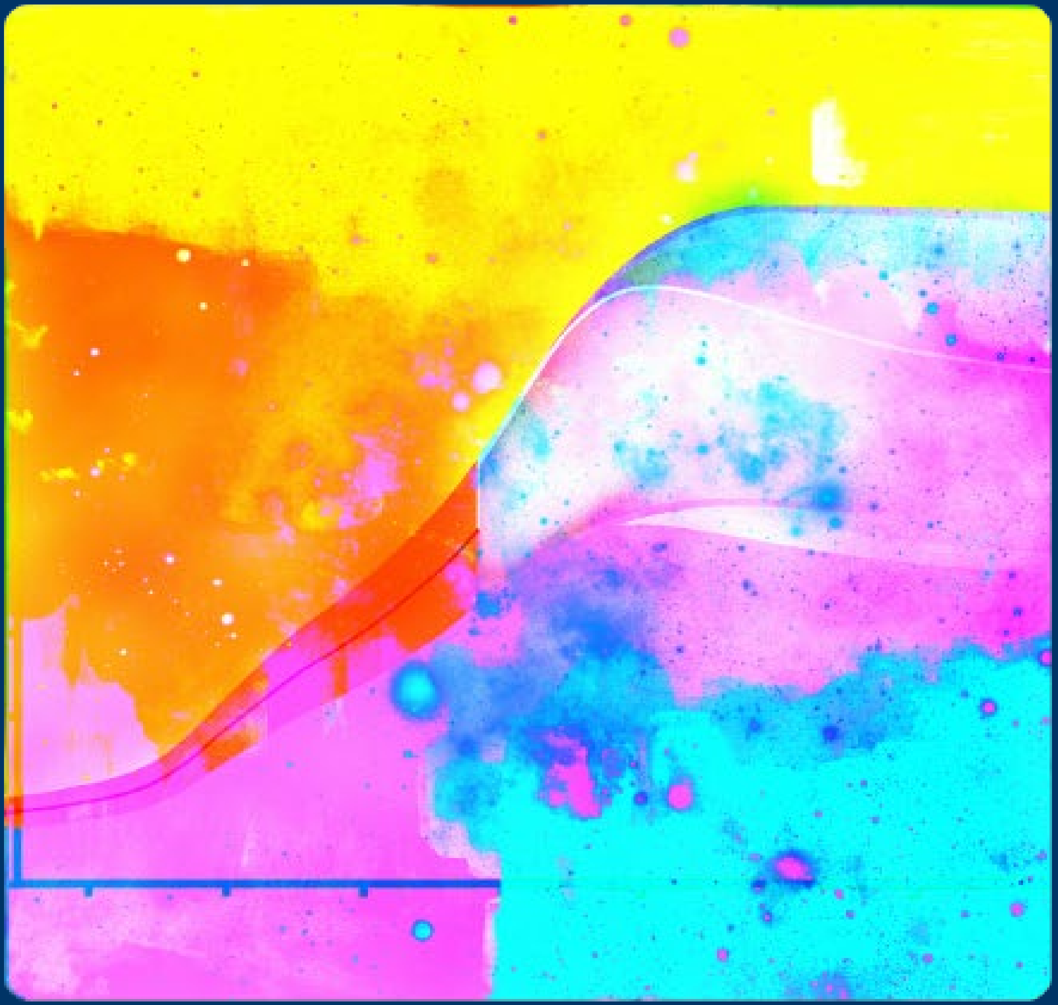

IPCC Special Report on Global Warming of 1.5°C

#SR15

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.

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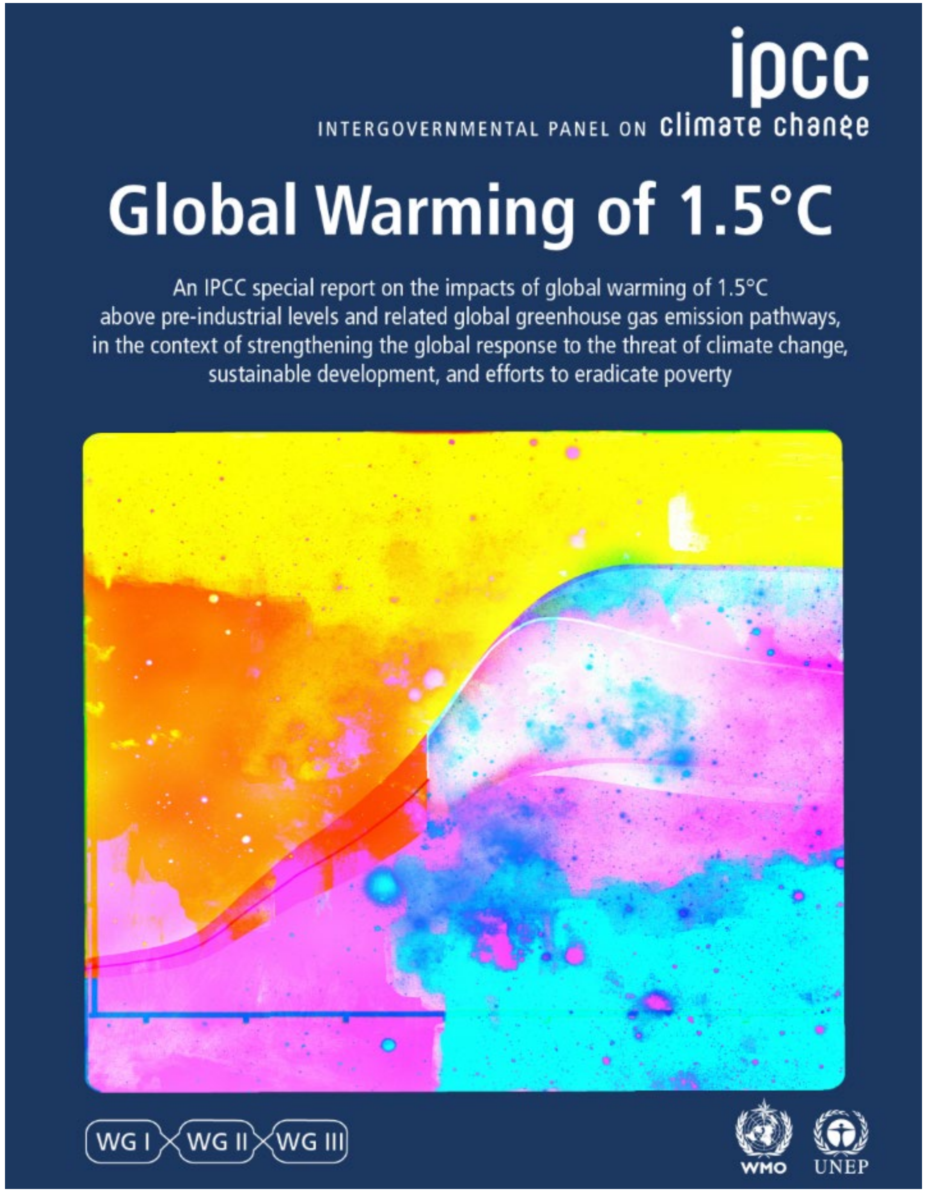

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The report in numbers

91 Authors from **40** Countries

133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments

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Every bit of warming matters

Every year matters

Every choice matters

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

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

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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

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

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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 25% for 2°C
- To limit warming to 1.5°C, CO_2 emissions would need to reach ‘net zero’ around 2050
  - ↳ Compared to around 2070 for 2°C
- Reducing non-CO_2 emissions would have direct and immediate health benefits

Neil Emmerson / Aurora Photos

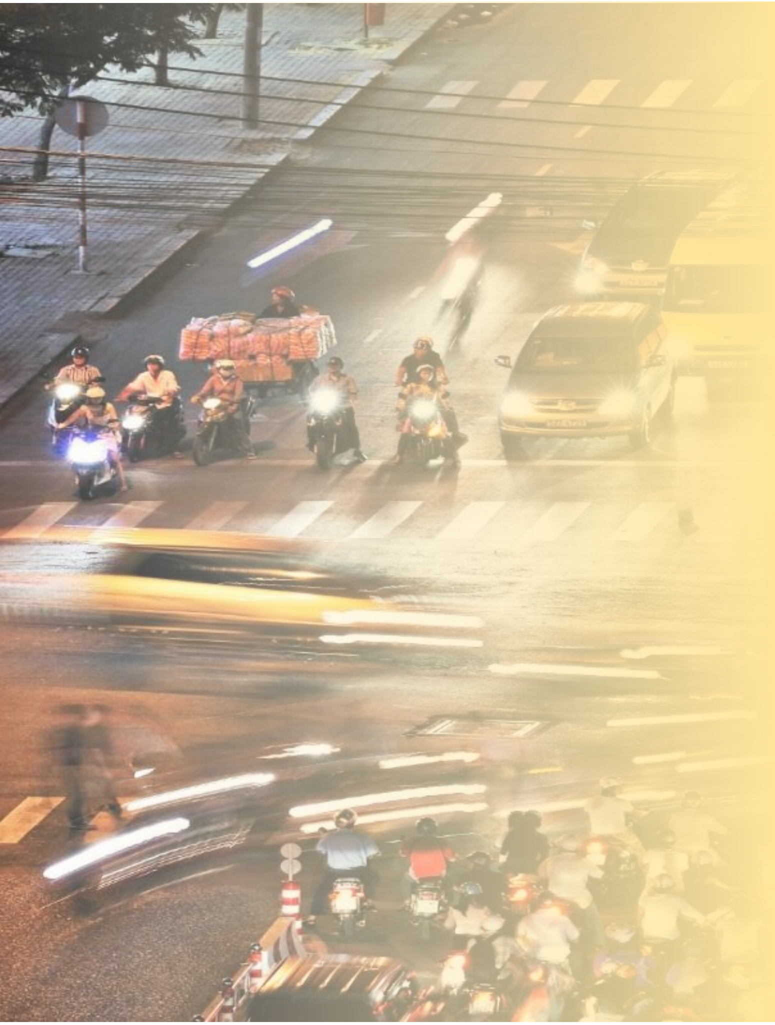
Greenhouse gas emissions pathways

- 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

Peter Essick / Aurora Photos

Greenhouse gas emissions pathways

- 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
- Avoiding warming of more than 1.5°C would require CO_2 emissions to decline substantially before 2030

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

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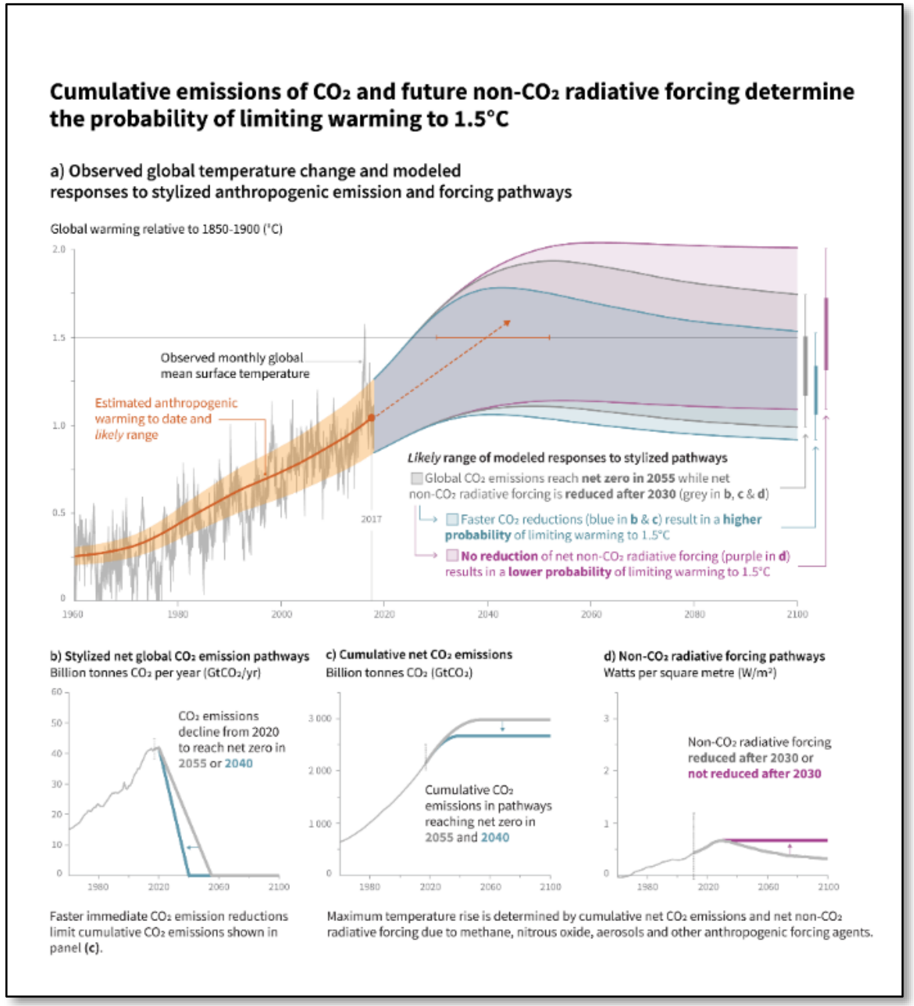
Ashley Cooper/ Aurora Photos

