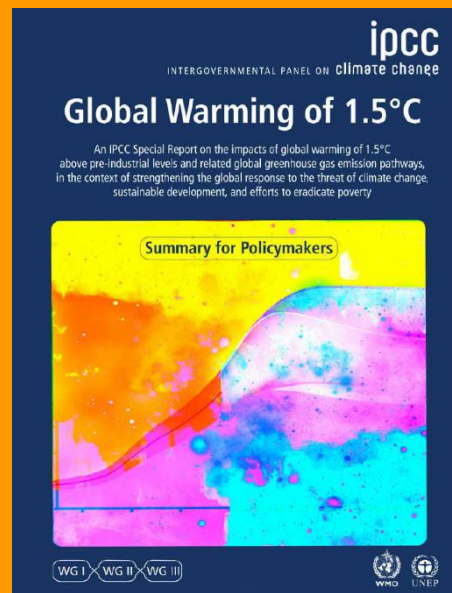




The difference between 2 in 1.5 warmer world

Lučka Kajfež Bogataj
University of Ljubljana

COMPOSE 5th Consortium Meeting
Granollers, Catalonia, Spain

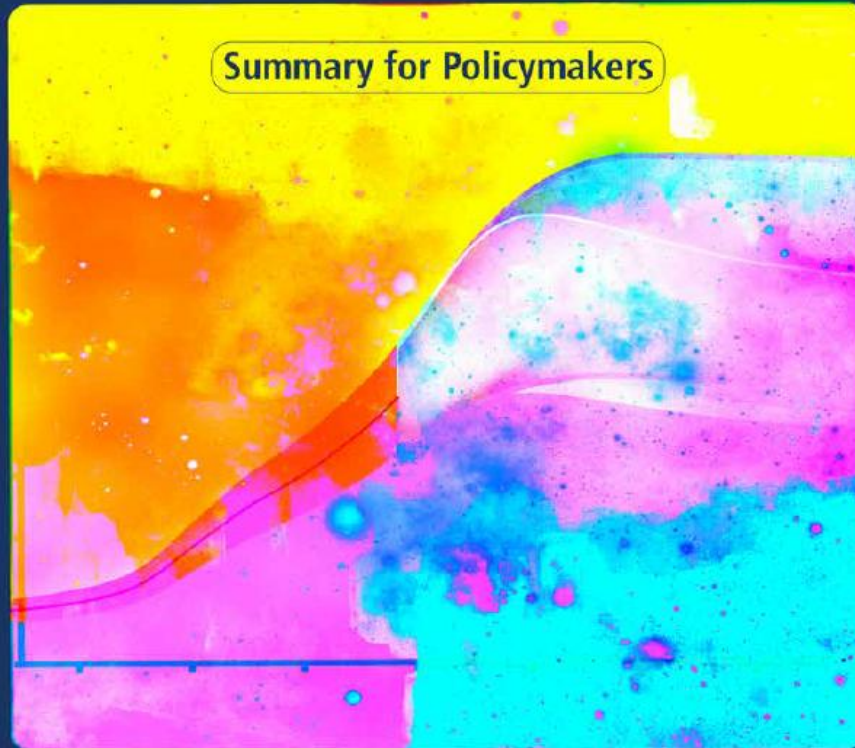
ipcc

INTERGOVERNMENTAL PANEL ON climate change

