1.5°C Global Warming

Can we still get there?

Insights based on the IPCC's Special Report

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Professor, Central European University

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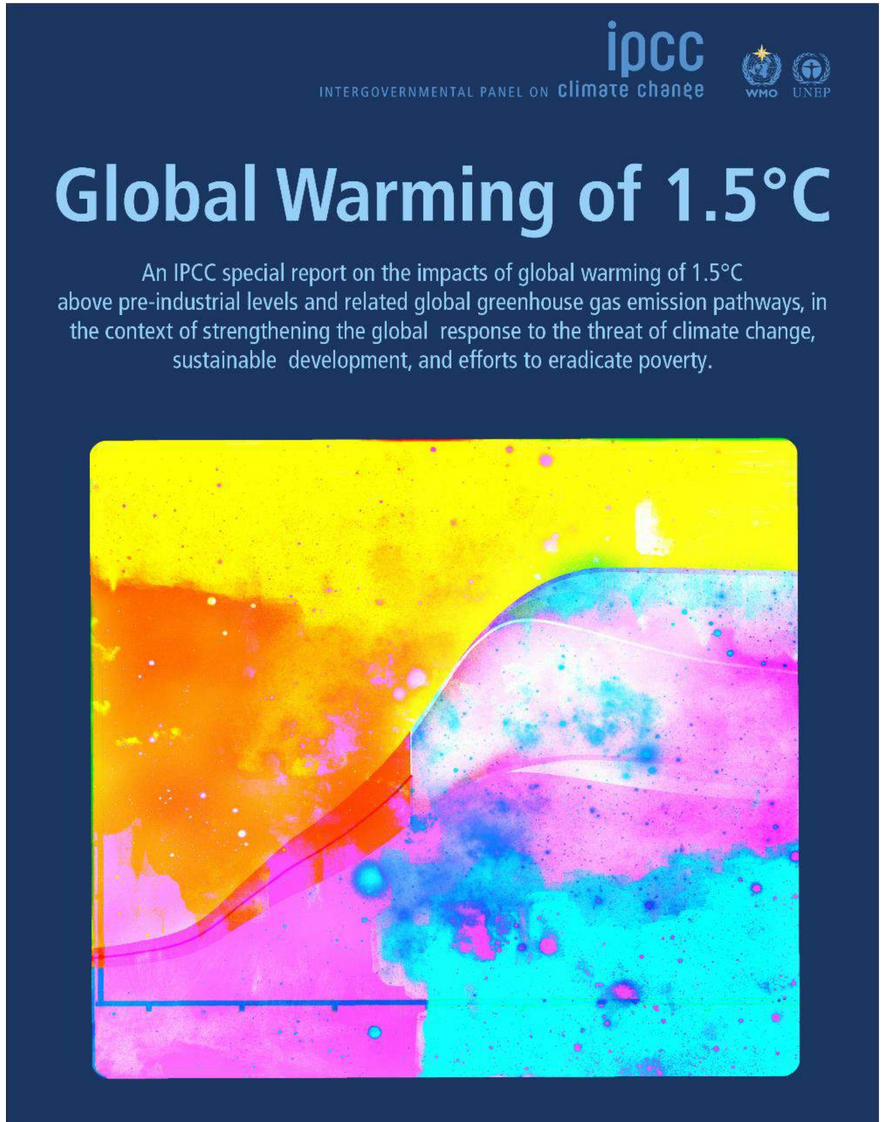
History of the 1.5C warming target

- The lowest emission pathways assessed in AR5 were 450ppm scenarios, i.e. 2C scenarios, lower temperature targets were not assessed
- UNFCCC requests the IPCC to write a special report on 1.5C global warming in the context of the Paris Agreement
- There was initial reluctance to accept the invitation due to concerns about the lack of literature and potential unattainability of the target
- However, at the IPCC plenary in April 2016 this SR was not questioned any more
  - 3 other special reports were decided on
  - Making this the most intensive cycle in IPCC's history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WMO
UNEP
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.

Landslide media success

- Stayed in top headline news of most international and national news media for at least 24 hours but often longer
- Coverage all over the world
  - In the first 48 hours, just what was recorded by IPCC:
  - Over 15,000 online and print articles
  - Often cover page story
  - Over 8 million hits
  - Over 4200 broadcasts
- The quality and quantity of media coverage was completely unprecedented in IPCC history

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NATIONAL

SINKING FEELING
Land in the Mekong Delta is sinking at a rate of around 1.1cm each year, causing serious flooding concerns for local administrators.

PAGE 4

INSIGHT
VIOLENCE SPIKE
A recent spike in violence in the volatile regions of the Democratic Republic of Congo is being blamed on a shadowy armed group of rebels.

PAGE 12

PM Phúc calls for SOE investment from Japan

Prime Minister Nguyễn Xuân Phúc has encouraged Japanese businesses to become strategic partners with Việt Nam's State-owned enterprises, especially in industrial infrastructure construction

Story on Page 13

Eurasian speakers wrap up third meeting in Turkey

The third Meeting of Speakers of Eurasian Countries' Parliaments in Turkey, closed on Tuesday with National Assembly Chairwoman Nguyễn Thị Kim Ngân leading a Vietnamese delegation to the event

Story on Page 2

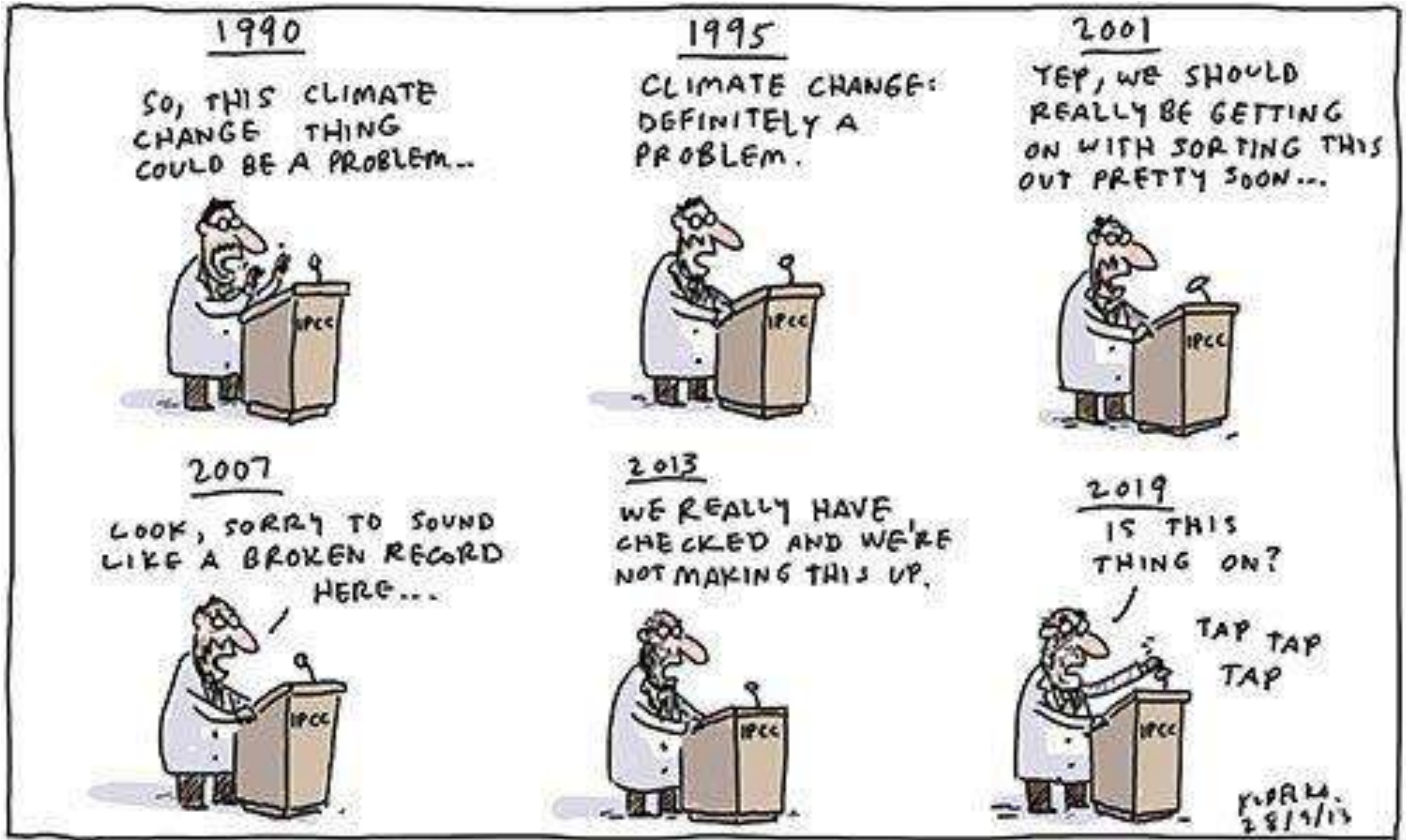
UN climate change report revealed in Việt Nam

A landmark UN report on the impacts of global warming was shared in Việt Nam yesterday

Story on Page 6

Inflation fears as fuel prices scale up

...nmental protection taxes on petroleum from next year would


1990
SO, THIS CLIMATE CHANGE THING COULD BE A PROBLEM...
IPCC
1995
CLIMATE CHANGE: DEFINITELY A PROBLEM.
IPCC
2001
YEP, WE SHOULD REALLY BE GETTING ON WITH SORTING THIS OUT PRETTY SOON...
IPCC
2007
LOOK, SORRY TO SOUND LIKE A BROKEN RECORD HERE...
IPCC
2013
WE REALLY HAVE CHECKED AND WE'RE NOT MAKING THIS UP.
IPCC
2019
IS THIS THING ON?
TAP TAP TAP
IPCC

Selected main questions asked in the report

- Does 0.5˚C difference matter?
- Can warming still be capped at 1.5˚C?
- If yes, how?

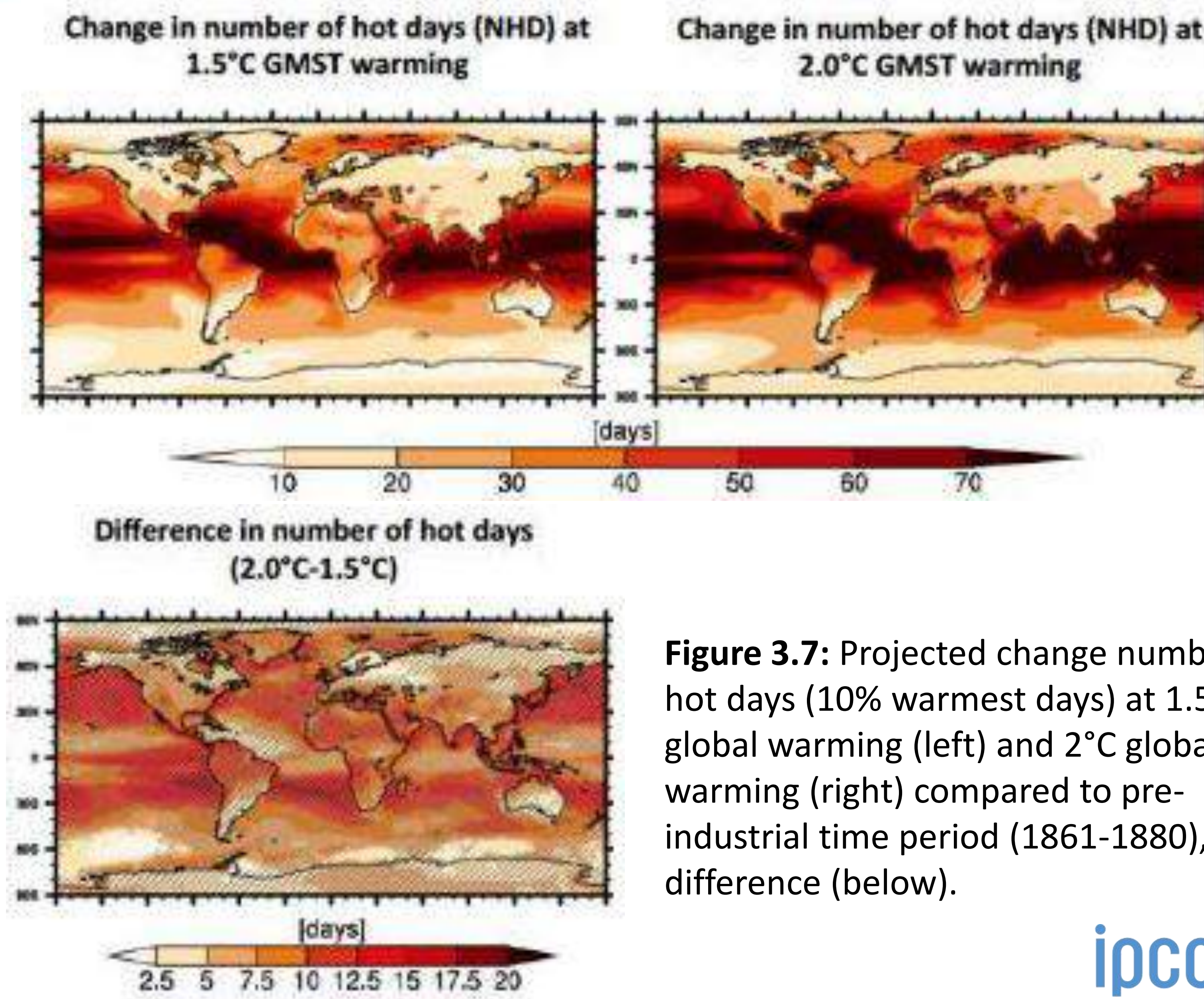


Figure 3.7: Projected change number of hot days (10% warmest days) at 1.5°C global warming (left) and 2°C global 10 warming (right) compared to pre-industrial time period (1861-1880), and difference (below).

Understanding feasibility

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Feasibility

- no single answer
  - *Defined in this report: the capacity of a system as a whole to achieve a specific outcome*
- Feasibility decomposed into:
  - Geophysical
  - Technological
  - Economic
  - environmental-ecological
  - socio-cultural
  - institutional

Where are we now?