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

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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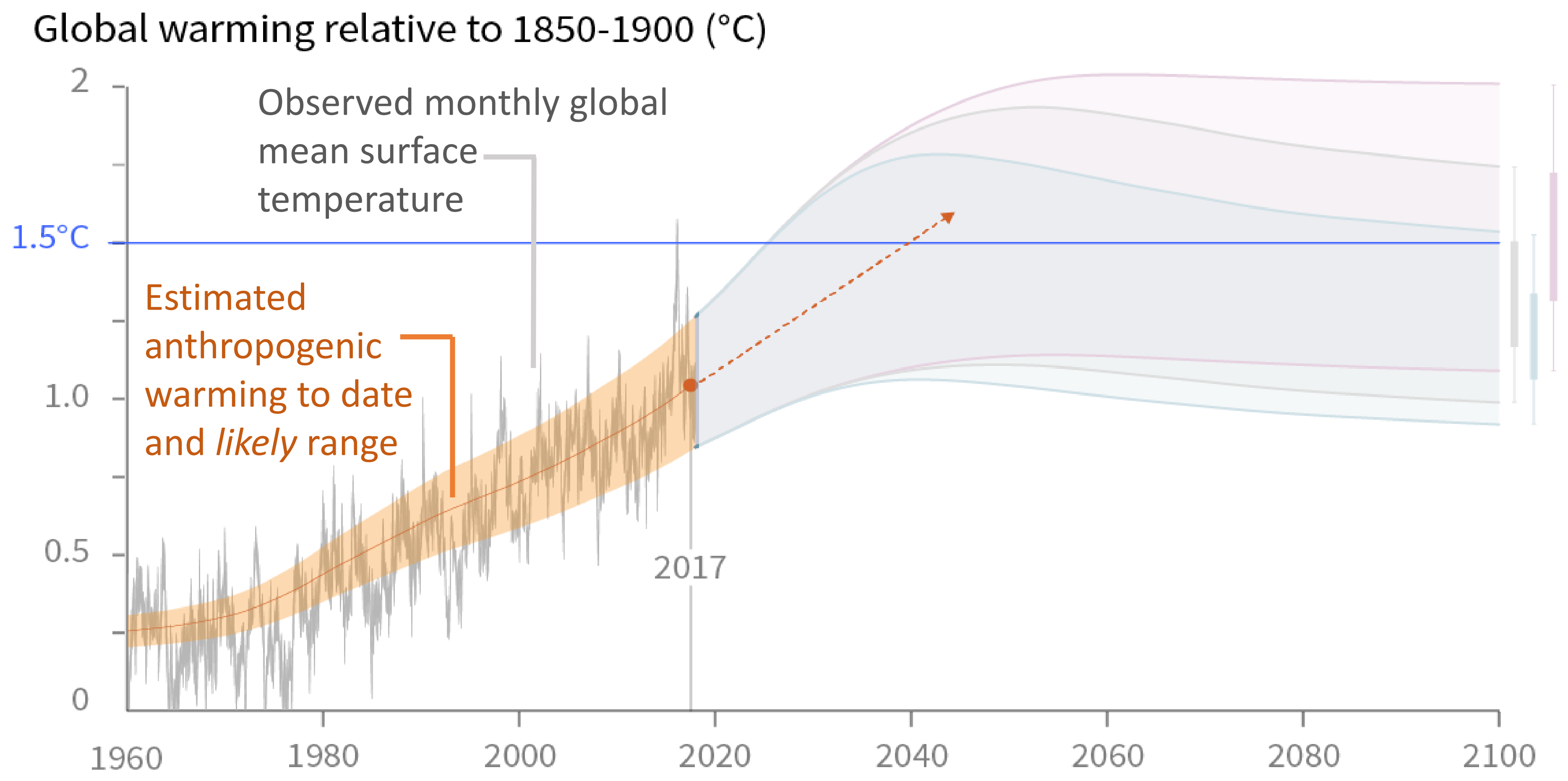
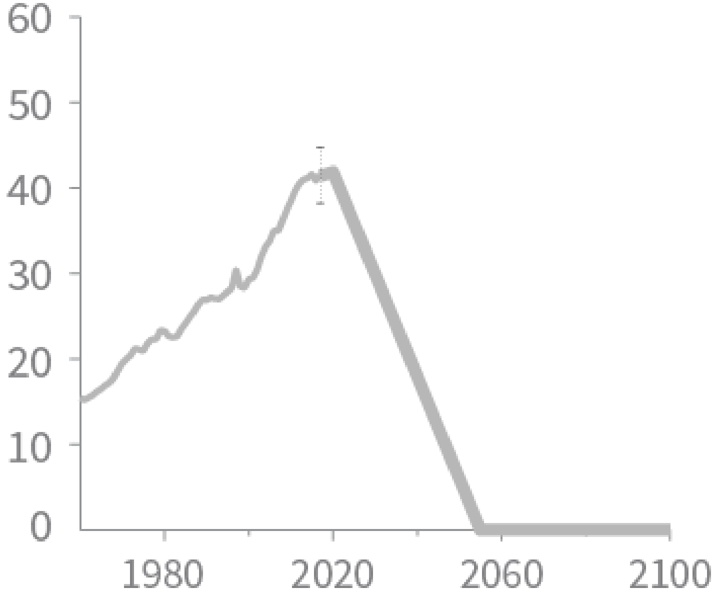


SPM1 | Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

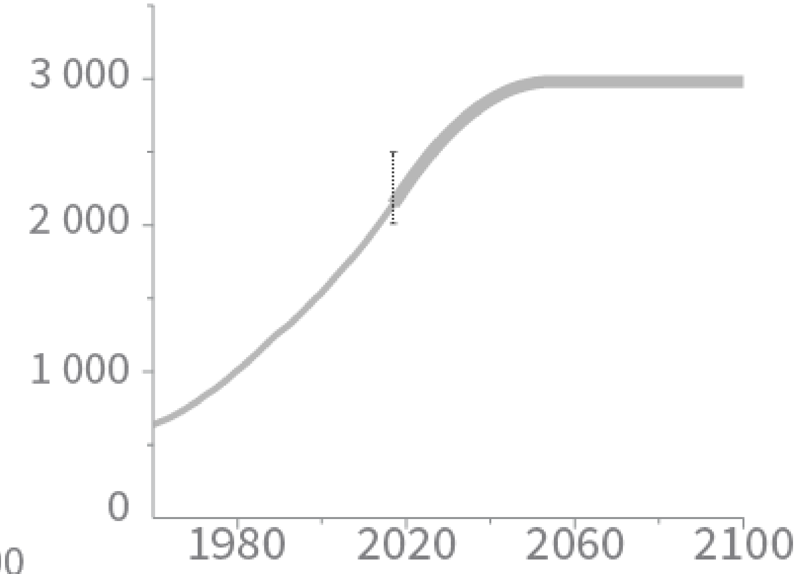
b) Stylized net global CO_2 emission pathways

Billion tonnes CO_2 per year ($GtCO_2$/yr)



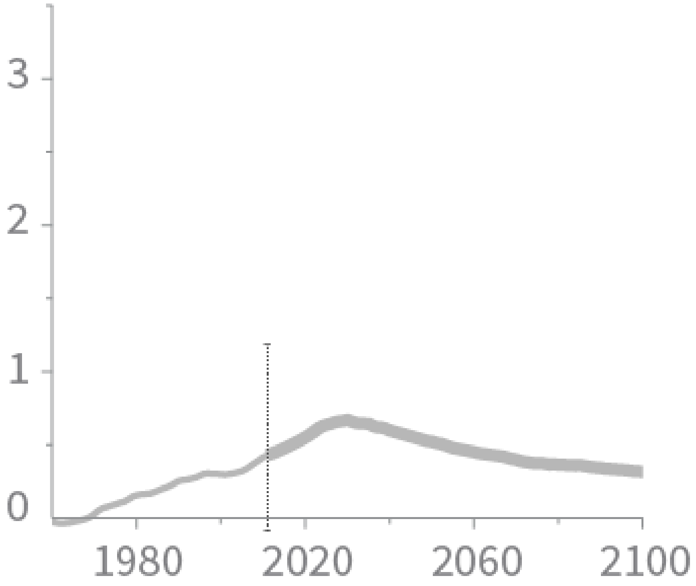
c) Cumulative net CO_2 emissions

Billion tonnes CO_2 ($GtCO_2$)



d) Non-CO2 radiative forcing pathways

Watts per square metre (W/m²)



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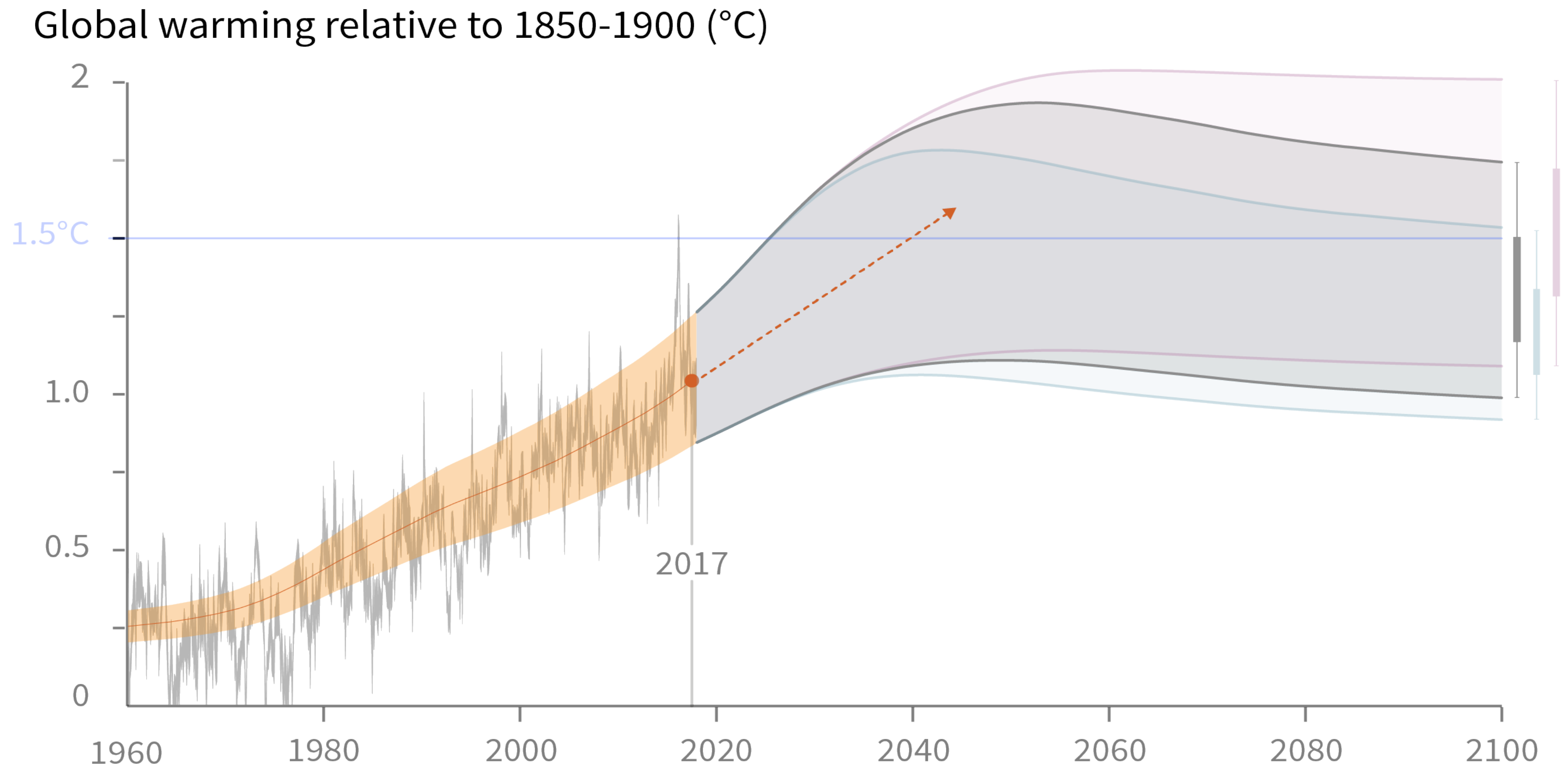

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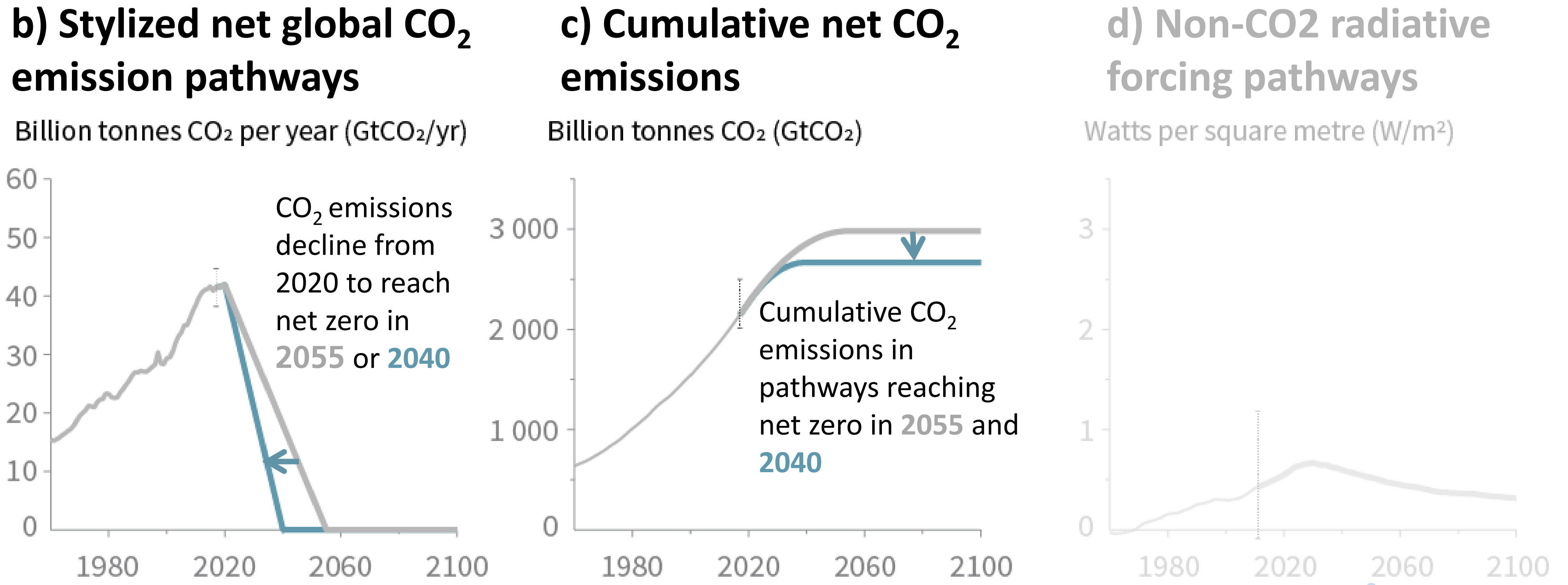

