CLIMATE ANALYTICS

From the smallest islands to the highest peaks – oceans, ice and climate change

26 September 2019

Dr Adelle Thomas, Dr Michiel Schaeffer

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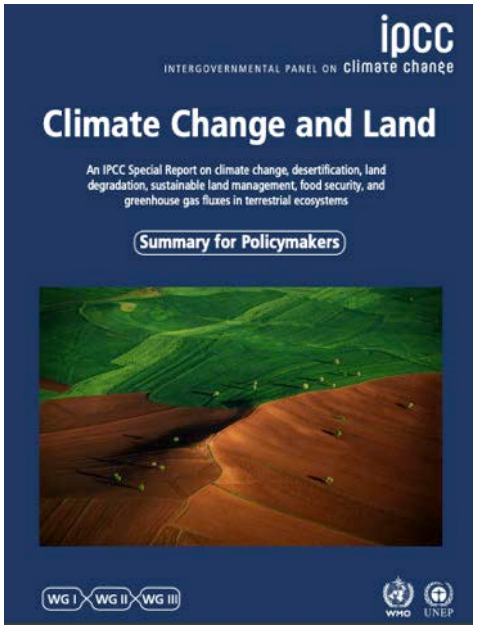
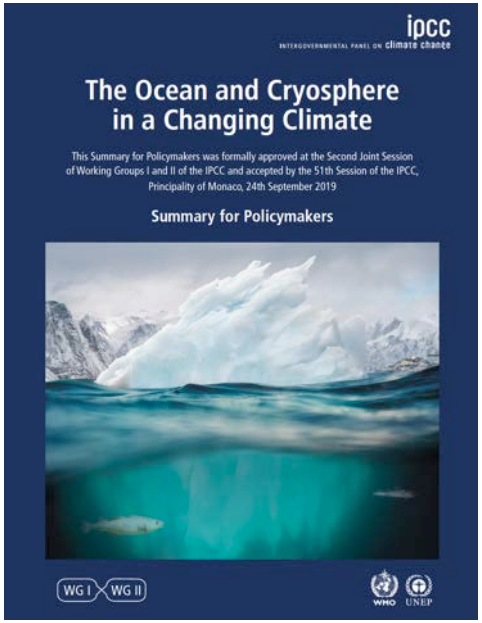
Key Findings from IPCC Special Report on Oceans and Cryosphere

Focus on SIDS and LDCs

Dr. Adelle Thomas
Senior Caribbean Research Associate
Climate Analytics

Last of Special Reports in AR6 Cycle





Scope of SROCC

Physical Science and Impacts

Vulnerabilities and Adaptation Capacities

Climate-resilient Development Pathways

Particularly relevant for LDCs..

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Nepal: July 2019
64 deaths
~80,000 ppl displaced

And SIDS…

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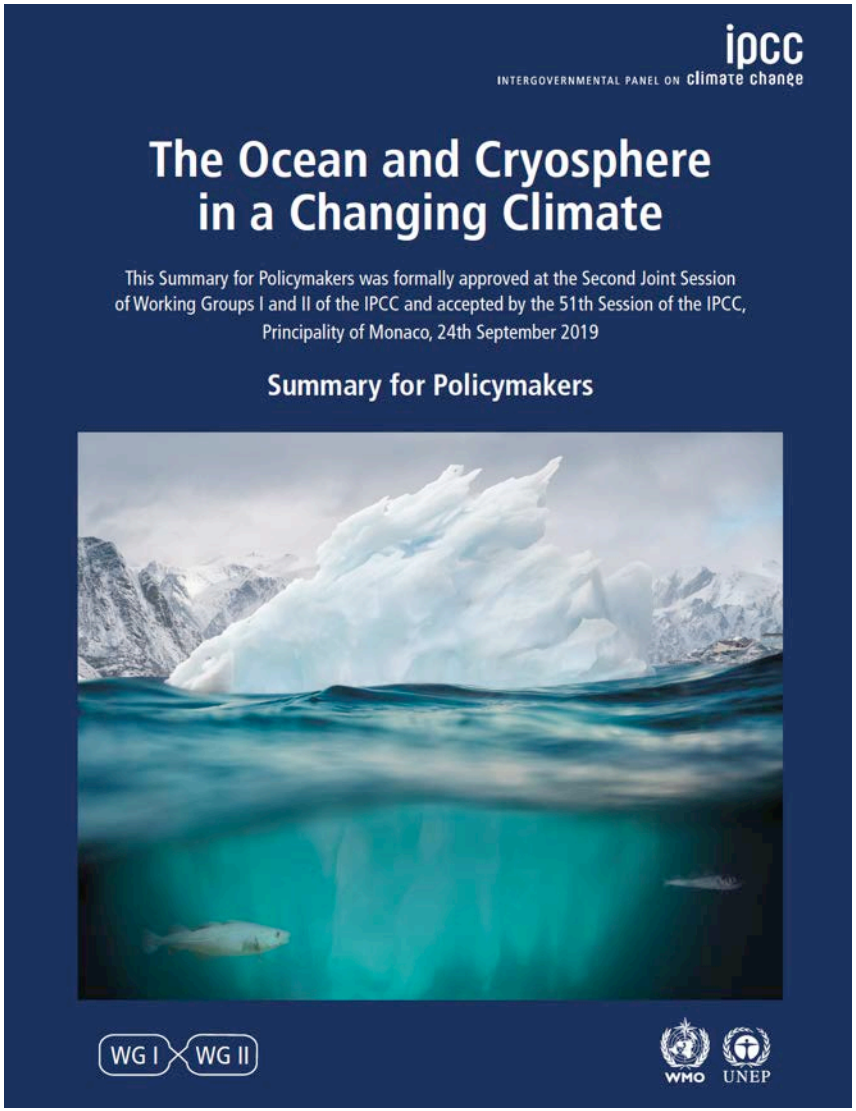
Bahamas: September 2019
>50 deaths
~80,000 ppl displaced

5 KEY MESSAGES FROM SUMMARY FOR POLICYMAKERS



1. Widespread shrinking of cryosphere

- Glaciers, snow, ice and permafrost are declining
- Stability of high-mountain slopes is decreasing
- September Arctic sea ice reductions are unprecedented for last >1000 years

Changes to the cryosphere are affecting ecosystems and communities

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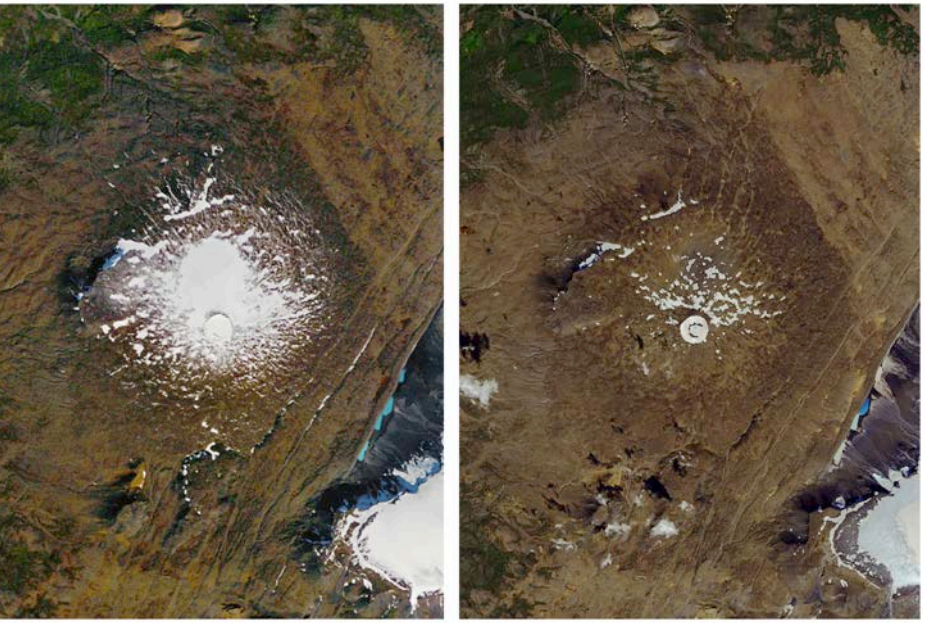
- Changes in the amount and seasonality of runoff and water resources
- Declines in agricultural yields
- Linked to disasters in High Mountains
- High Mountain aesthetic and cultural aspects have been negatively impacted
- Shifts in ranges of plants and animals

Major projected changes to the cryosphere still to come



- By 2100, glacier mass reductions of 18% - 36%; 10% reduction in basin runoff
- Smaller glaciers may lose more than 80% of their mass by 2100, many projected to disappear
- Floods, landslides and snow avalanches to occur in new locations or different seasons
- Reduced livelihood options

2. Oceans are warming rapidly

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- Rate of ocean warming has more than doubled since 1993
- Ocean has absorbed > 90% of the heat added to the climate system
- Marine heatwaves have doubled in frequency, become longer-lasting, more intense and more extensive
- Oceans have become more acidic, absorbing 20-30% of total CO_2 emissions

Changes to oceans have extensive impacts now

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- Marine species shifting towards the poles, challenging fisheries governance
- ~50% of vegetated coastal ecosystems lost over past 100 years
- Large-scale coral bleaching events occurring with increased frequency since 1997, with slow recovery
- Increased range and frequency of harmful algal blooms

Changes to oceans projected to increase

- Unprecedented changes to temperature, acidification, oxygen
- Decline in fisheries catch potential
- More frequent and intense marine heatwaves and El Nino and La Nina events
- Near complete loss of warm-water coral reefs, even at 1.5C
- Seafood safety compromised

3. Sea level rise is accelerating

- Rate of sea level rise is unprecedented over last century and is accelerating
- Already seeing changes in Antarctica which may lead to irreversible ice sheet instability
- Extreme sea level events, coastal erosion and flooding have increased

Sea levels will continue to rise at an increasing rate

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- Extreme sea level events will occur more frequently
- SIDS are projected to experience historical centennial events at least annually by 2050
- Increased risk of erosion, land loss, flooding, salinization, cascading impacts
- Sea levels will continue to rise for centuries even after emissions have stopped
- Some island nations may become uninhabitable

