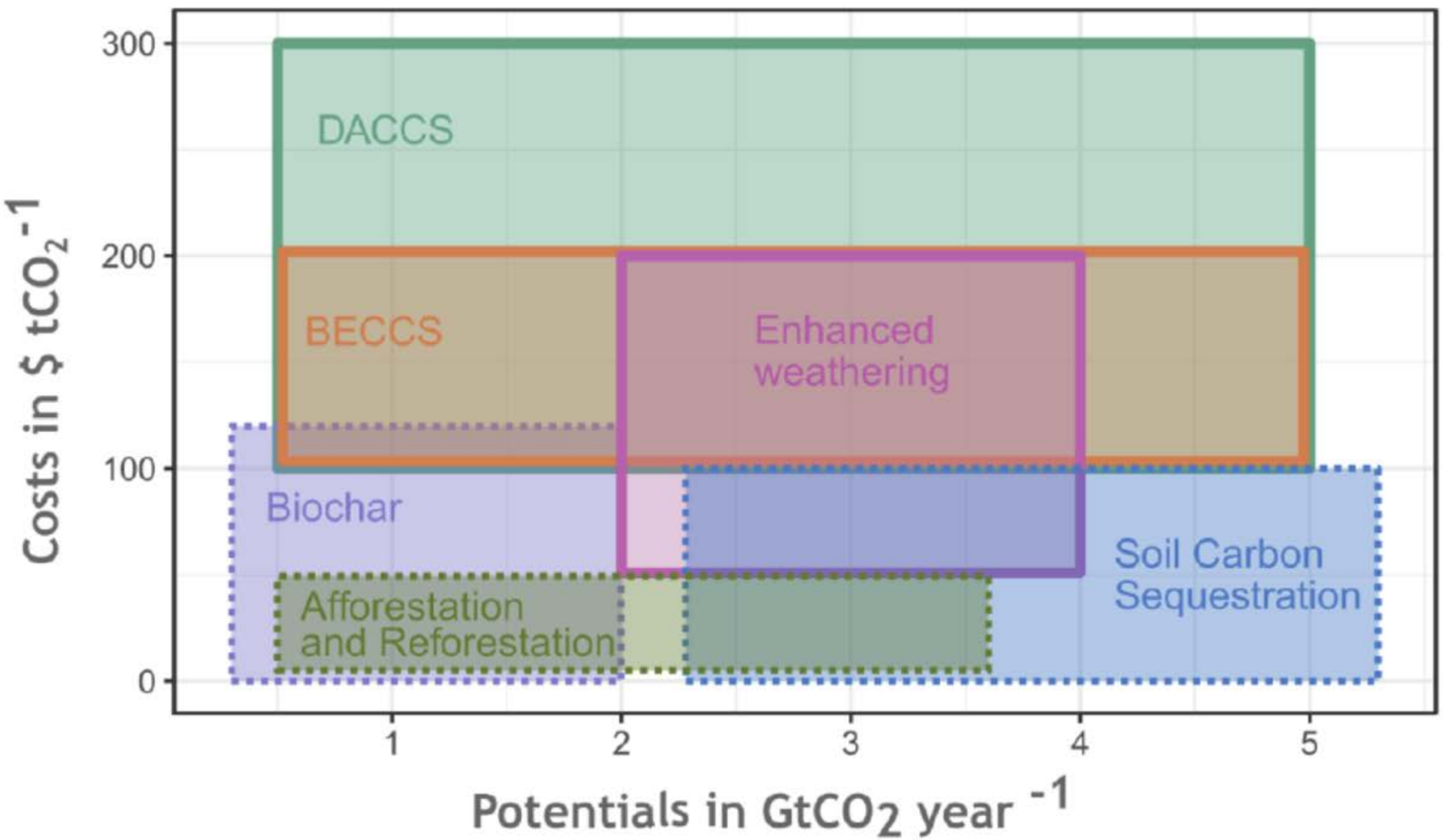
Energy systems

Carbon dioxide removal

Agriculture

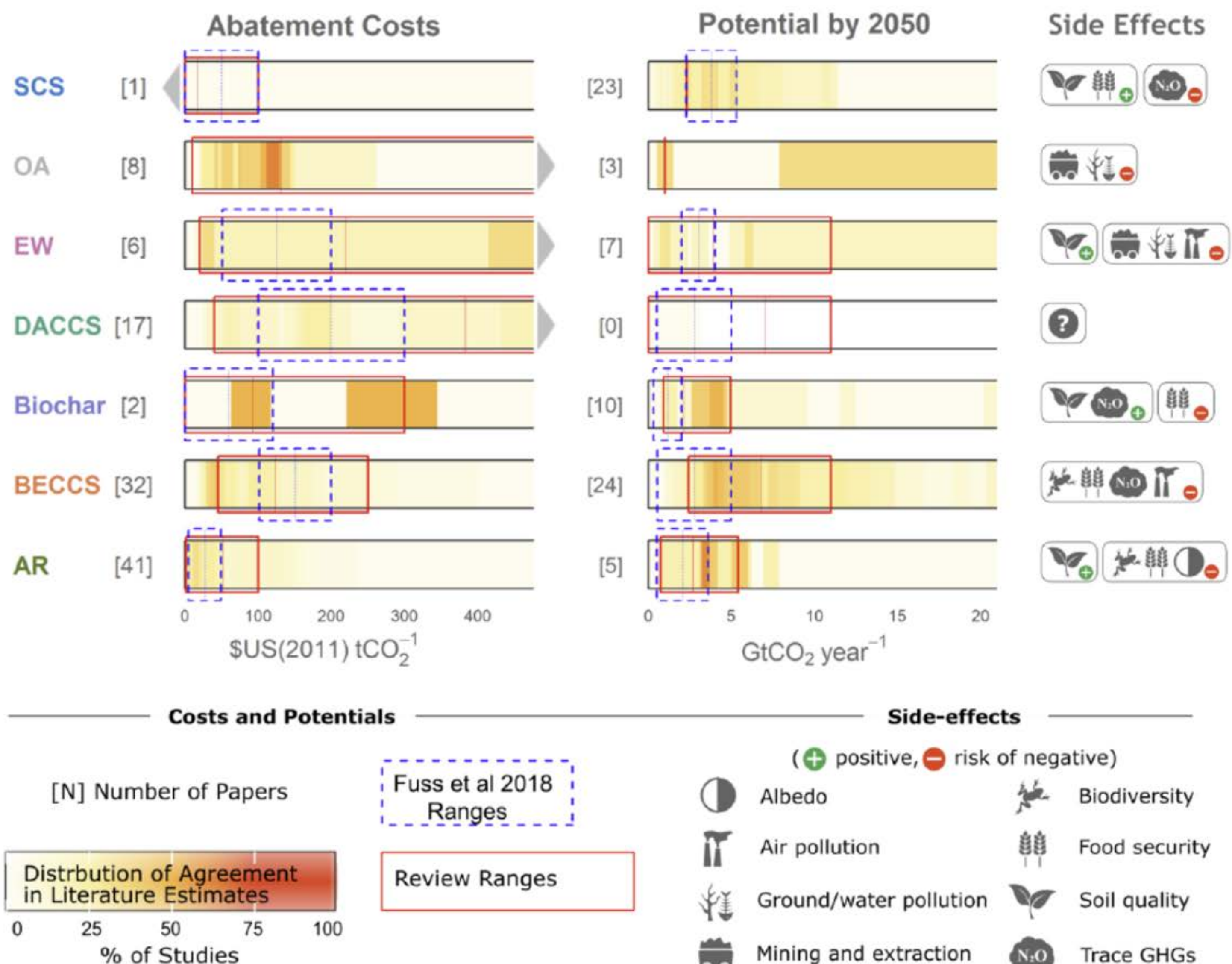
NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

** Kyoto-gas emissions are based on SAR GWP-100*
*** Changes in energy demand are associated with improvements in energy efficiency and behaviour change*



DACCS=direct air capture and storage
BECCS=bioenergy carbon capture and storage

SR1.5 report (2018); Chapter 4.



SCS=soil carbon sequestration;
OA=ocean alkanization;
EW=enhanced weathering
AR=afforestation

SR1.5 report (2018); Chapter 4.