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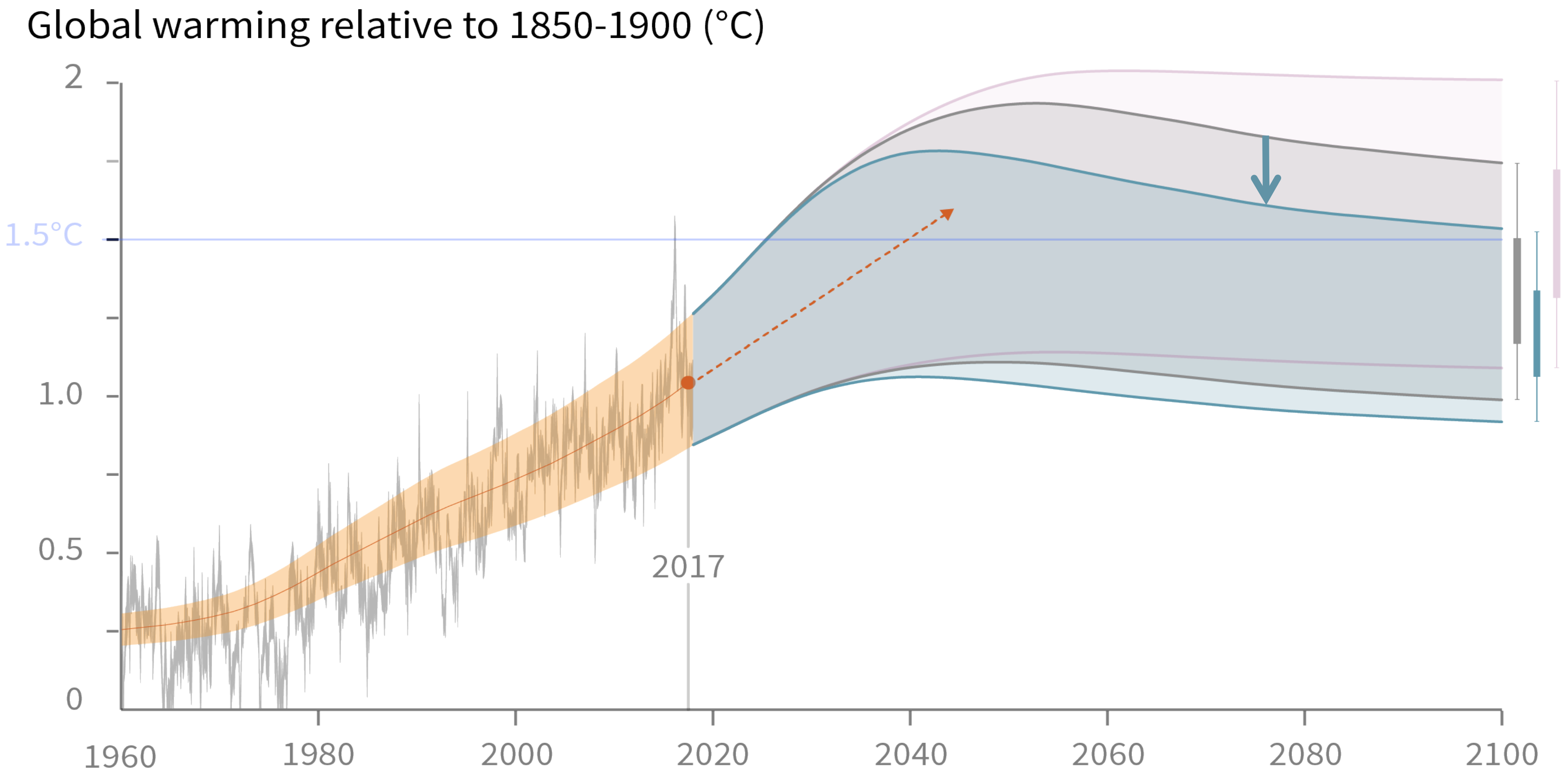

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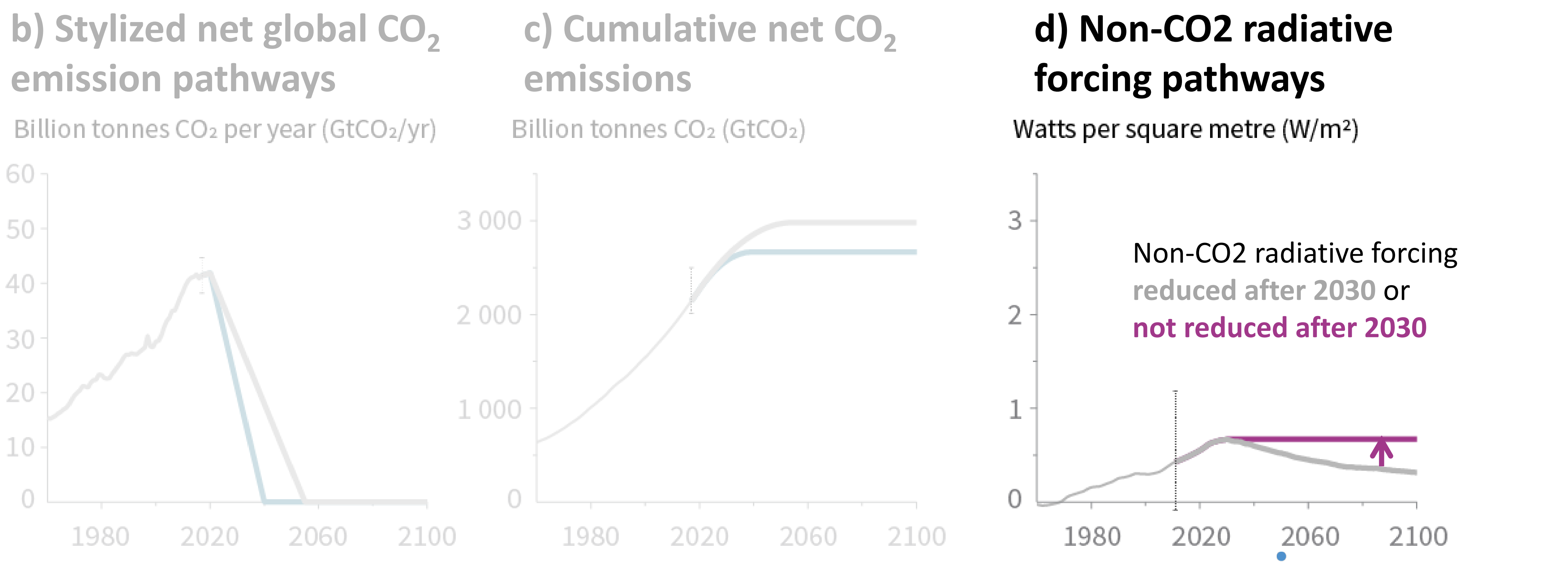

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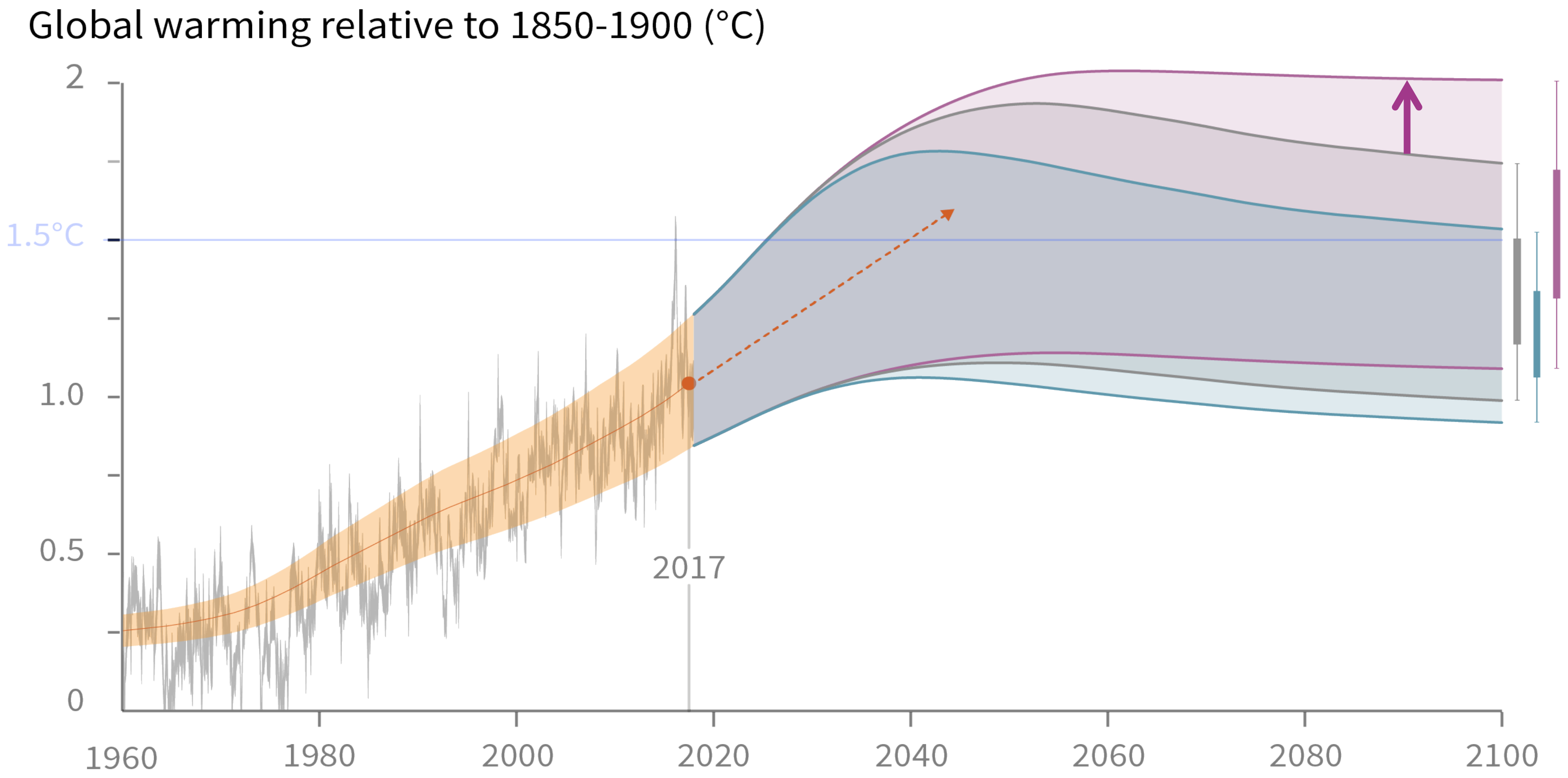
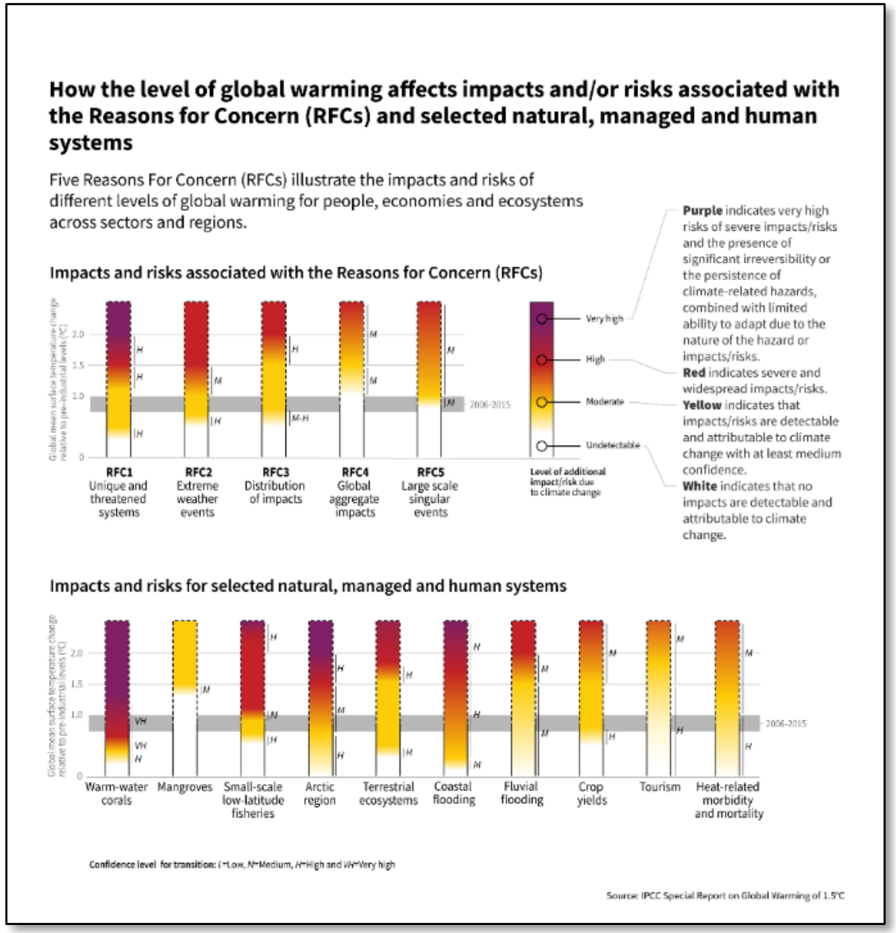


SPM2| How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems



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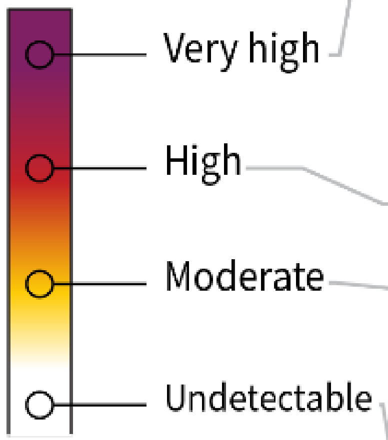
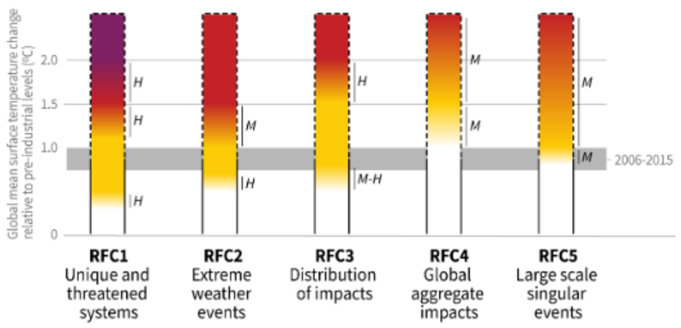


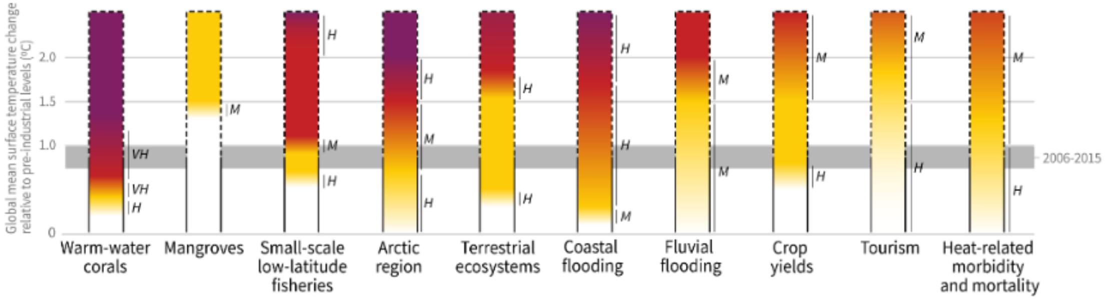
Level of additional impact/risk due to climate change

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.