4. Tropical cyclones are becoming more intense

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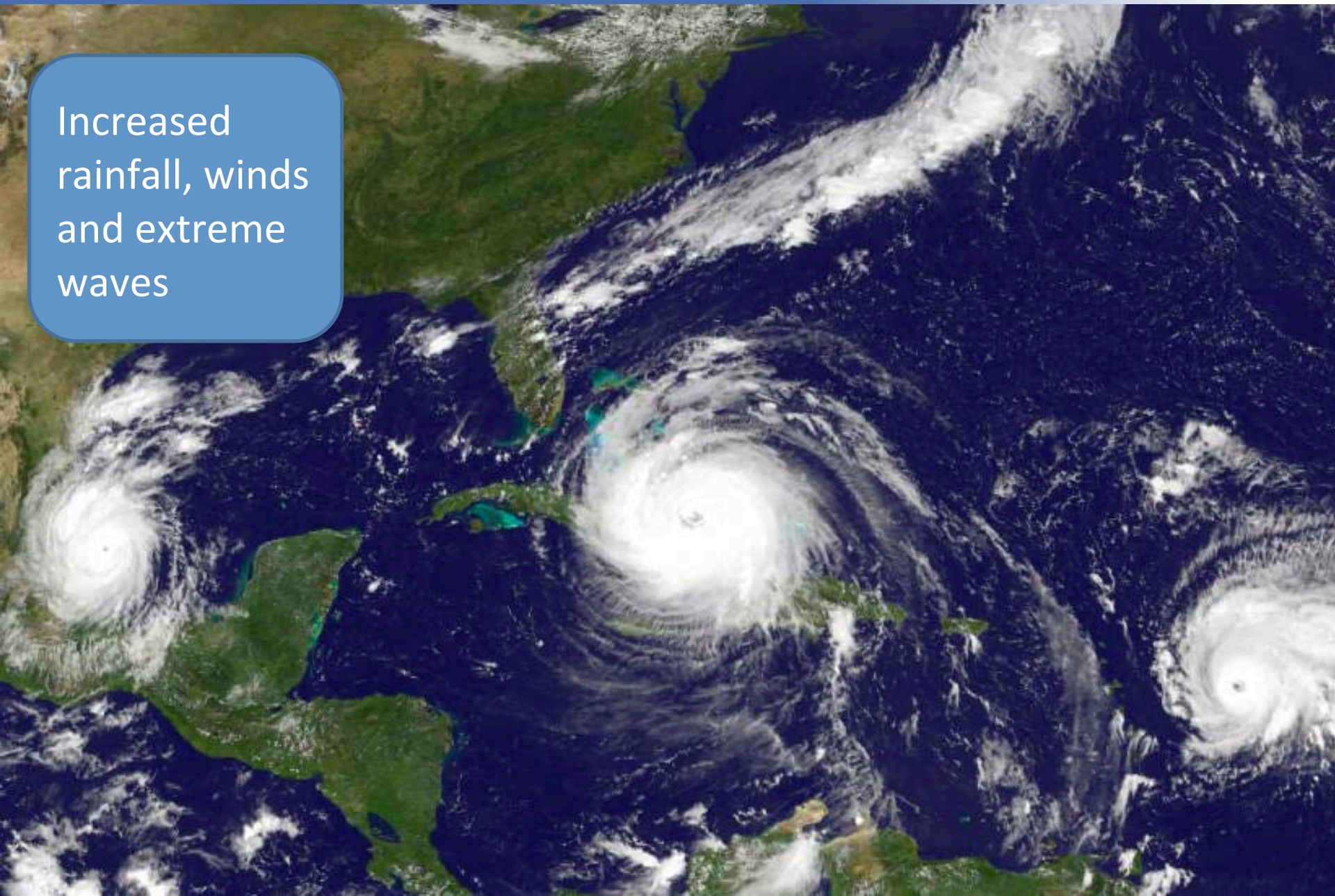

Increased rainfall, winds and extreme waves

Projected increase in intensity of tropical cyclones

- Intensity, proportion of Category 4 and 5 cyclones and average precipitation rates are projected to increase at 2°C
- Rising sea levels will contribute to higher storm surges

5. Adaptation can only temporarily address climate change risks

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- Adaptation is essential to reduce risks, but is a governance challenge
- Ecosystem based adaptation has limits, even at 1.5ºC
- Barriers to adaptation can reduce effectiveness or lead to limits
- Even with major adaptation efforts, residual risks and associated losses are projected to occur

Choices made now are critical for the future of our ocean and cryosphere

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- SROCC underscores the message of great urgency needed to address climate change
- Changes to the ocean and cryosphere are already happening, with significant impacts for LDCs and SIDS
- While LDCs and SIDS may be on the frontline of climate change, the impacts of climate change will be significant for everyone if we stay on the current emissions trajectory

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Oceans, ice & NDCs

What does the special report on oceans and ice mean for mitigation?

Dr Michiel Schaeffer

Paris Agreement and IPCC Special Report on the Ocean and Cryosphere in a Changing Climate

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- SROCC does not speak much directly to 1.5°C, but substantial part of underlying literature does
- Content of presentation:
  - Adding to previous presentation by drawing from the literature to make the connection between SROCC messages and Paris Agreement
  - Step through key mitigation efforts and enhancing NDCs

SROCC SPM.1: Observed & modelled historical changes in the ocean and cryosphere since 1950 and projections under low and high emissions scenarios

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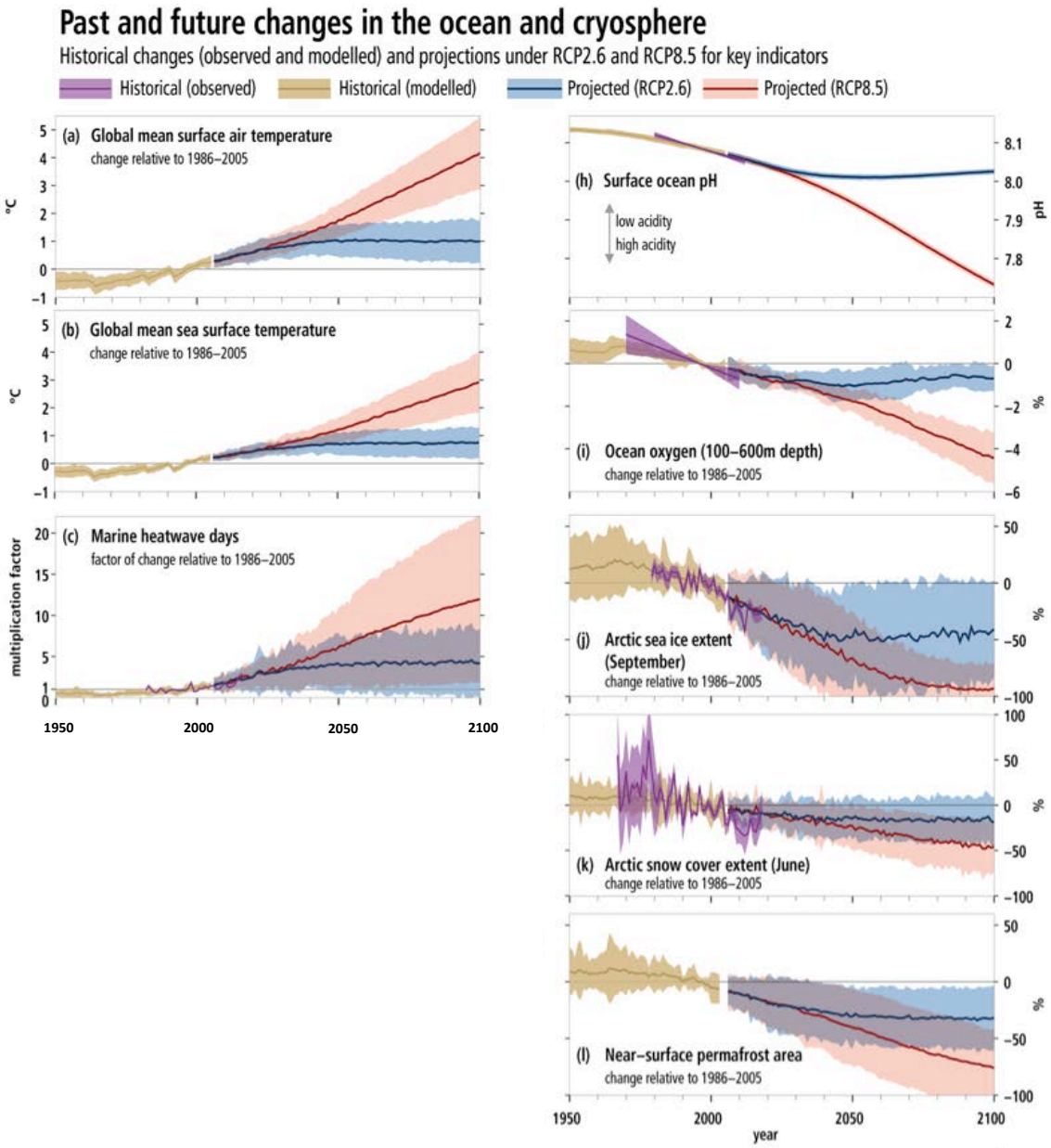

