Avoided impacts and social and economic benefits: state of science

Michiel Schaeffer

18 May 2016

CLIMATE ANALYTICS

New results on difference between impacts and risks at 1.5°C and 2°C

- **IPCC AR5 differentiation between warming levels focused on higher levels of warming**
- **New study led by Climate Analytics scientists out a few weeks ago is first to address the difference in climate impacts between 1.5°C and 2°C warming** for 11 key impact indicators, including extreme events (hot, wet and dry events), water availability, crop yields, risk to coral reefs and sea-level rise – based on a consistent and comprehensive assessment of existing projections
- **Regional perspective:** Assessment of 25 world regions providing detailed information at regional and sectoral level
- **Significant differences between 1.5°C and 2°C** on the regional level for all indicators considered

Schleussner et al.: Differential climate impacts for policy-relevant limits to global warming: the case of 1.5°C and 2 °C Earth Syst. Dynam., 7, 1–25, 2016 doi:10.5194/esd-7-1-2016

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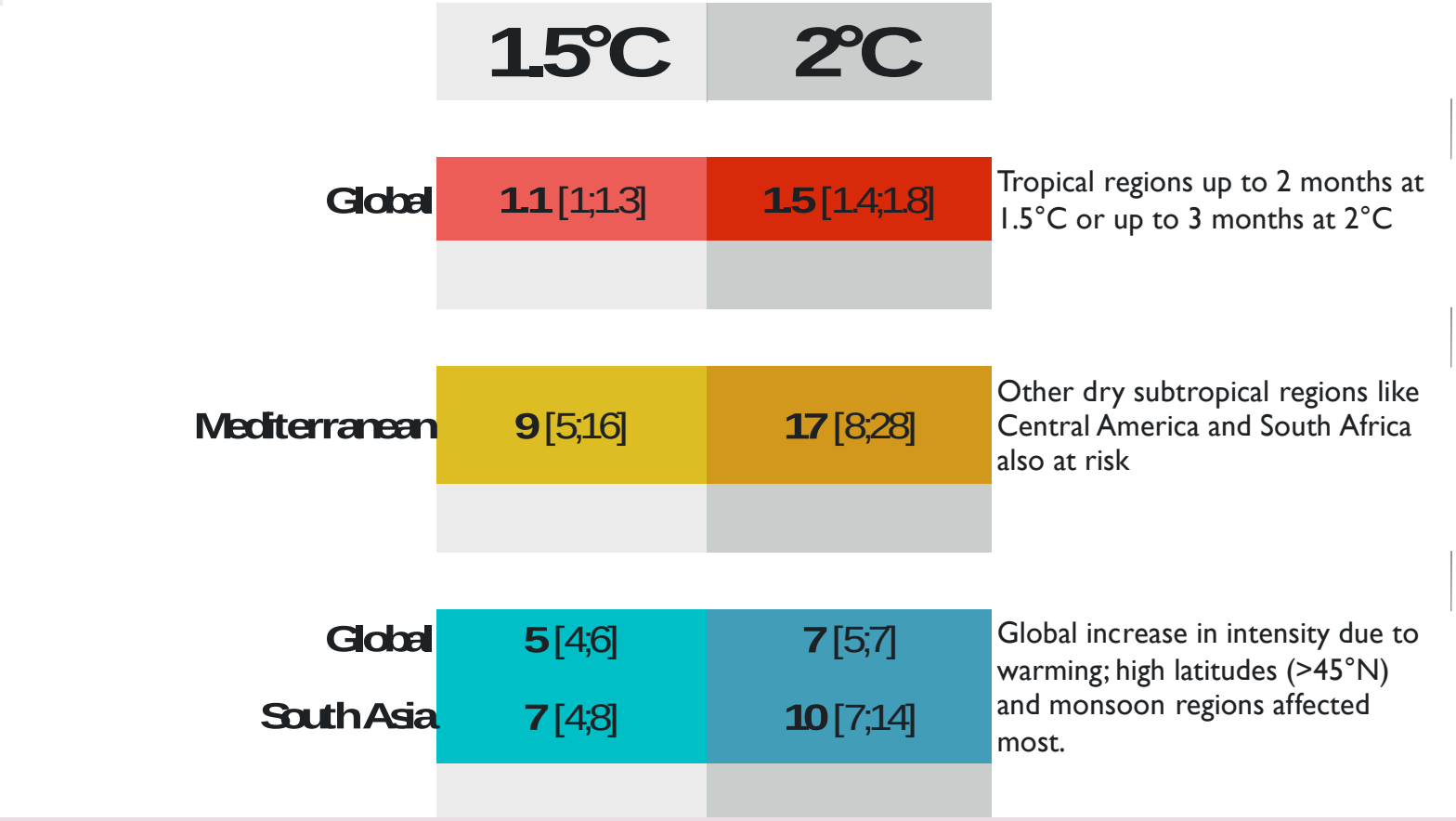
The difference between 1.5°C and 2°C



- 1.5°C climate at outer edge of historical experience, 2°C represents new climate regime, particularly in tropical regions.
- 50% increase in heat-wave length
- Near-doubling of water availability reduction in dry subtropical regions

Unprecedented global, mass coral bleaching event under way…

Images from December 2014 (left) and February 2015 show coral bleaching in the Pacific waters around American Samoa.

ECOLOGY

El Niño's warmth devastating reefs worldwide

Recent aerial surveys of Australia's Great Barrier Reef find massive coral bleaching

CLIMATE ANALYTICS

Science (2016)

The difference between 1.5°C and 2°C – A reason for concern

	1.5°C	2°C
2050	about 90%	near 100%
2100	about 70%	near 100%
50% of current crop-producing regions may experience yield reductions of	Wheat: 14% Maize: 8% Rice: 8% Soy: 10%	Wheat: 19% Maize: 12% Rice: 16% Soy: 12%

- Decisive for the future of tropical coral reefs
- Substantial risk increase for regional crop yield reductions

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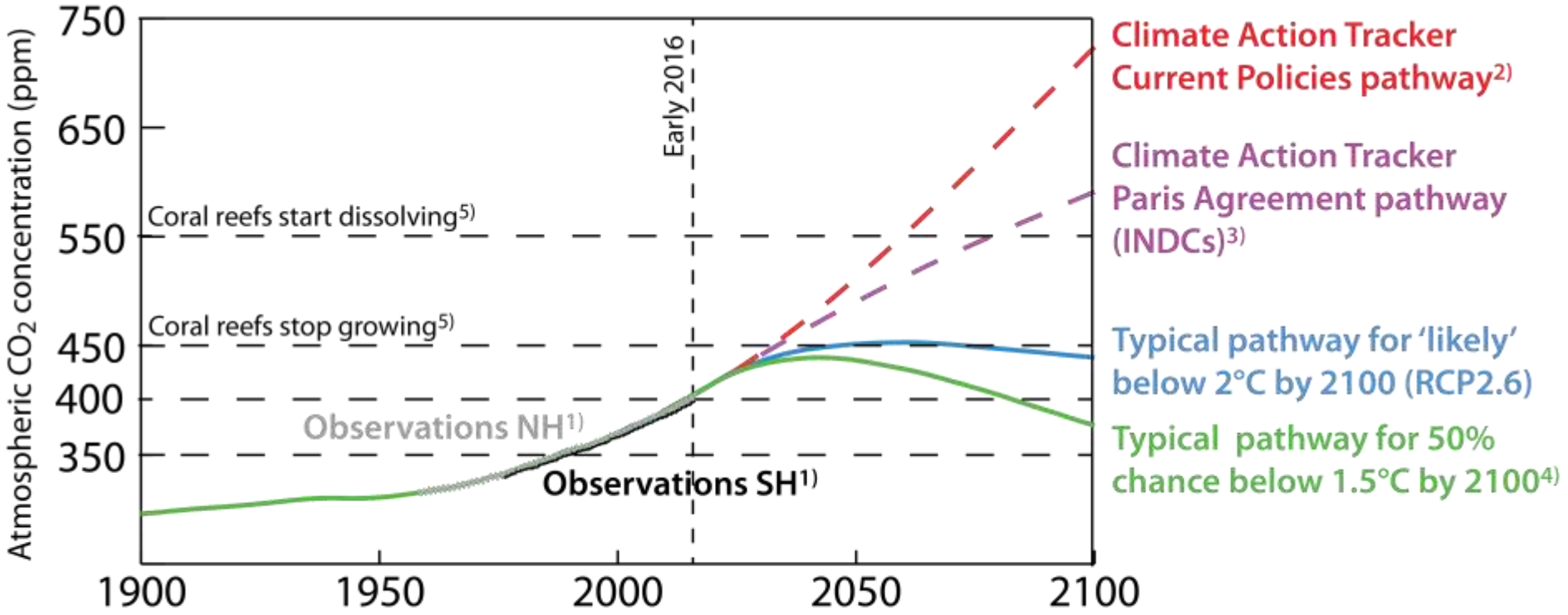
Schleussner et al. (2016)

Ocean acidification: corals and other sea life also at risk from high CO_2 concentrations