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

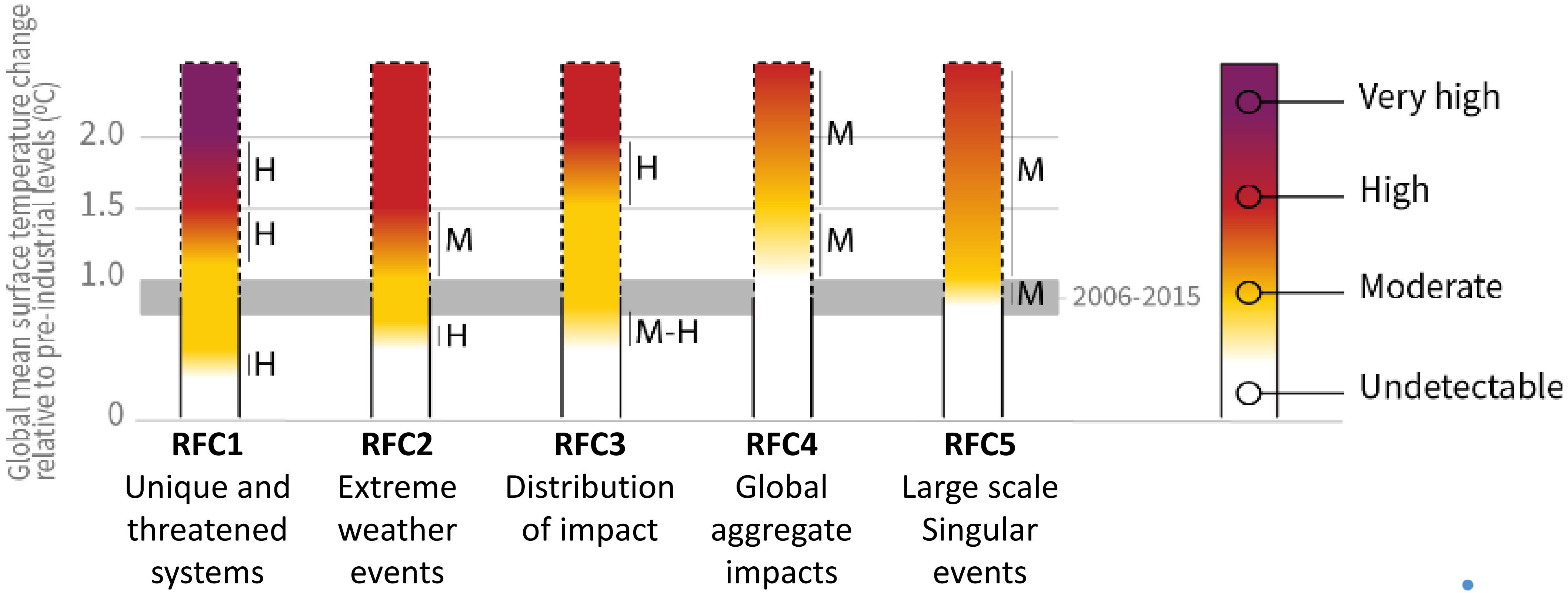


Impacts and risks for selected natural, managed and human systems



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

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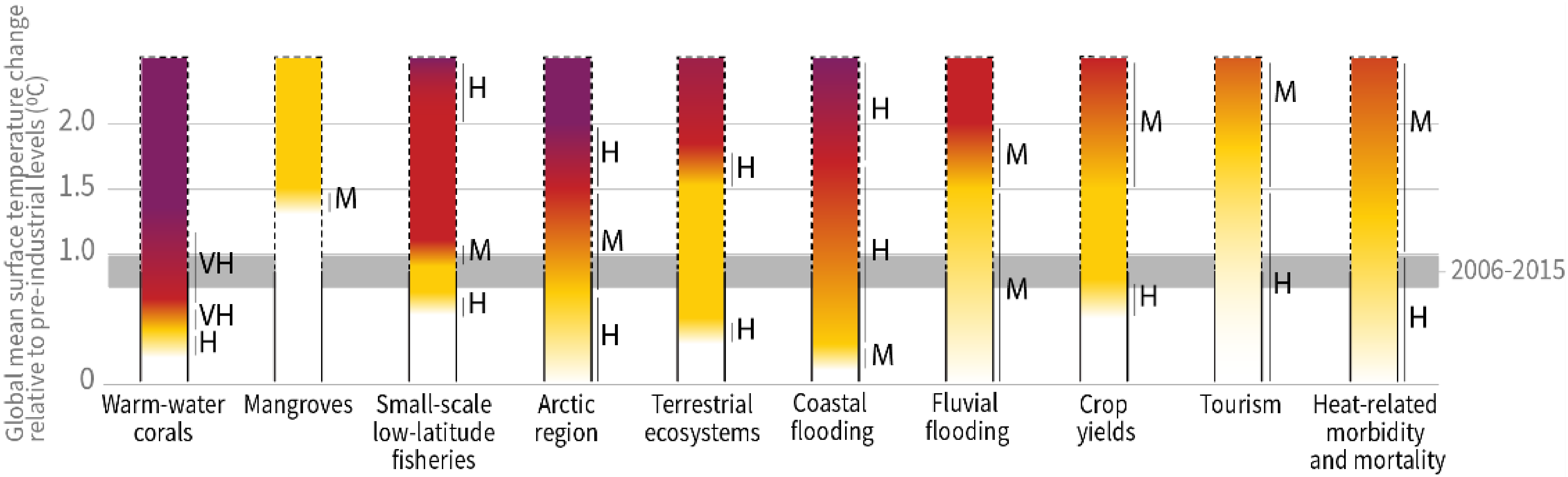
SPM2| How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Impacts and risks for selected natural, managed and human systems



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

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SPM2 | Example : Terrestrial ecosystems

By 2.5°C, **biome shifts** and species range losses escalate to very high levels – adaptation options are very limited (*irreversible*).

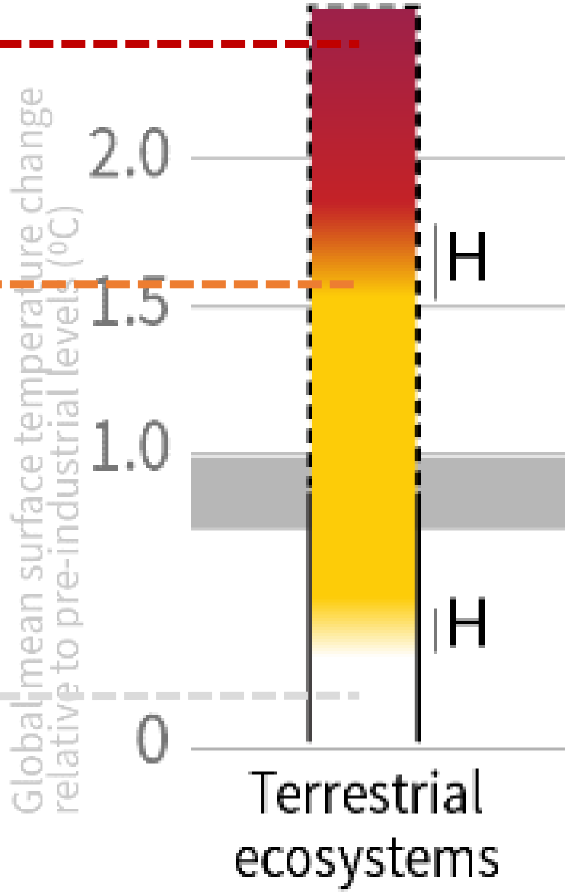
> 2.0°C (risk)

Key transition between 1.5°C to 2.0°C due to extensive shifts of biomes and a doubling or tripling of the number of plants, animals or insects losing over half of their climatically determined geographic ranges

+ 1.5 to 2.0°C (risk)

No detection and attribution of impacts of global warming on terrestrial ecosystems

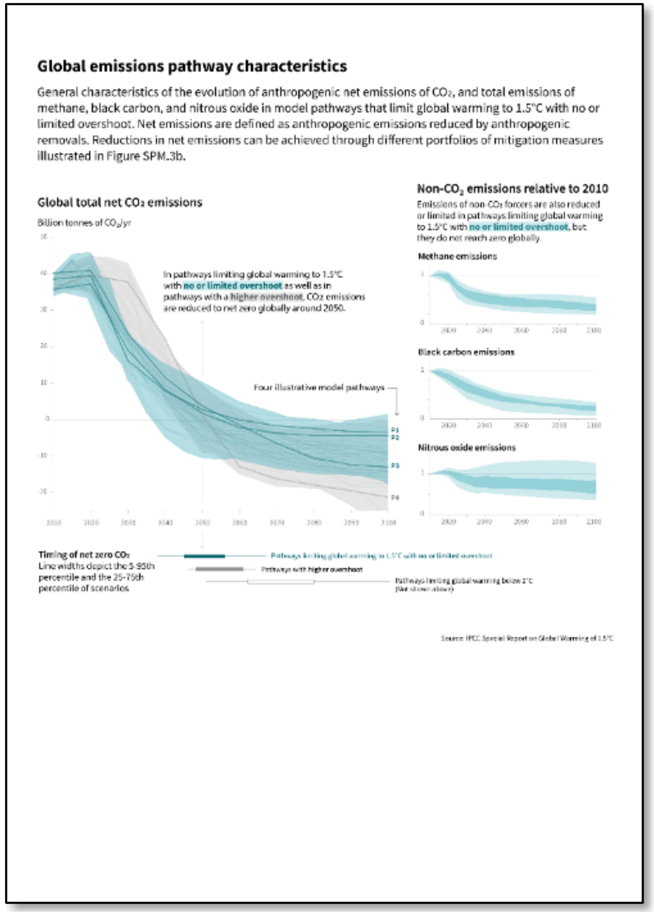
+ < 0.3°C (< 1975)



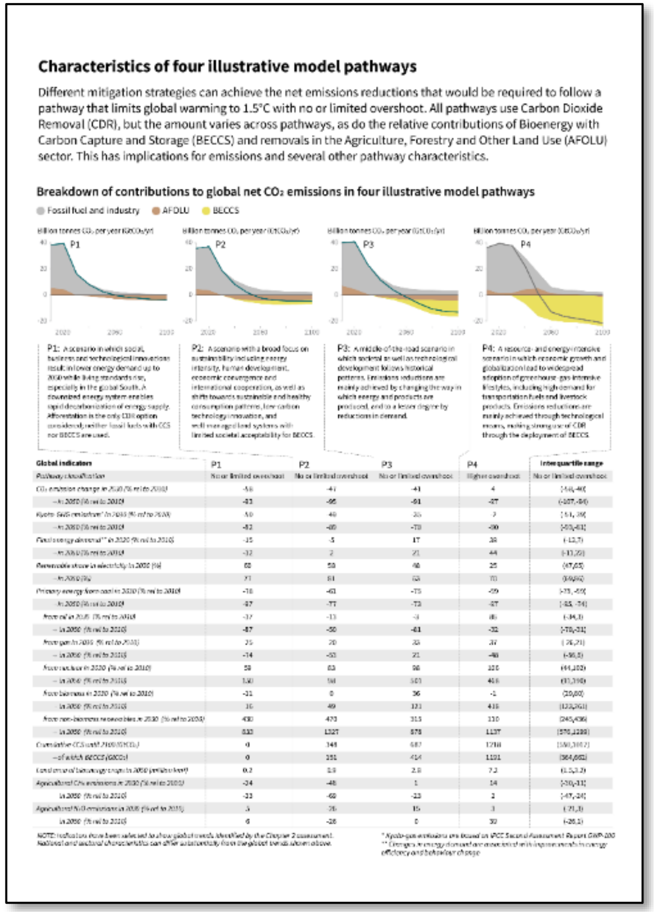
<u>Differences</u> become much larger between 1.5°C and 2.0°C

SPM3 | a) Global emissions pathway characteristics b) Characteristics of four illustrative model pathways

a)



b)