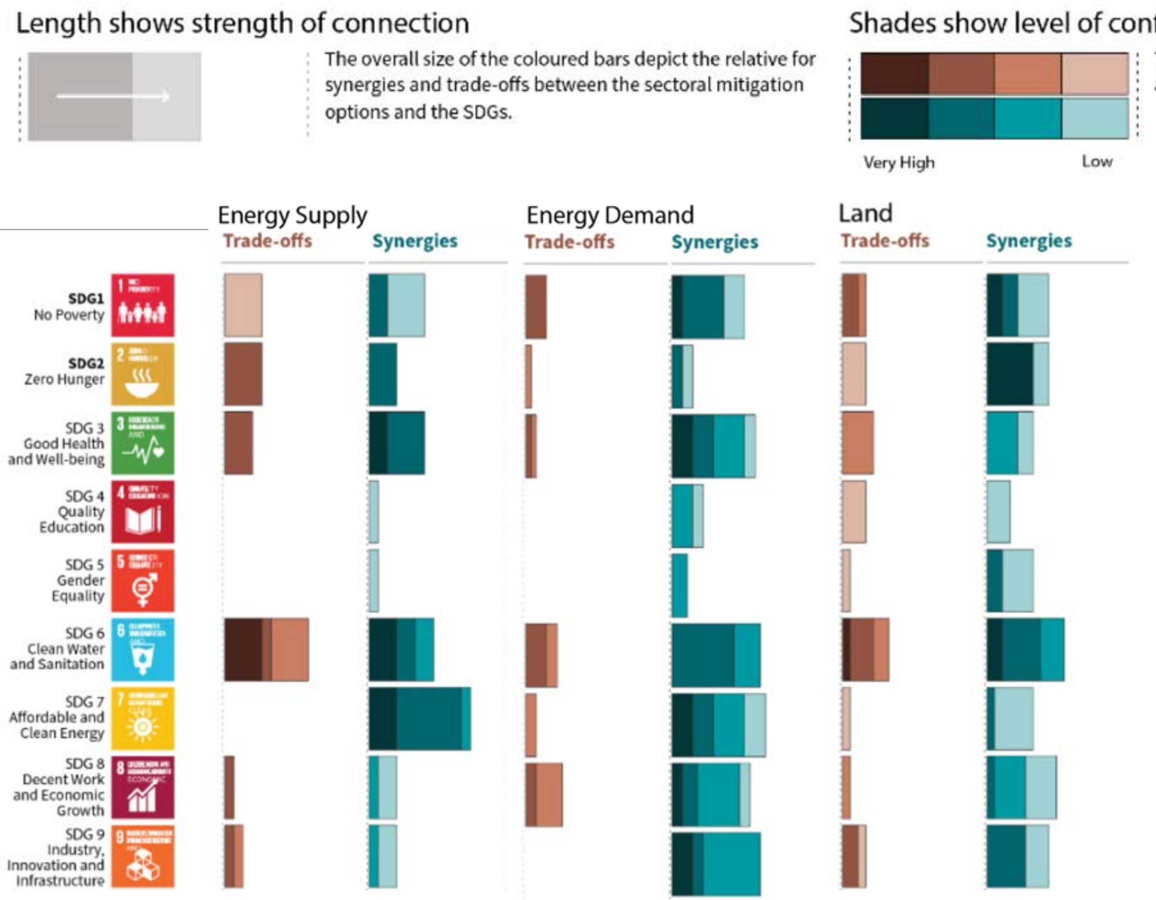
Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

Ashley Cooper/ Aurora Photos

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

SPM4 | Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)