Ashley Cooper / Aurora Photos

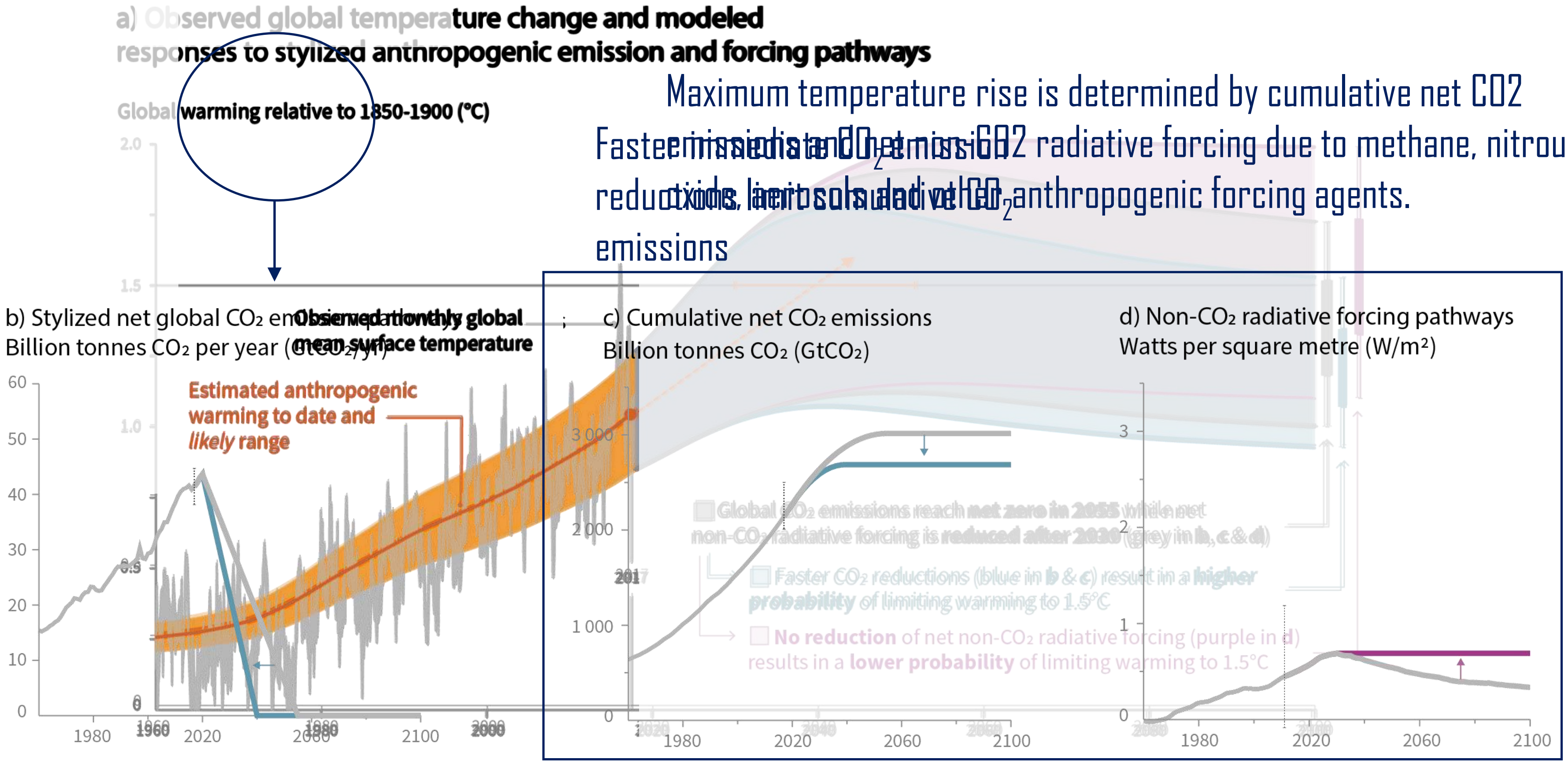
Since pre-industrial times, human activities have caused approximately 1˚C of global warming.

- 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

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.

Faster immediate CO_2 emission reductions limit cumulative CO_2 emissions



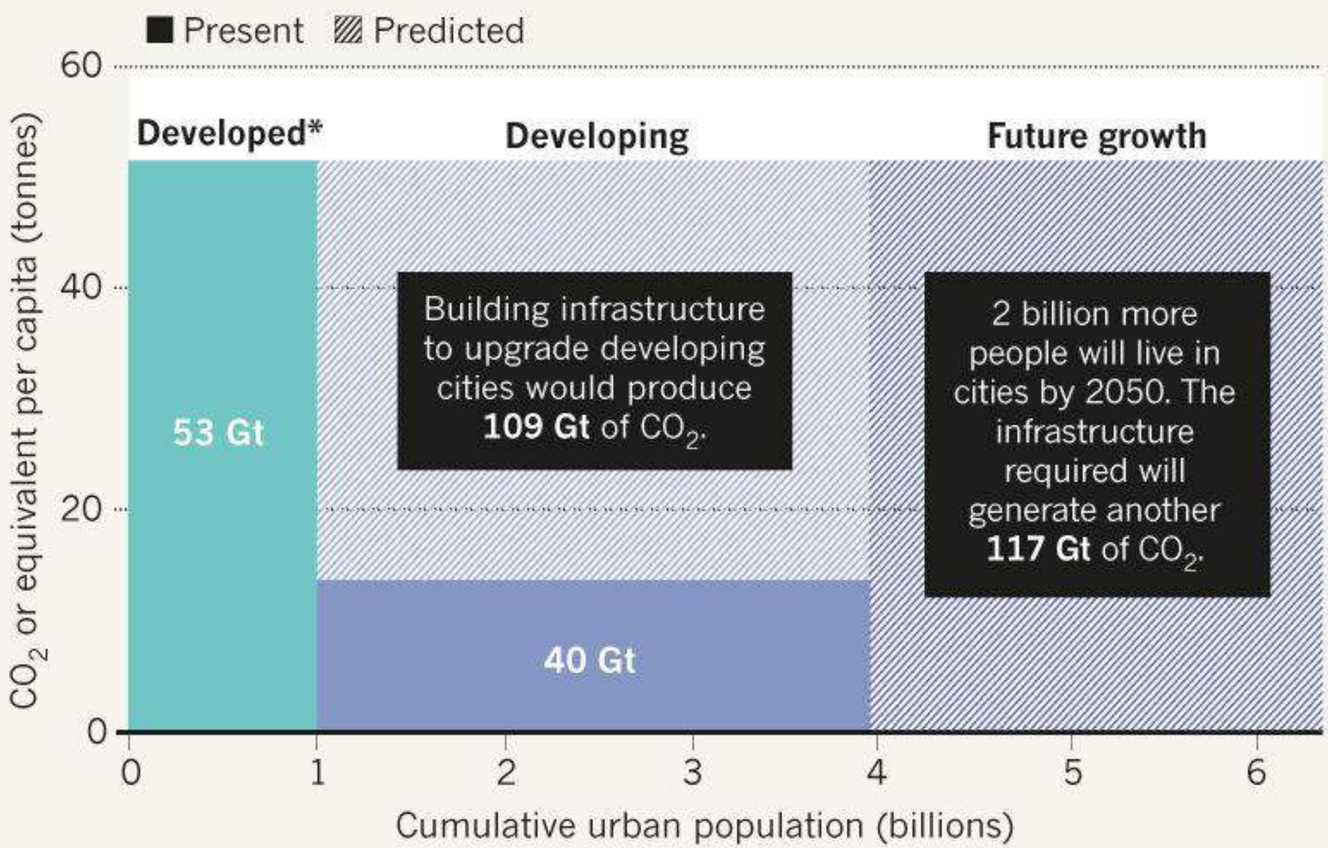
Updated figures on our remaining carbon budget (CB)

- By 2017, humans depleted the CB by app **2200 GtCO_2**
- current emissions are at app **42 GtCO_2 per year**
- The choice of the measure of global temperature affects the estimated remaining carbon budget
- Using global mean **surface *air* tempera**ture, as in AR5, gives an estimate of the remaining CB of **580 GtCO_2 for a 50%** probability**, 420 GtCO_2 for a 66%** probability
- using **GMST** gives estimates of **770** and **570 GtCO_2**, for **50%** and **66%** probabilities
- *At current rates of emissions,* this gives us **app. 10 – 18 year window** to decarbonise our economies in order to stay within the carbon budget

Put into context: Urban infrastructure development can consume app a third of our remaining carbon budget to a 1.5C target?

URBAN DEVELOPMENT CHALLENGE

Building infrastructure for fast-growing cities in developing countries could release 226 gigatonnes (Gt) of carbon dioxide by 2050 — more than four times the amount used to build existing developed-world infrastructure. To curb emissions, cities need low-carbon construction, alternative transport and better planning and design.



*Developed countries are as listed in Annex I to the Kyoto Protocol. Developing countries are those not listed in Annex I.

Source: Bai, X. et al. Six Research Priorities for Cities and Climate Change. Nature, Mar 1, 2018.

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

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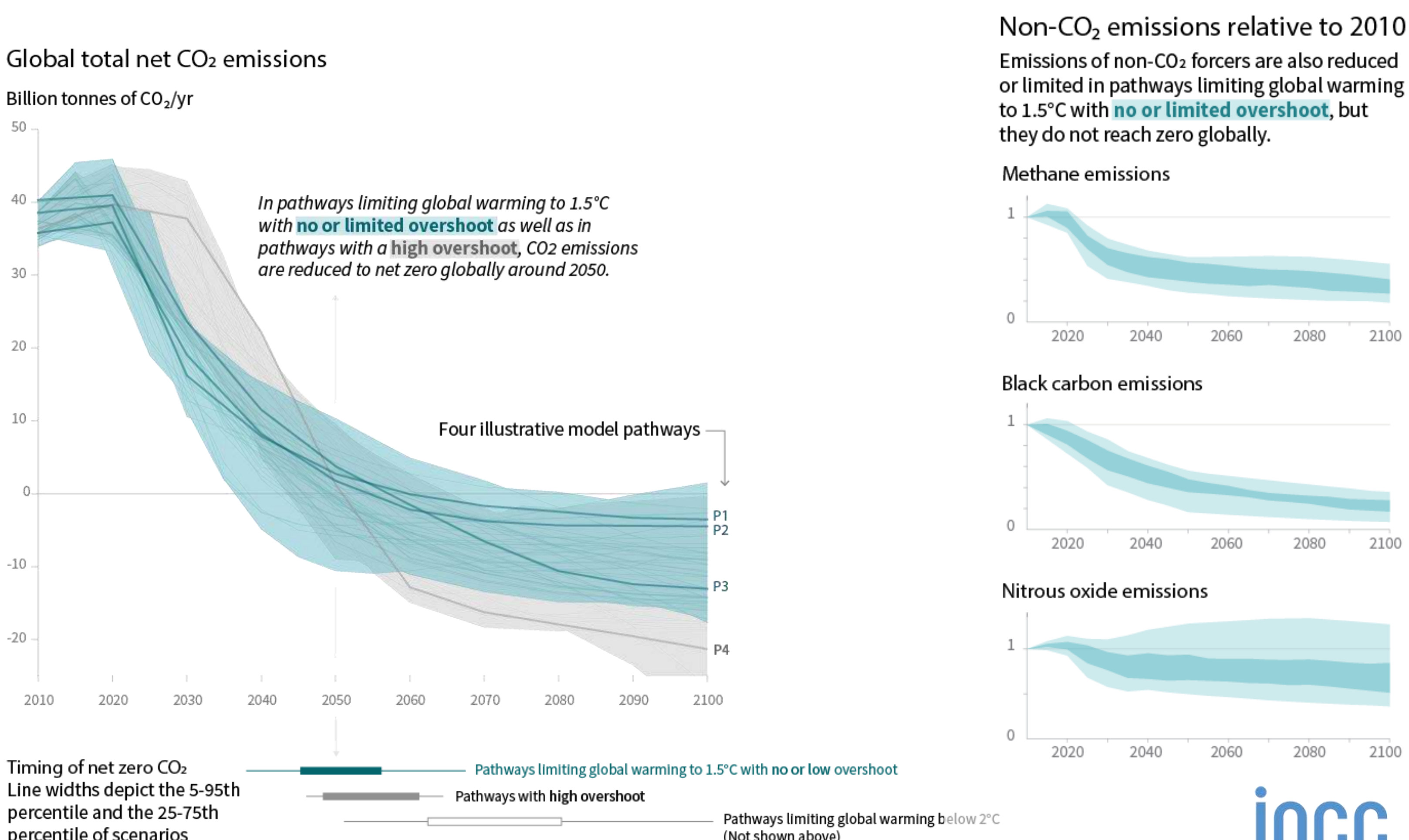
Emission pathways - definition

- The modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways.
- Emission pathways are classified by their temperature trajectory over the 21st century:
  - pathways giving **at least 50% probability** based on current knowledge of limiting global warming to **below 1.5°C** are classified as '**no overshoot**';
  - those limiting warming **to below 1.6°C** and **returning to 1.5°C by 2100** are classified as '**1.5°C limited-overshoot**';
  - while those **exceeding 1.6°C** but still **returning to 1.5°C by 2100** are classified as '**higher-overshoot**'.

SPM3a | Global emissions pathway characteristics



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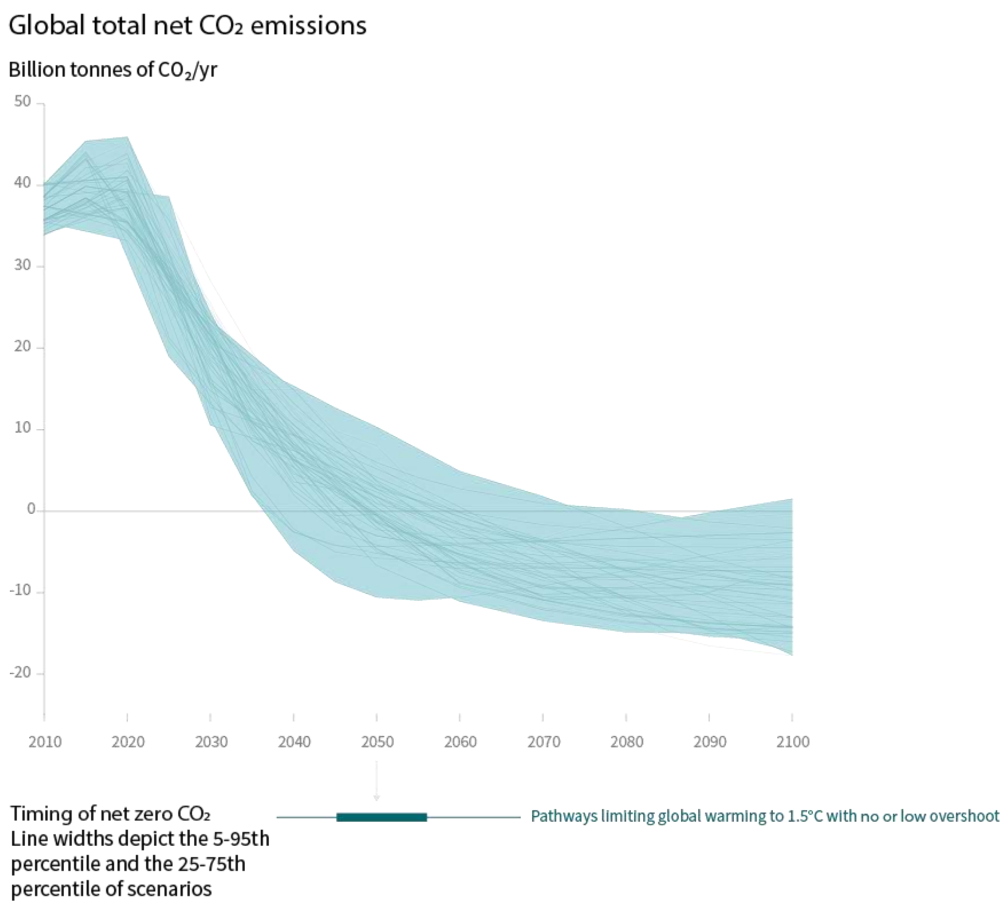