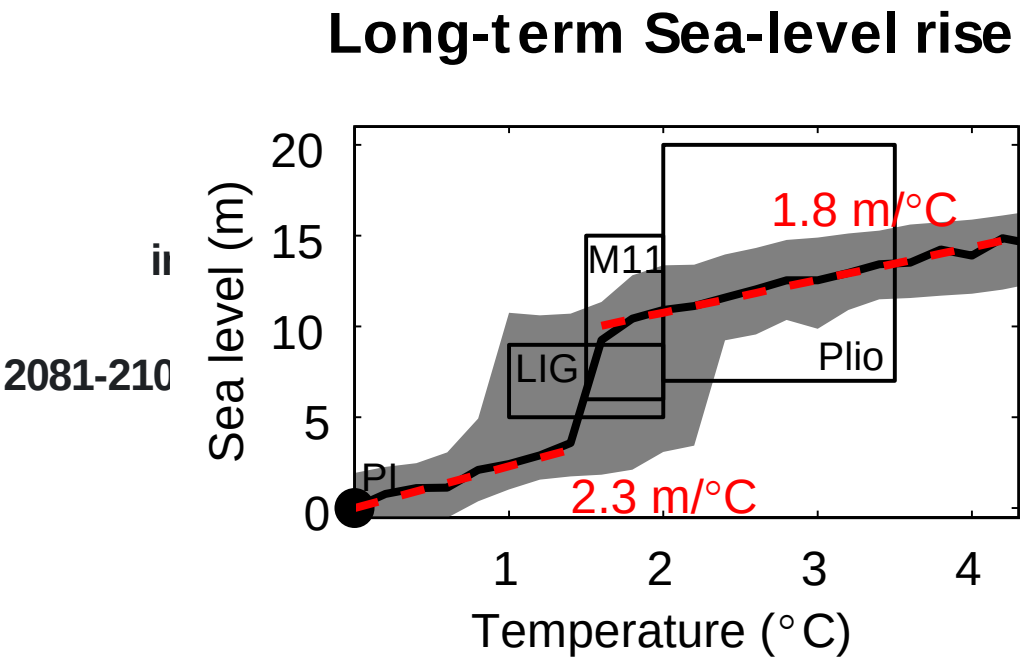
1) NH: Mauna Loa (grey), SH: Cape Grim (black)
2) Current policies presently in place around the world (http://climateactiontracker.org/global.html)

3) Unconditional pledges or promises that governments have made, including in submitted INDCs as of 1 October 2015 (http://climateactiontracker.org/global.html)

4) MESSAGE Integrated Assessment Model (IAM) of energy-economic system (Rogelj et al. 2015)
5) Cao & Caldeira (2008), Silverman et al. (2009)

CLIMATE ANALYTICS

Only 1.5°C may prevent long-term multi-meter sea-level rise…



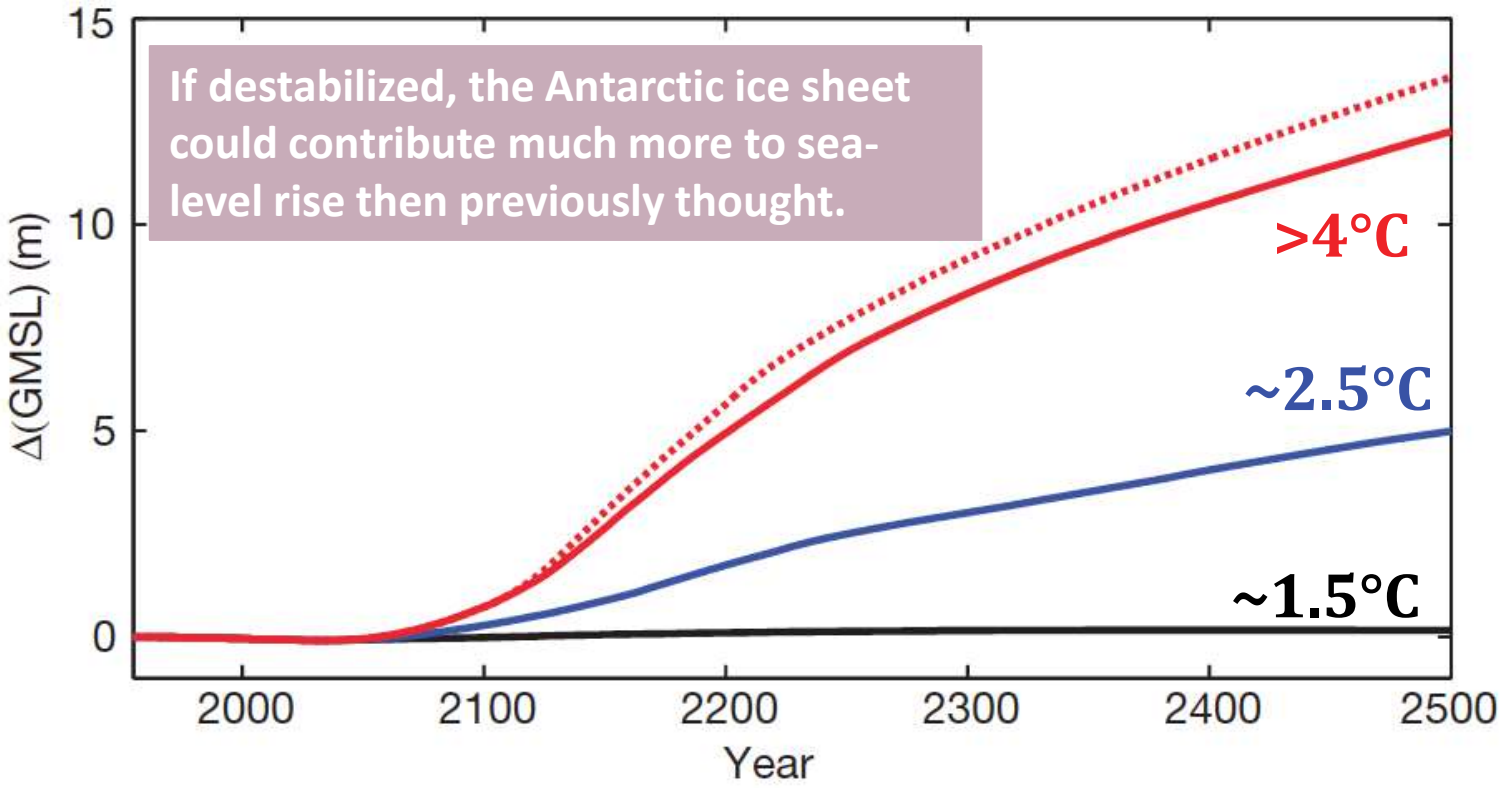
Levermann, A. et al. PNAS (2013).

of sea-level
declines only
r 1.5° C
arios

Schleussner et al. (2016)

CLIMATE ANALYTICS

Instability of Antarctic ice sheet might lead to up to 1m additional sea-level rise in 2100…



Deconto & Pollard (2016)

CLIMATE ANALYTICS

Going from 1.5°C to 2°C warming risks crossing many more tipping points in the earth system

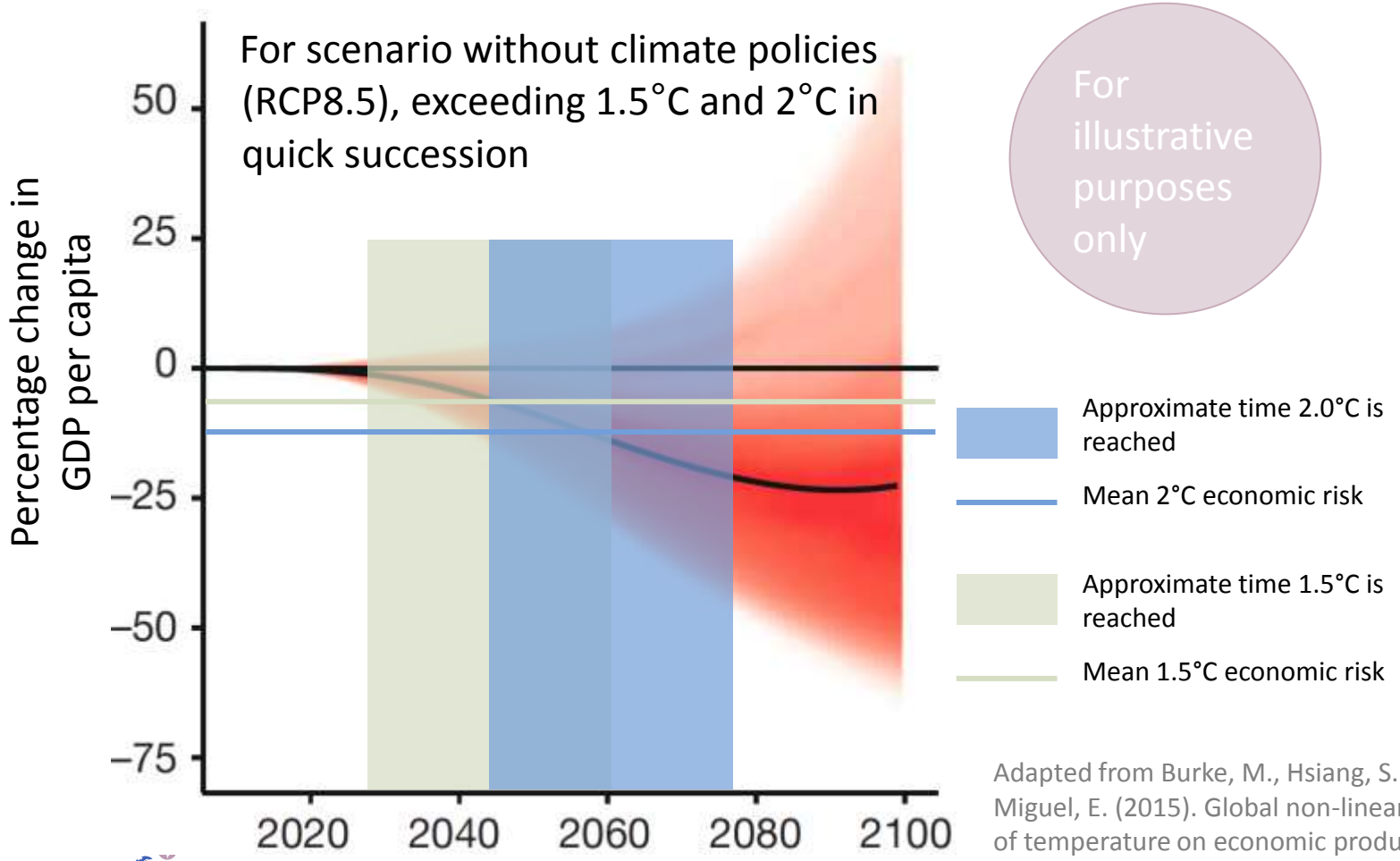
	1.5°C	2°C
Number of crossed thresholds of abrupt shifts in earth system models	**20%**	**50%**

- Scientific review (meta-analysis) of multiple abrupt shifts in climate system reveal steep increase between 1.5°C and 2°C
- Risk for "tipping" of Greenland and parts of West-Antarctic ice-sheet increase rapidly

CLIMATE ANALYTICS

Drijfhout et al. (2015)
Levermann et al. (2012)

Global economic impacts are significantly lower at 1.5°C…



Adapted from Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. Nature.