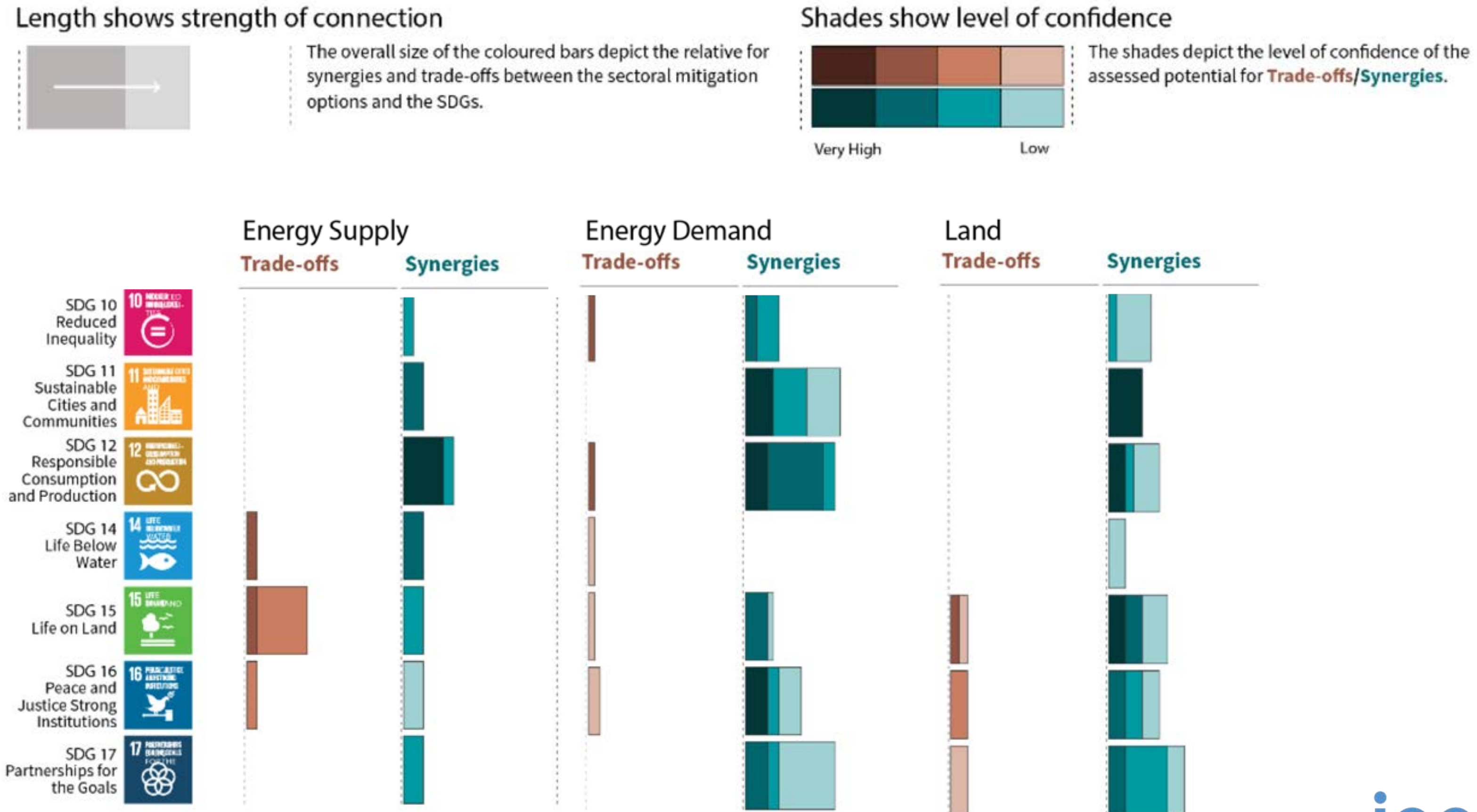


Energy supply: switch over energy to sustainable energy

Energy Demand: behavior change

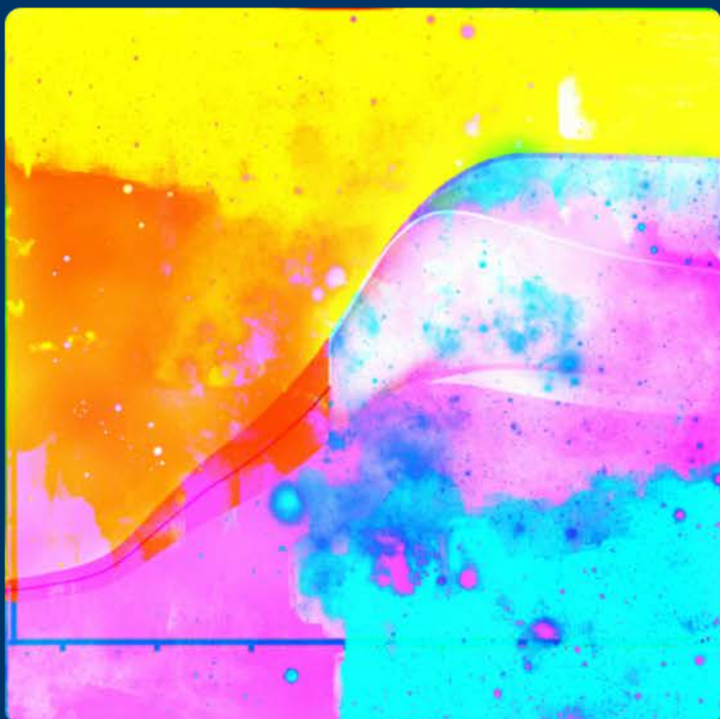
Land: reduce food waste, switching diets, soil C sequestration, forest preservation

SPM4 | Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)