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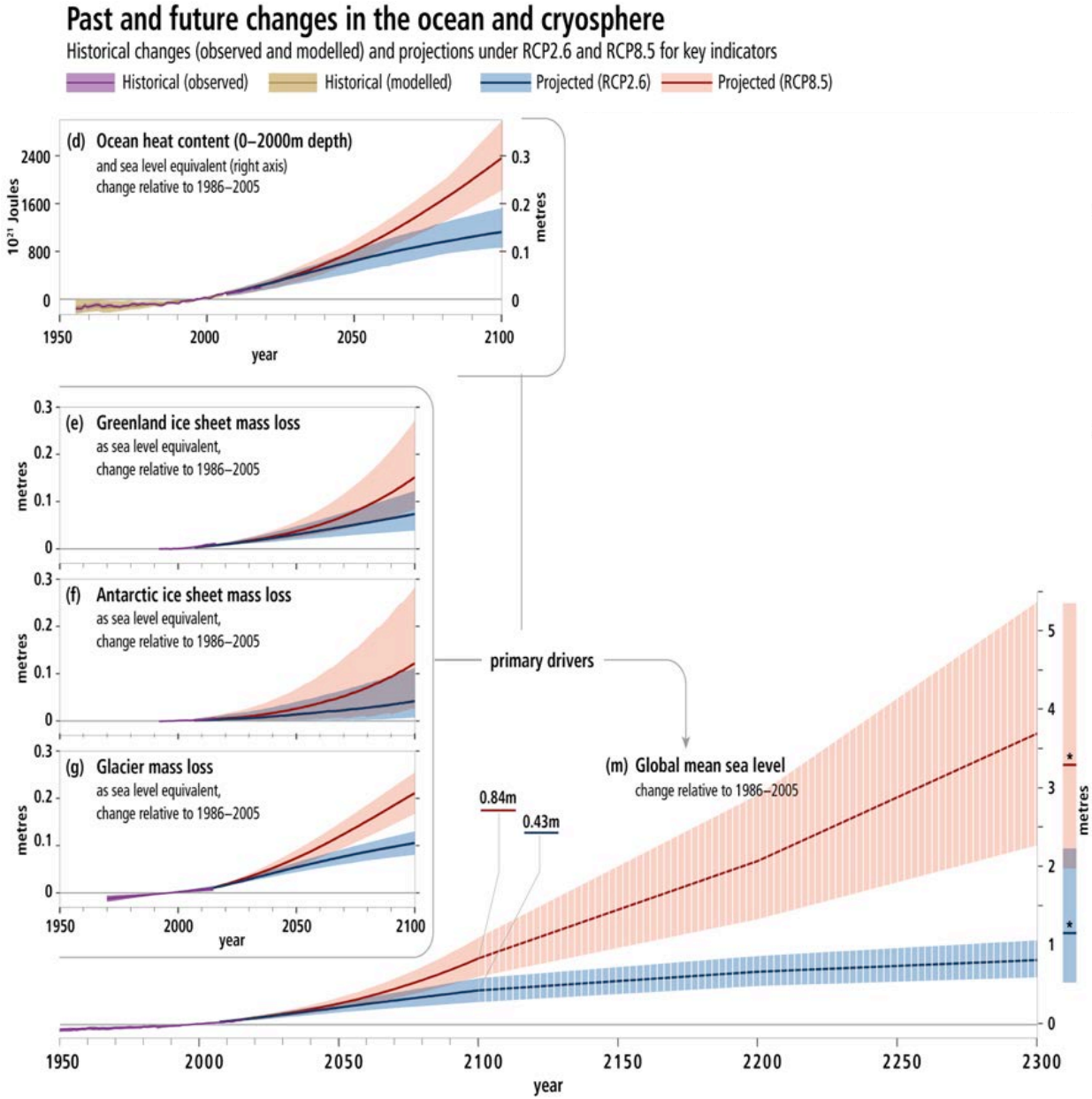

Link to mitigation challenge: permafrost thawing

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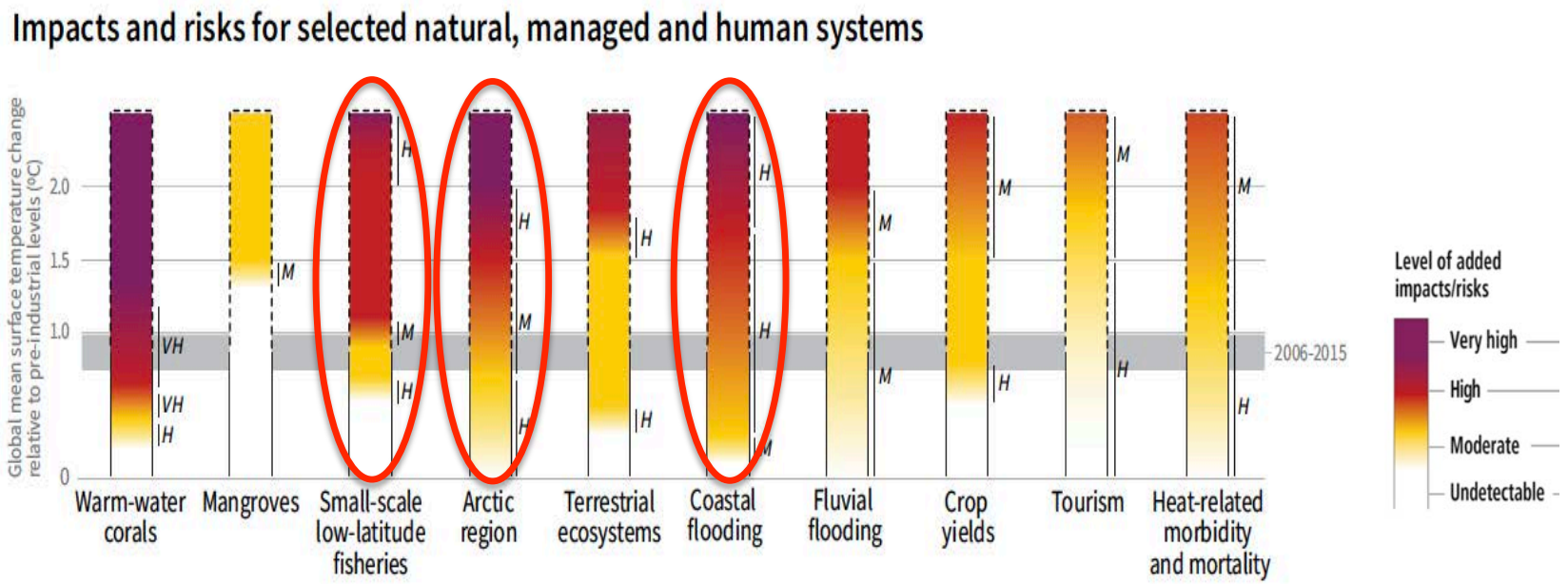
B1.4 Widespread permafrost thaw is projected for this century (*very high confidence*) and beyond. By 2100, projected near-surface (within 3–4 m) permafrost area shows a decrease of 24 +/-16% (likely range) for RCP2.6 and 69 +/-20% (likely range) for RCP8.5. **The RCP8.5 scenario leads to the cumulative release of tens to hundreds of billions of tons (GtC) of permafrost carbon as CO_2[26] and methane to the atmosphere by 2100 with the potential to exacerbate climate change (*medium confidence*).** Lower emissions scenarios dampen the response of carbon emissions from the permafrost region (*high confidence*). Methane contributes a small fraction of the total additional carbon release but is significant because of its higher warming potential. Increased plant growth is projected to replenish soil carbon in part, but will not match carbon releases over the long term (*medium confidence*)…

FOOTNOTE 26: For context, total annual anthropogenic CO_2 emissions were 10.8 +/- 0.8 GtC yr^{-1} (39.6 +/- 2.9 $GtCO_2$ yr^{-1}) on average over the period 2008–2017. Total annual anthropogenic methane emissions were 0.35 +/- 0.01 $GtCH_4$ yr^{-1}, on average over the period 2003–2012…

Why does 1.5°C matter?
"Reasons for concern" diagrams



SR1.5 Figure SPM.2

SR1.5

- Focused on 1.5 vs 2°C

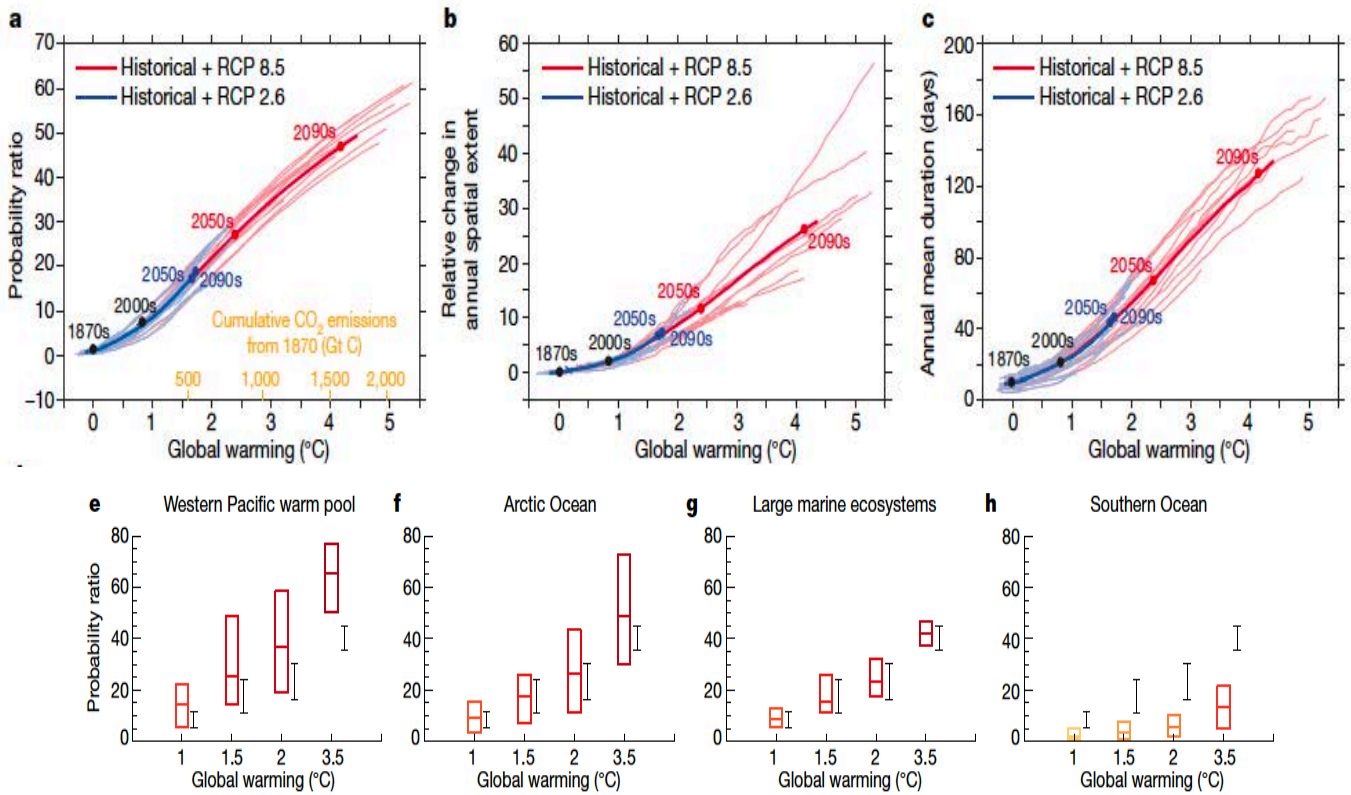
SROCC SPM

- Does not speak much on 1.5°C specifically
- Extends RFCs range upward to 3-4°C (current policies & NDCs)
- Risk diagram covers ecosystems, does not include fisheries, Arctic region and coastal flooding for which SR1.5 shows medium-high risk at 1.5°C

Why does 1.5°C matter?
Marine heatwaves (frequency, extent, duration)

	1.5C	2C	3.5C
Marine heatwaves			
Increase in global marine heatwave days per year	x16	x23	x41