CLIMATE ANALYTICS

The 1.5°C temperature limit in the Paris Agreement and implications for energy transformation

Bill Hare

18 May 2016

CLIMATE ANALYTICS

Recent temperature records, the 1.5°C limit and what this means…

01

Has the 1.5°C limit been broken?
Observations of recent warming compared to long-term temperature projections

02

Is 1.5°C still feasible? What does it mean for the energy system?

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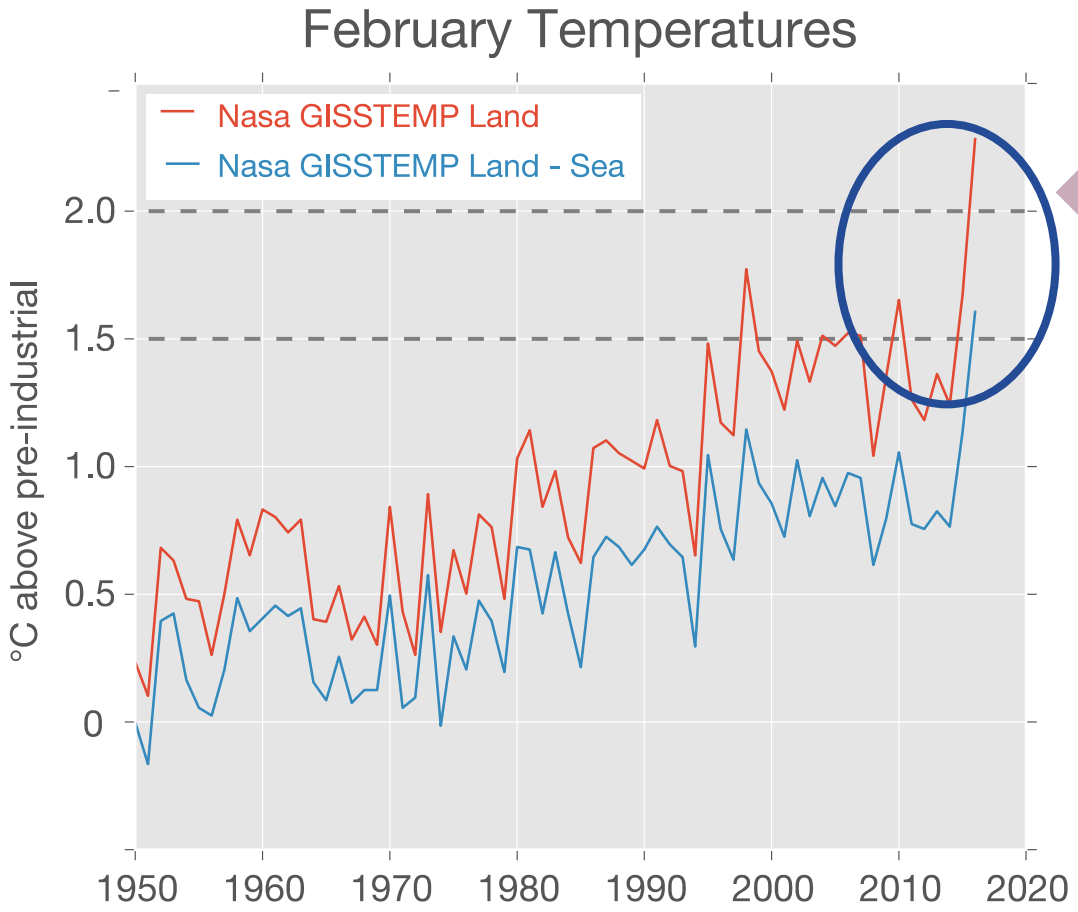
In February 2016 global mean temperatures spiked to more than 1.5° C above pre-industrial levels…



Does this mean that a long-term global mean temperature limit of 1.5°C is out of sight?

CLIMATE ANALYTICS

Source http://data.giss.nasa.gov/gistemp/

No!

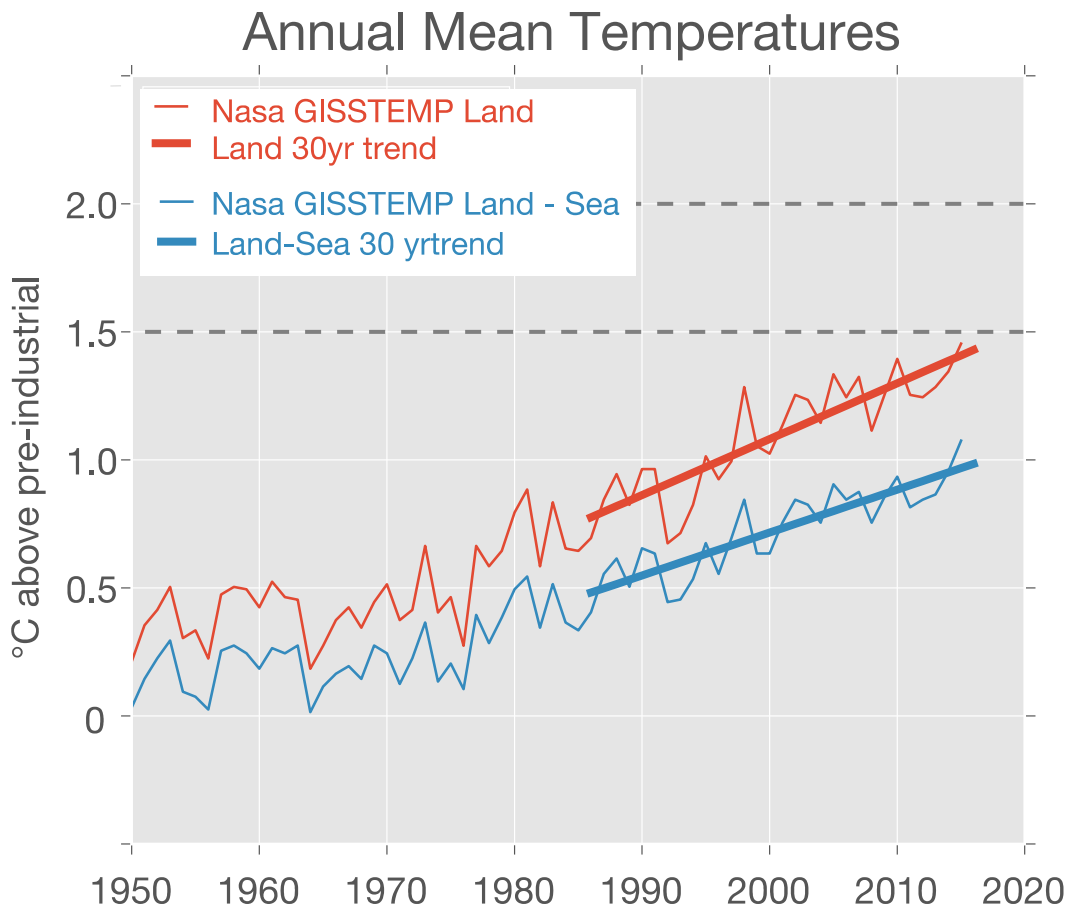
And here is why:

CLIMATE ANALYTICS

Long-term warming of about 1°C above pre-industrial is in line with the 30 year long-term trend…

- On longer time scales, signatures of natural variability (positive as well as negative) vanish

Observed warming is in line with long-term trend



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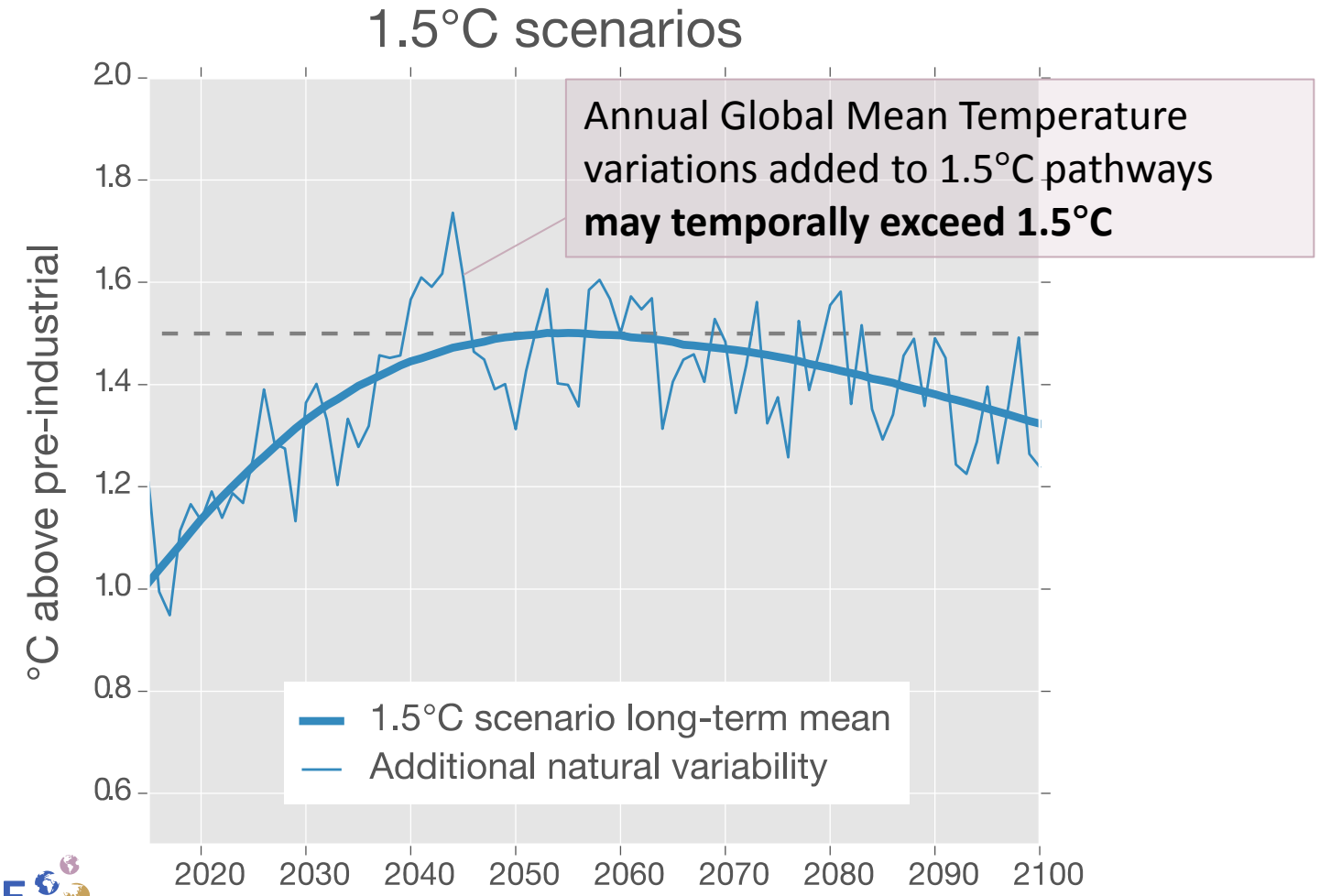
What does this entail for long-term warming trajectories?