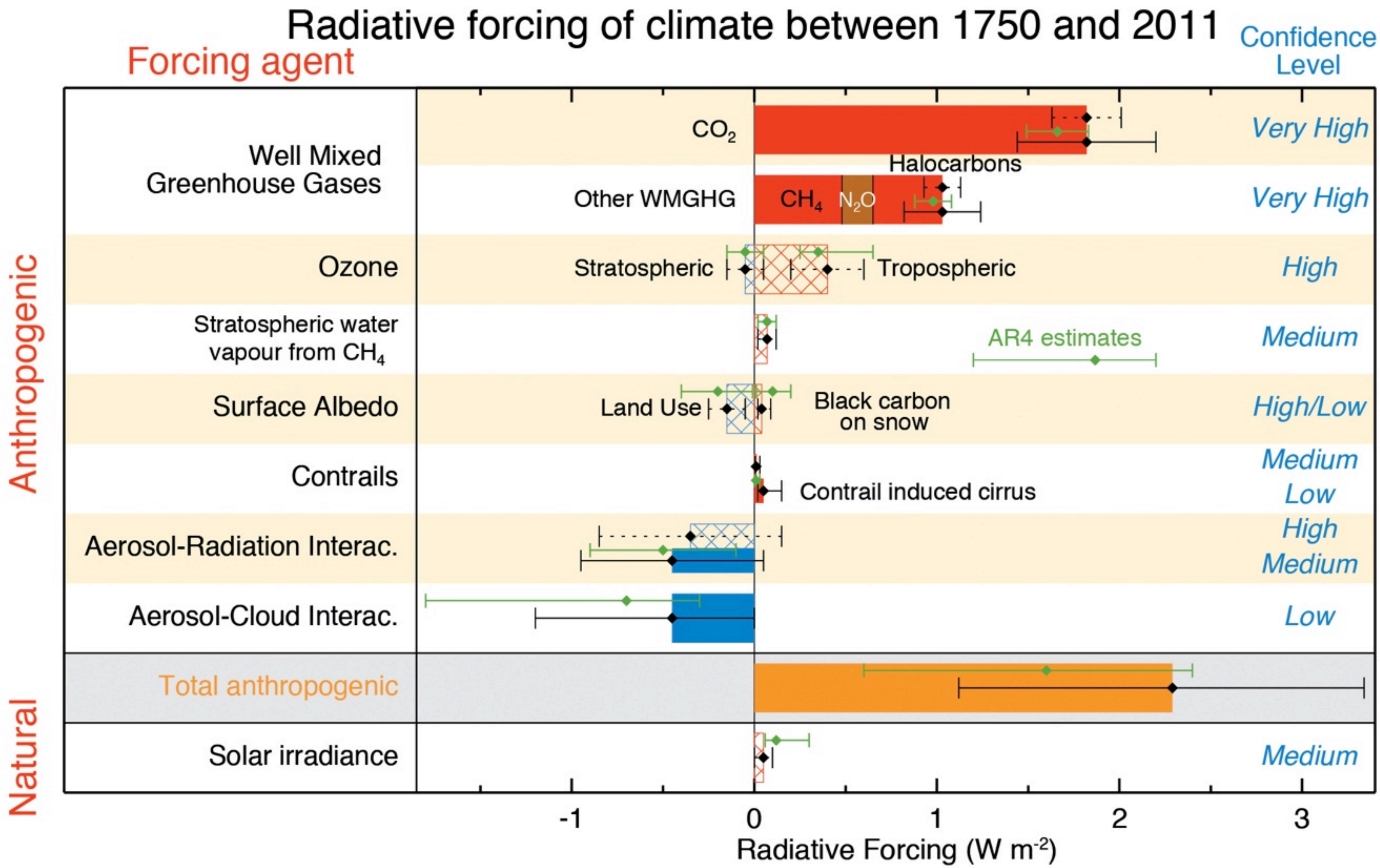


Summary

- 1C warming already: not impossible to be under 1.5C
- Need to adapt to current level and 1.5C or higher: already seeing harms
- Very ambitious to reach 1.5C or 2C
  - Need to move to sustainable energy now
  - Need to have behavior change now (less energy and ag used)
  - Need to move to sustainable ag now
  - Need to develop carbon dioxide removal technologies now (current technologies have many negative impacts)
- Report identifies many potential trade-offs between climate policy and sustainable development
  - Need to make sure expensive technologies aren't required: don't block developing countries or eradication of poverty.
- Report identifies many potential synergies between climate action and other goals (clean air, clean water, biodiversity)



Questions?

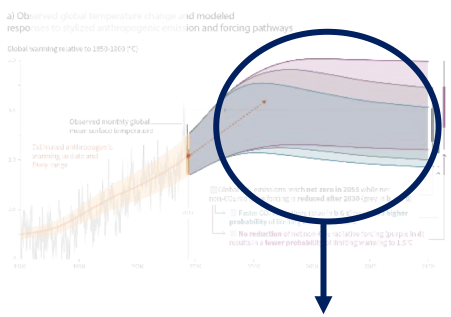

Radiative forcing of climate between 1750 and 2011
Forcing agent
Confidence Level
Anthropogenic
Natural
Well Mixed Greenhouse Gases
CO_2
Very High
Other WMGHG
CH_4
N_2O
Halocarbons
Very High
Ozone
Stratospheric
Tropospheric
High
Stratospheric water vapour from CH_4