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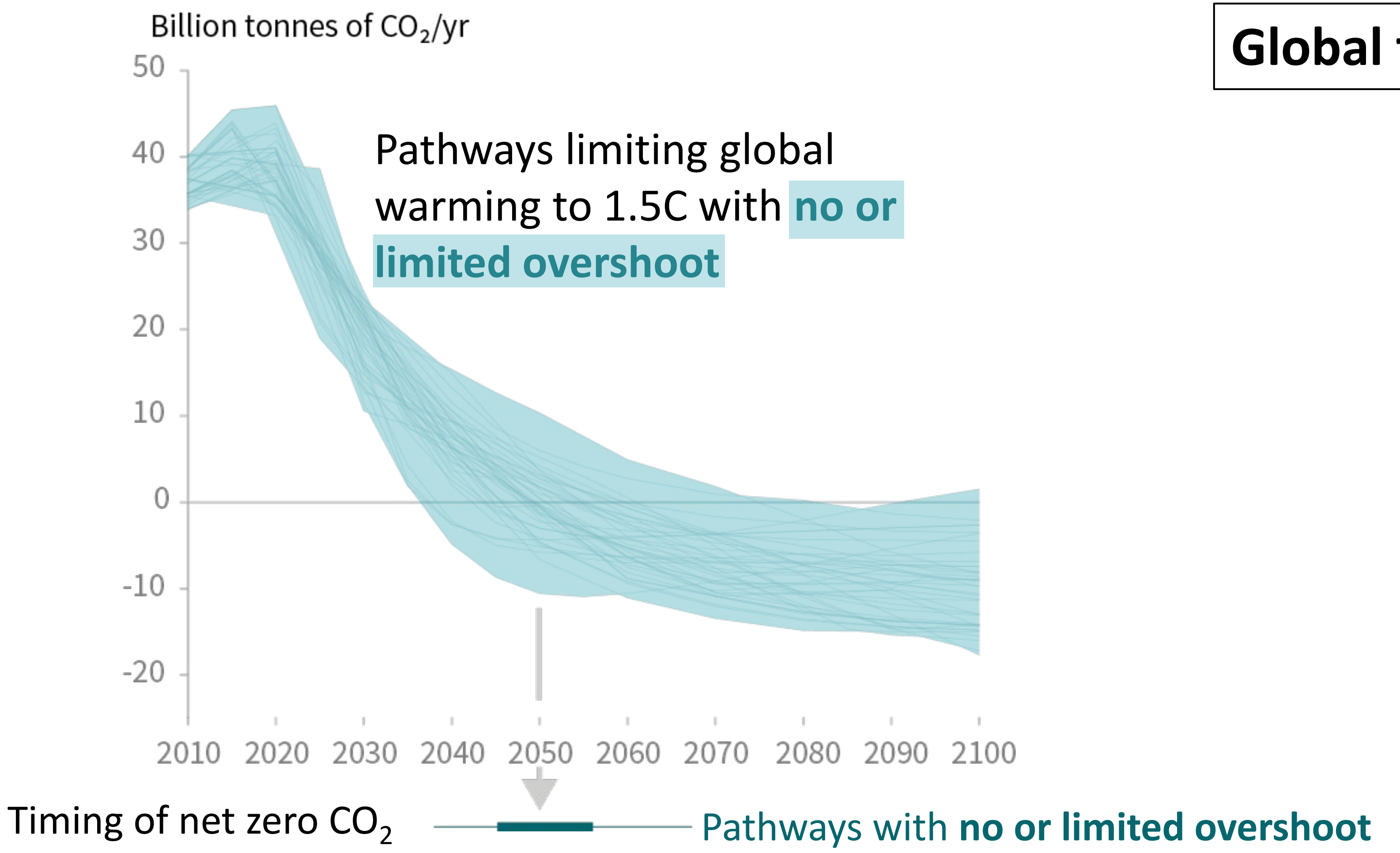
SPM3a | Global emissions pathway characteristics

Global total net CO_2 emissions



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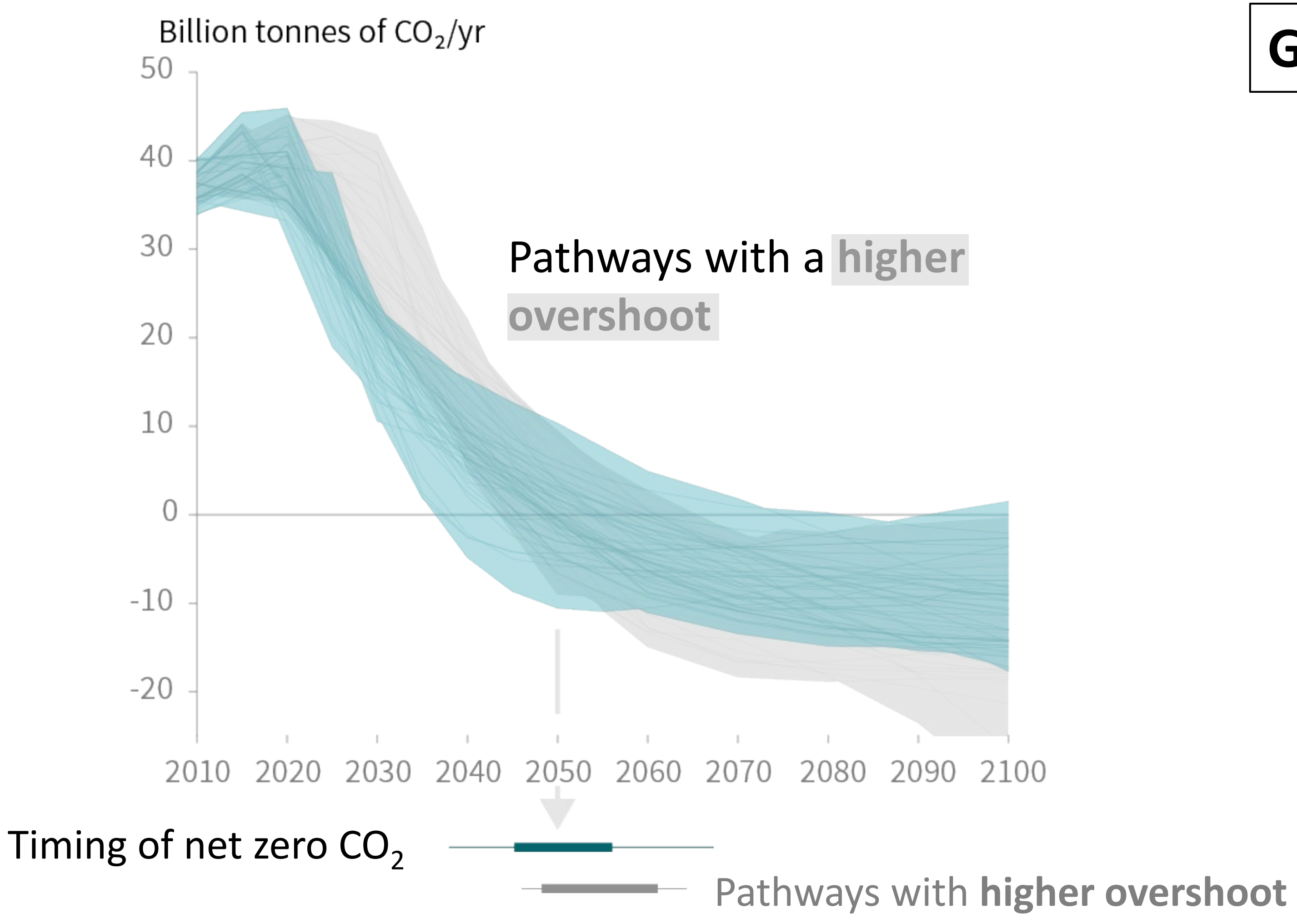
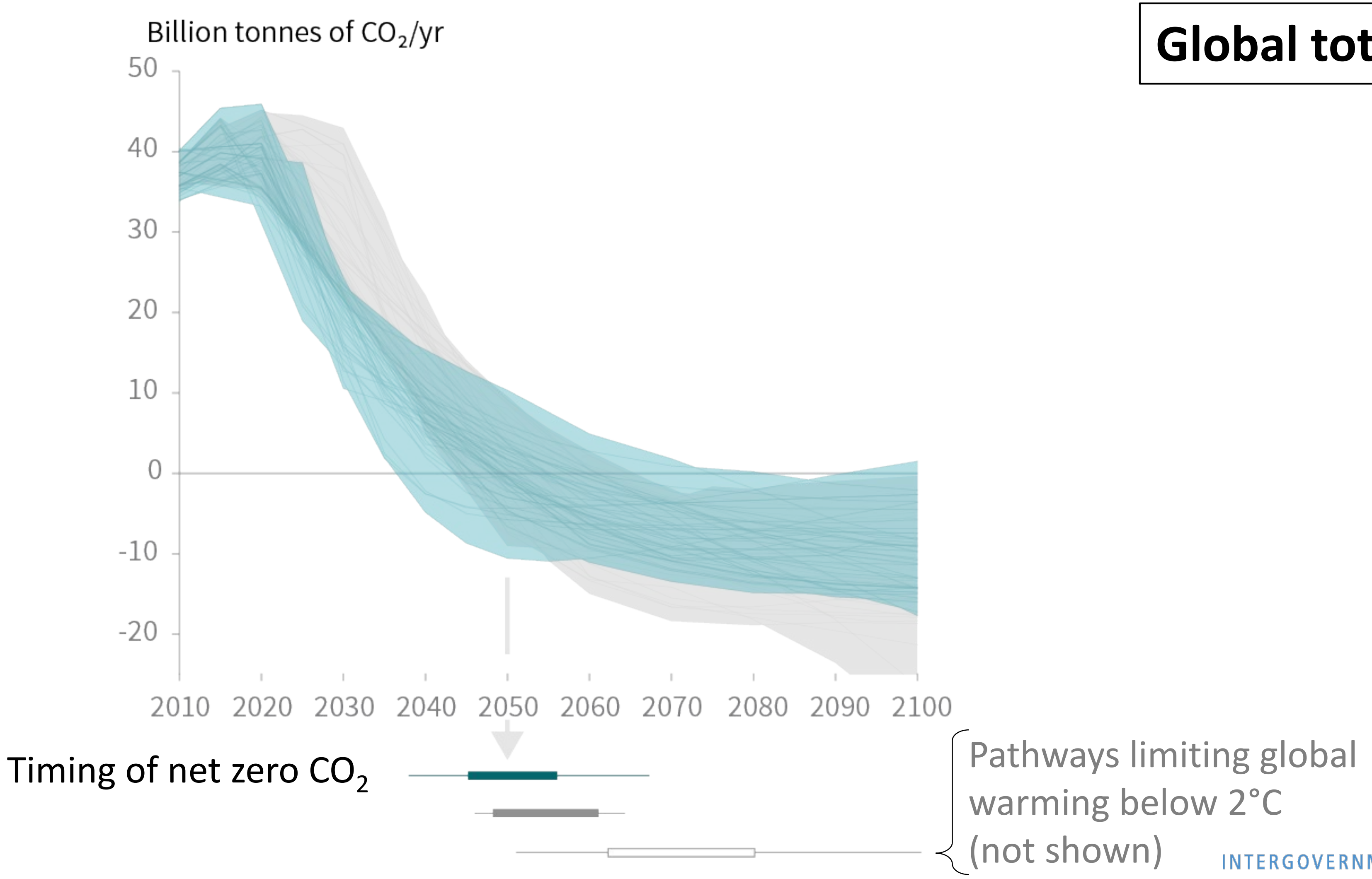
SPM3a | Global emissions pathway characteristics