Carbon Brief 2018



Frölicher et al. 2018

Why does 1.5°C matter?
Survival chances for tropical coral reefs

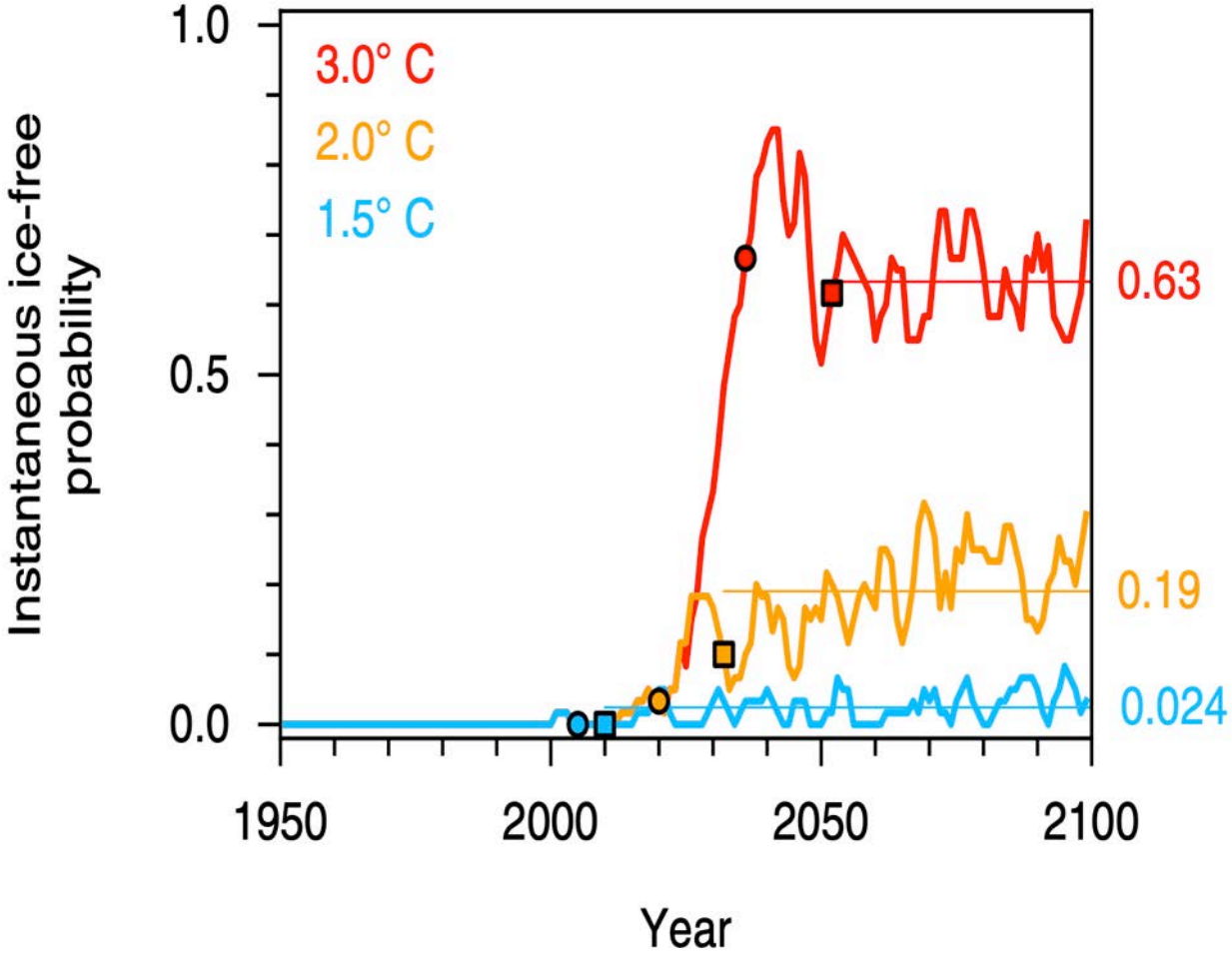
	1.5°C	2°C
CORAL REEF DEGRADATION	~70%	~99%

Virtually all coral reefs at risk of annual bleaching at 2°C of warming

- Negative impacts reef fish and other resources
- Negative impacts on tourism industry

Source: Schleussner et al., 2016b, King et al., 2017

Why does 1.5°C matter?
Arctic Sea Ice: probability of ice-free Arctic summer (September)



→ Once every 1.5 years

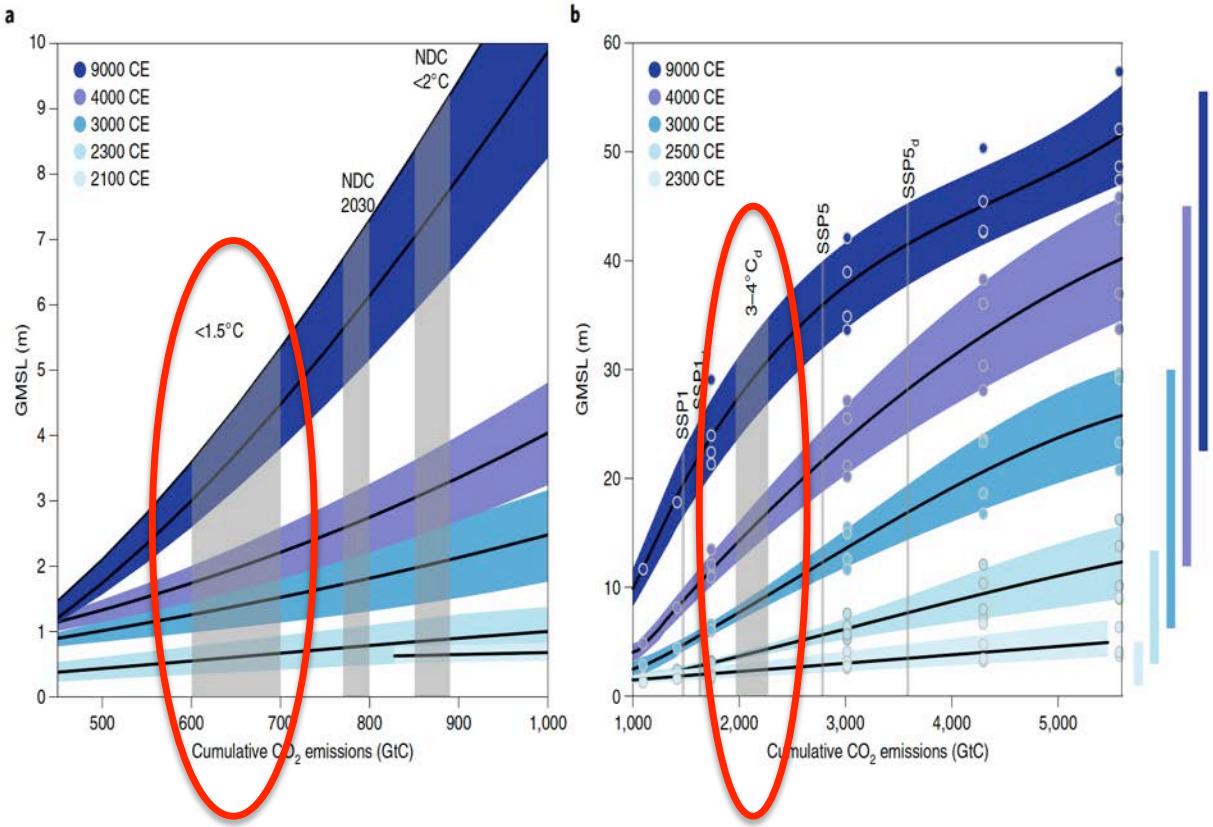
→ Once every 5 years

→ Once every 40 years

Sigmond et al. 2018

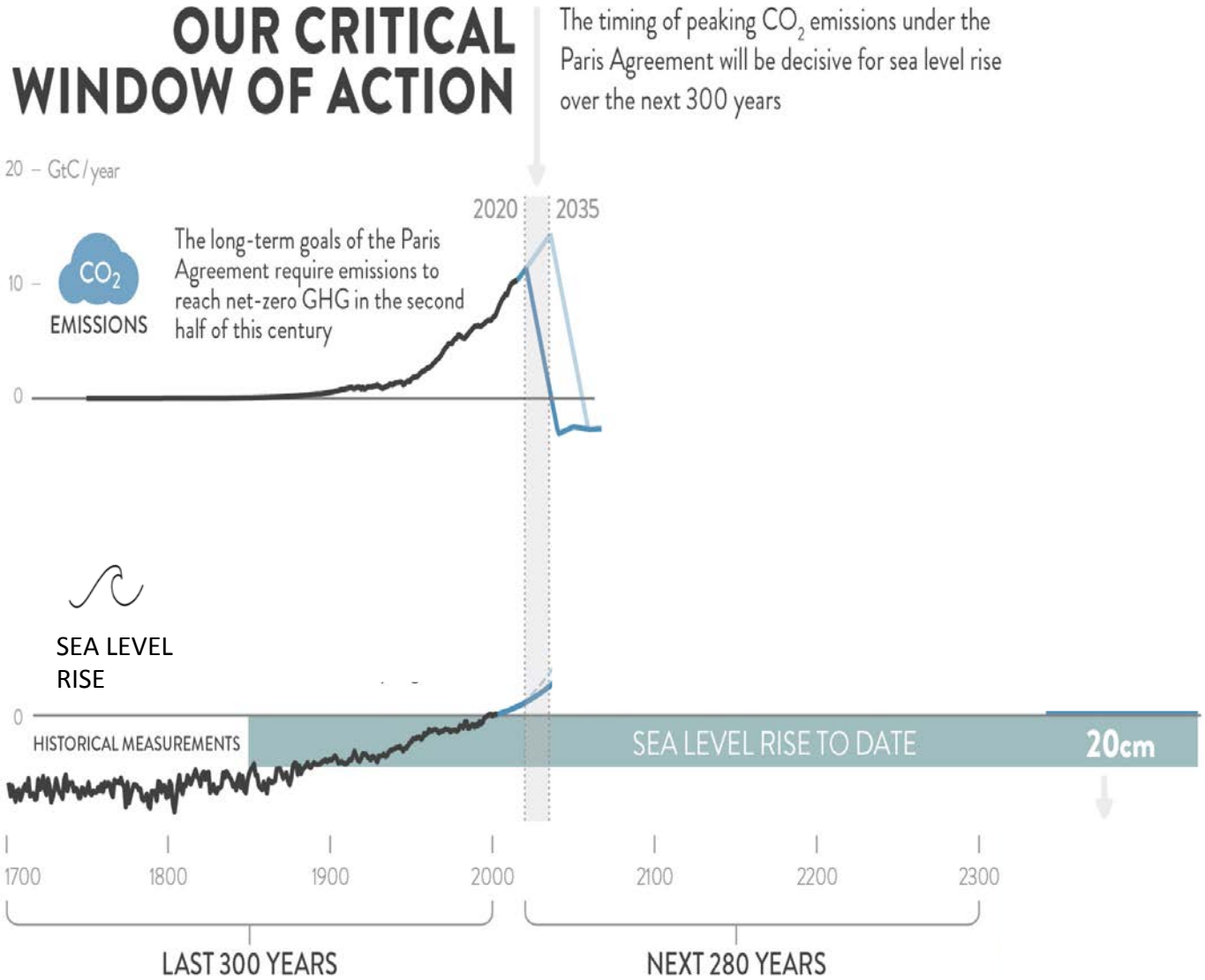
Why does 1.5°C matter?
Sea level rise

- Sea level rise (SLR) will continue well beyond 2100 for centuries to millennia
- <1.5°C warming implies about 1.5m SLR by 3000
- 3-4°C warming (Current policies and NDCs) implies about 6.5m SLR by 3000