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

Summary for Policymakers

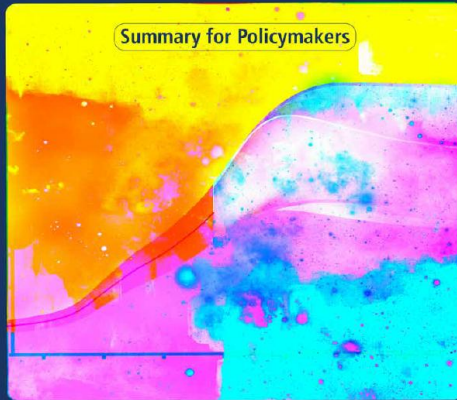


WG I WG II WG III



Global Warming of 1.5°C

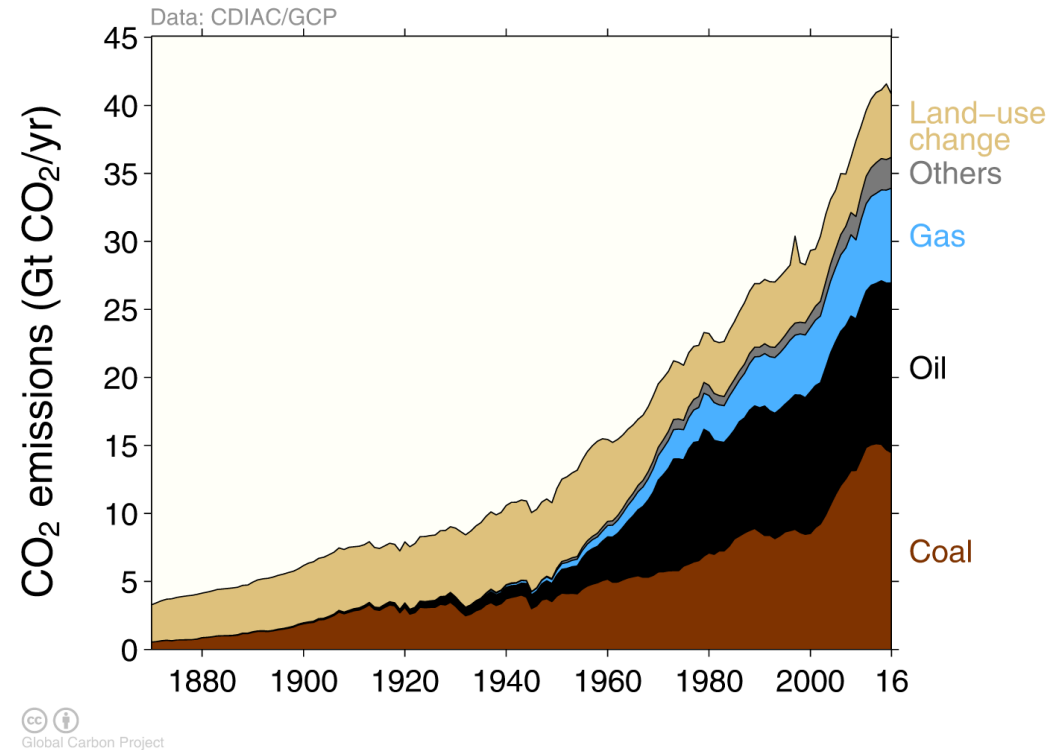
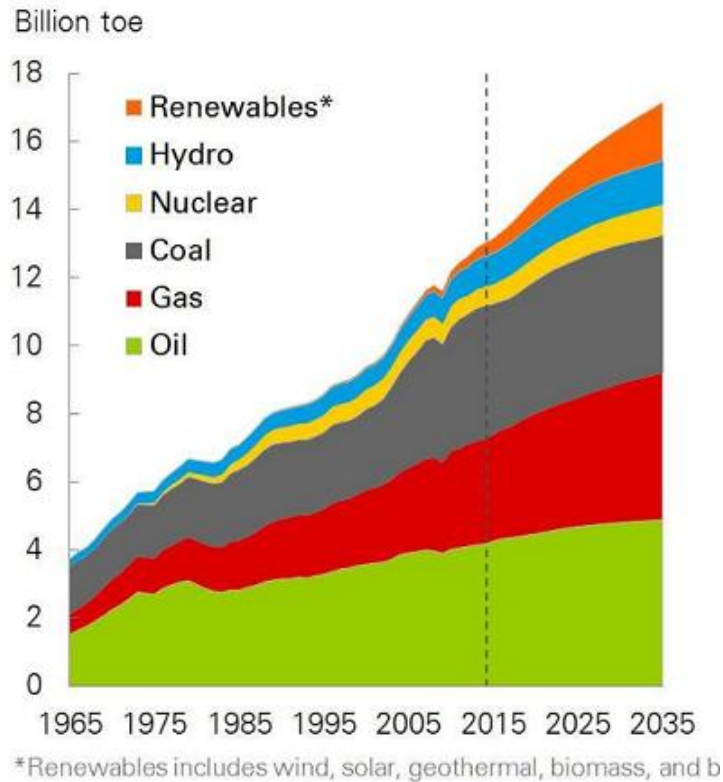
An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