AR4 estimates
Medium
Surface Albedo
Land Use
Black carbon on snow
High/Low
Contrails
Contrail induced cirrus
Medium
Low
Aerosol-Radiation Interac.
High
Medium
Aerosol-Cloud Interac.
Low
Total anthropogenic
Solar irradiance
Medium
-1
0
1
2
3
Radiative Forcing (W m^{-2})

IPCC 2013

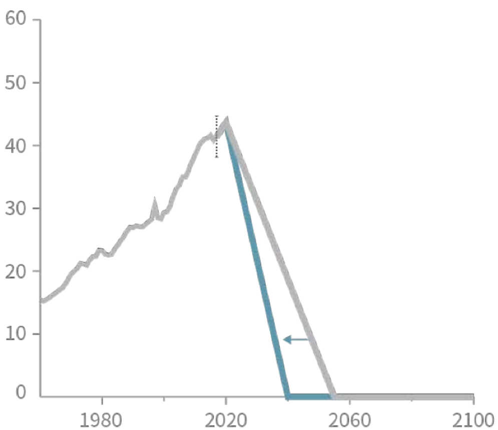
C2.6 Total annual average energy-related mitigation investment for the period 2015 to 2050 in pathways limiting warming to 1.5°C is estimated to be around 900 billion USD2015 (range of 180 billion to 1800 billion USD2015 across six models[17]). This corresponds to total annual average energy supply investments of 1600 to 3800 billion USD2015 and total annual average energy demand investments of 700 to 1000 billion USD2015 for the period 2015 to 2050, and an increase in total energy-related investments of about 12% (range of 3% to 23%) in 1.5°C pathways relative to 2°C pathways. Average annual investment in low-carbon energy technologies and energy efficiency are upscaled by roughly a factor of five (range of factor of 4 to 5) by 2050 compared to 2015 (*medium confidence*). {2.5.2, Box 4.8, Figure 2.27}