Global total net CO_2 emissions

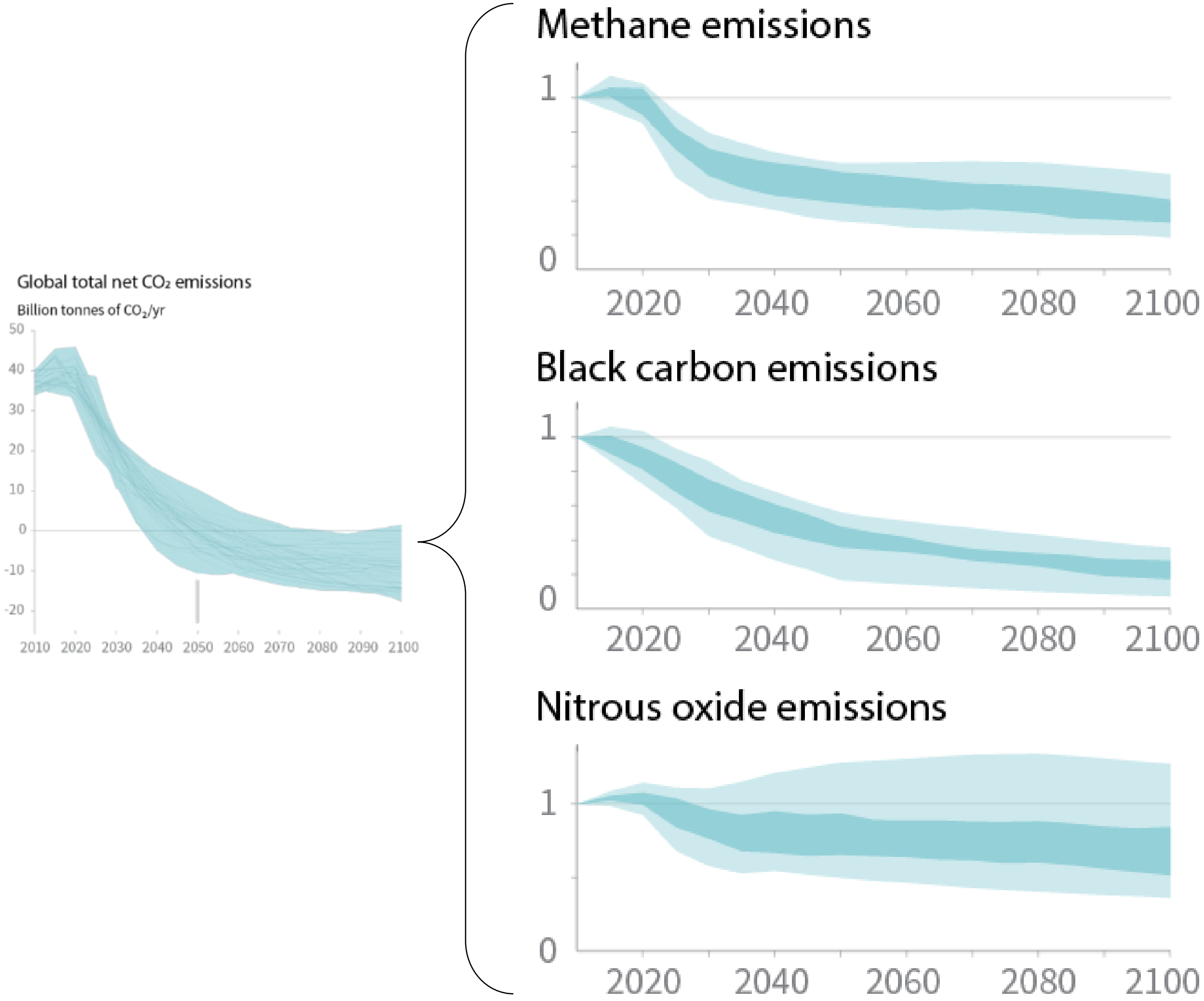


SPM3a | Global emissions pathway characteristics

Global total net CO_2 emissions



SPM3a | Global emissions pathway characteristics

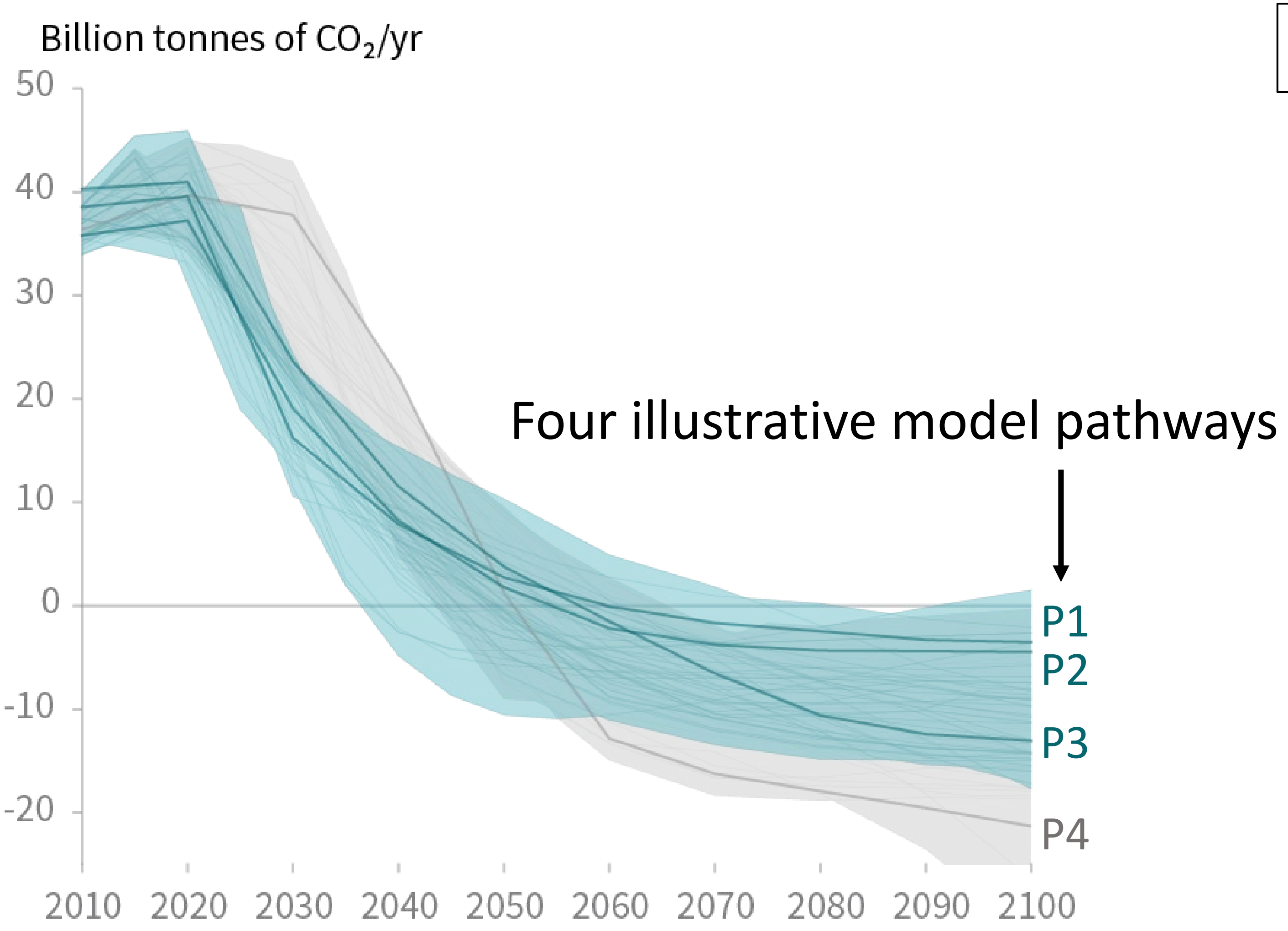


Non-CO_2 emissions relative to 2010

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.

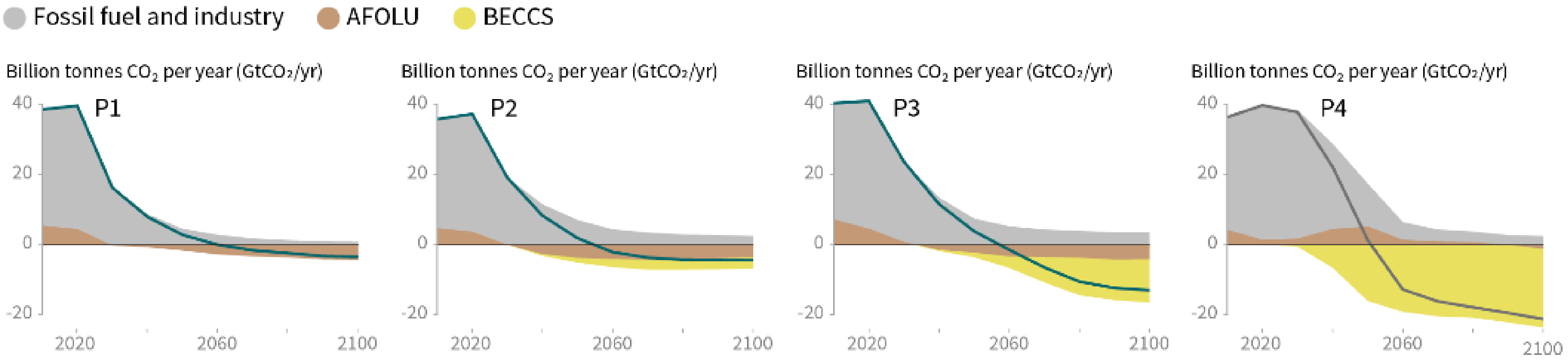
SPM3a | Global emissions pathway characteristics

Global total net CO_2 emissions



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.

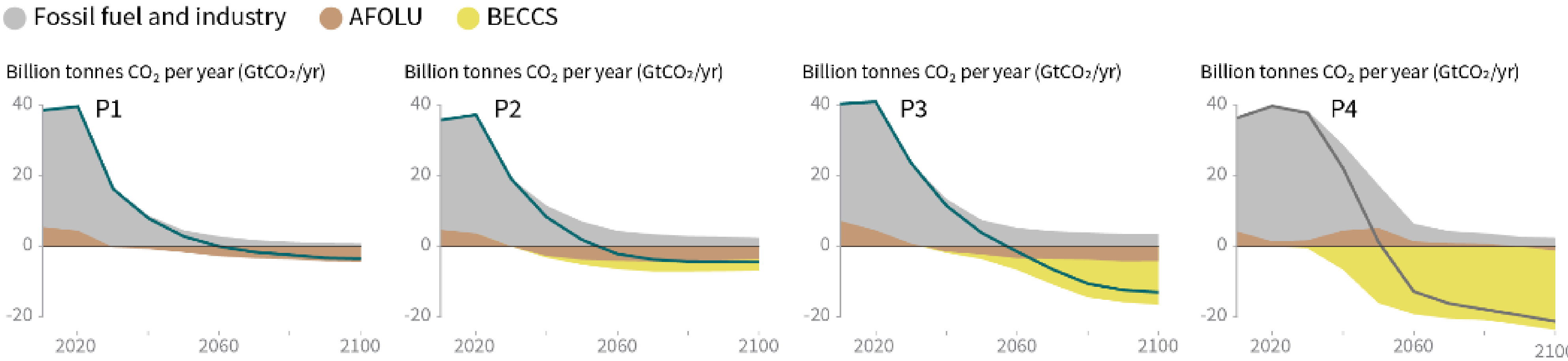
P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal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

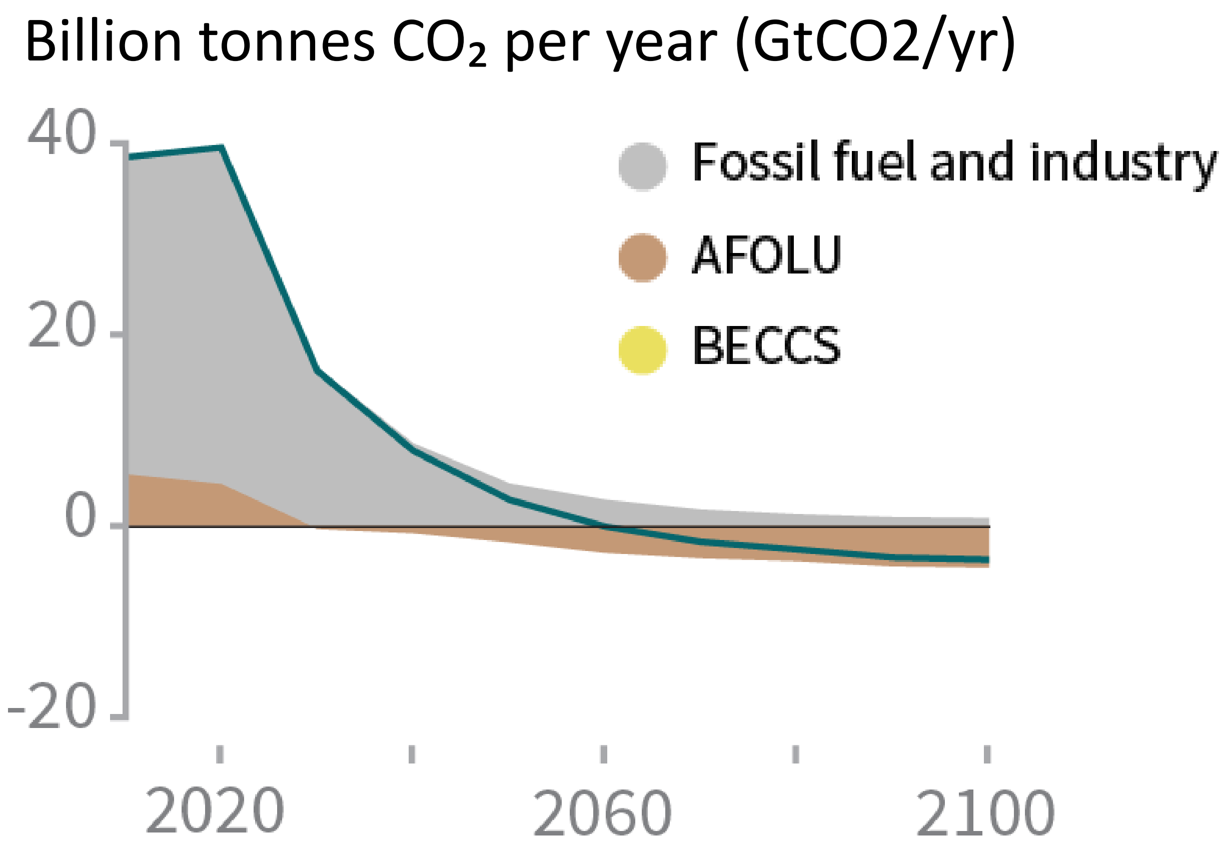
Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



Innovation and lower energy demand, with development	Innovation and sustainability focus	Middle of the road, historical patterns of development	Resource and energy intensive

SPM3b | Characteristics of four illustrative model pathways

P1



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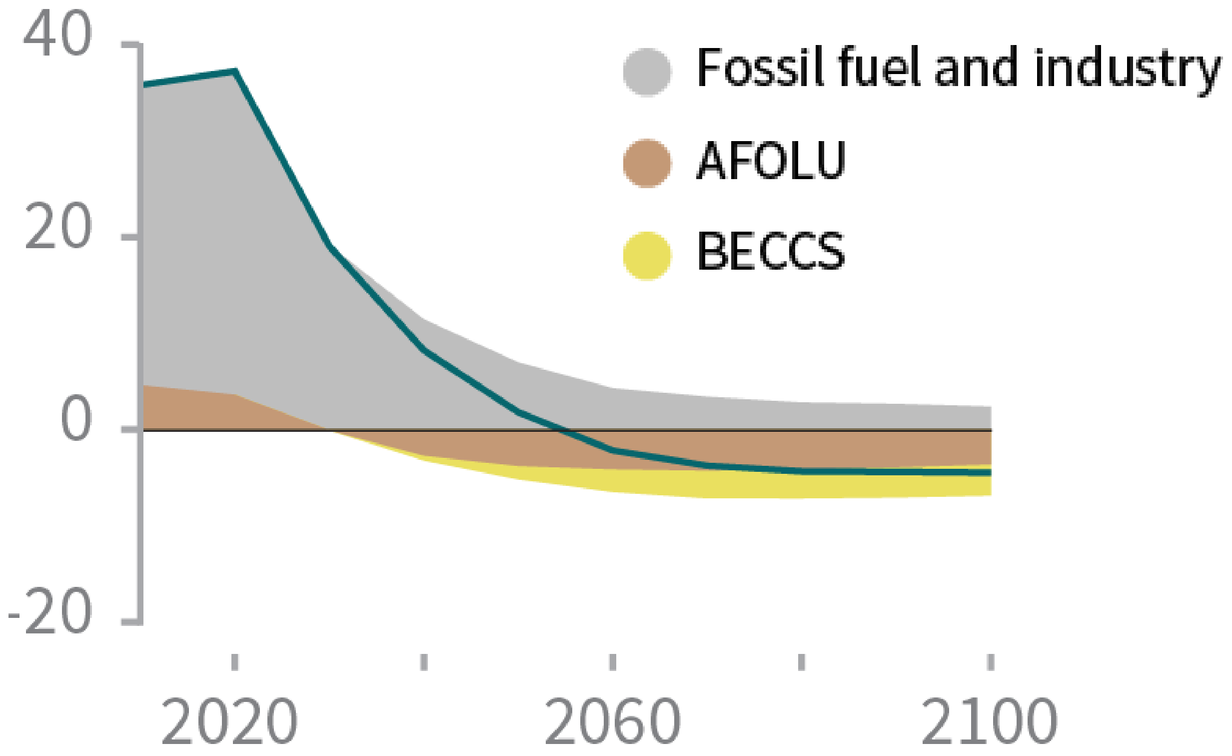
SPM3b| Characteristics of four illustrative model pathways