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Note: "Additional natural variability" depicted here is typical of the past and was added to long-term 1.5°C pathway for illustrative purposes only

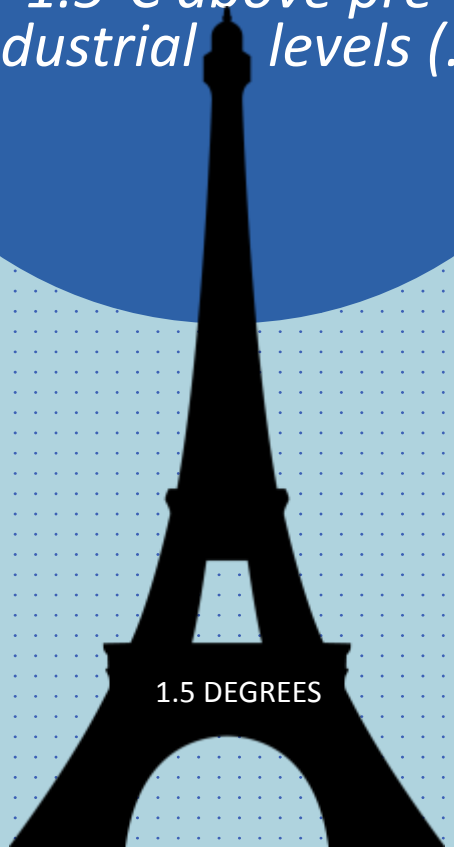
What are the regional implications?

"Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels (..)"

What are the implications for policy makers?

What are the implications for different sectors?

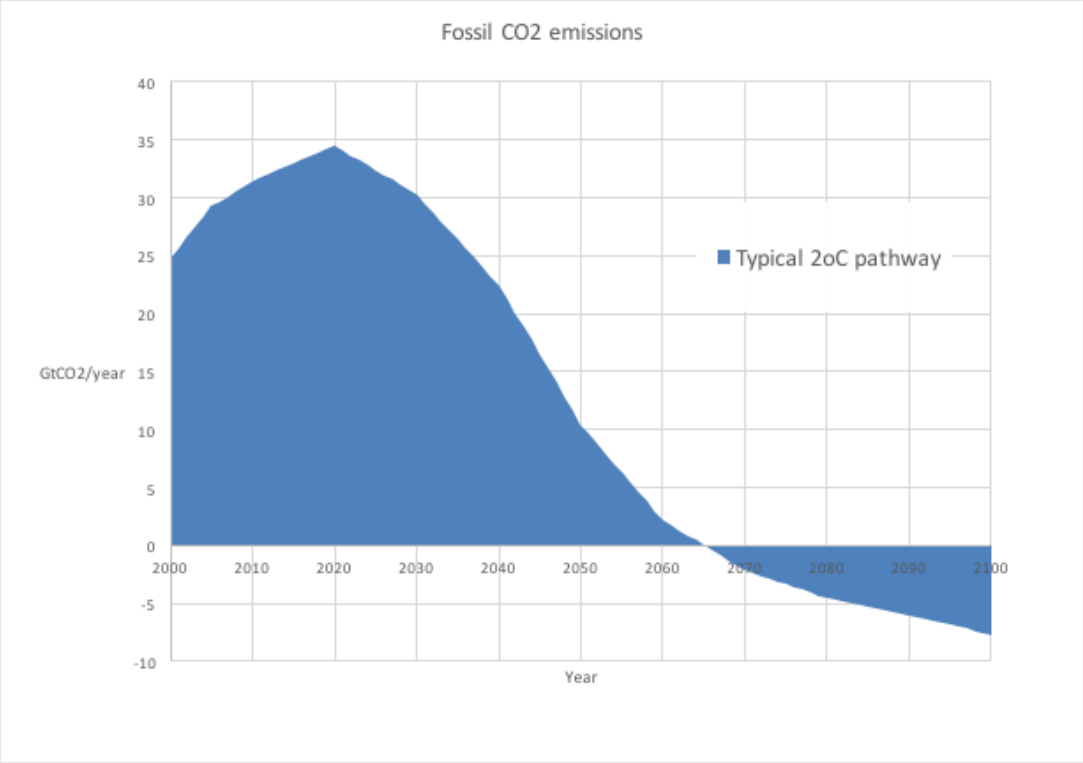
How to get onto a 1.5°C pathway?



CLIMATE ANALYTICS

What are the implications of 1.5°C for policy makers?

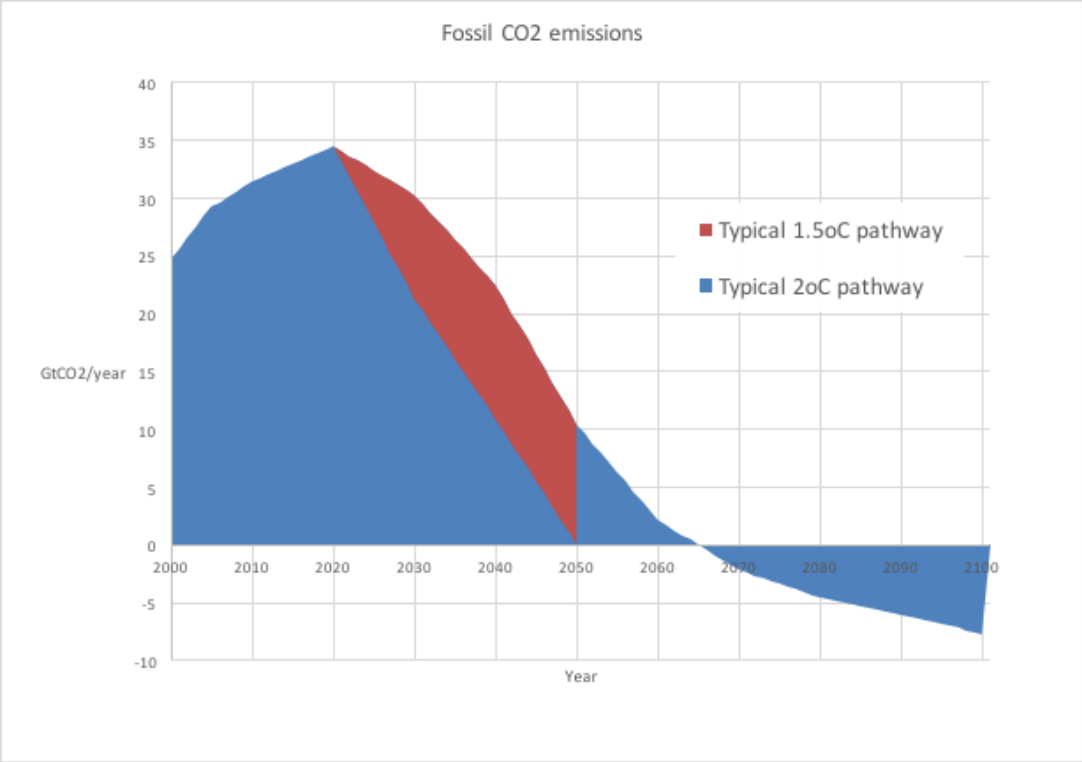
What does 1.5ºC mean for global fossil-fuel related emissions?



Cumulative global fossil-fuel related emissions (GtCO2)

	2015-2050	2051-2100	2015-2100
1.5°C	**680**	**-300**	**380**
2°C	**930**	**-90**	**840**

What does 1.5ºC mean for global fossil-fuel related emissions?



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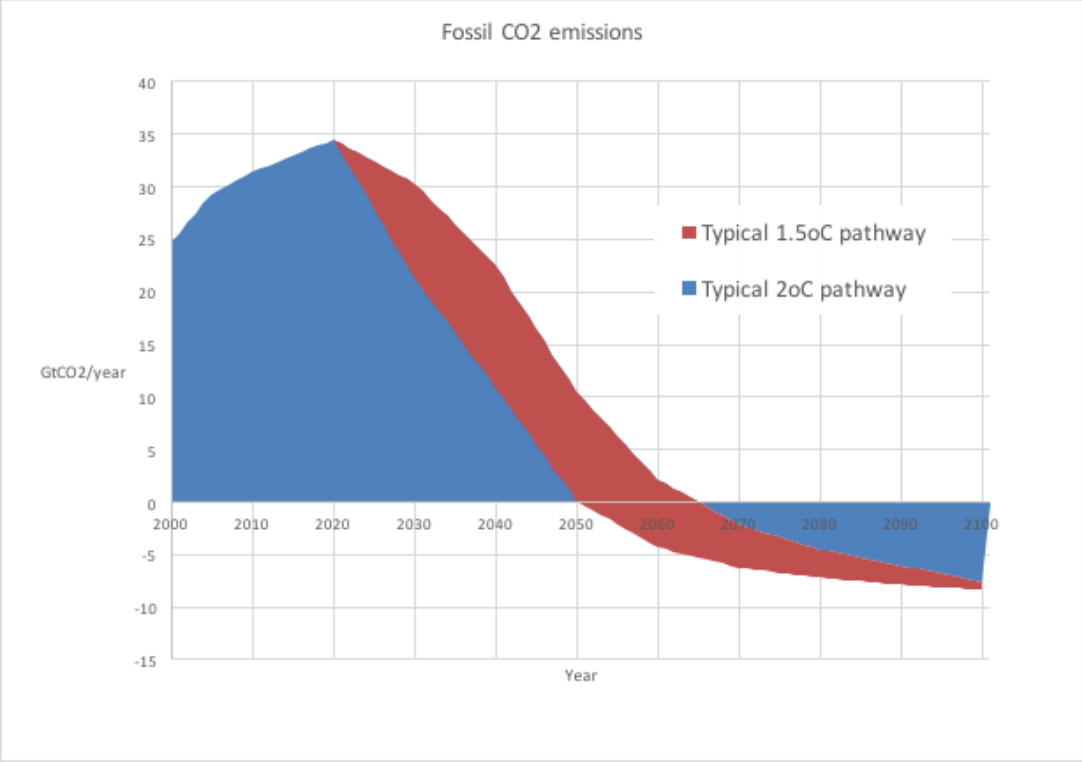