Clark et al. 2018

Why does 1.5°C matter?
The legacy of inaction



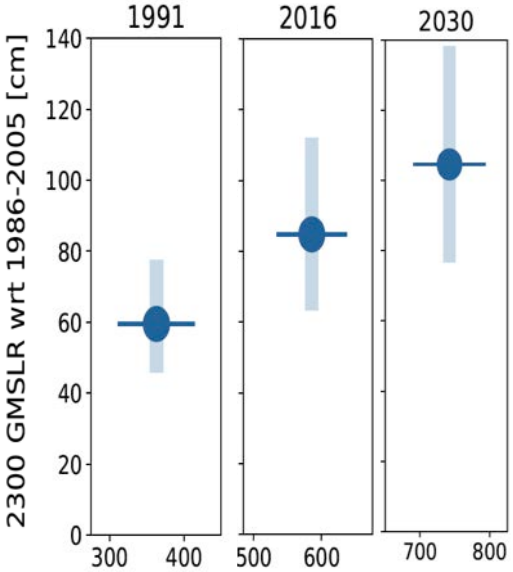
SOURCE Committed sea-level rise under the Paris Agreement and the legacy of delayed mitigation action - *Mengel et. al. 2018* - Nature Communications

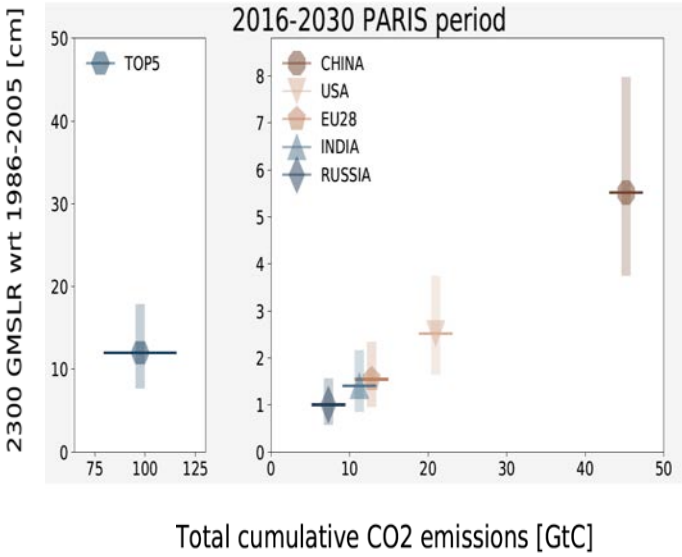
Why does 1.5°C matter?
Sea level commitment of the NDCs

- Addition sea level rise commitment of about 20 cm by 2300 every 15 years under 2030 NDC pathway

- 2030 NDC levels commit us to sea level rise in 2300 of >1m

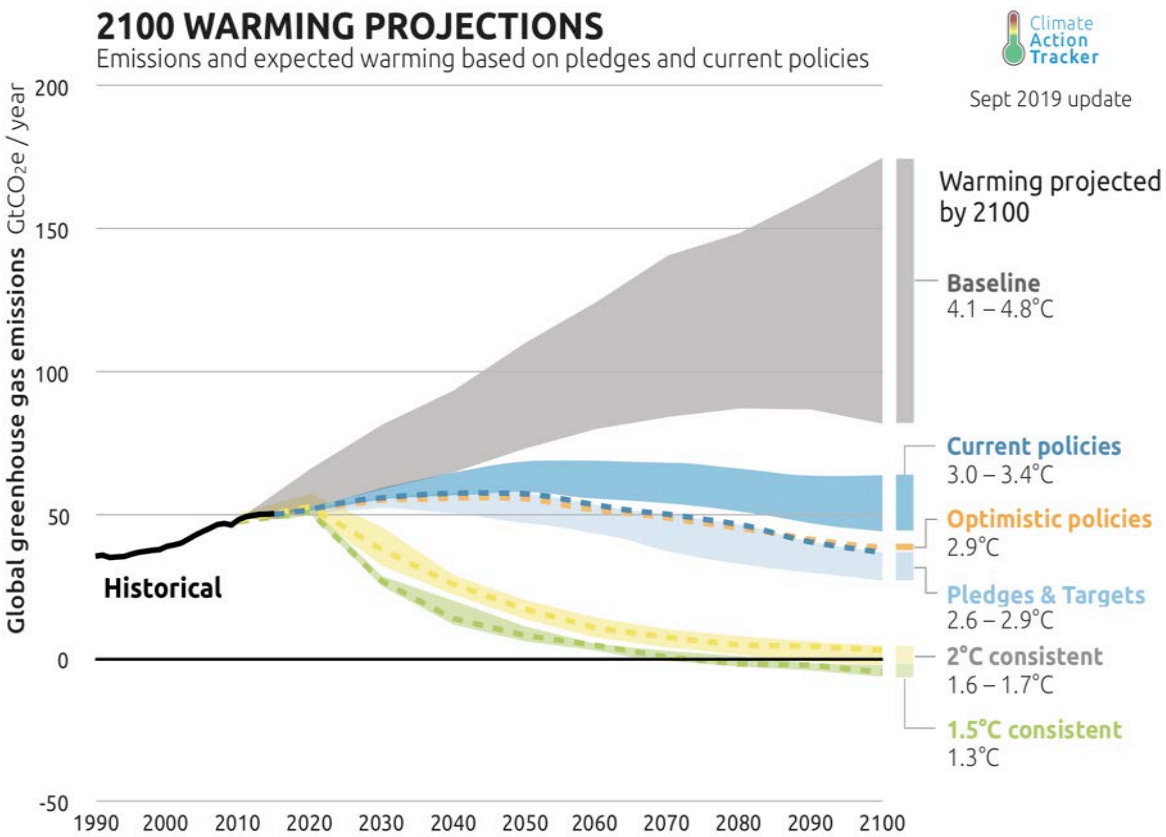
- Top-5 emitters commit more than 10 cm of sea level rise by 2300 due to GHG emitted between Paris Agreement adoption in 2015 and the end of the first NDC cycle in 2030

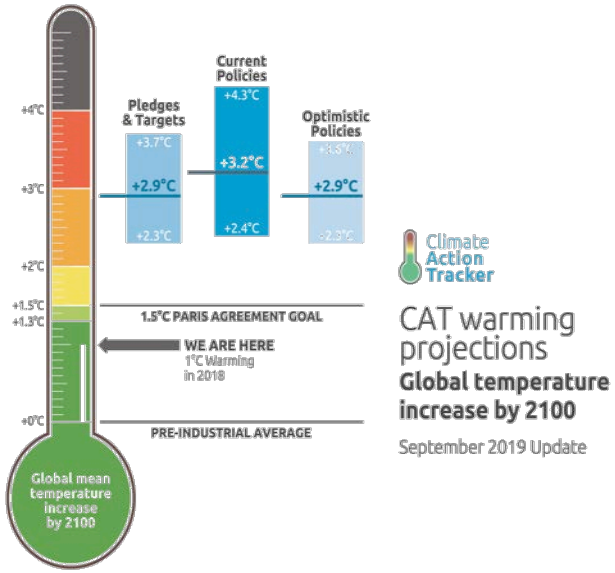




Nauels et al. (accepted)

Where do we stand?
Significant acceleration in ambition and action needed





Getting to Zero: Key Global Benchmarks Paris Compatible 1.5°C Emission Pathways

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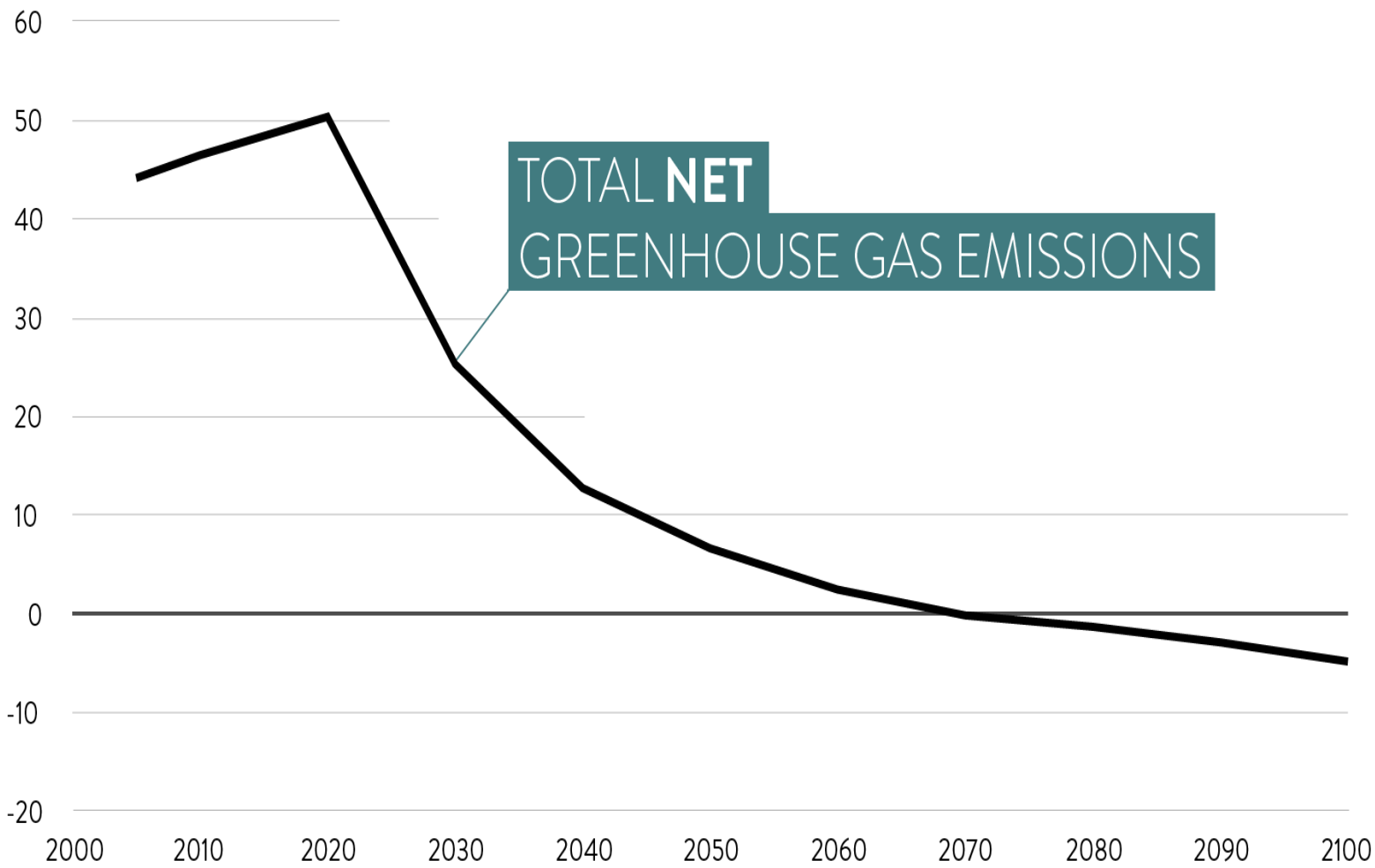