P2

Billion tonnes CO_2 per year (GtCO2/yr)

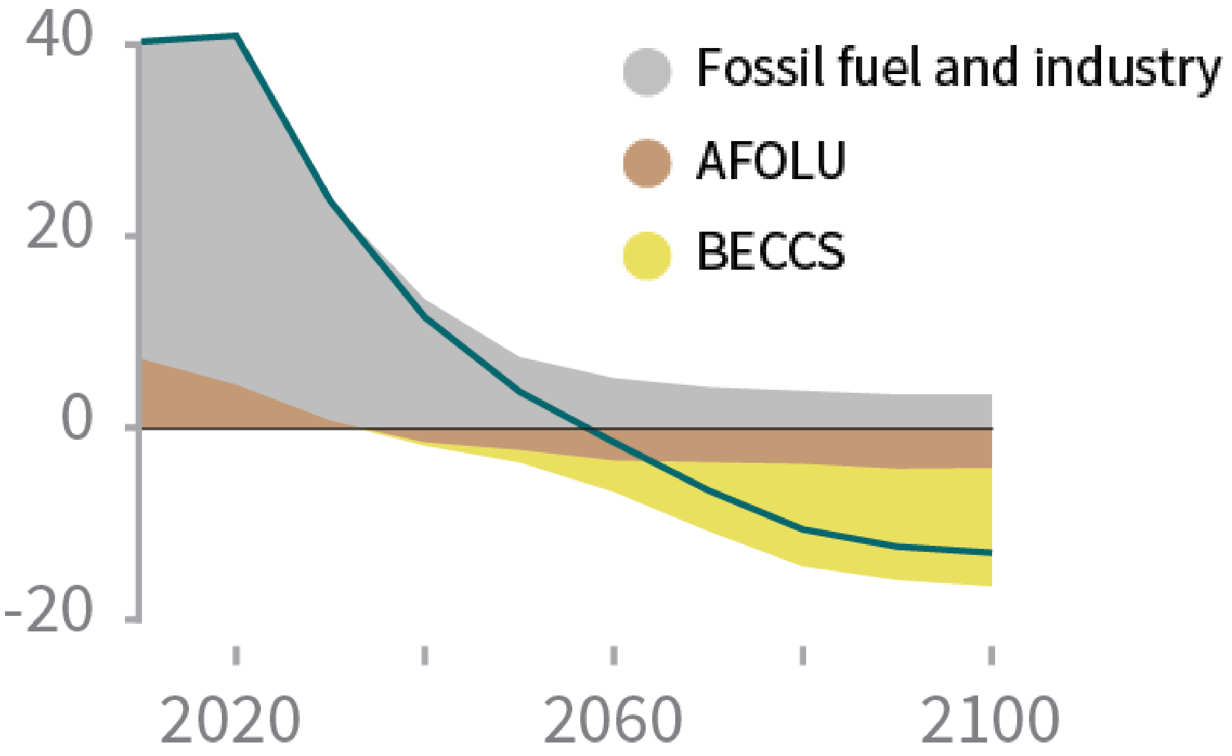


P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal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

SPM3b | Characteristics of four illustrative model pathways

P3

Billion tonnes CO_2 per year (GtCO2/yr)

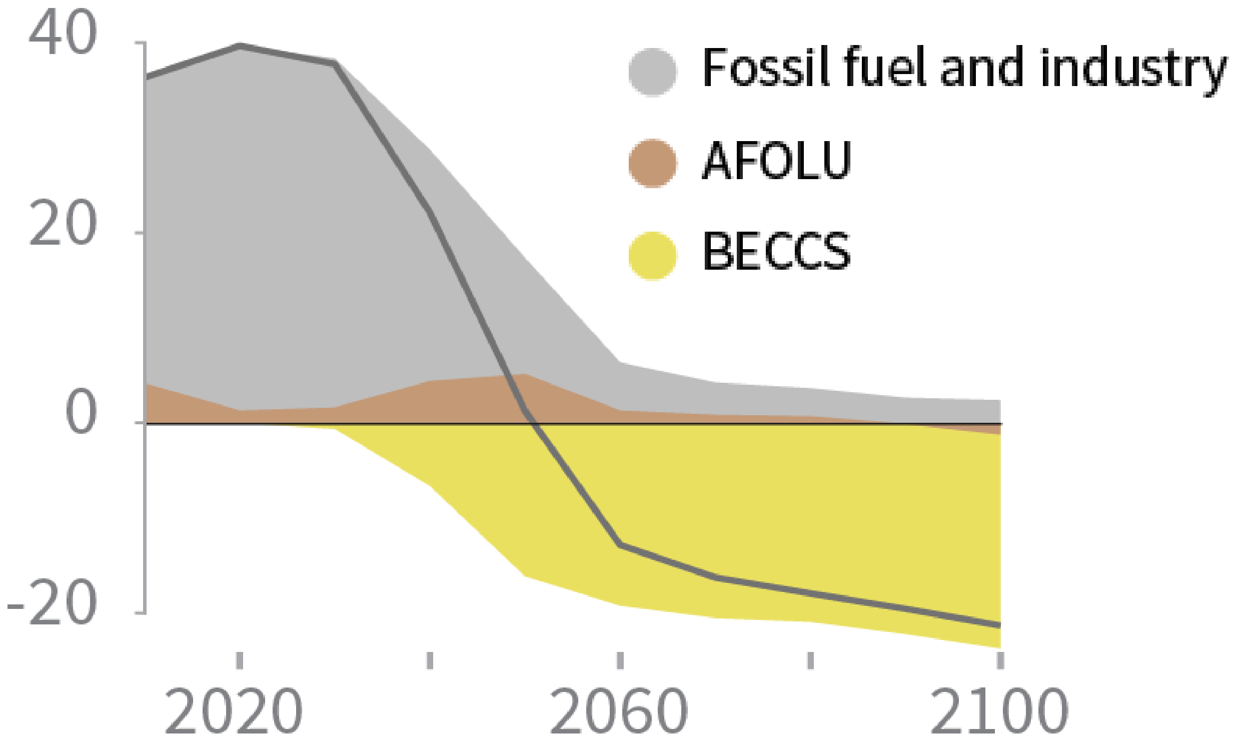


P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

SPM3b| Characteristics of four illustrative model pathways

P4

Billion tonnes CO_2 per year (GtCO2/yr)



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
Temperature and emissions	*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)
Energy systems	*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)
Carbon dioxide removal	*Cumulative CCS until 2100 ($GtCO_2$)*	0	348	687	1218	(550, 1017)
	↳ of which BECCS ($GtCO_2$)	0	151	414	1191	(364, 662)
Agriculture	*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)

SPM3b| Characteristics of four illustrative model pathways

Temperature and emissions

Global indicators	P1	P2	P3	P4	Interquartile range
	No or limited overshoot			Higher overshoot	No or limited overshoot
CO_2 emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-58,-40)
↳ in 2050 (% rel to 2010)	-93	-95	-91	-97	(-107,-94)
Kyoto-GHG emissions* in 2030 (% rel to 2010)	-50	-49	-35	-2	(-51,-39)
↳ in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)

SPM3b | Characteristics of four illustrative model pathways

Energy systems

Global indicators	P1	P2	P3	P4	Interquartile range
	No or limited overshoot		Higher overshoot	No or limited overshoot	
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	(69,86)
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)
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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	(245,436)
↳ in 2050 (% rel to 2010)	833	1327	878	1137	(576,1299)

SPM3b | Characteristics of four illustrative model pathways

Carbon dioxide removal

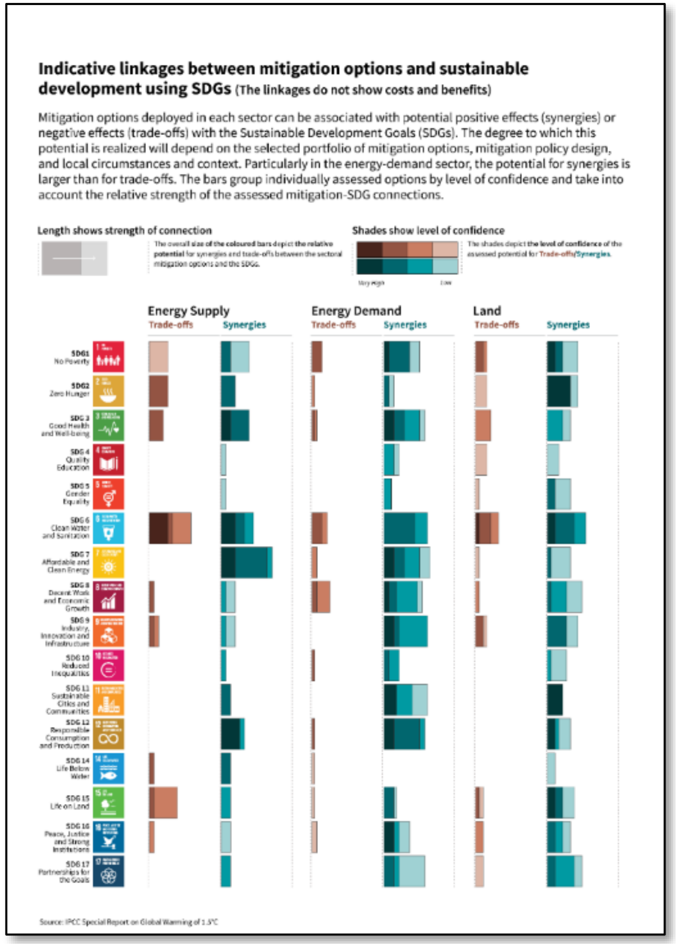
Global indicators	No or limited overshoot			Higher overshoot	No or limited overshoot
	P1	P2	P3	P4	Interquartile range
Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218	(550,1017)
↳ of which BECCS ($GtCO_2$)	0	151	414	1191	(364,662)

SPM3b | Characteristics of four illustrative model pathways

Agriculture

Global indicators	No or limited overshoot P1	 P2	 P3	Higher overshoot P4	No or limited overshoot Interquartile range
Land area of bioenergy crops in 2050 (million km²)	0.2	0.9	2.8	7.2	(1.5,3.2)
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
↳ in 2050 (% rel to 2010)	-33	-69	-23	2	(-47,-24)
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,3)
↳ in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

SPM4 | Indicative linkages between mitigation and sustainable development using SDGs



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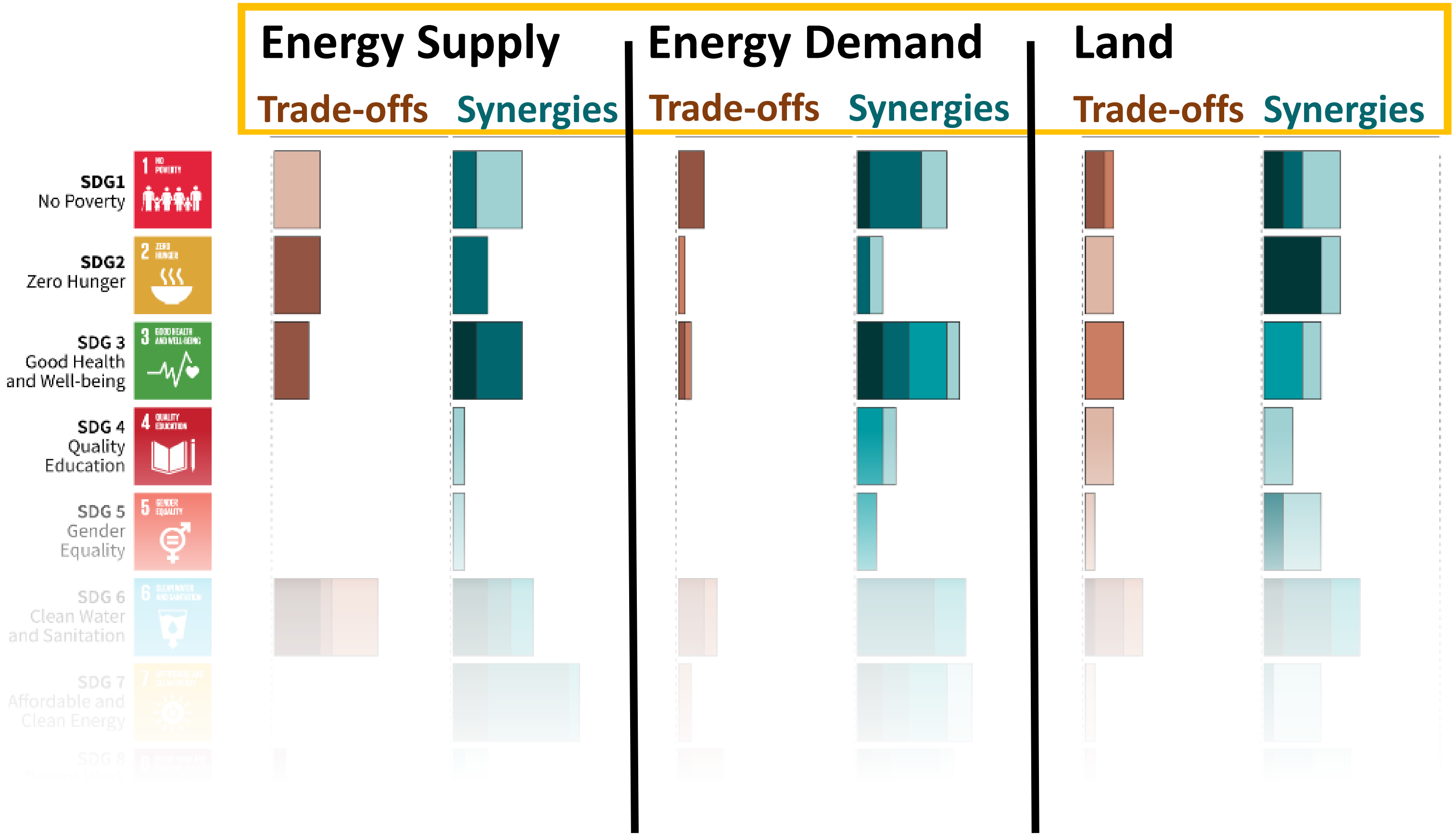
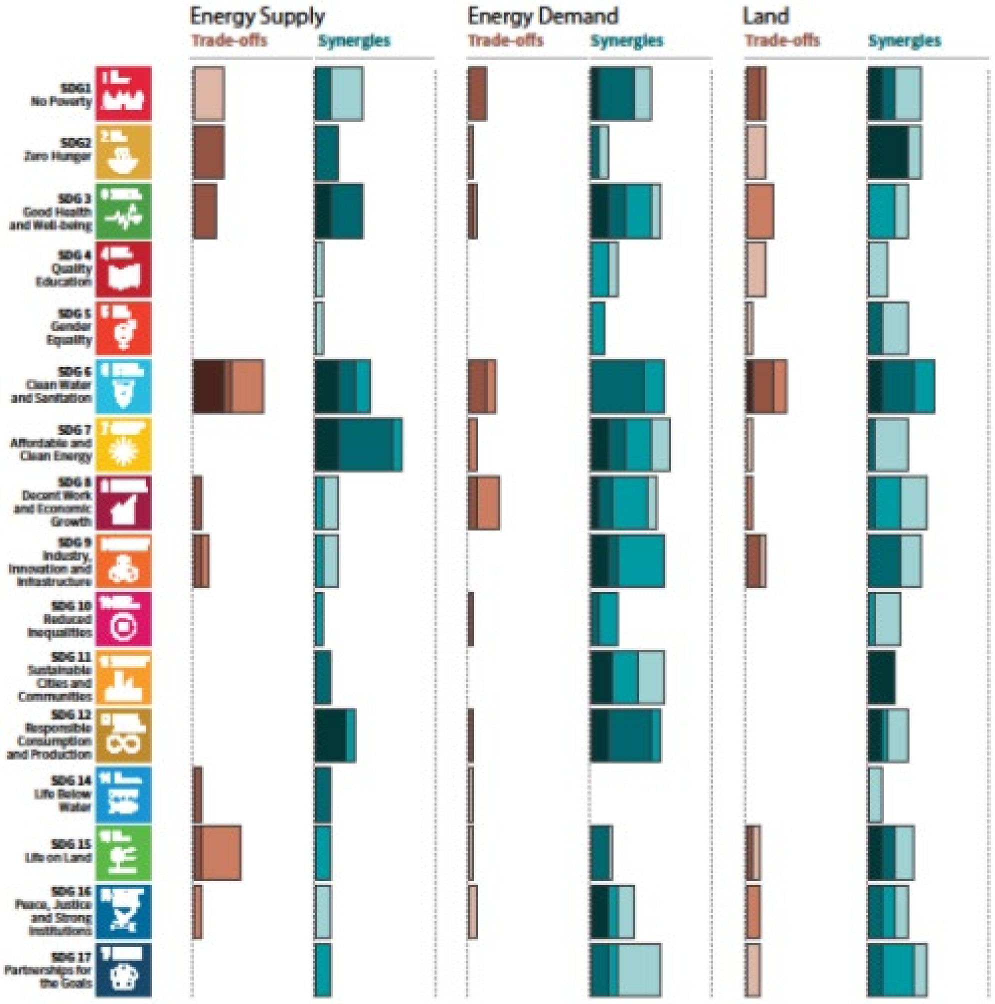
SPM4 | Indicative linkages between mitigation and sustainable development using SDGs