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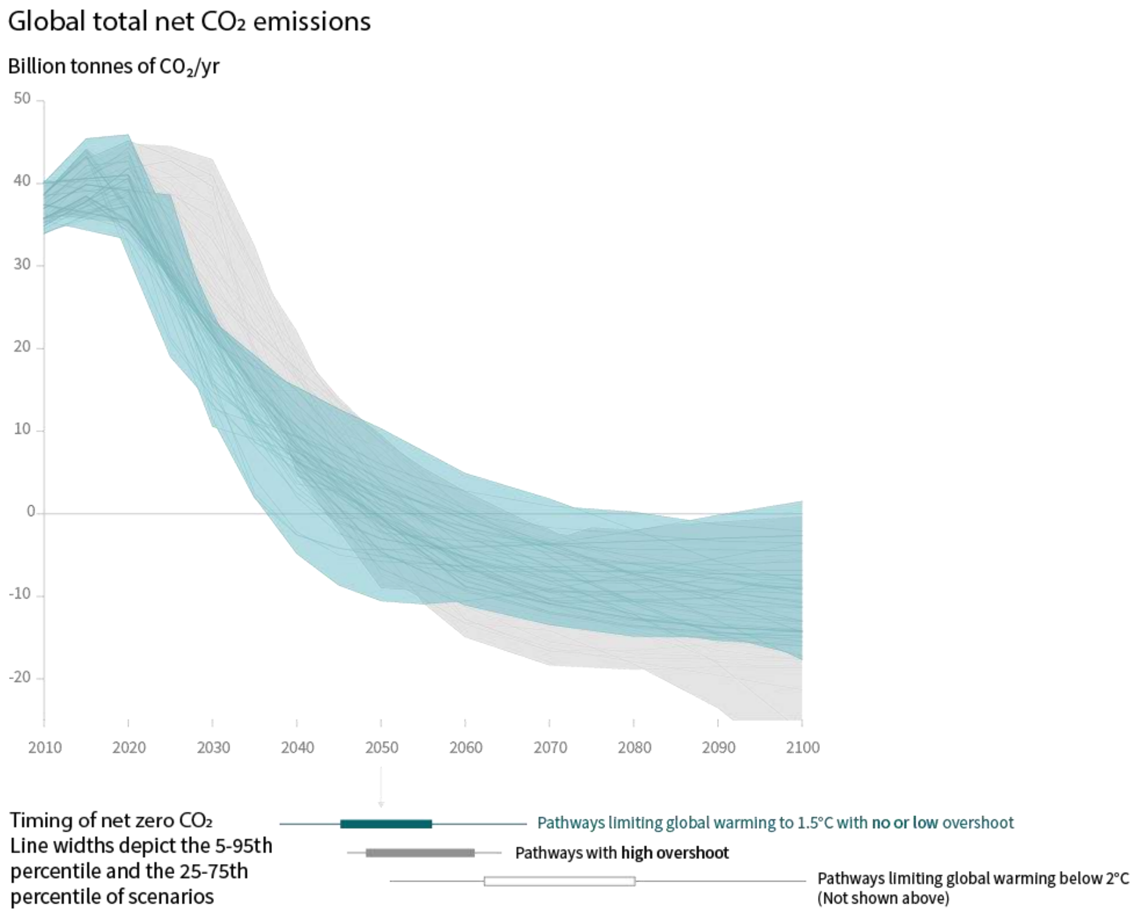

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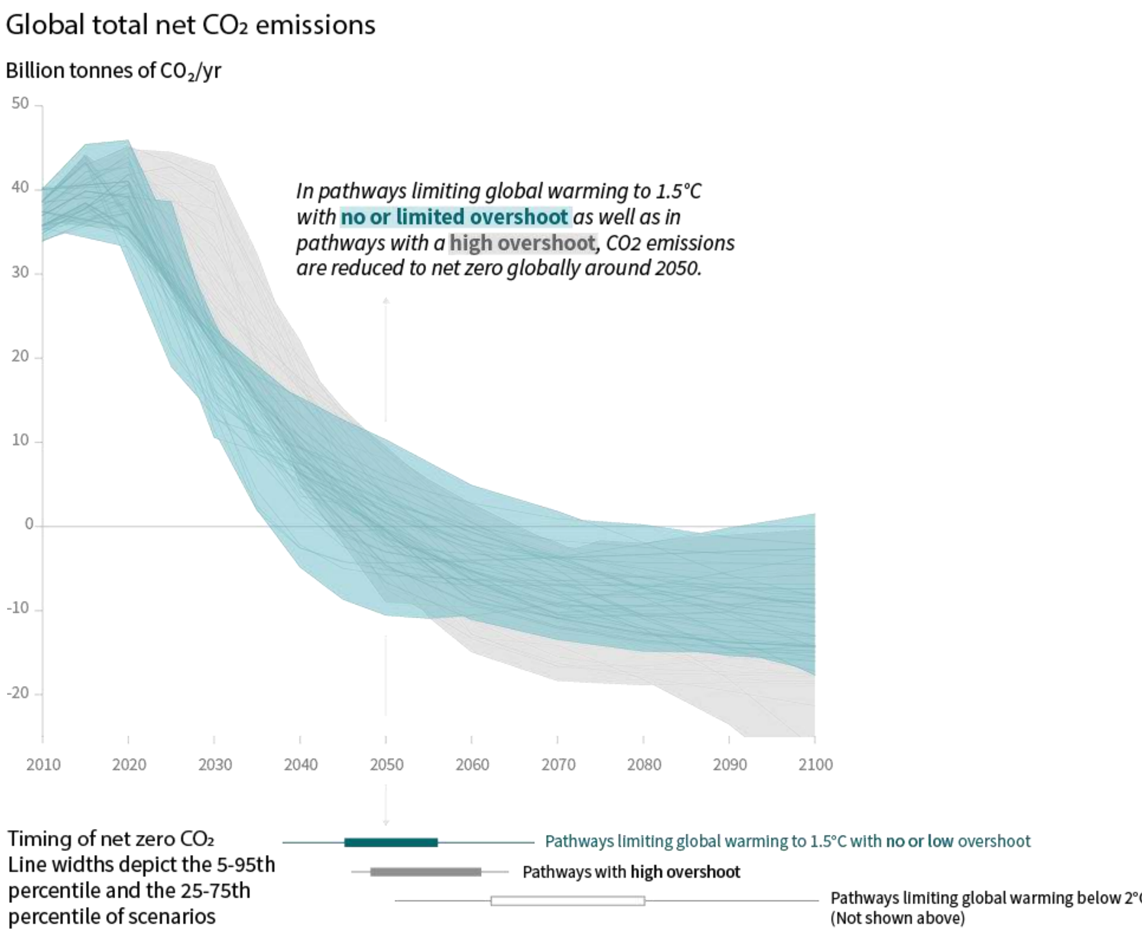
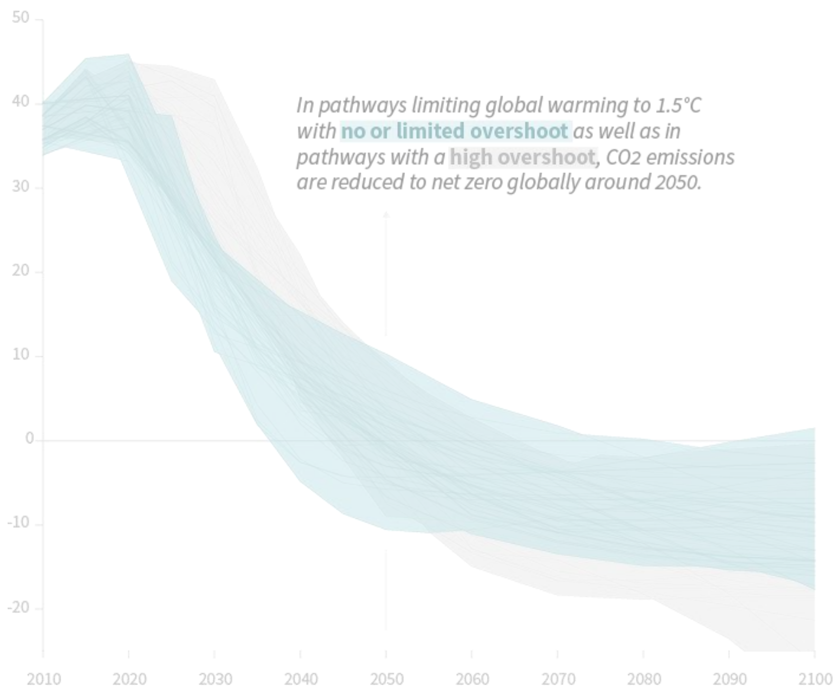
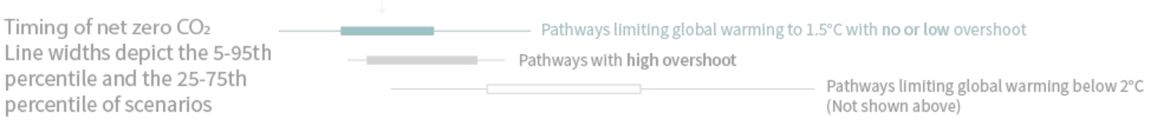


SPM3a | Global emissions pathway characteristics

Global total net CO_2 emissions

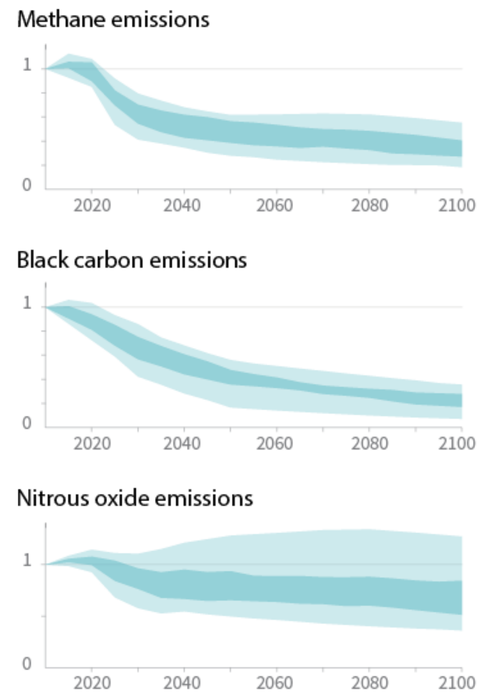
Billion tonnes of CO_2/yr





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.



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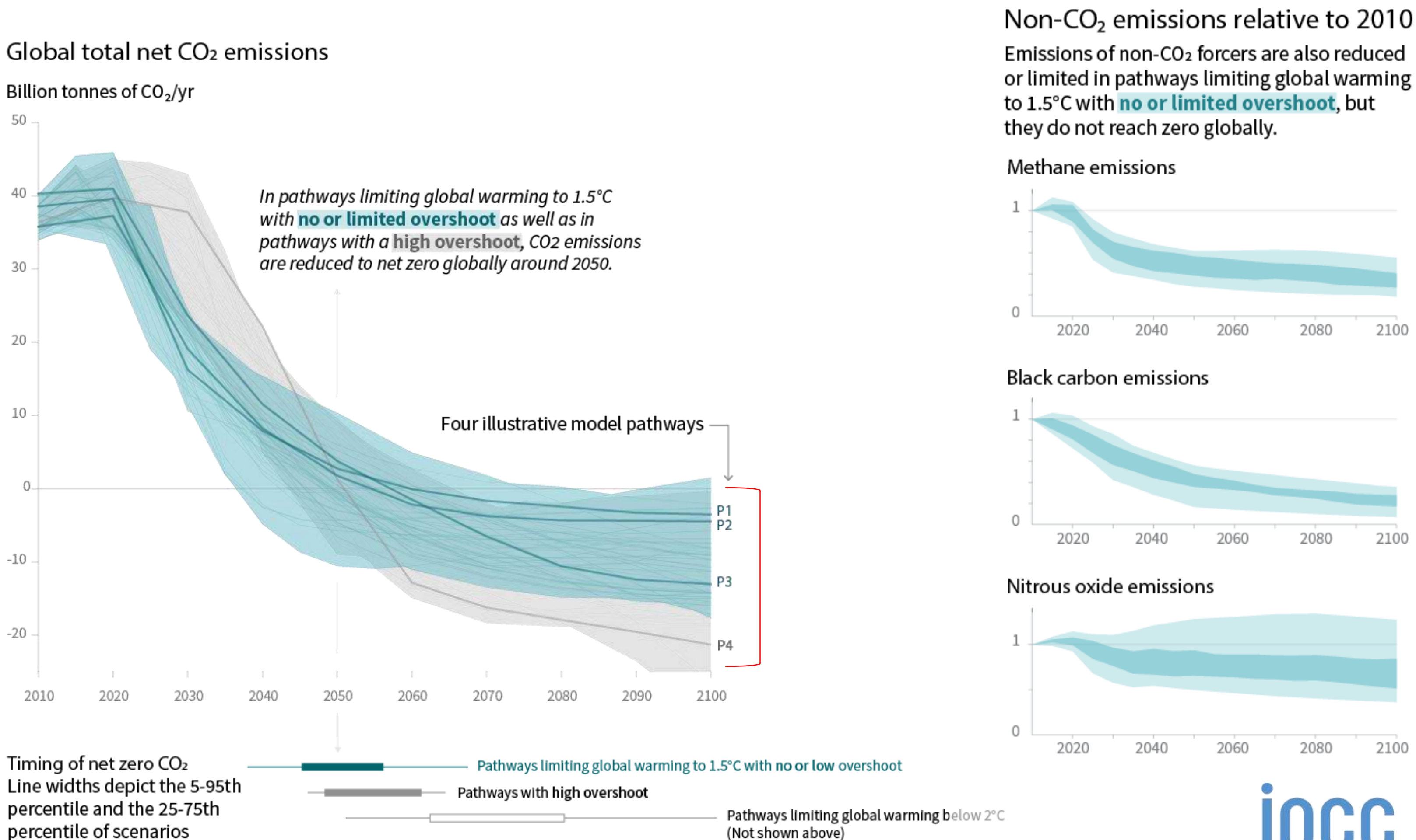

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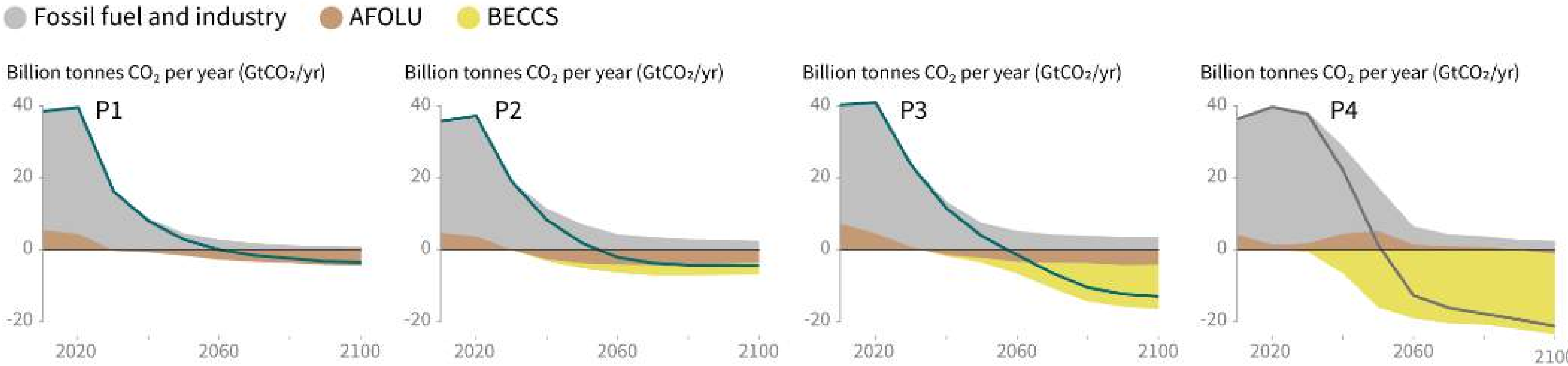
SPM3b | Characteristics of four illustrative model pathways

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 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.