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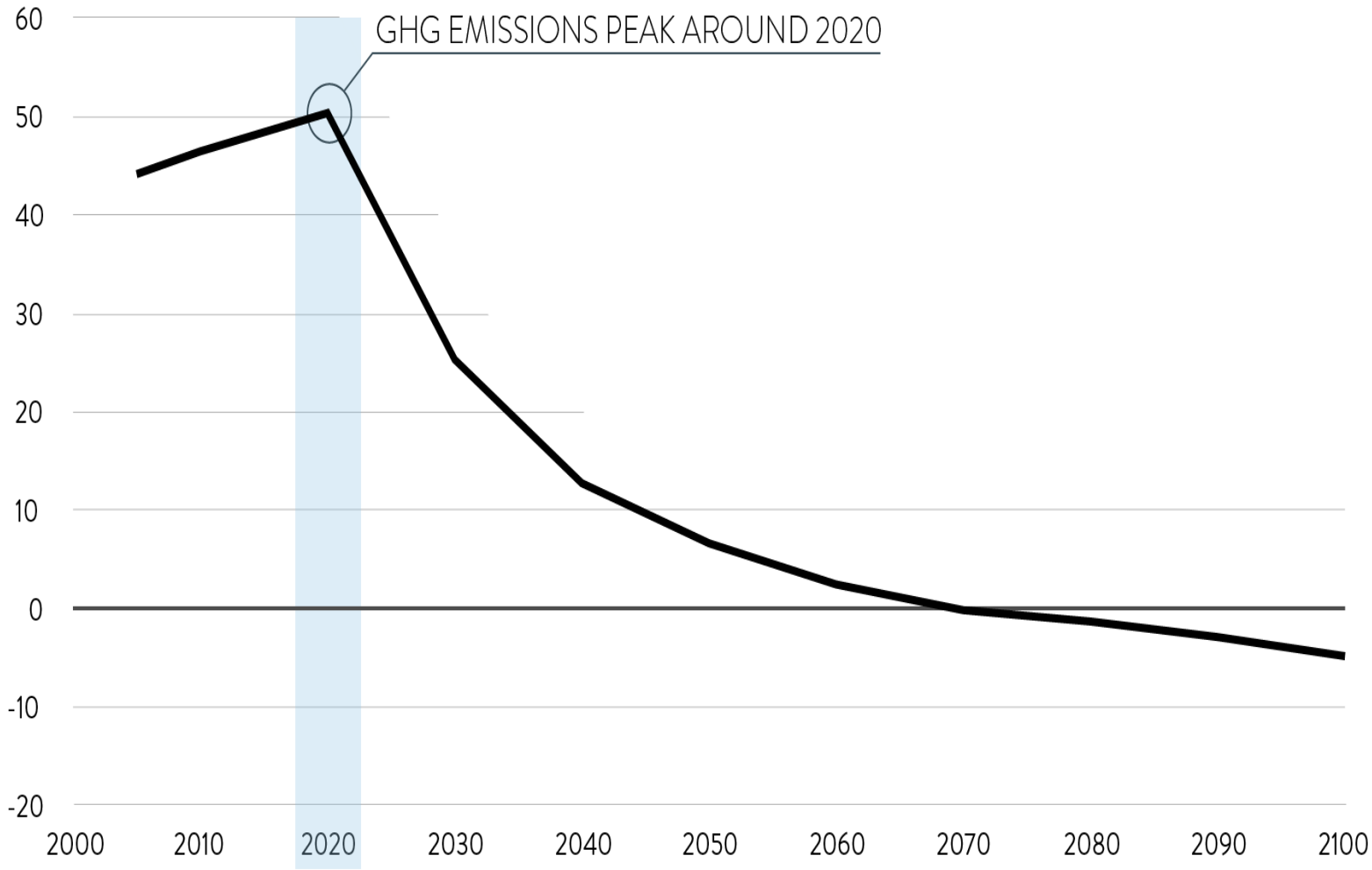

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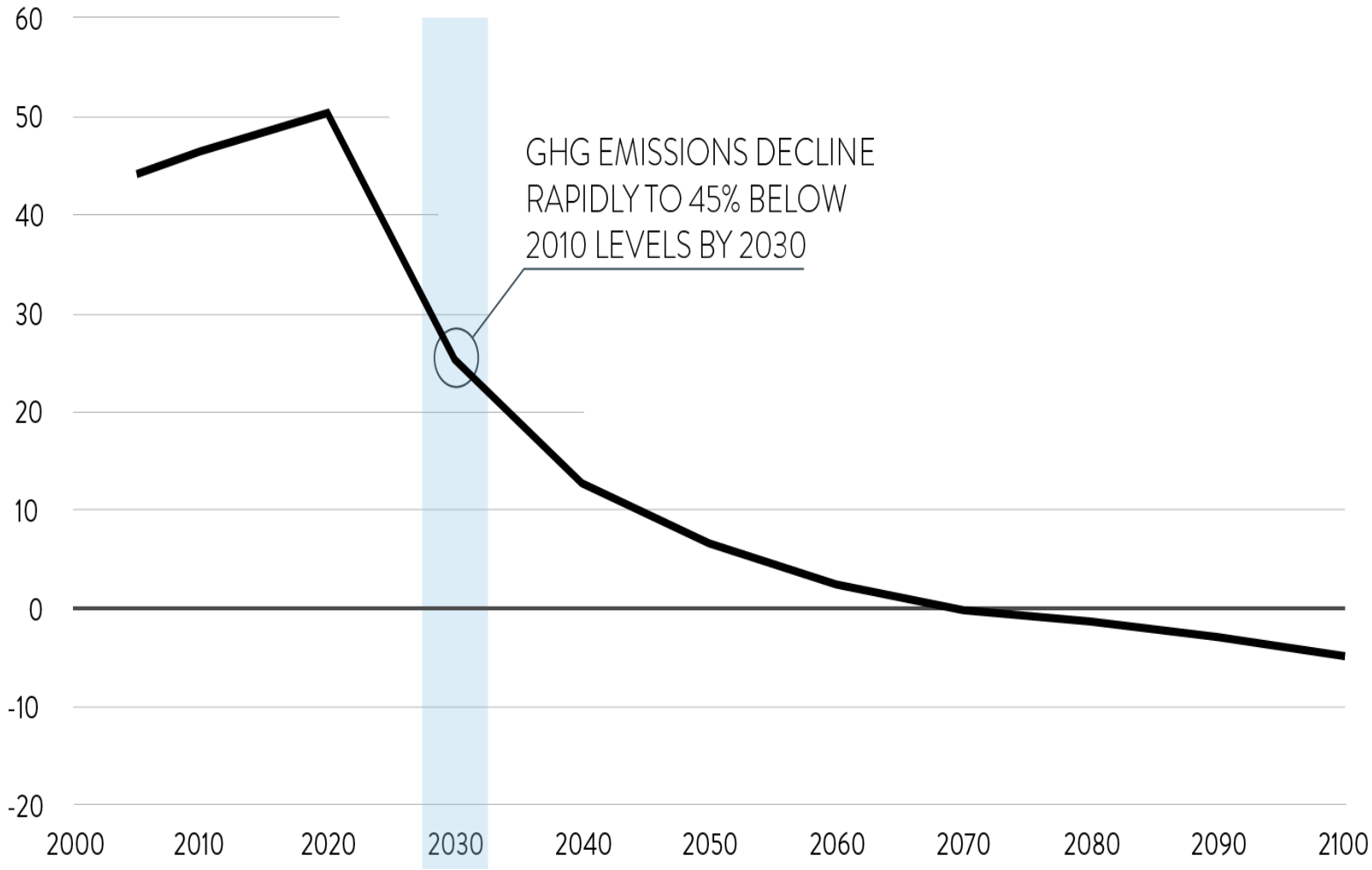