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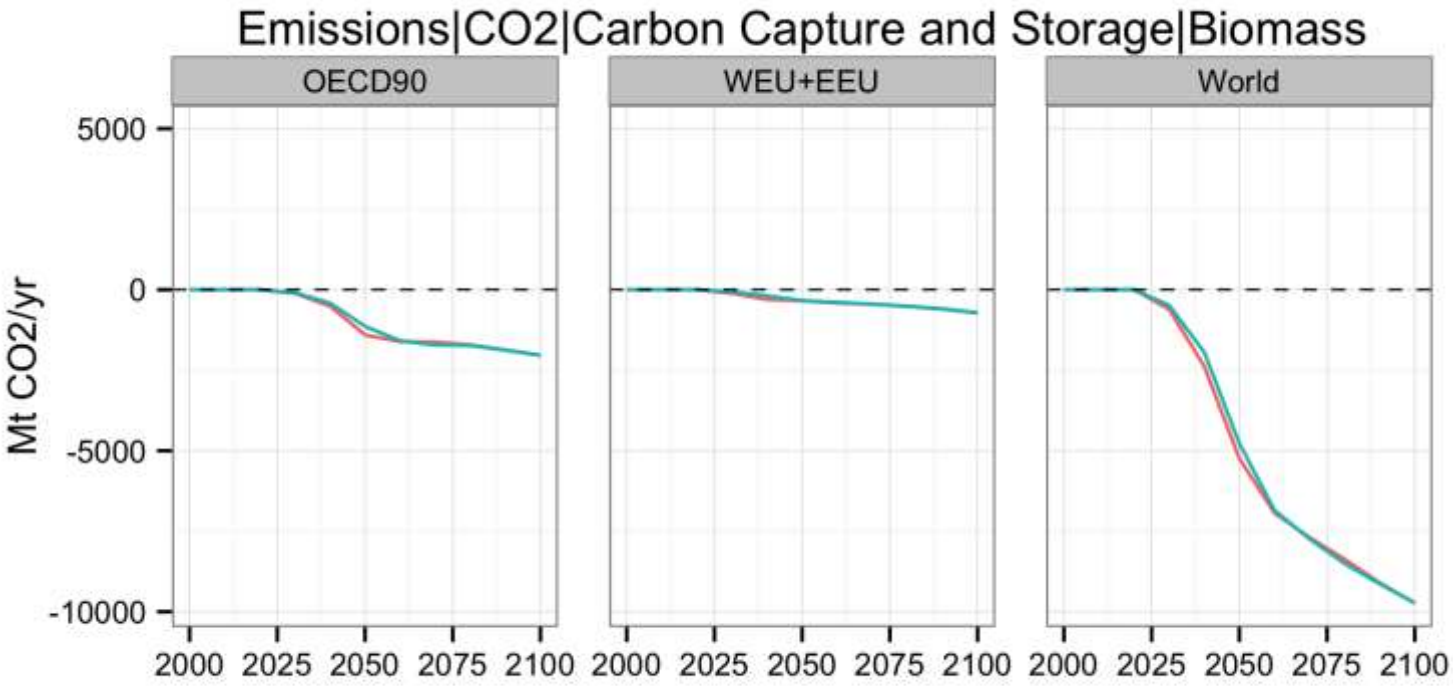
2°C	**930**	**-90**	**840**

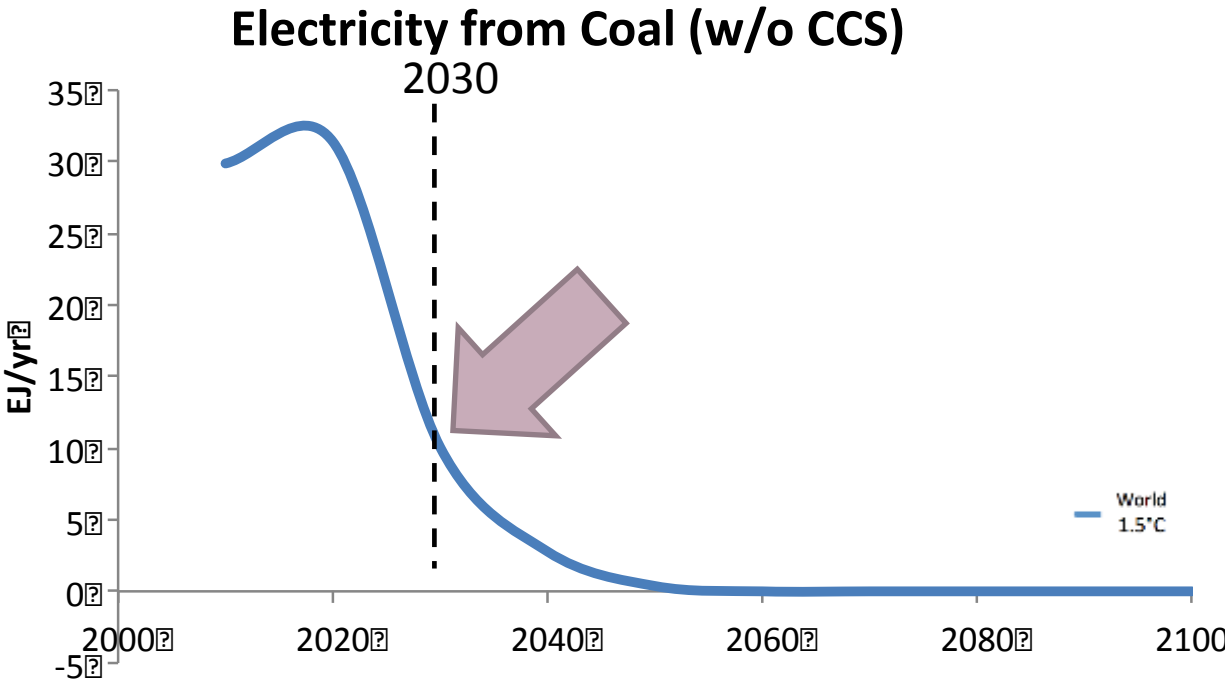
What does 1.5°C mean for negative emissions?



Cumulative negative emissions (GtCO2)

	World
1.5°C	**-457**
2°C	**-448**

Power Sector: rapid phase out of coal



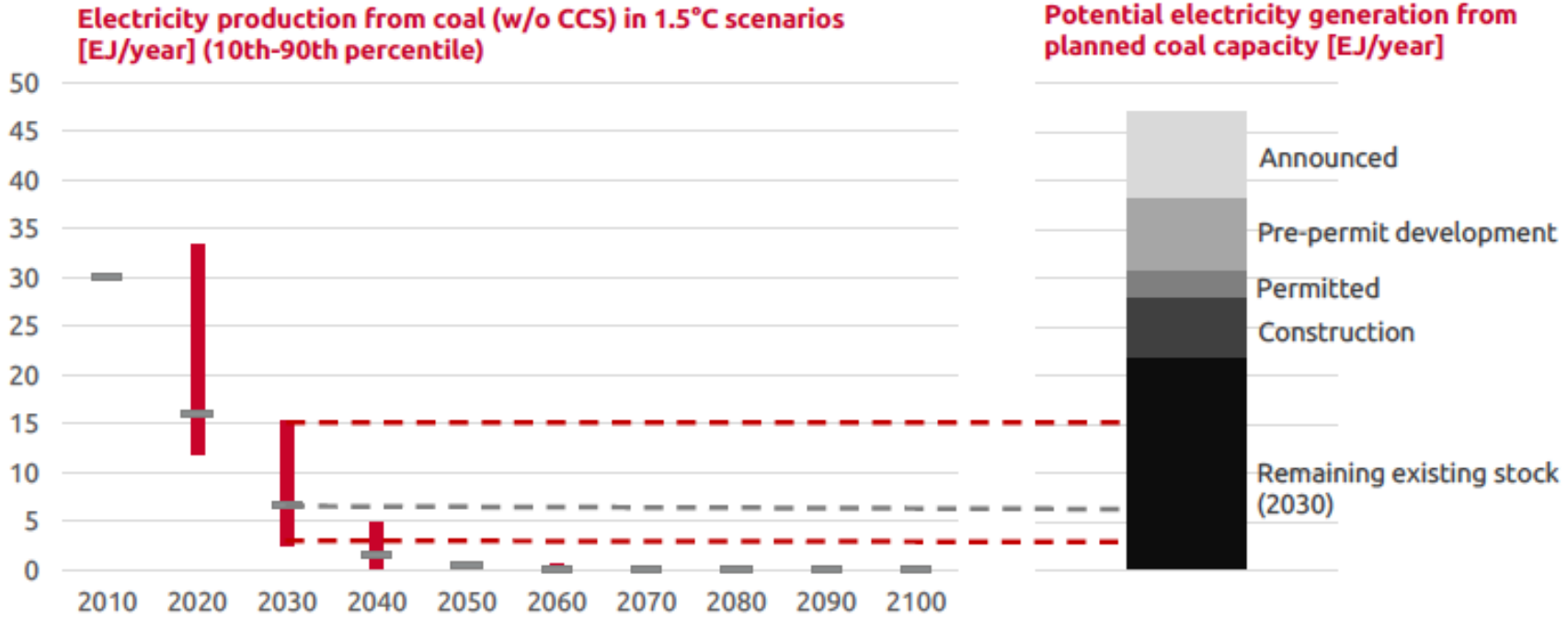
Source: Message Model

Where we need to go:
(-70% by 2030)