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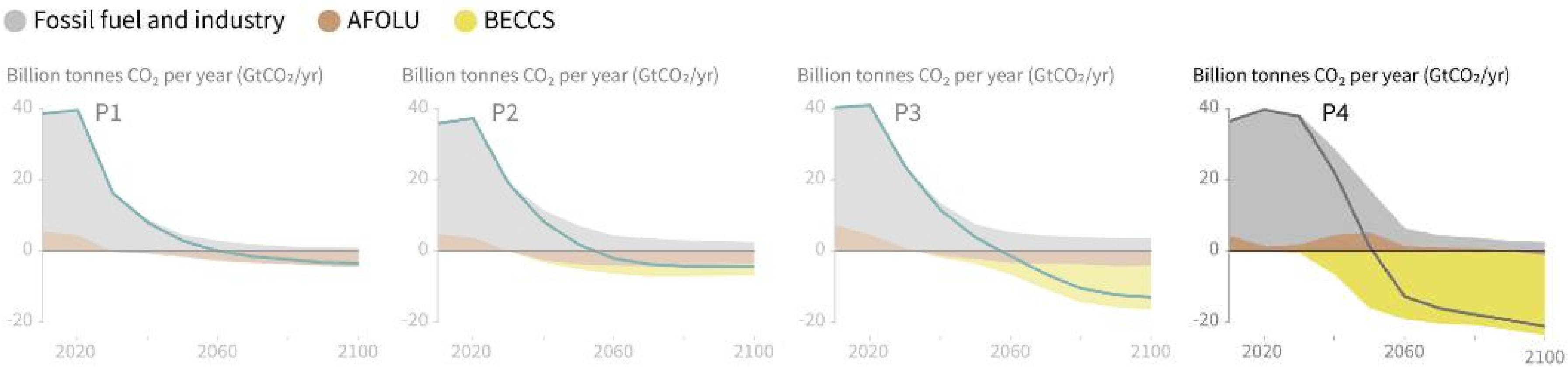

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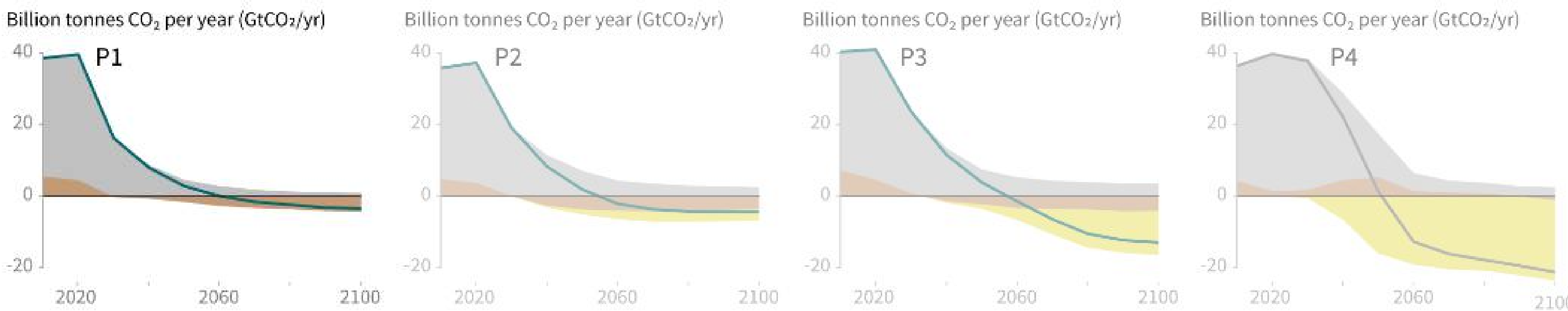
Fossil fuel and industry AFOLU BECCS



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What can we learn from the pathways?

- Capping warming at 1.5C is feasible from a technological perspective
- There are still choices in the pathways how we can get there
- However, each pathway involves virtually all options (except BECCS or CCS), the difference is only in the emphasis on different options
- All pathways peak global emissions in the next few years, and radically reduce emissions afterwards
- The pathways have markedly different implications on sustainable development

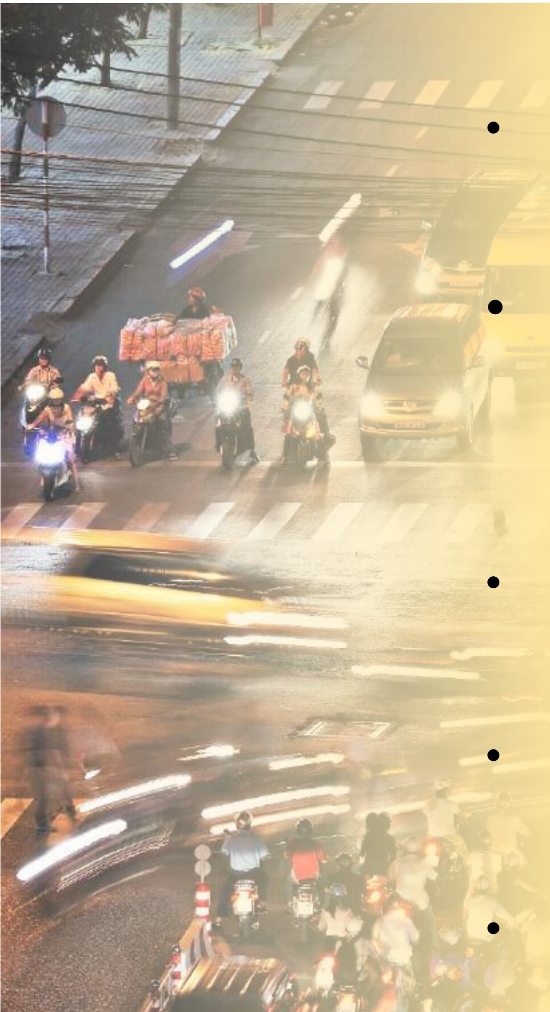
Gerhard Zwerger-Schoner / Aurora Photos

Key characteristics of the 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

Costs

- economy wide costs and benefits of limiting warming to 1.5°C.
  - limited number of model studies report economy wide mitigation costs
  - Such costs do not include the benefits of reduced climate change as well as synergies and trade-offs of mitigation
- [these model studies project **1.5-2.7%** (interquartile range) **lower consumption in 2050** compared to 2°C pathways,
  - which in turn project 1.4-3.7% lower consumption than in the baseline
- Consumption in the **baseline** underlying these estimates grows between 270-320% from 2010 to 2050.]



Gerhard Zwerger-Schoner / Aurora Photos

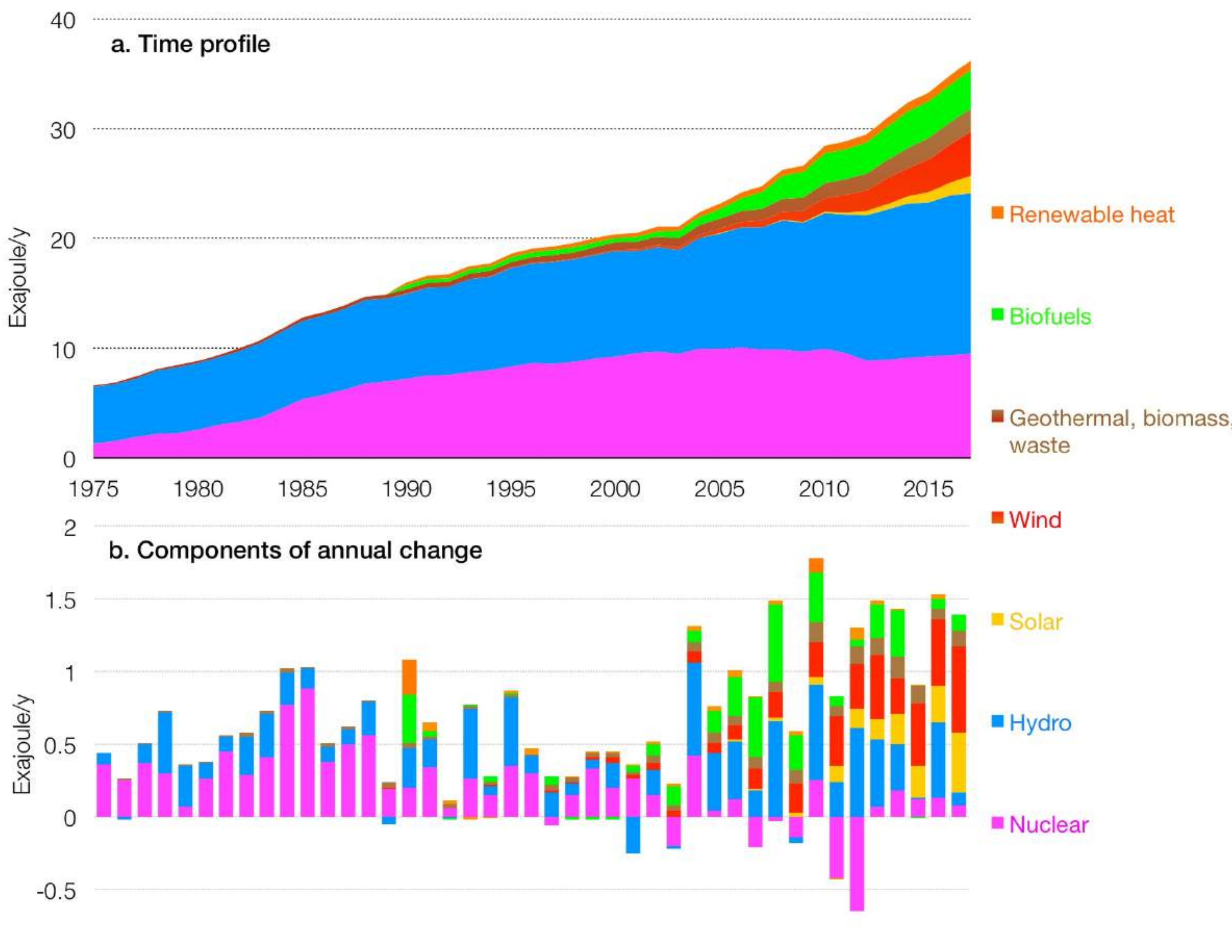
Necessary transitions

- Pathways with no or limited overshoot show **system changes** that are **more rapid and pronounced** over the next two decades than in 2°C pathways
- The rates of system changes **have occurred in the past within specific sectors, technologies and spatial contexts**, but **there is no documented historic precedent for their scale**
- The **energy system transition** that is required to limit global warming to 1.5°C **is underway in many sectors and regions** around the world
- The political, economic, social and technical feasibility of **solar** and **wind** energy and electricity **storage has improved dramatically over the past few years**,
- while that of **nuclear energy** and **CCS have not shown similar improvements.**

Some facts on the energy system transition

- In 2017, **64%** of the world's net additions of electric generating capacity were modern renewables (*i.e*. excluding hydroelectric dams of ≥50 MW_e)
- These **passed nuclear power output in 2016** and a one trillion watts' installed global capacity in mid-2017.
- today's PV capacity is >40 x IEA's 2002 forecast
- renewable prices: world levelized nominal prices fell ***in 2016 alone*** by 18% for onshore wind, 17% for utility-scale PV, and 28% for offshore wind, while the lowest bids fell 37% for Mexican PV and 43% for EU offshore wind
- Bloomberg energy finance outlook projects that to **>80%** of global electricity related investments between 2018–40 will be into new renewables

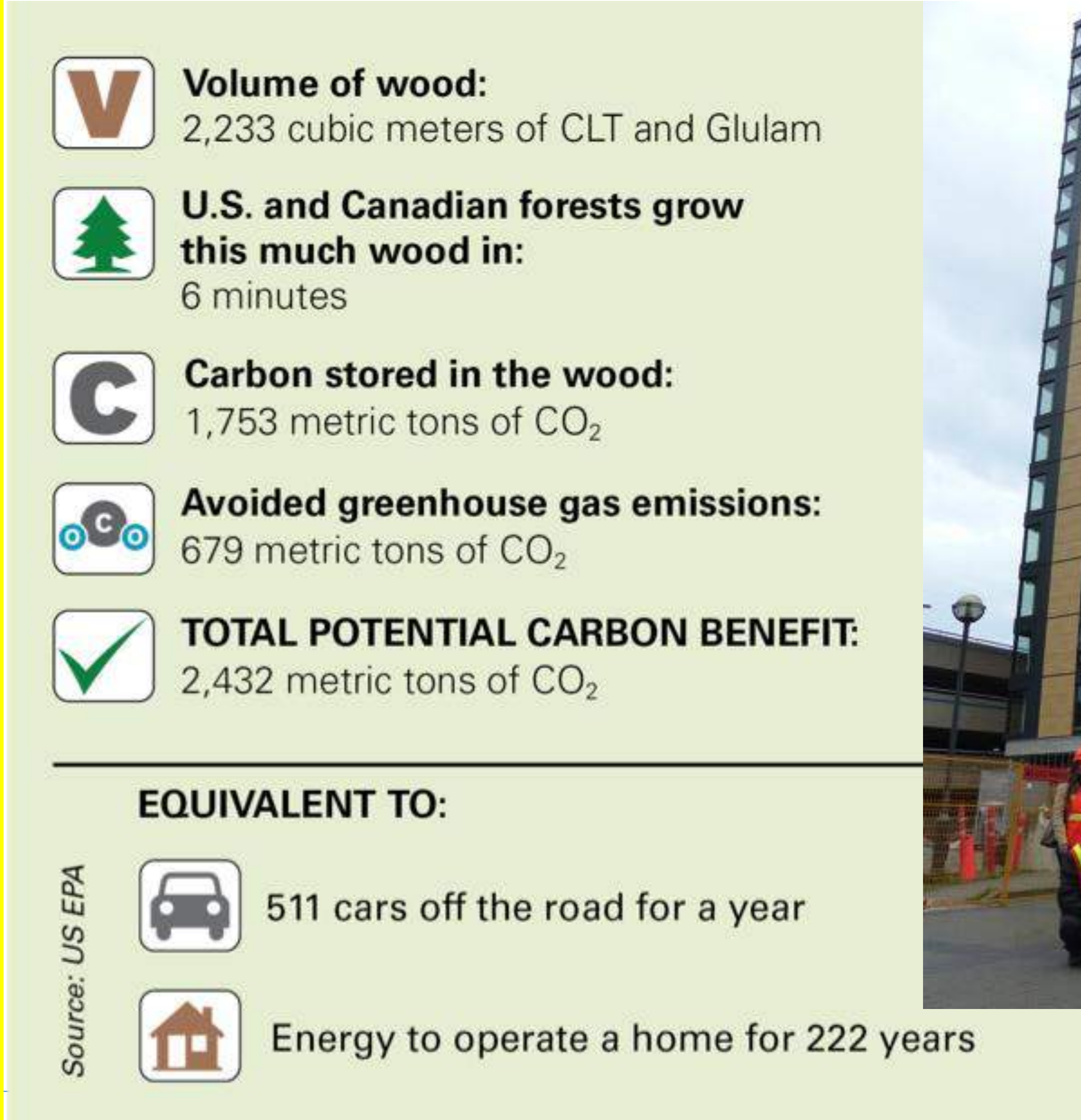
Global total final commercial energy consumption from non-fossil-fuel sources, 1975–2017 (21% of 2016 total)