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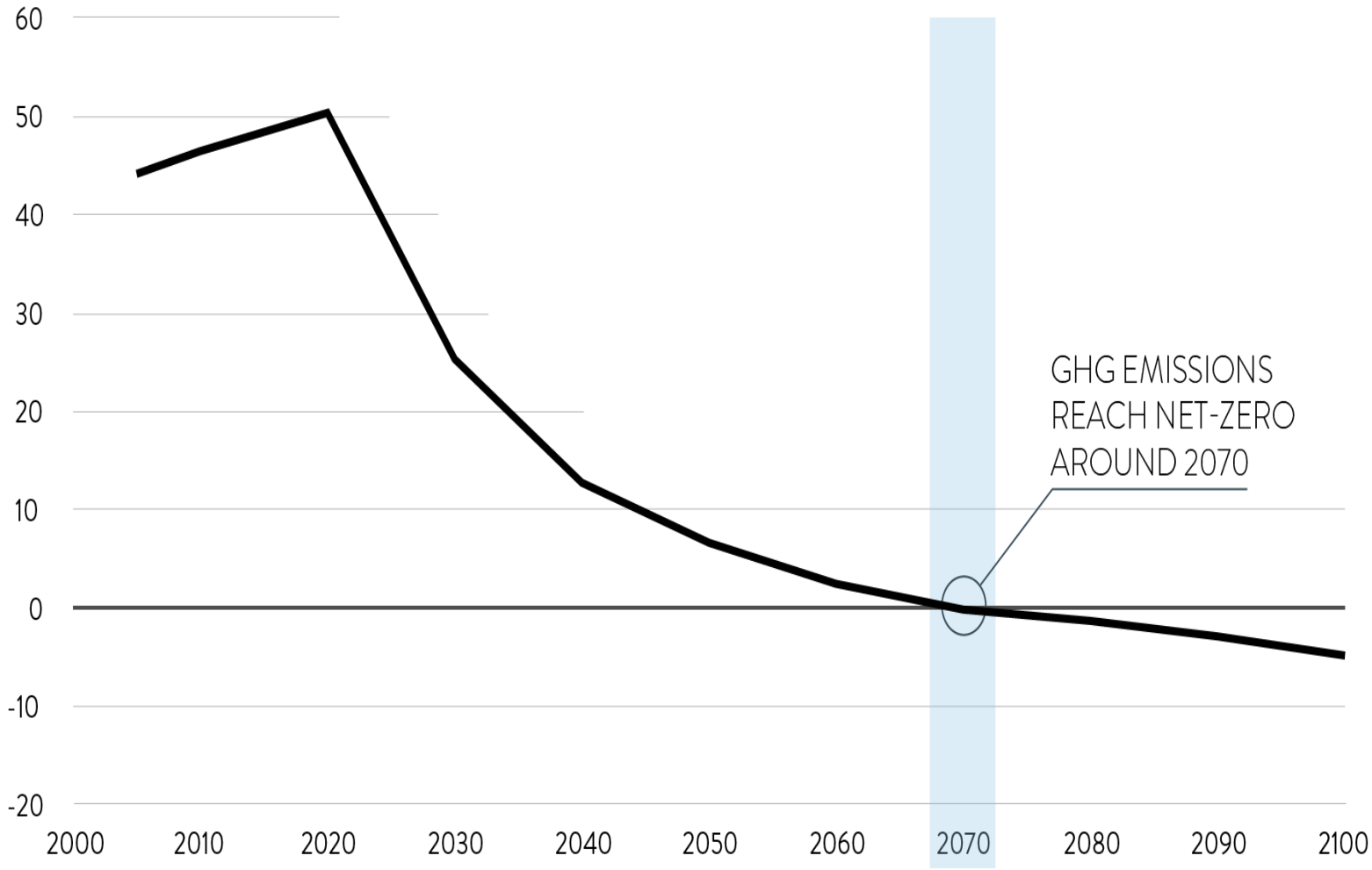

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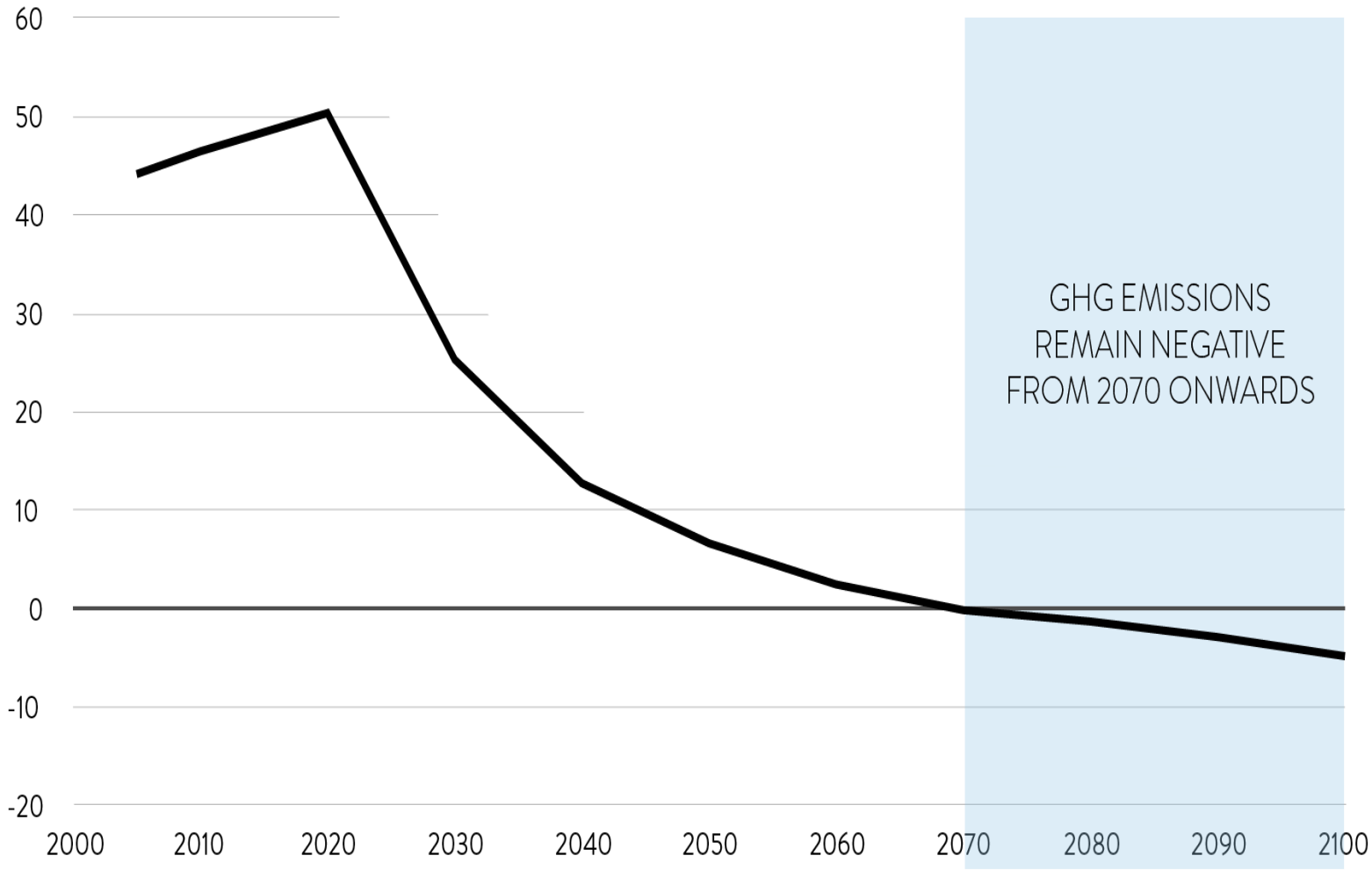

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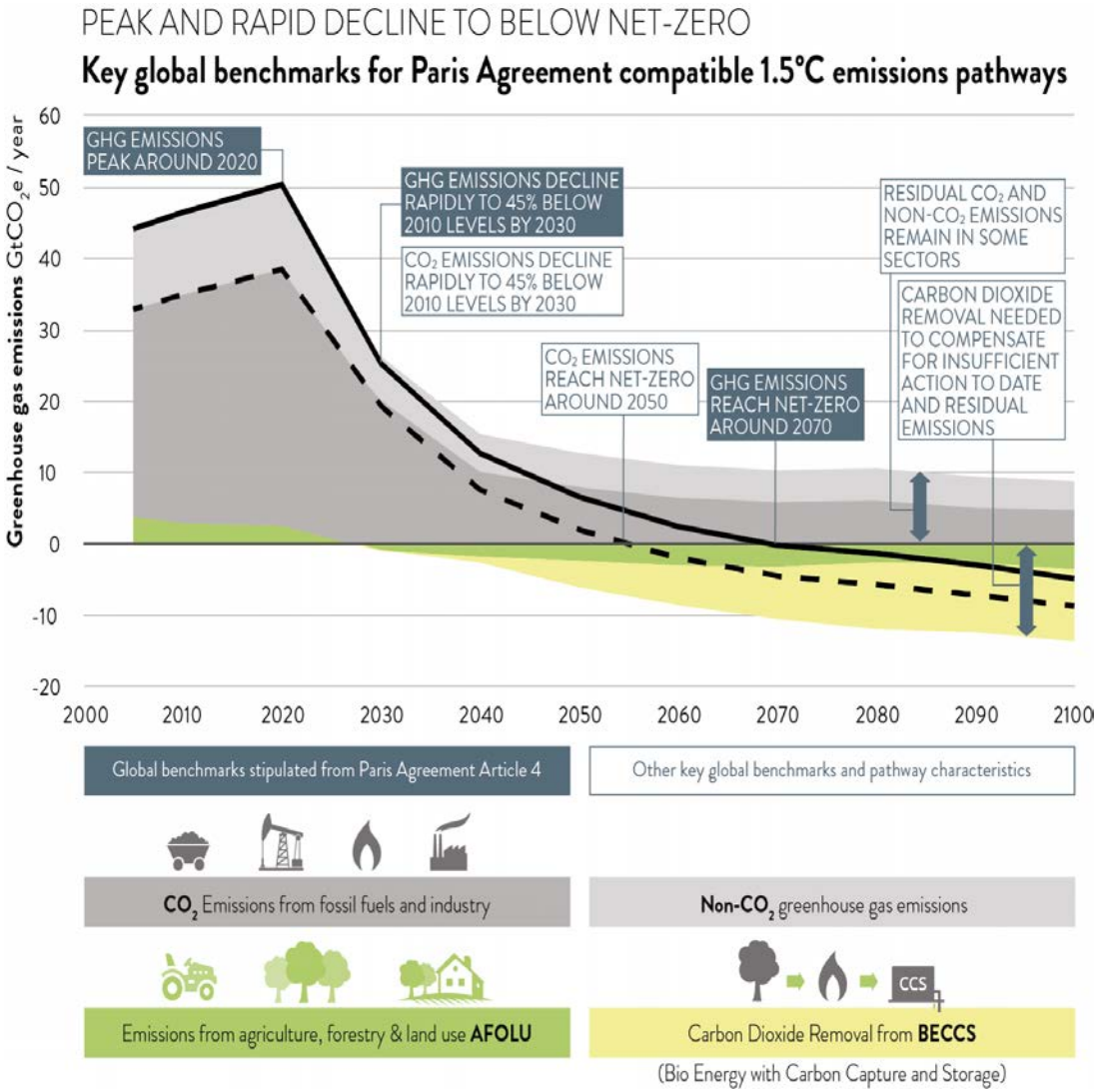
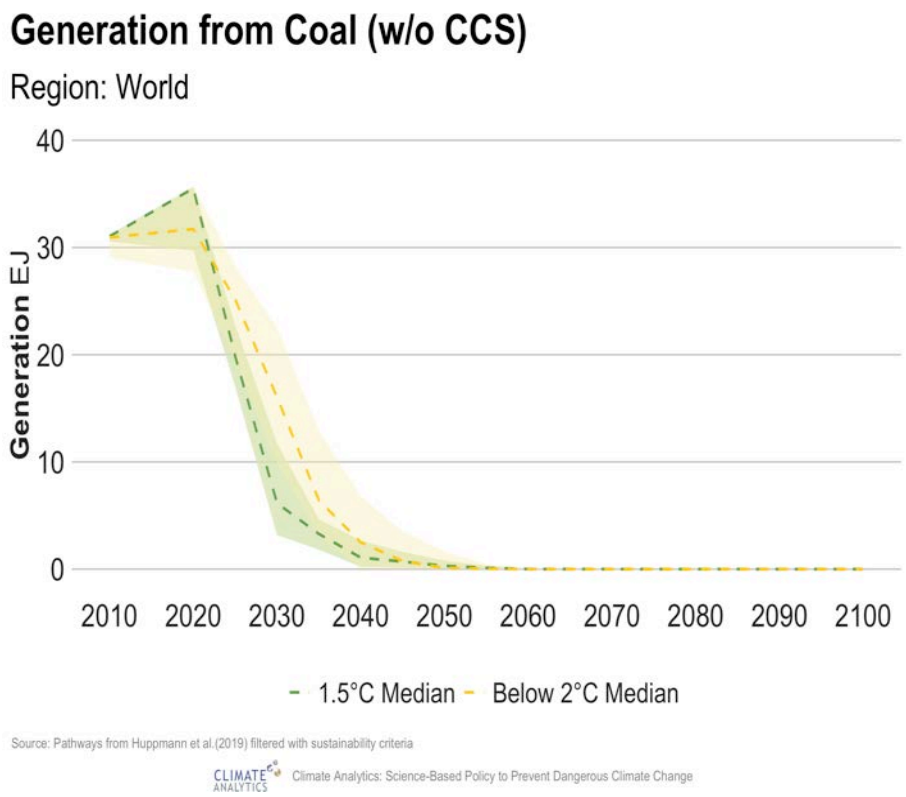