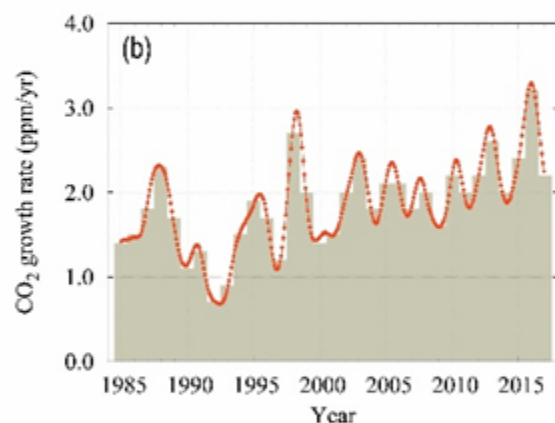
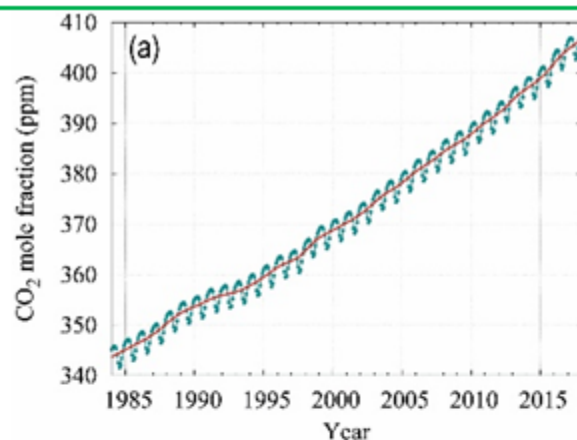


WG I WG II WG III

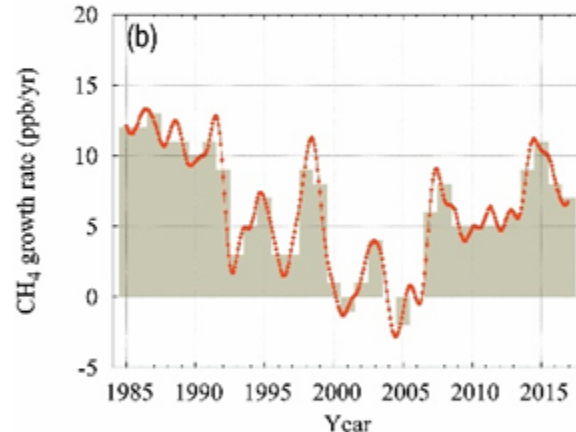
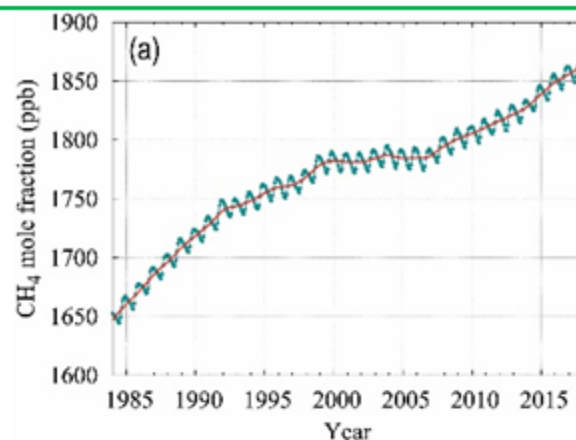


Primary energy consumption and total global emissions are increasing

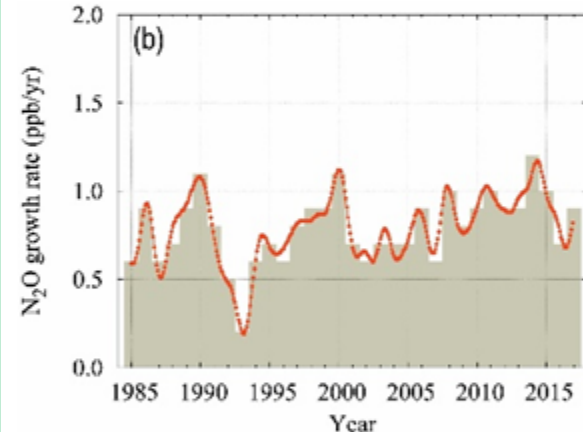
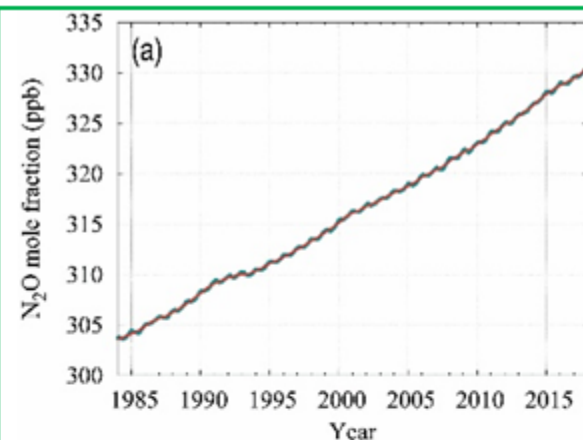




Globally averaged CO₂ mole fraction (a) and its growth rate (b) from 1984 to 2017. Increases in successive annual means are shown as the shaded columns in (b). The red line in (a) is the monthly mean with the seasonal variation removed; the blue dots and line depict the monthly averages. Observations from 129 stations have been used for this analysis.