Potentially important mitigation opportunities relevant for low demand scenarios

- Urban design of new city parts and their infrastructures will be pivotal
- Architecture minimizing cooling loads (e.g. by insulation with heat recovery ventilation, external shading)
- Minimising concrete use for urban expansion and building construction, where possible
  - Smart designs; using bio-based materials
- Net zero, or energy plus buildings are now feasible and affordable

Brock Commons: first 19-storey high-rise from wood
Carbon Impact



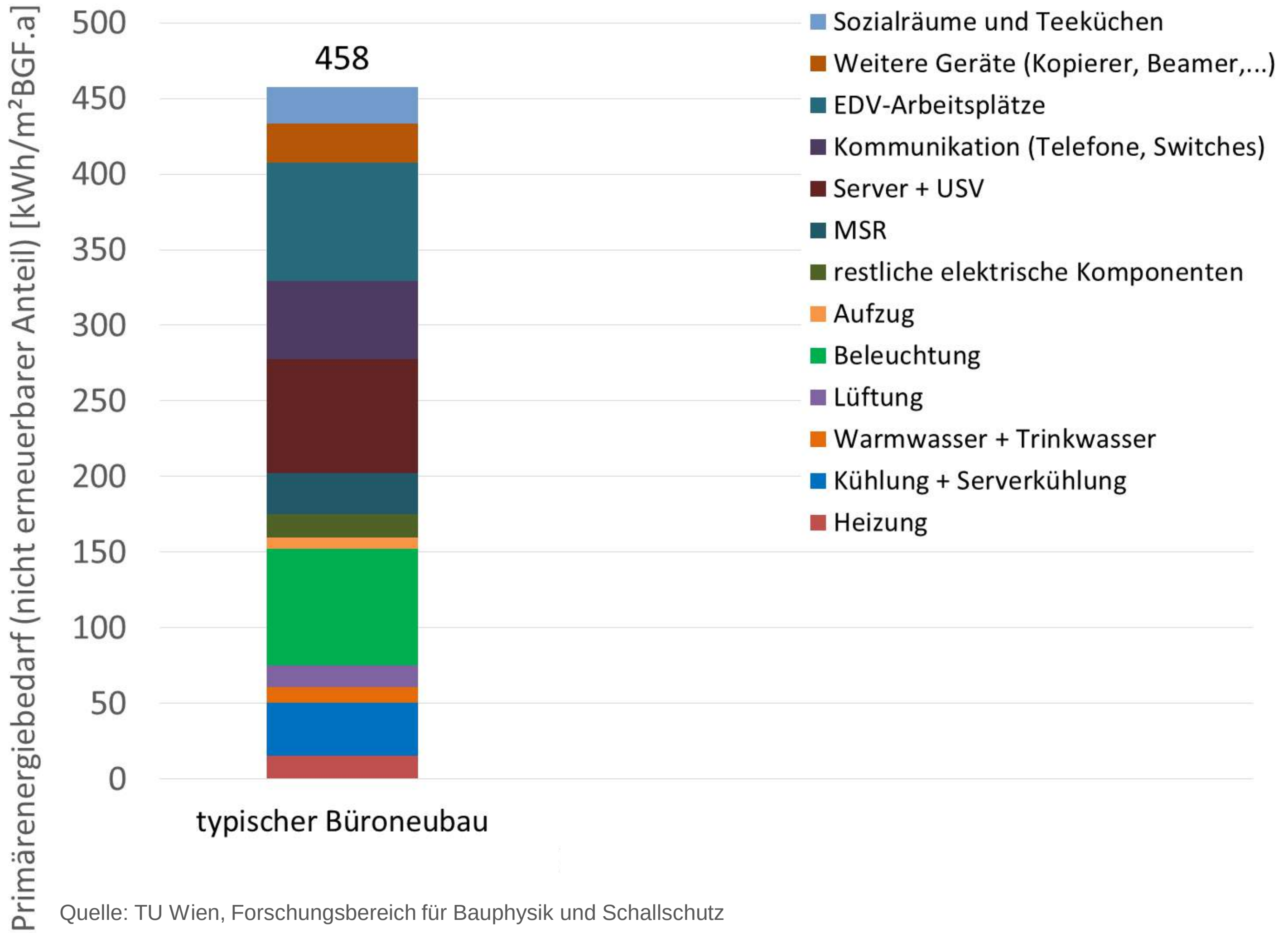
Source: Naturallywood

Retrofit of Vienna Technical University building to energy plus level

Schöberl & Pöll GmbH
BAUPHYSIK und FORSCHUNG

Source: Klemens Schlögl, Schöber & Pöll, Austrian World Summit 2018, Vienna, May 2018

Disruptive electricity demand reductions arrive from innovatively optimising opportunities in systems rather than replacing individual technologies



Quelle: TU Wien, Forschungsbereich für Bauphysik und Schallschutz

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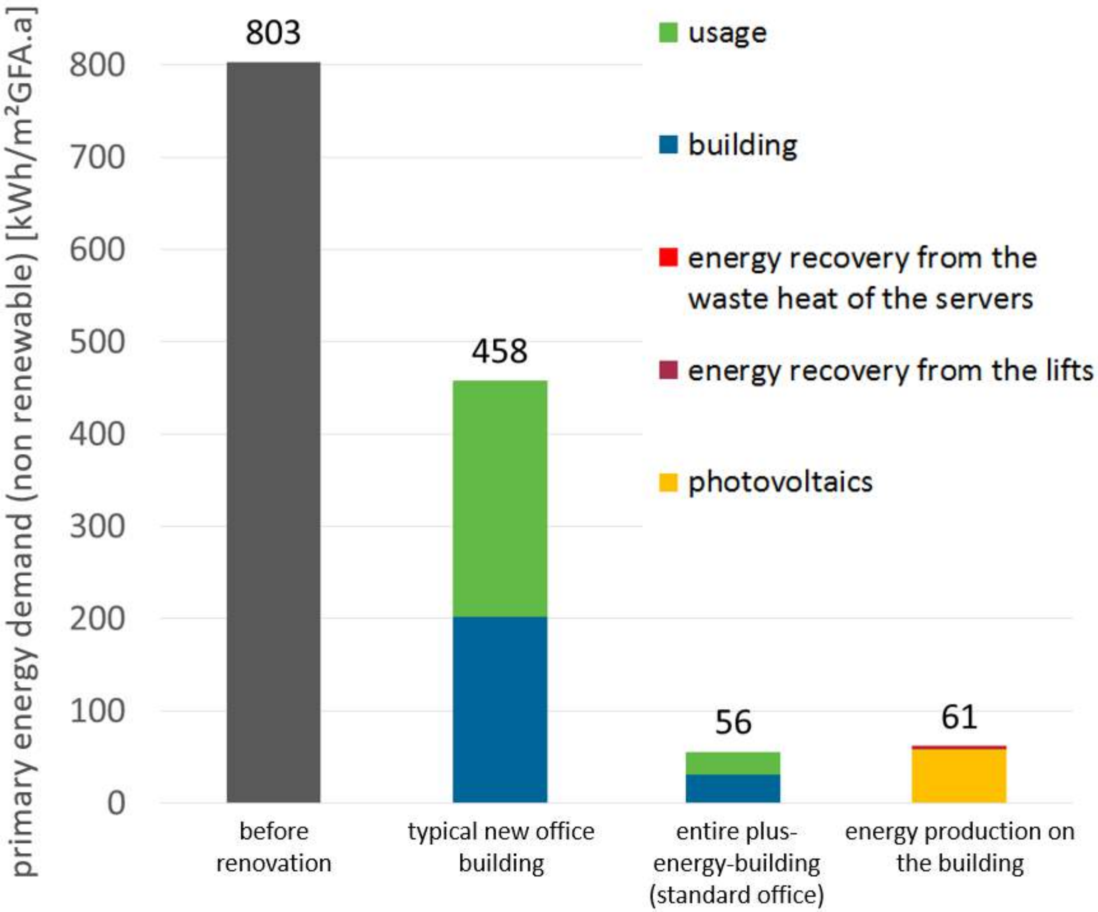
AUSTRIAN WORLD SUMMIT

Schöberl & Pöll GmbH
BAUPHYSIK und FORSCHUNG



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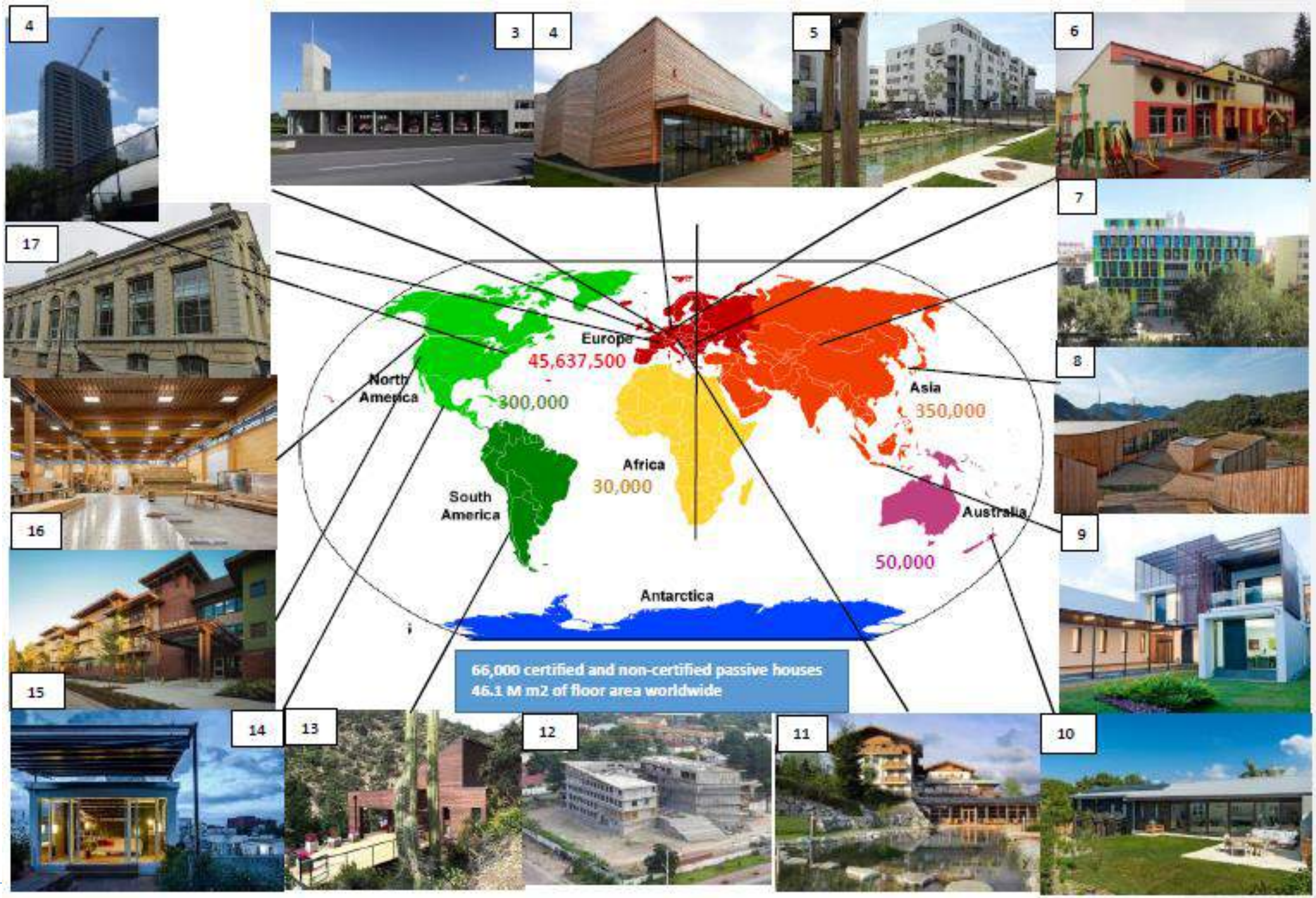
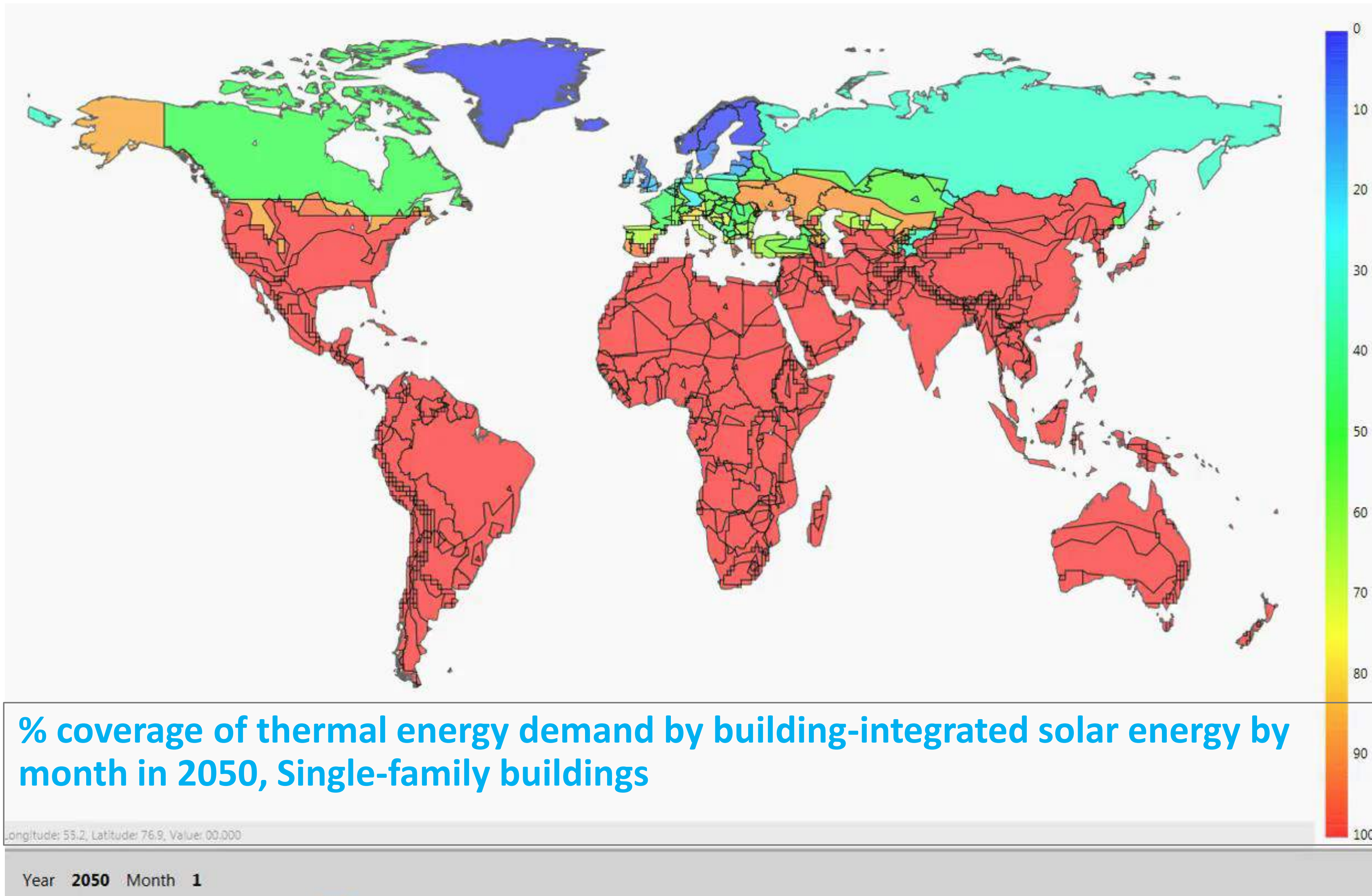
Passsive houses spread around the world