Where we are going:
2440 new coal power plants planned around the world

CLIMATE ANALYTICS

Power Sector: rapid phase out of coal



CLIMATE ANALYTICS

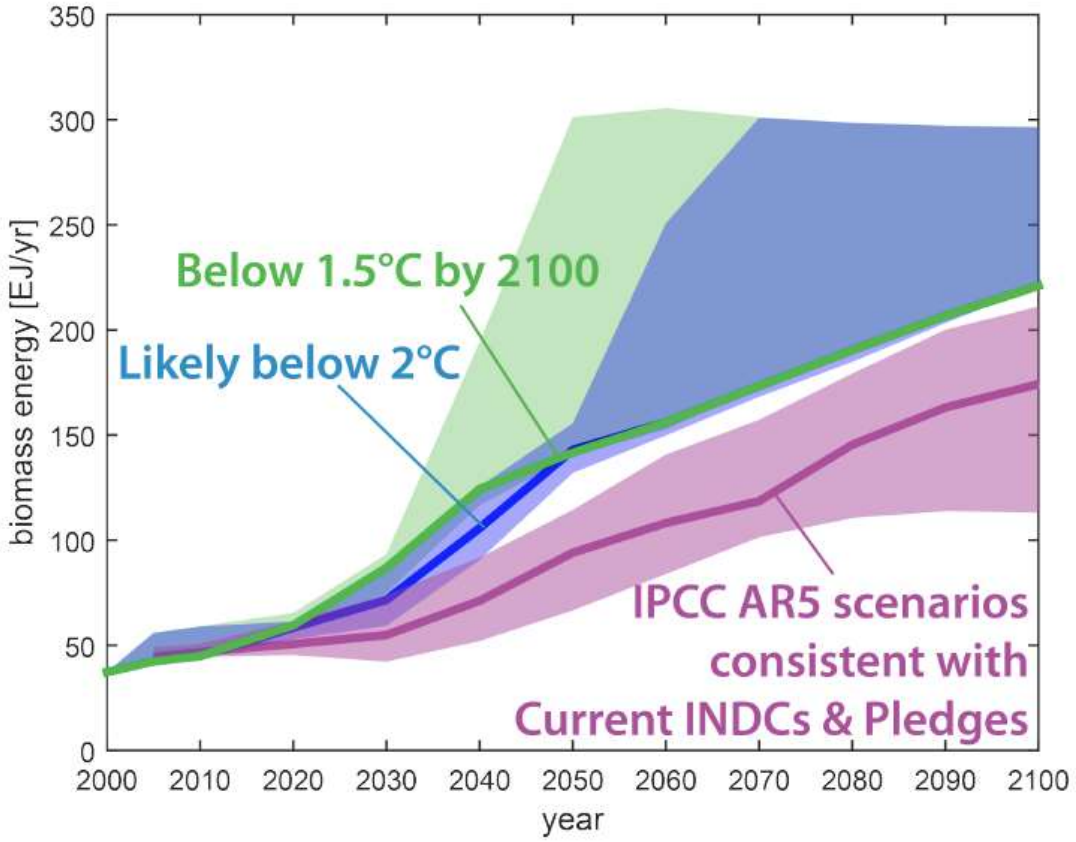
By increasing investment in renewable energy!

- Global technical **potential is substantially higher than demand**
- Economic wide policies are **cost effective**
- Some renewable energy technologies are already **broadly competitive** at existing energy prices
- There is **no fundamental technological limit to renewable energy integration** to existing energy systems
- **Contribution to sustainable development:** development increased energy security, access to energy, reduced air pollution and related health problems

Source: IPCC Special Report on Renewable Energy Sources (SRREN)

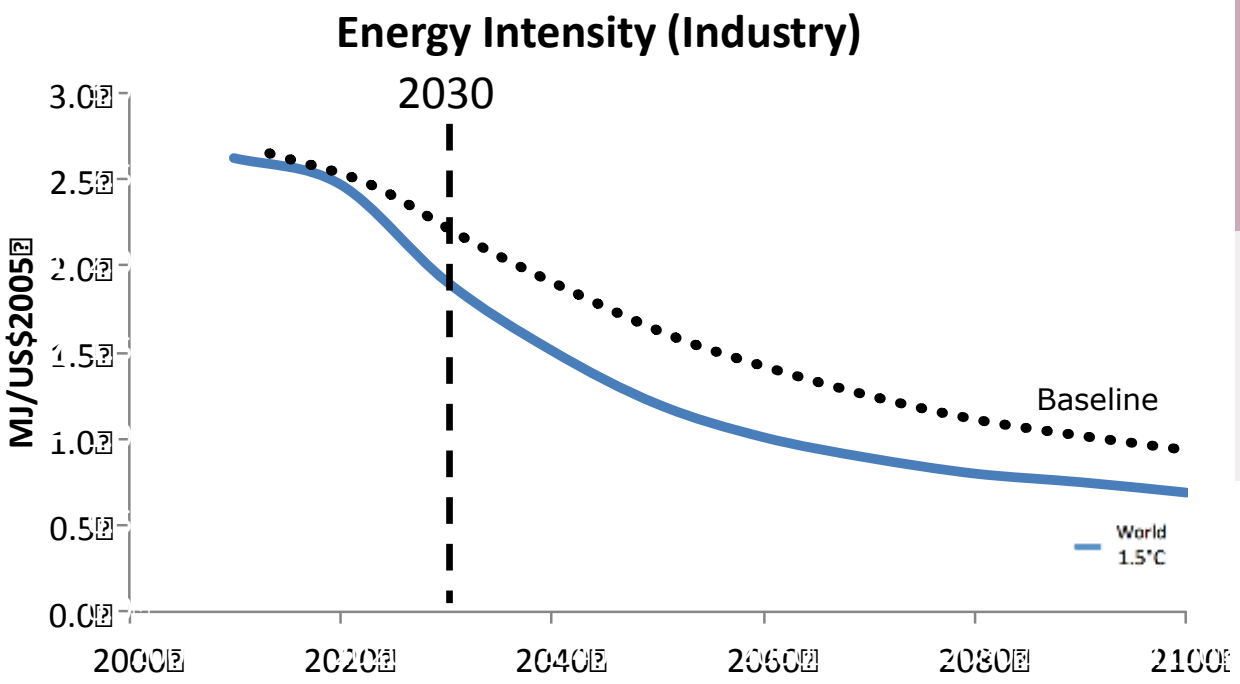
Bioenergy: not a decisive difference between 1.5 and 2°C

- Reaching the 1.5° C limit requires the same technologies as 2° C, but deployed earlier
- Bioenergy demand for 1.5° C is not higher than for 2° C, but needs to be introduced faster and reach large scale around 10 years earlier



CLIMATE ANALYTICS

Industry: energy efficiency is key to reduce energy intensity



Source: Message Model

Where we need to go: -30% by 2030. Acceleration of efforts is required.

Where we are going: -20% below 2010 (Baseline)

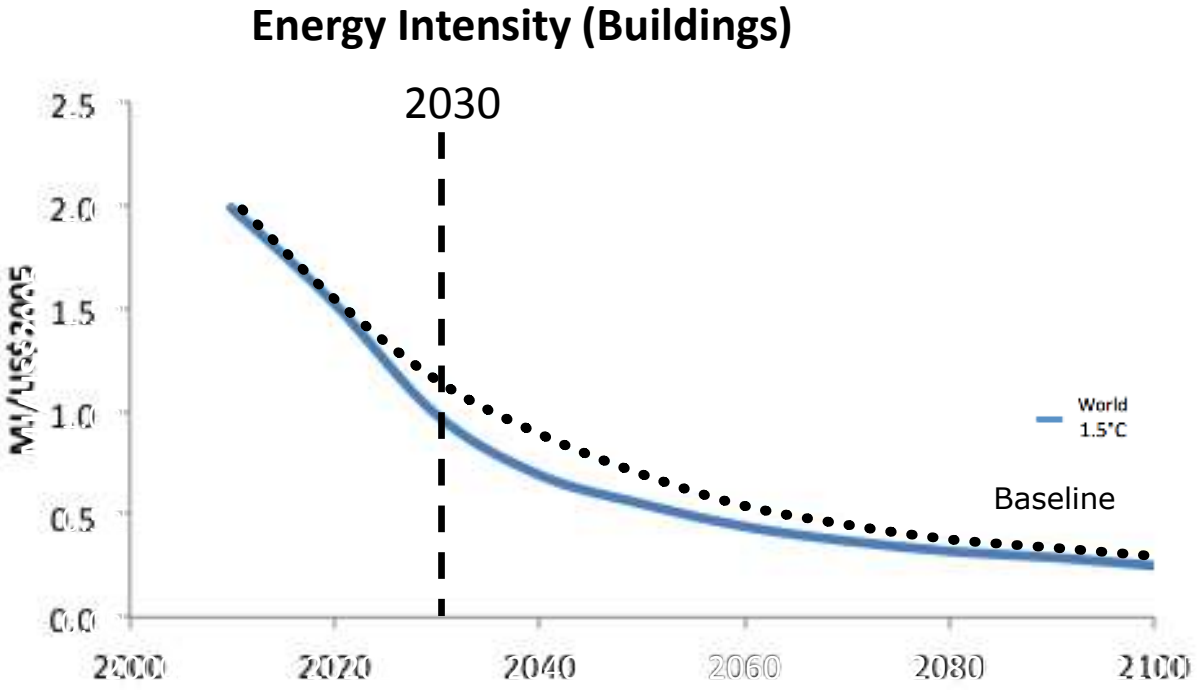
CLIMATE ANALYTICS

By enhancing energy and material efficiency!