1.5°C transformation requires action in all sectors

Source: Climate Analytics (2019); IPCC (2018)

- With full transformation of energy-related sectors still strong push needed in land sectors
- **Investment** in low-carbon energy technologies and energy efficiency needs to be **increased by factor 6** by 2050
  - Global annual investments in low-carbon energy technologies **overtake fossil investments already by around 2025**

Rapid Phaseout of Coal needed to get to 1.5°C
...and even to 2°C



Region	Phaseout Date
OECD+EU	2031
ASIA	2037
LATIN AMERICA	2032
MIDDLE EAST AND AFRICA	2034
EASTERN EUROPE AND FORMER SOVIET UNION	2031

Single most important step to keep the door open for achieving the Paris Agreement

Coal power generation must:

- **Peak by 2020**, and
- Rapidly decrease to **80% below 2010 levels by 2030**, and
- Be **phased out by 2040** at the latest

Energy system transformations for 1.5°C (SR1.5)

- **Fully decarbonised primary energy supply by 2050** (including with CCS)
- **Large reductions of fossil fuel use, in particular coal:**
  - minus 64% by 2030
  - minus 75% by 2050

  and oil:
  - minus 11% by 2030
  - minus 60% by 2050
- **Enhanced energy efficiency, faster electrification in all sectors with large energy demand reductions across all end-use sectors**
- **Bioenergy is used in 1.5°C pathways (and in 2°C pathways),** both with CCS (BECCS) and without, with uncertainties regarding limits to sustainable use
- **Far-reaching transitions** in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence)

Vast majority of NDCs not in line with Paris Agreement

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4°C+ World	< 4°C World	< 3°C World	< 2°C World	< 1.5°C World	<< 1.5°C World
CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL
RUSSIA	ARGENTINA	AUSTRALIA	BHUTAN	MOROCCO	0 Countries
SAUDI ARABIA	CHILE	BRAZIL	COSTA RICA	THE GAMBIA	
TURKEY	CHINA	CANADA	ETHIOPIA	2 Countries	
UKRAINE	INDONESIA	EU	INDIA		
USA	JAPAN	KAZAKHSTAN	PHILIPPINES		
5 Countries	SINGAPORE	MEXICO	5 Countries		
	SOUTH AFRICA	NEW ZEALAND			
	SOUTH KOREA	NORWAY			
	UAE	PERU			
	9 Countries	SWITZERLAND			
		10 Countries			

Climate Action Tracker

June 2019 update

The vast majority of countries have insufficient targets that must be improved

What level of ambition do we need to close the gap to 1.5°C?

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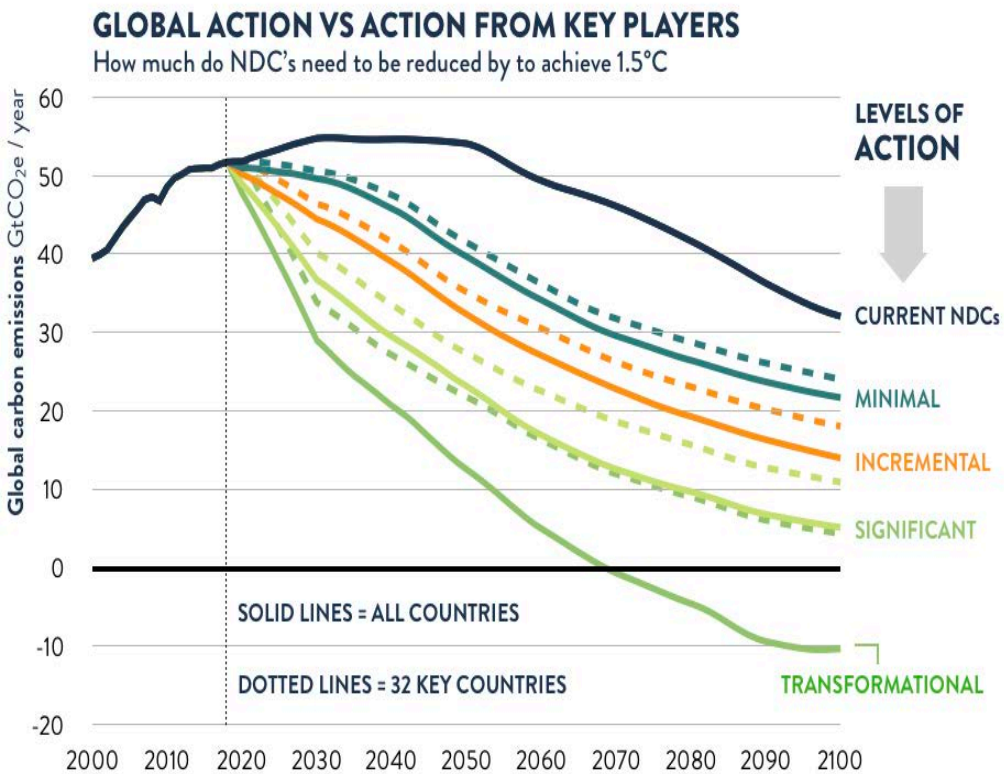

Scenario	Reduction in 2030 emissions from current NDC levels (%)	Change compared to 2010 emissions (%)	Estimated global temperature increase 2100
Reference scenario (current NDCs)		+12 %	2.8 °C
CAT countries			
Minimal ambition increase	7%	+ 4 %	2.4 °C
Incremental ambition increase	15 %	- 54.5 %	2.2 °C
Significant ambition increase	26 %	- 17.5%	1.9 °C
Transformational ambition increase	38%	-30%	1.65°C
All countries			
Minimal ambition increase	10%	+ 2%	2.35°C
Incremental ambition increase	20%	-8.5%	2.1°C
Significant ambition increase	35%	- 24.5 %	1.7 °C
Transformational ambition increase	50%	- 40 %	1.5 °C

Incrementalism risks the Paris Agreement goal slipping out of reach

- A **long-term** and **whole-economy** view is essential
- Full transformation is needed across **all sectors**
- Need for increased ambition in **all countries**

Geiges et al (2019)

Reducing warming will reduce climate impacts

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Climate Impact	Year	NDC reference scenario	%33% ambition increase for big emitters	1.5°C scenario
Median increase in annual maximum temperature (TXx) relative to 1986-2005	2100	+2.7°C	+1.8°C	+1.1°C
Sea level rise relative to average between 1986-2005	2100	64 (50-81) cm	54 (43 -68) cm	45 (36-57) cm
	2300	190 (140-250)cm	140 (110-180) cm	100 (80-130) cm
GDP reductions relative to a no-climate %change scenario for LDC countries	2050	-20%	-17%	-14%
	2100	-63%	-48%	-34%


Incremental improvements of 2030 targets insufficient to achieve the Paris Agreement goals

Andreas Geiges[1], Paola Yanguas Parra[1], Marina Andrijevic[1,2], William Hare[1], Alexander Nauels[1], Peter Pfleiderer[1,2,3], Michiel Schaeffer[1,4], and Carl-Friedrich Schleussner[1,2,3]

[1]Climate Analytics, 10961 Berlin, Germany
[2]IRITHESys, Humboldt University, 10117 Berlin, Germany
[3]Potsdam Institute for Climate Impact Research, 14473 Potsdam, Germany

Geiges et al (2019)

Substantial reduction in climate impact resulting from high ambition in short term

Conclusions

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- SROCC and SR1.5 together point to climate risks at 1.5°C that increase rapidly above that level – complementary reports
- NDCs and current policies are not sufficient to reach 1.5°C. Strongly enhanced NDCs and LTSs are needed by 2020
- SR1.5 is clear that 1.5°C is still feasible
- However, we are at a **critical window of opportunity** for increased climate action and ambition.
- **Incrementalism** risks the Paris Agreement goal slipping out of reach
  - A long-term and whole-economy view is essential
  - Full transformation is needed across all sectors
- There is **room for substantial** NDC updates (and not incremental)

Thank you!

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