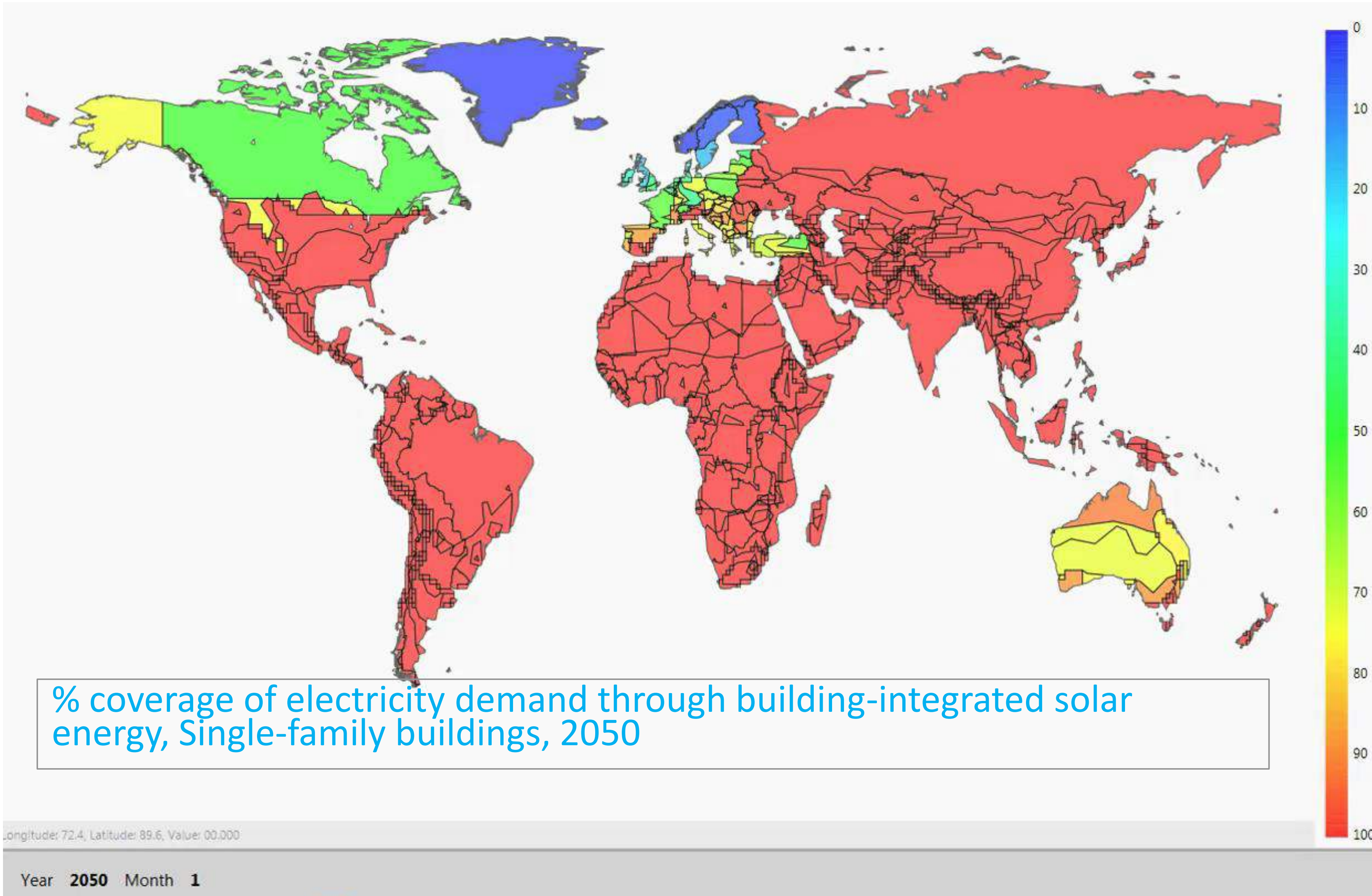


From E-On Energy Globe Award Hungary 2018

% coverage of thermal energy demand by building-integrated solar energy by month in 2050, Single-family buildings



Petrichenko 2014: Net Zero Energy Buildings: Global and Regional Perspectives. PhD Dissertation, Central European University.



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From E-On Energy Globe Award Hungary 2018

World's largest Passive House city district

Zero-Emission-City areal **Heidelberg-Bahnstadt**

116 ha, 1,700 flats

Passive House as Standard for urban development

www.heidelberg-bahnstadt.de

Courtesy of Gunther Lang

Banana crops #70-74, House of Amory Lovins, Colorado, down to -44C outside, no furnace; *“cheaper to build that way”*

Concluding thoughts

- whether 1.5C is feasible is up to us (institutional, social/cultural enabling)
- the demand side will play a crucial role
- NZ is at the frontier of several areas of mitigation and can showcase the world these opportunities
- But there are still areas for potential improvement

Thank you for your attention

Feasibility of CDR

- **BECCS and AR** may be technically and geophysically feasible, they face **constraints related to land use**.
- The land footprint/tO2 removed is higher for AR than for BECCS, but in the light of low current deployment, the speed and scales required for limiting warming to 1.5°C pose a **considerable implementation challenge,** even if the issues of *public acceptance* and *missing economic incentives* were to be resolved
- The **large potentials of afforestation** and their cobenefits if implemented appropriately (e.g. on biodiversity, soil quality) **will diminish over time**, as forests saturate.
- The energy requirements and economic **costs** of Direct Air Carbon Capture and Storage **(DACCS)** and **enhanced weathe**ring remain **high**
- At the local scale, **soil carbon sequestration** has co-benefits with agriculture and is cost-effective even without climate policy. Its **potential global feasibility and cost effectiveness appears to be more limited**

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

Climate change and people

Ashley Cooper/ Aurora Photos

- 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

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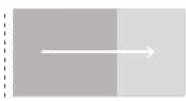
Thank you for your attention

Vorsatzd@ceu.edu

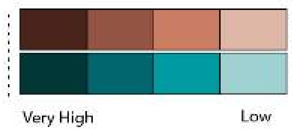
SPM4 | Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)

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



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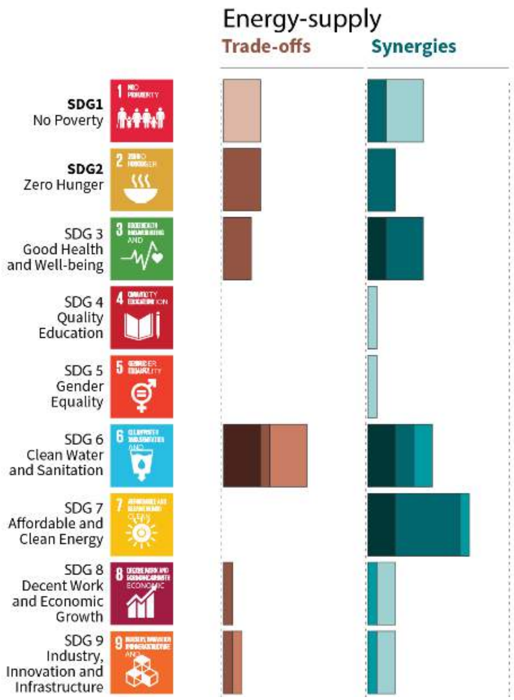

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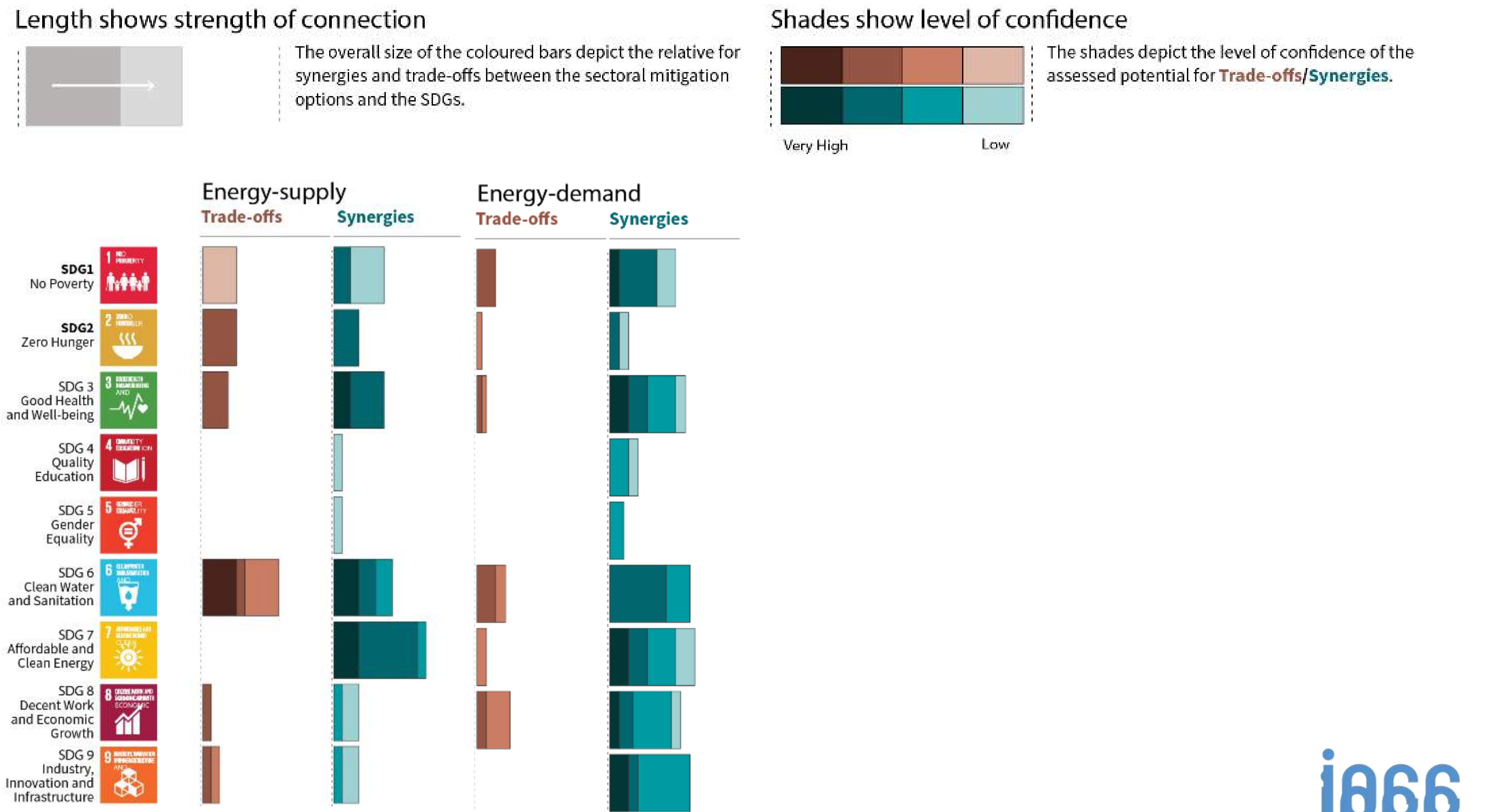