C2.7. Modelled pathways limiting global warming to 1.5°C with no or limited overshoot project a wide range of global average discounted marginal abatement costs over the 21st century. They are roughly 3-4 times higher than in pathways limiting global warming to below 2°C (*high confidence*). The economic literature distinguishes marginal abatement costs from total mitigation costs in the economy. The literature on total mitigation costs of 1.5°C mitigation pathways is limited and was not assessed in this report. Knowledge gaps remain in the integrated assessment of the economy wide costs and benefits of mitigation in line with pathways limiting warming to 1.5°C. {2.5.2; 2.6; Figure 2.26}

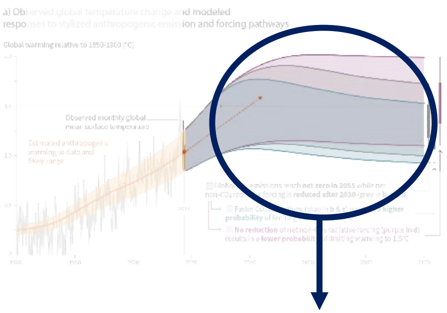
SPM1 | Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C



b) Stylized net global CO_2 emission pathways
Billion tonnes CO_2 per year ($GtCO_2$/yr)

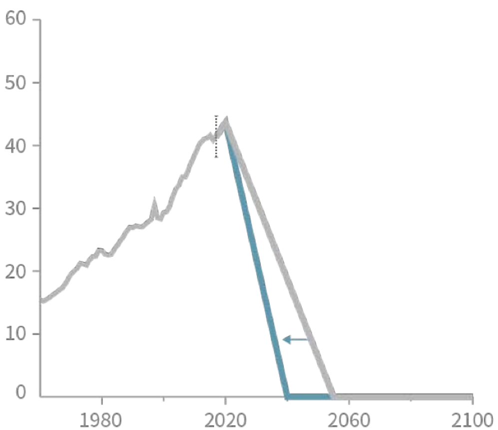


SPM1 | Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

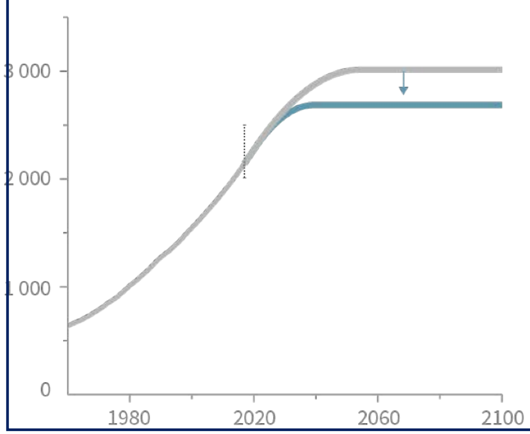


Faster immediate CO_2 emission reductions limit cumulative CO_2 emissions

b) Stylized net global CO_2 emission pathways
Billion tonnes CO_2 per year ($GtCO_2$/yr)



c) Cumulative net CO_2 emissions
Billion tonnes CO_2 ($GtCO_2$)



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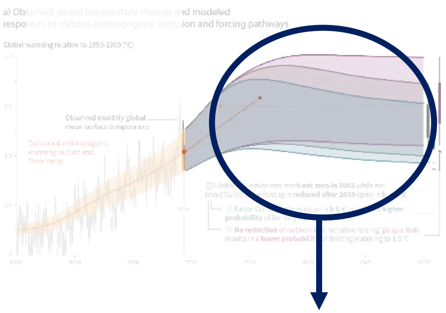

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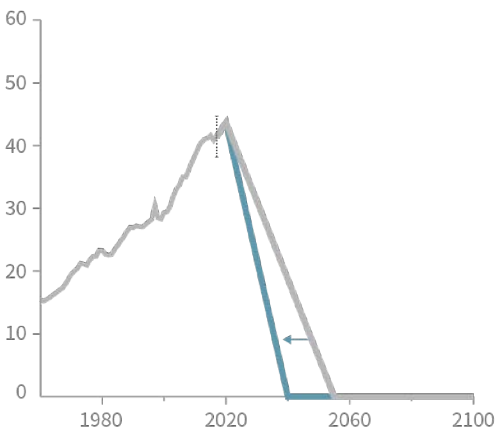