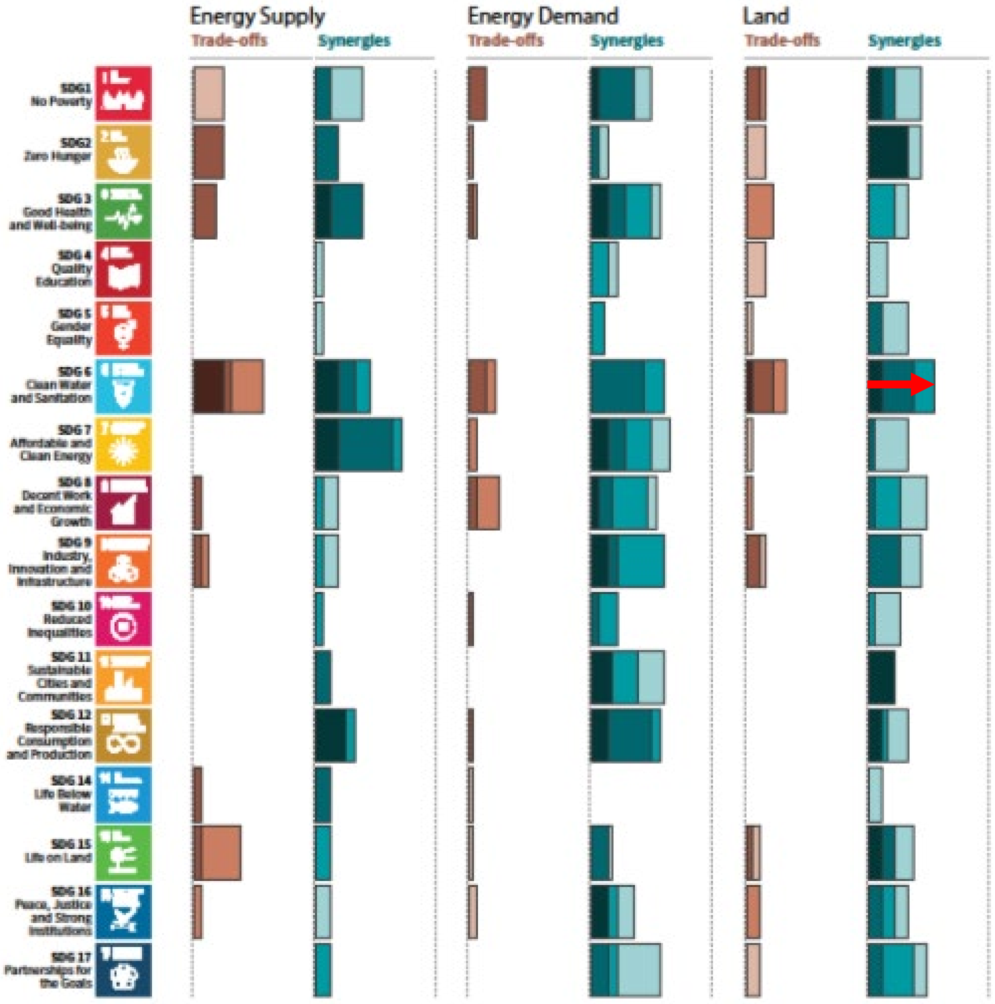
SPM4 | Indicative linkages between mitigation and sustainable development using SDGs



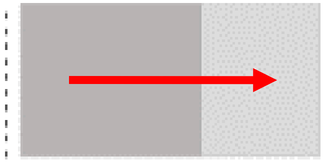
Length shows strength of connection

The overall **size of the coloured bars (from 0 to 100%)** depict **the relative potential** for synergies and trade-offs between the sectoral mitigation options and the SDGs.

SPM4 | Indicative linkages between mitigation and sustainable development using SDGs

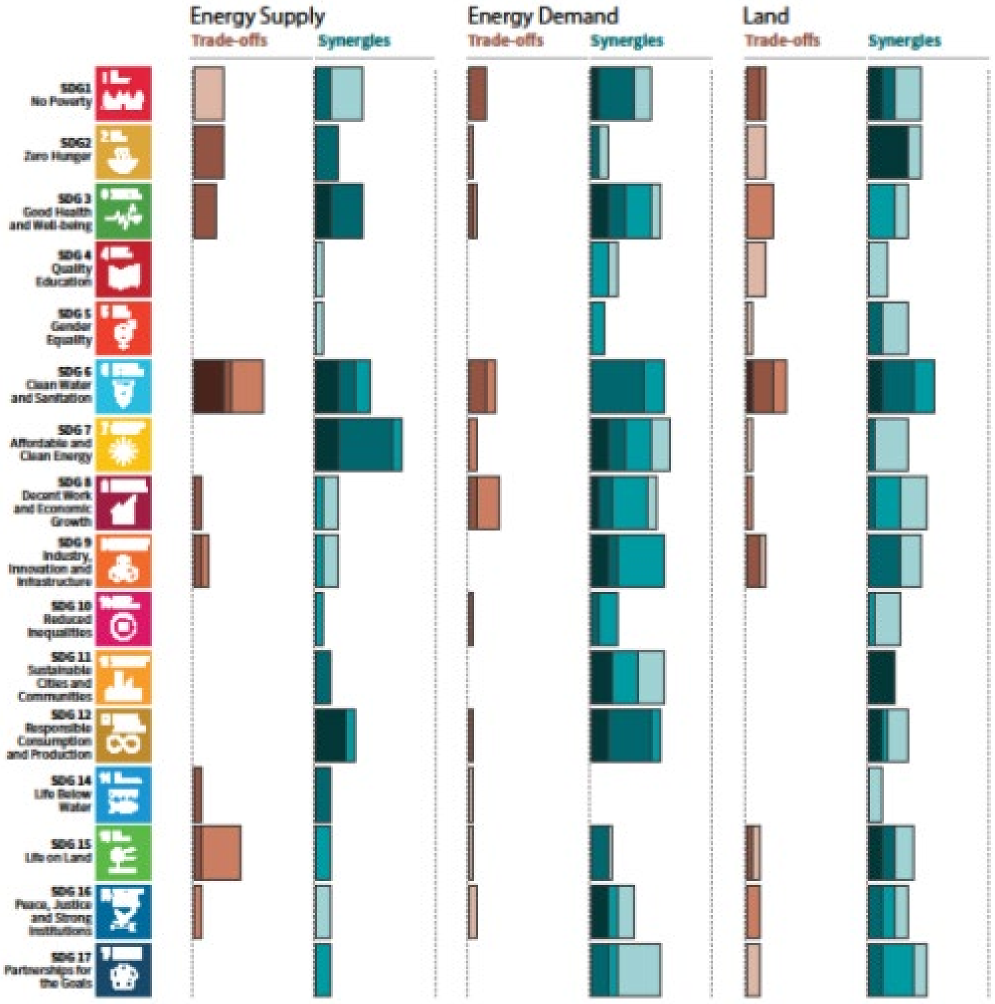


Length shows strength of connection



The overall **size of the coloured bars (from 0 to 100%)** depict **the relative potential** for synergies and trade-offs between the sectoral mitigation options and the SDGs.

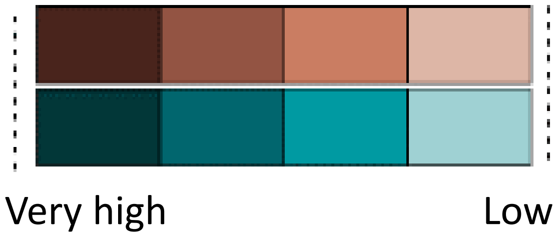
SPM4 | Indicative linkages between mitigation and sustainable development using SDGs



Length shows strength of connection

The overall **size of the coloured bars (from 0 to 100%)** depict **the relative potential** 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**

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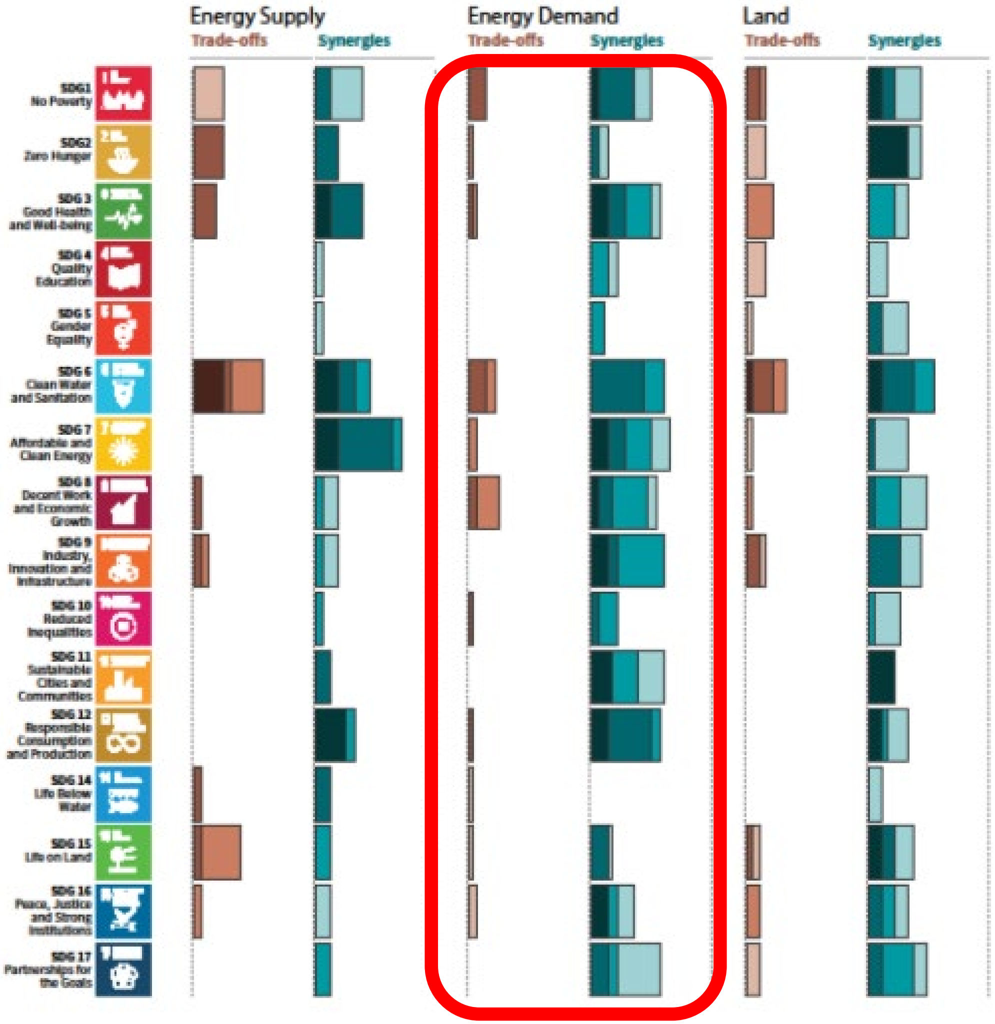
SPM4 | Indicative linkages between mitigation and sustainable development using SDGs



- Mitigation may result at the same time into synergies and trade-offs

- Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs.

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