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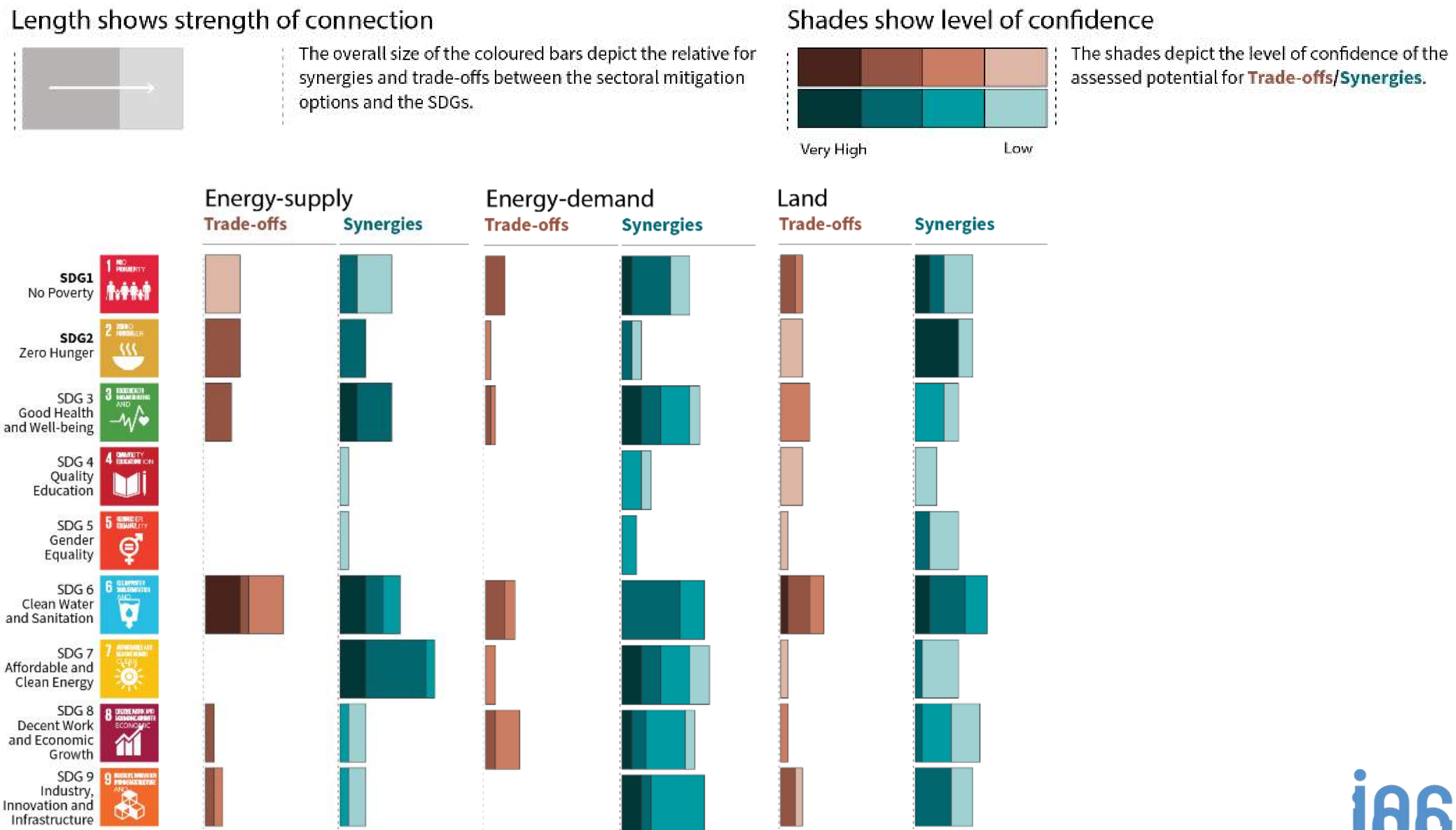

INTERGOVERNMENTAL PANEL ON climate change

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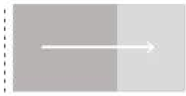

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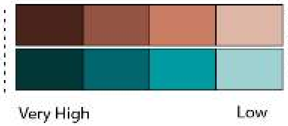
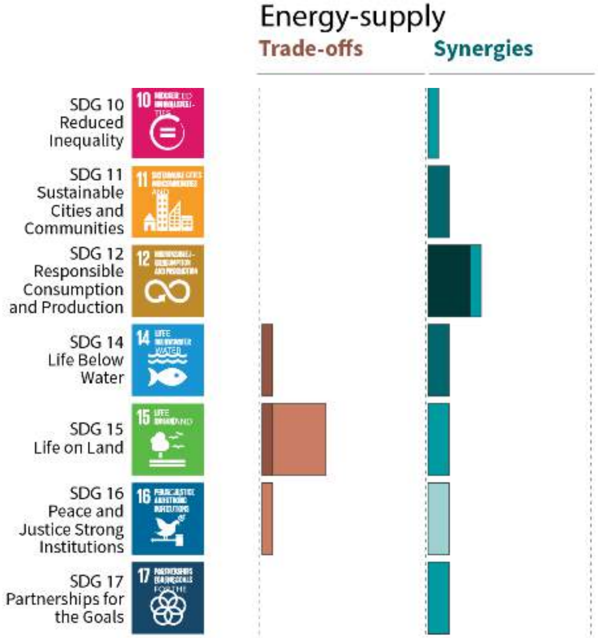
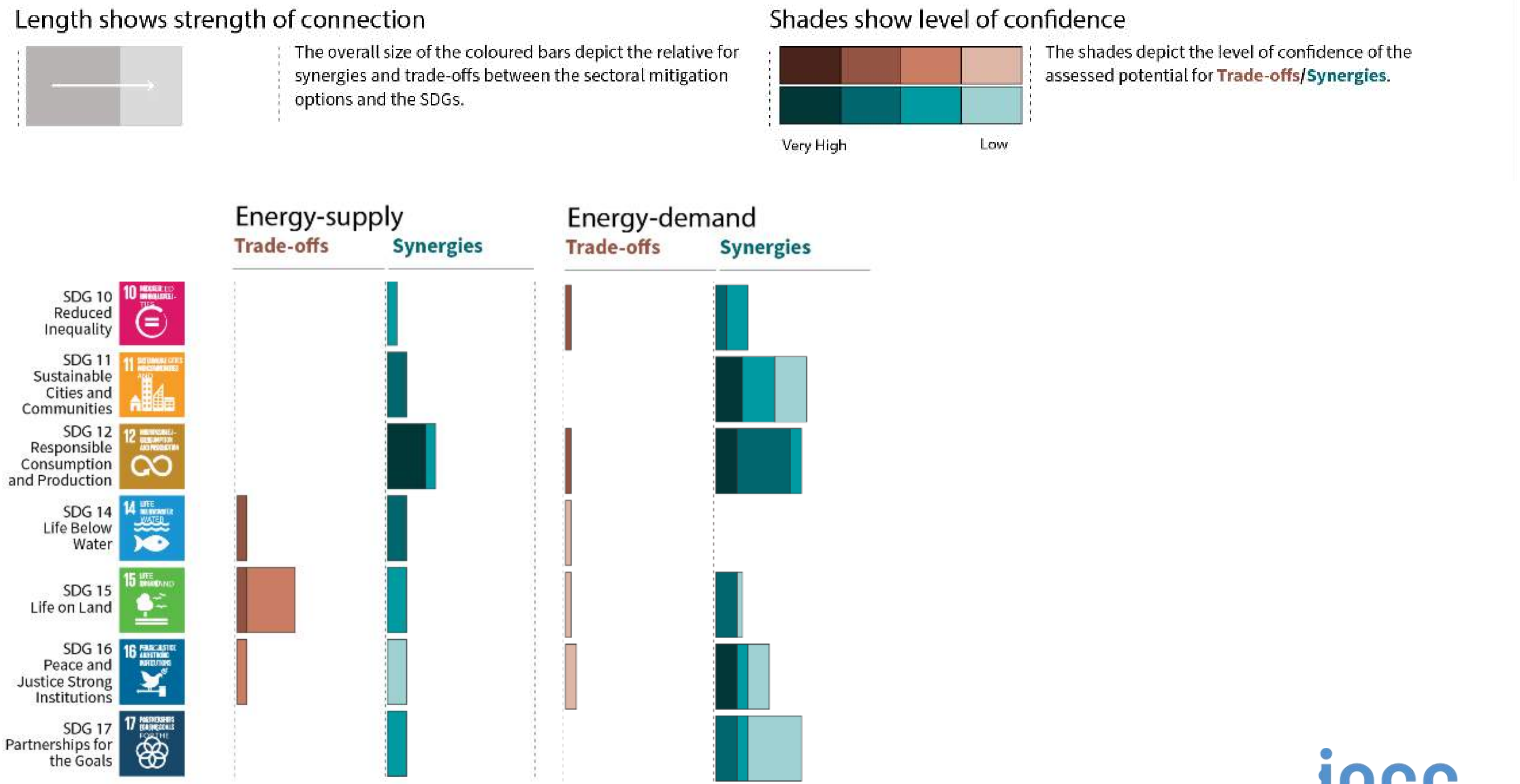


The shades depict the level of confidence of the assessed potential for **Trade-offs**/**Synergies**.

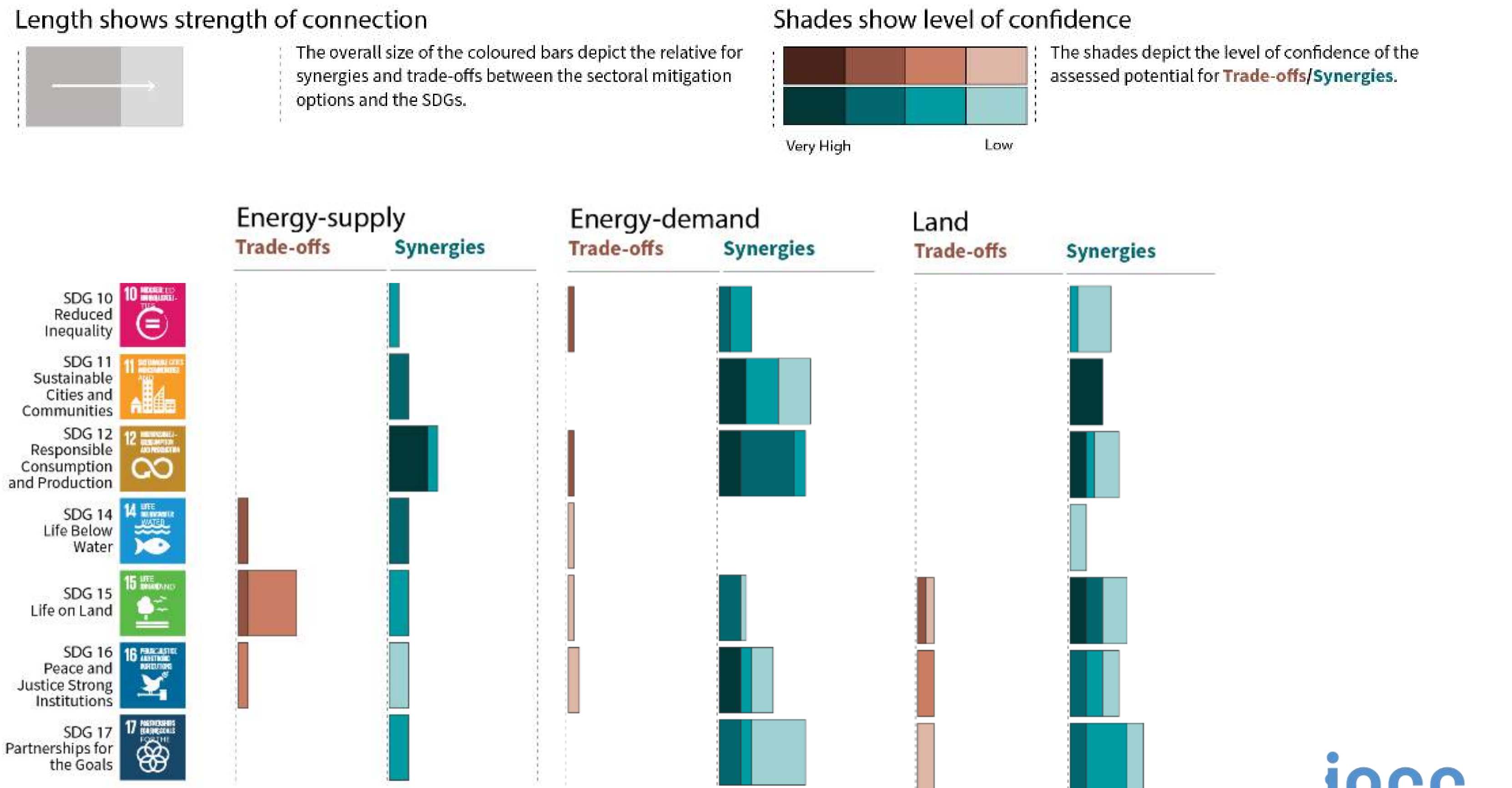


INTERGOVERNMENTAL PANEL ON climate change

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



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



Uncertainties in carbon budget figures

- Uncertainties in the climate response to CO_2 and non-CO_2 emissions –> ±400 $GtCO_2$
- level of historic warming –> ±250 $GtCO_2$
- Potential additional carbon release from future permafrost thawing and methane release from wetlands –> up to -100 $GtCO_2$ over the course of this century and more thereafter
- the level of non-CO_2 mitigation in the future could alter the remaining carbon budget by 250 $GtCO_2$ in either direction

Jason Florio / Aurora Photos

Impacts of global warming 1.5˚C

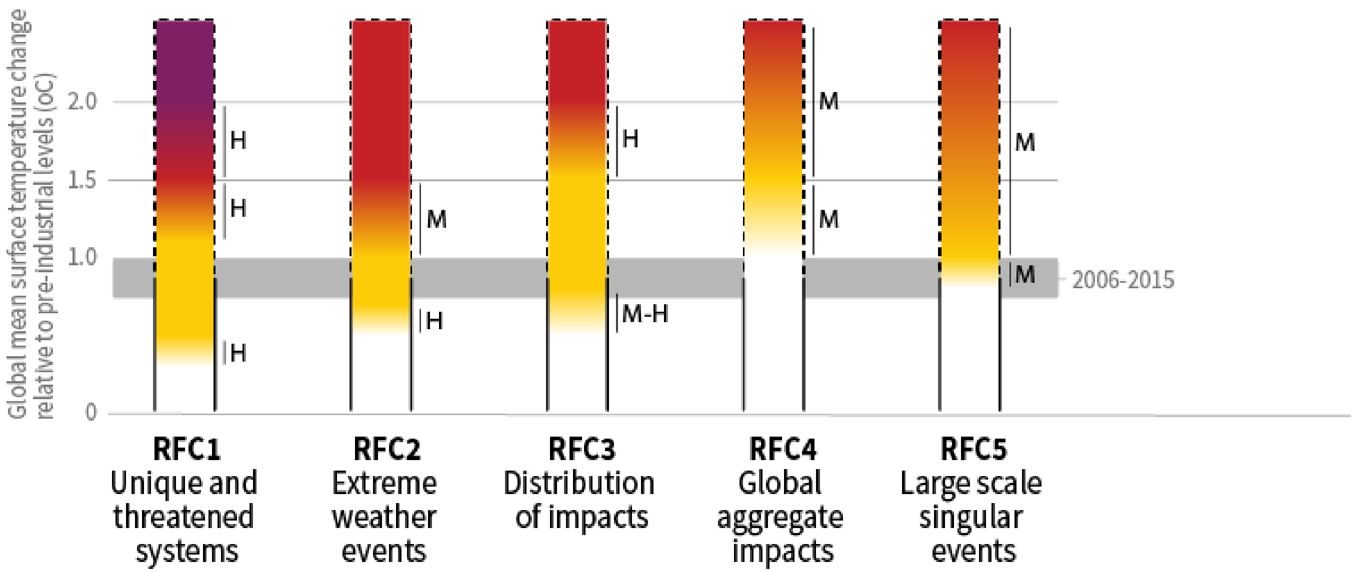
At 1.5˚C compared to 2˚C:

- 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

INTERGOVERNMENTAL PANEL ON climate change

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

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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WMO UNEP

The report in numbers

91 Authors from **40** Countries

133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments

Additional background

- All IPCC authors and Bureau members work on a fully voluntary basis (unless own government provides funds, but this is more an exception)
- The most challenging timeline and workload in IPCC's history
- Chapter 4 received app. 1300 comments on the first draft, and over 4300 on SOD
- Responses needed to be checked on an almost-impossible timescale
- *Indebted to CEU students for their help on a voluntary basis*
  - *Stefanie Berendsen*
  - *Brendan Pipkin*
  - *Agnes Deme*

Additional background 2

- The approval took 1.5 days longer than planned
- the last negotiation session was a 31-hour straight session with almost no breaks or food
- Delegates exhibited an unprecedented commitment to arrive at a consensus
  - IPCC decisions are on a consensus basis, with 195 member governments!