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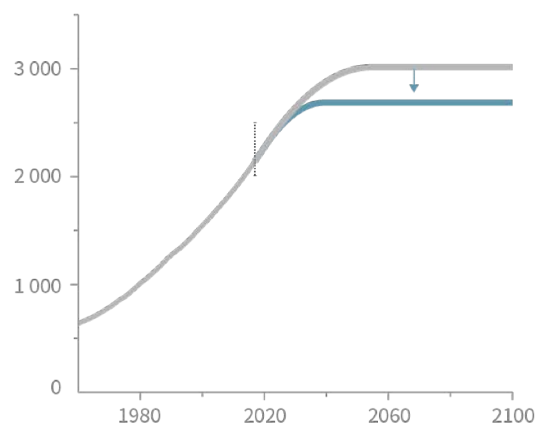
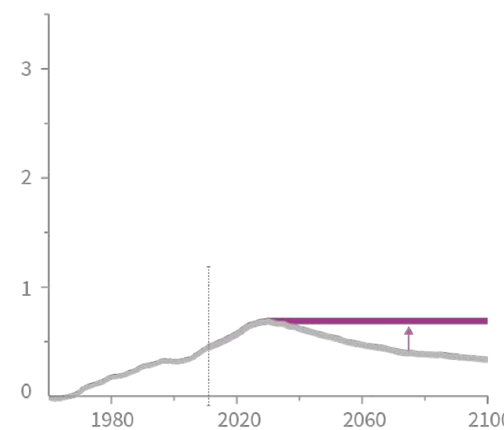
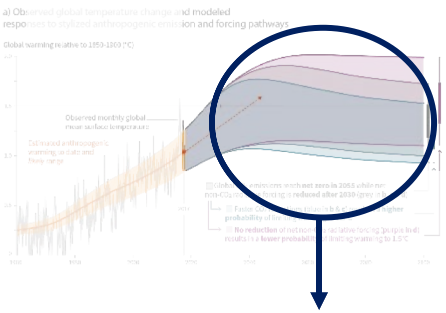


d) Non-CO_2 radiative forcing pathways
Watts per square metre (W/m^2)

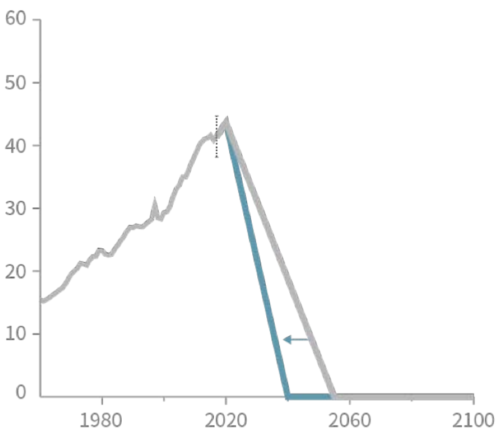


SPM1 | Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

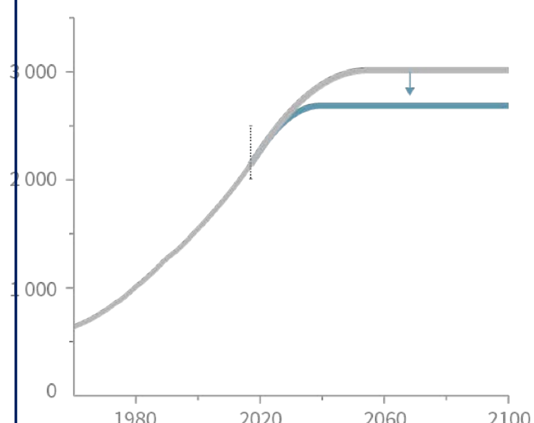


Maximum temperature rise is determined by cumulative net CO2 emissions and net non-CO2 radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

b) Stylized net global CO_2 emission pathways
Billion tonnes CO_2 per year ($GtCO_2$/yr)



c) Cumulative net CO_2 emissions
Billion tonnes CO_2 ($GtCO_2$)



d) Non-CO_2 radiative forcing pathways
Watts per square metre (W/m²)