- Huge co-benefits in **energy security, economic growth and the environment**
- No unexpected technological breakthroughs needed
- 80% of potential in the building sector, more than 50% in industry are not tapped
- Growth in global primary energy demand could be halved by 2035 whilst meeting energy service needs!
- Every additional dollar invested can generate **three dollars in future fuel savings by 2050**
- **Short payback periods**: between 2 and 8 years

Source: IEA World Energy Outlook 2012

Buildings: energy efficiency is key to reduce energy intensity



Where we need to go: -50% by 2030, below 2010. Sustained efforts are required

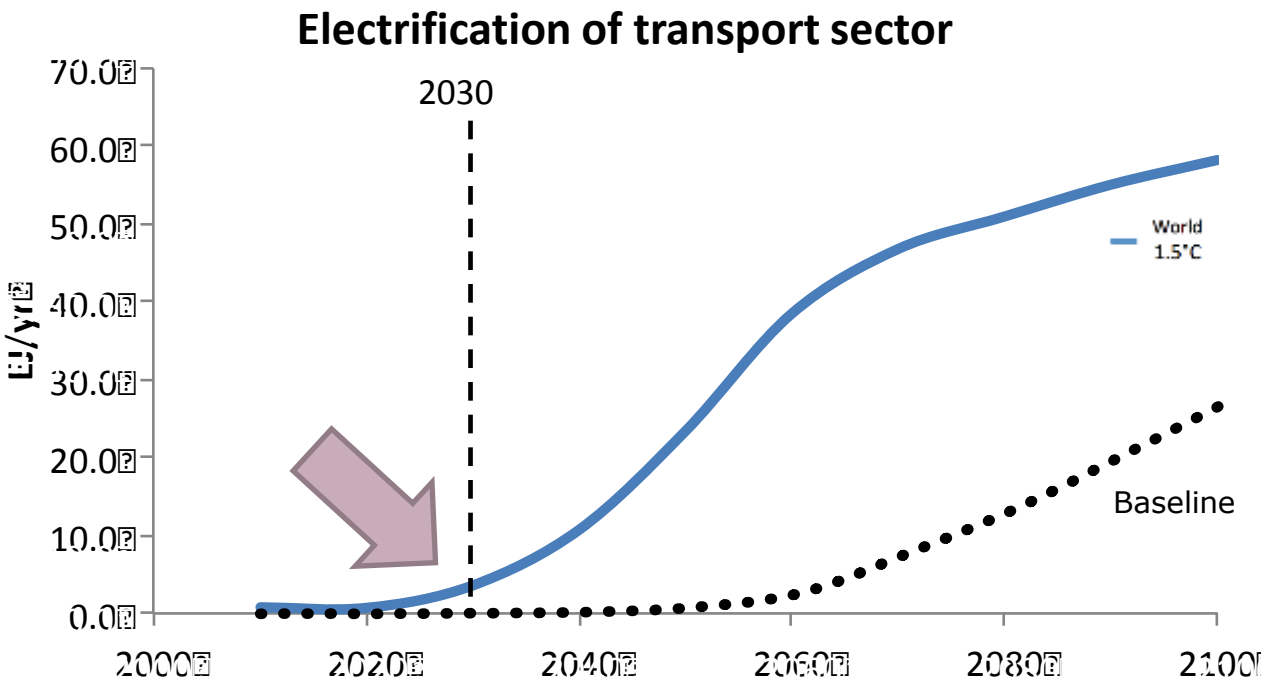
Where we are going: -40% (Baseline scenario)

Source: Message Model

It might seem a small difference, but very important to get 1.5C

CLIMATE ANALYTICS

Transport: electrification is key



Where we need to go

- 4 fold increase by 2030

Where we are going:

- 12% increase by 2030

CLIMATE ANALYTICS

The 1.5°C pathway - summary

Mitigation Costs of 1.5°C pathway vs 2°C pathway

- Mitigation Cost of limiting warming below 2°C is a reduction in global GDP growth of about 0.06% of GDP p.a. over the 21st century.
  - Reduce economic growth rate from, say, 2.30% to 2.24% per year.
    - 2 year delay in reaching the same level of global wealth over the period from 2010 to 2100.
- Mitigation Cost of limiting warming below 1.5°C by 2100 is about 50% more, about 0.1 % of GDP p.a. over century.
  - Reduce economic growth from, say, 2.30% to 2.20% per
  - 4 year delay in reaching the same level of global wealth over the period from 2010 to 2100.
- Mitigation costs do not include the co-benefits which are often as large as or greater than the direct costs.

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1.5°C Pathway

- 1.5°C pathway: technically and economically feasible
    - **Aggregated long-term mitigation costs that are about 1.5 to 2.1 times higher for 1.5°C than for 2°C scenarios, with a larger effect on near-term costs than on long-term costs;**
- Same technologies as 2°C, to be deployed 10-20 years earlier
- Phase out coal much faster
- Tackle all sectors including building and transport
- Increase energy efficiency
- Negative CO_2 emissions required in the second half of the century
- No silver bullet!

CLIMATE ANALYTICS

CLIMATE
ACTION
TRACKER

Assessment of INDCs and implications for the 1.5˚C temperature limit

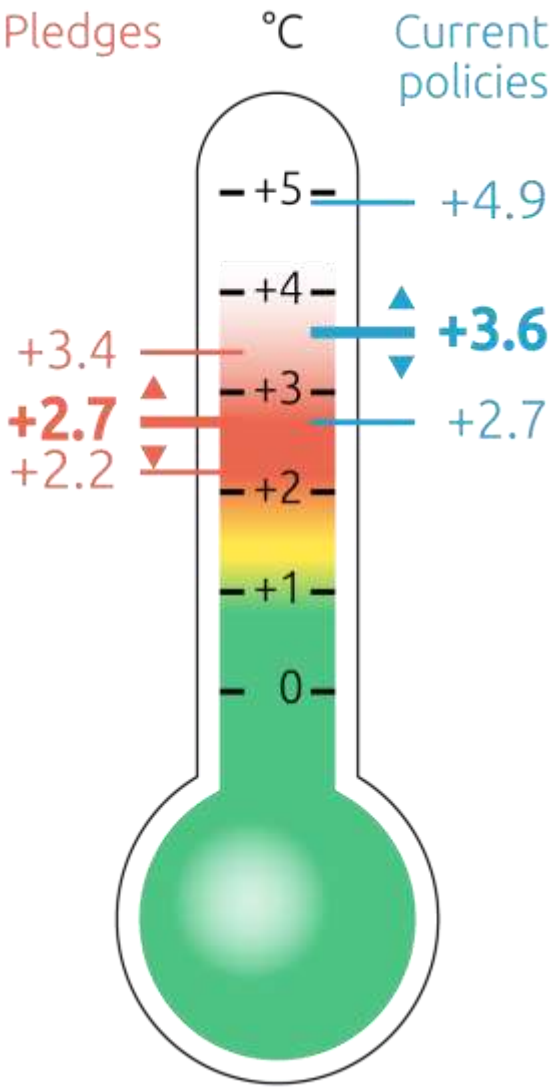
Jasmin Cantzler

18 May 2016

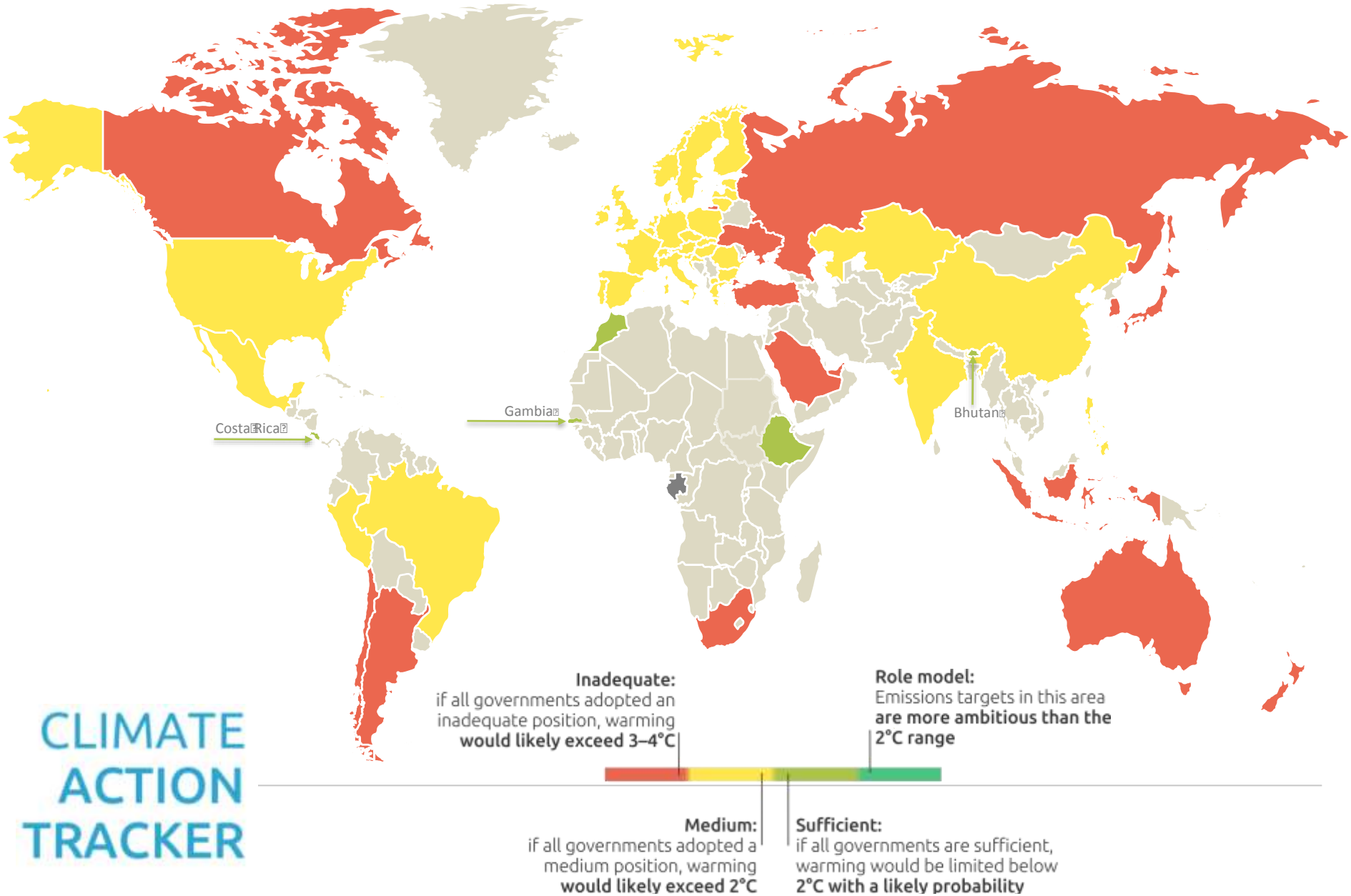
CLIMATE
ANALYTICS

The Climate Action Tracker assesses INDCs and current policies

- Providing **national, fast-response assessments** for 30 countries covering more than 80% of global emissions.
- Evaluating emission reduction **targets,** current climate **policies**.
- Rating the adequacy of INDCs.
- Evaluating consequences of national emissions on global climate through **aggregation of national pathways to global level**.