Projected Climate Change, Potential Impacts and Associated Risks

INTERGOVERNMENTAL PANEL ON climate change

Impacts of global warming 1.5˚C


Jason Florio / Aurora Photos

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

Jason Florio / Aurora Photos

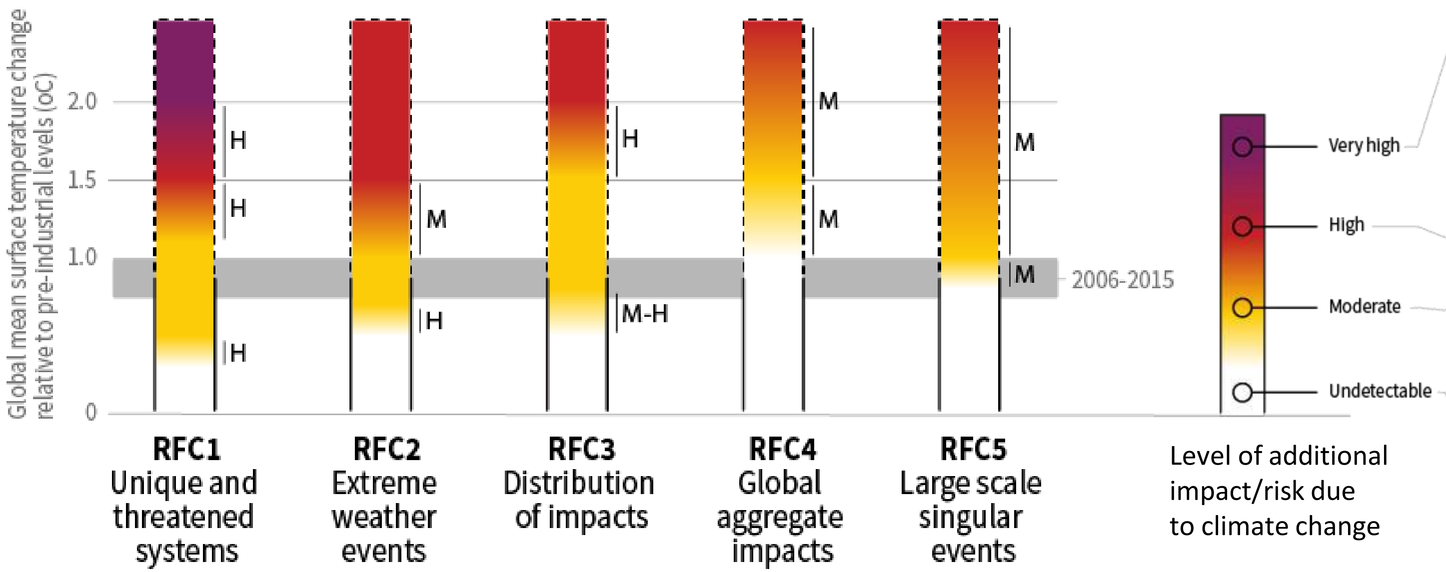
Impacts of global warming 1.5˚C

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

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)

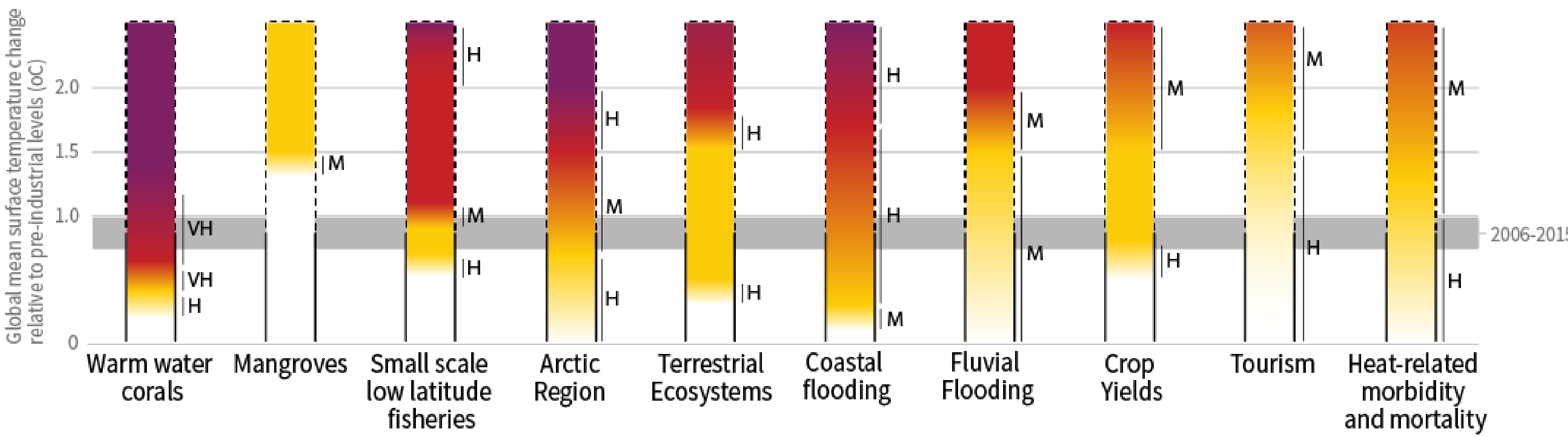


Purple indicates very high risks of severe impacts/risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.
Red indicates severe and widespread impacts/risks.
Yellow indicates 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.

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

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

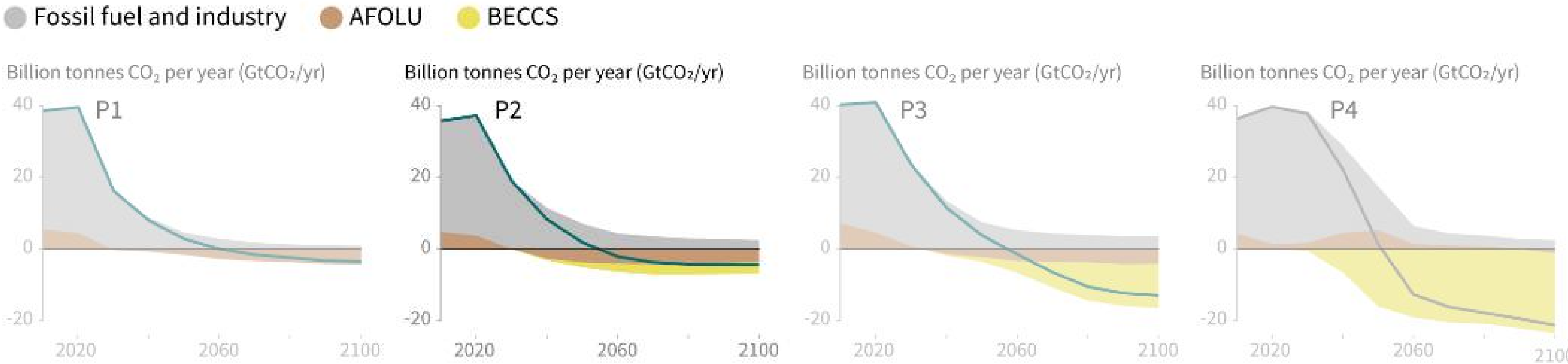


Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high

INTERGOVERNMENTAL PANEL ON climate change

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 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.

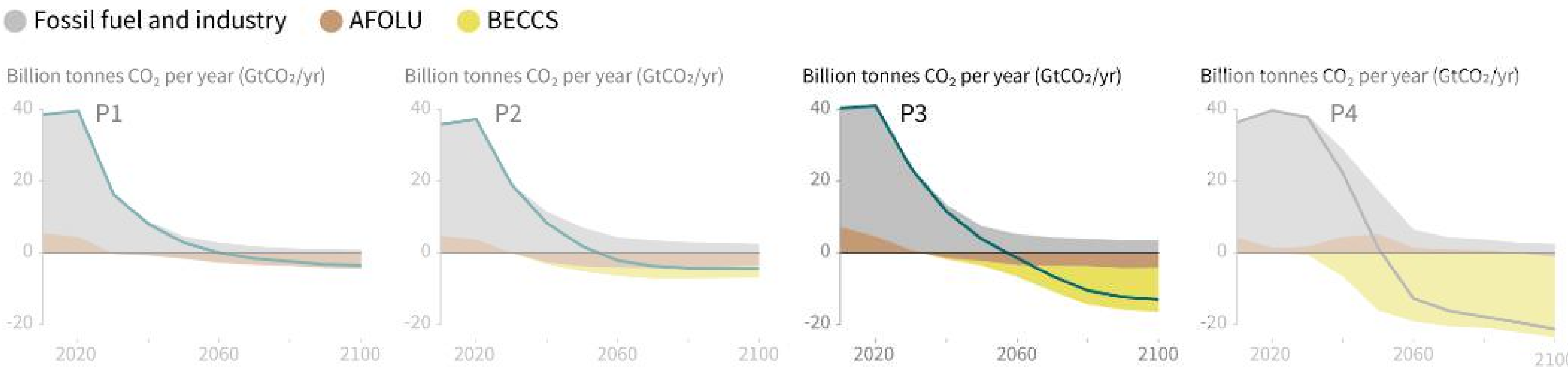
P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal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

SPM3b | Characteristics of four illustrative model pathways

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



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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)

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*

SPM3b | Characteristics of four illustrative model pathways

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Temperature and emissions

Energy systems

Carbon dioxide removal

Agriculture

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** Kyoto-gas emissions are based on SAR GWP-100*

*** Changes in energy demand are associated with improvements in energy efficiency and behaviour change*

SPM3 | 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)
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Peter Essick / Aurora Photos

Greenhouse gas emissions pathways

- Limiting warming to 1.5˚C requires changes on an **unprecedented scale**

  - Deep emissions cuts in all sectors
  - A range of technologies
  - Behavioural changes
  - Increased and by and large redirected investment in low carbon options

What can we learn from the pathways?

- Capping warming at 1.5C is feasible from a technological perspective
- There are still choices in the pathways how we can get there
- However, each pathway involves virtually all options (except BECCS or CCS), the difference is only in the emphasis on different options
- All pathways peak global emissions in the next few years, and radically reduce emissions afterwards
- The pathways have markedly different implications on sustainable development

Gerhard Zwerger-Schoner / 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

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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

INTERGOVERNMENTAL PANEL ON climate change


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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

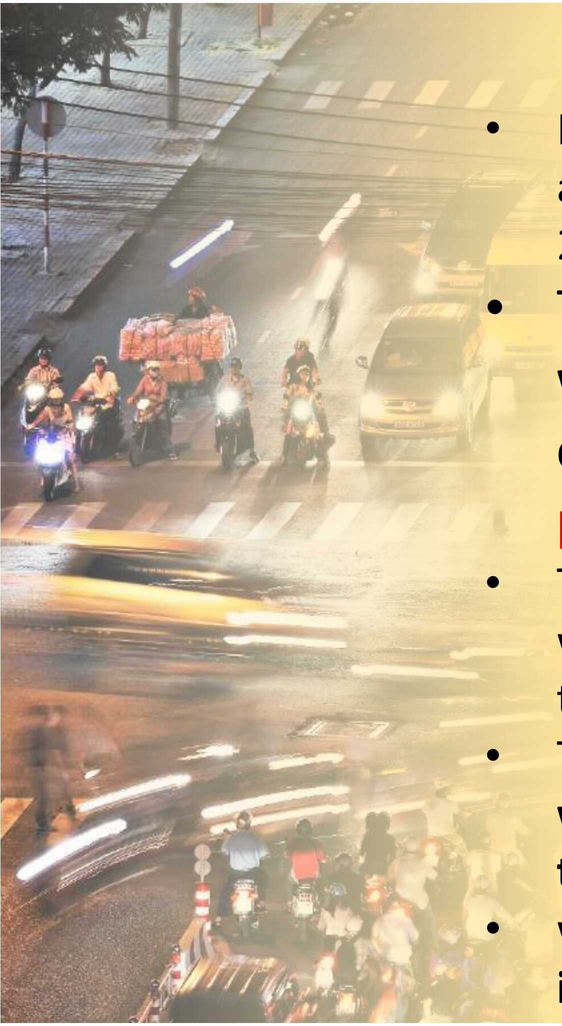
INTERGOVERNMENTAL PANEL ON climate change

Greenhouse gas emissions pathways

- 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

Peter Essick / Aurora Photos

Necessary transitions



Gerhard Zwerger-Schoner / Aurora Photos

- Pathways with no or limited overshoot show system changes that are more rapid and pronounced over the next two decades than in 2°C pathways
- The rates of system changes **have occurred in the past within specific sectors, technologies and spatial contexts**, but **there is no documented historic precedent for their scale**
- The **energy system transition** that is required to limit global warming to 1.5°C **is underway in many sectors and regions** around the world
- The political, economic, social and technical feasibility of **solar** and **wind** energy and electricity **storage has improved dramatically over the past few years**,
- while that of **nuclear energy** and **CCS have not shown similar improvements.**

Some facts on the energy system transition

- In 2017, **64%** of the world's net additions of electric generating capacity were modern renewables (*i.e*. excluding hydroelectric dams of ≥50 MW_e)
- These **passed nuclear power output in 2016** and a one trillion watts' installed global capacity in mid-2017.
- today's PV capacity is >40 x IEA's 2002 forecast
- renewable prices: world levelized nominal prices fell ***in 2016 alone*** by 18% for onshore wind, 17% for utility-scale PV, and 28% for offshore wind, while the lowest bids fell 37% for Mexican PV and 43% for EU offshore wind
- Bloomberg energy finance outlook projects that to **>80%** of global electricity related investments between 2018–40 will be into new renewables

Costs

- economy wide costs and benefits of limiting warming to 1.5°C.
  - limited number of model studies report economy wide mitigation costs
  - Such costs do not include the benefits of reduced climate change as well as synergies and trade-offs of mitigation
- [these model studies project **1.5-2.7%** (interquartile range**) lower consumption in 2050** compared to 2°C pathways,
  - which in turn project 1.4-3.7% lower consumption than in the baseline
- Consumption in the **baseline** underlying these estimates grows between 270-320% from 2010 to 2050.]
- The limited literature shows a 50% to threefold increase in economy wide mitigation costs in pathways limiting warming to 1.5°C compared to 2°C
- global average discounted *marginal abatement costs* over the 21st century are 3-4 times higher than in pathways limiting global warming to below 2°C