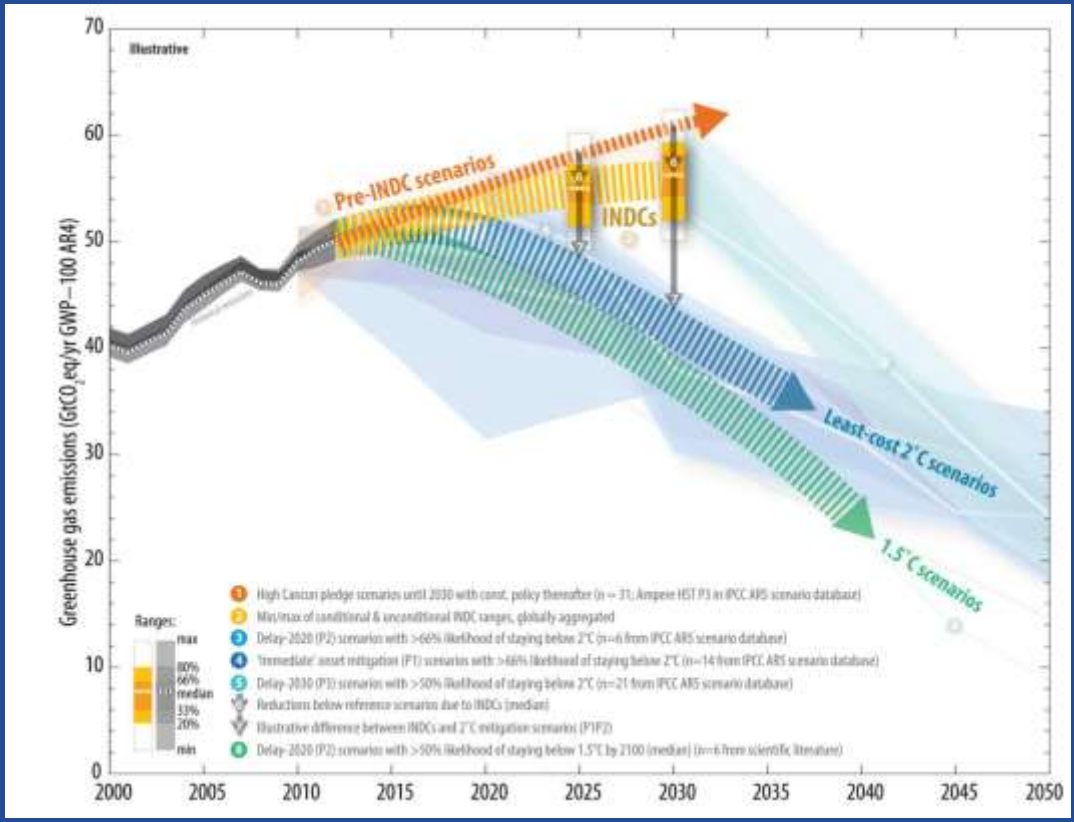
CLIMATE ANALYTICS NEW CLIMATE INSTITUTE CLIMATE ACTION TRACKER ECOFYS PIK



CLIMATE ACTION TRACKER

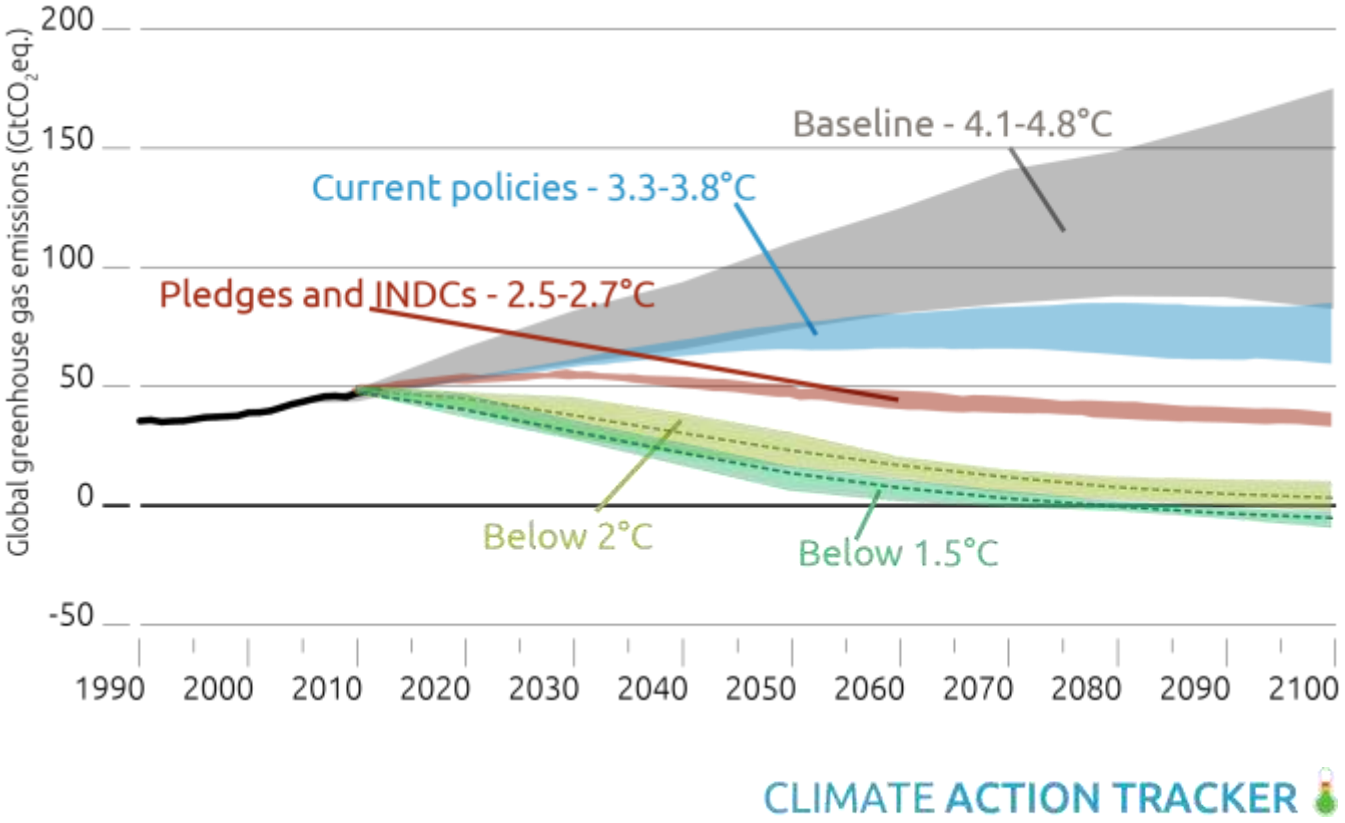
The current level of INDC ambition is not compatible with either 1.5 or 2°C pathways…

A finding that is also confirmed by the UNFCCC Synthesis Report!



CLIMATE ANALYTICS

What are the implications on temperature?



- **INDCs lead to 2.7° C** (likely below 3° C and a 90% chance of warming above 2° C)
- INDCs result in an improvement from current policies, BUT still a long way to go:
- Vast majority of **INDCs not in line with either 2° C or 1.5° C pathways**

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Implications for the 1.5° C temperature limit

INDCs

The current INDCs are not sufficient to meet the temperature goal agreed in Paris of holding warming well below 2° C and pursuing 1.5° C.

NDCs

The NDCs for the period up until 2025, 2030 must be substantially stronger than those currently on the table for holding warming well below 2° C and pursuing 1.5° C.

2018

Waiting until the Global Stocktake would be leaving it too late. Instead, the Facilitative Dialogue is the logical place for it.

All Parties' NDCs must continually increase in ambition; this was the process agreed in Paris.

CLIMATE ANALYTICS

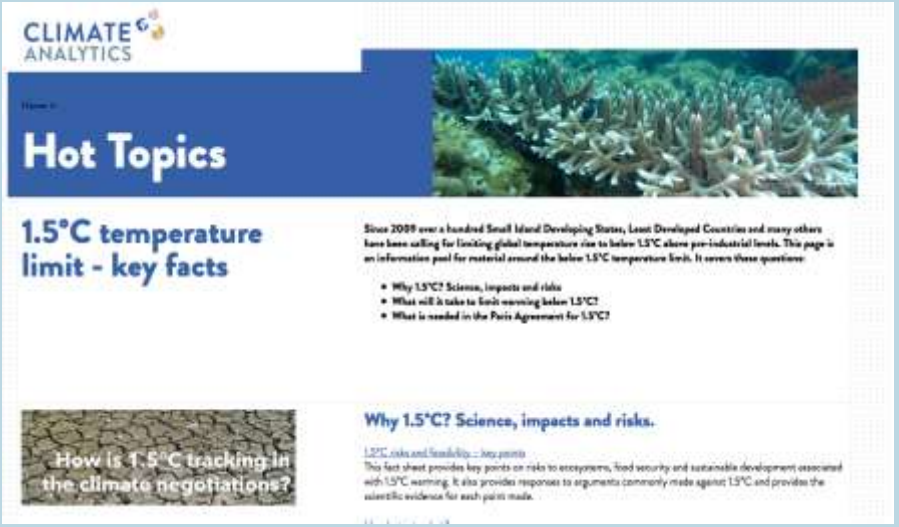
Science based policy to prevent dangerous climate change

www.climateanalytics.org

@CA_Latest

/ClimateAnalytics

You can find additional information about climate impacts and feasibility of the 1.5°C target on our website…



http://climateanalytics.org/hot-topics