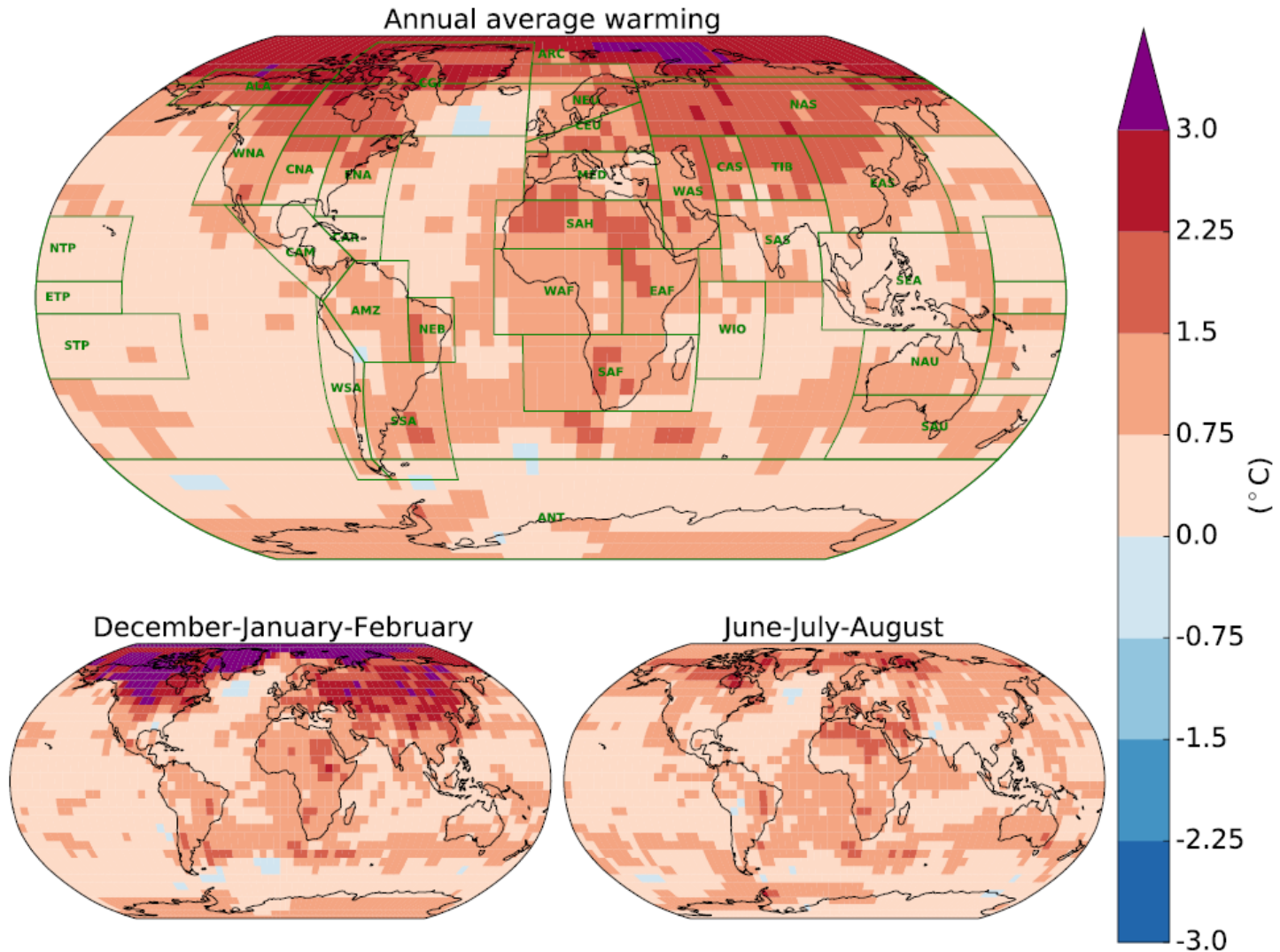
Globally averaged CH₄ mole fraction (a) and its growth rate (b) from 1984 to 2017. Increases in successive annual means are shown as the shaded columns in (b). The red line in (a) is the monthly mean with the seasonal variation removed; the blue dots and line depict the monthly averages. Observations from 126 stations have been used for this analysis.



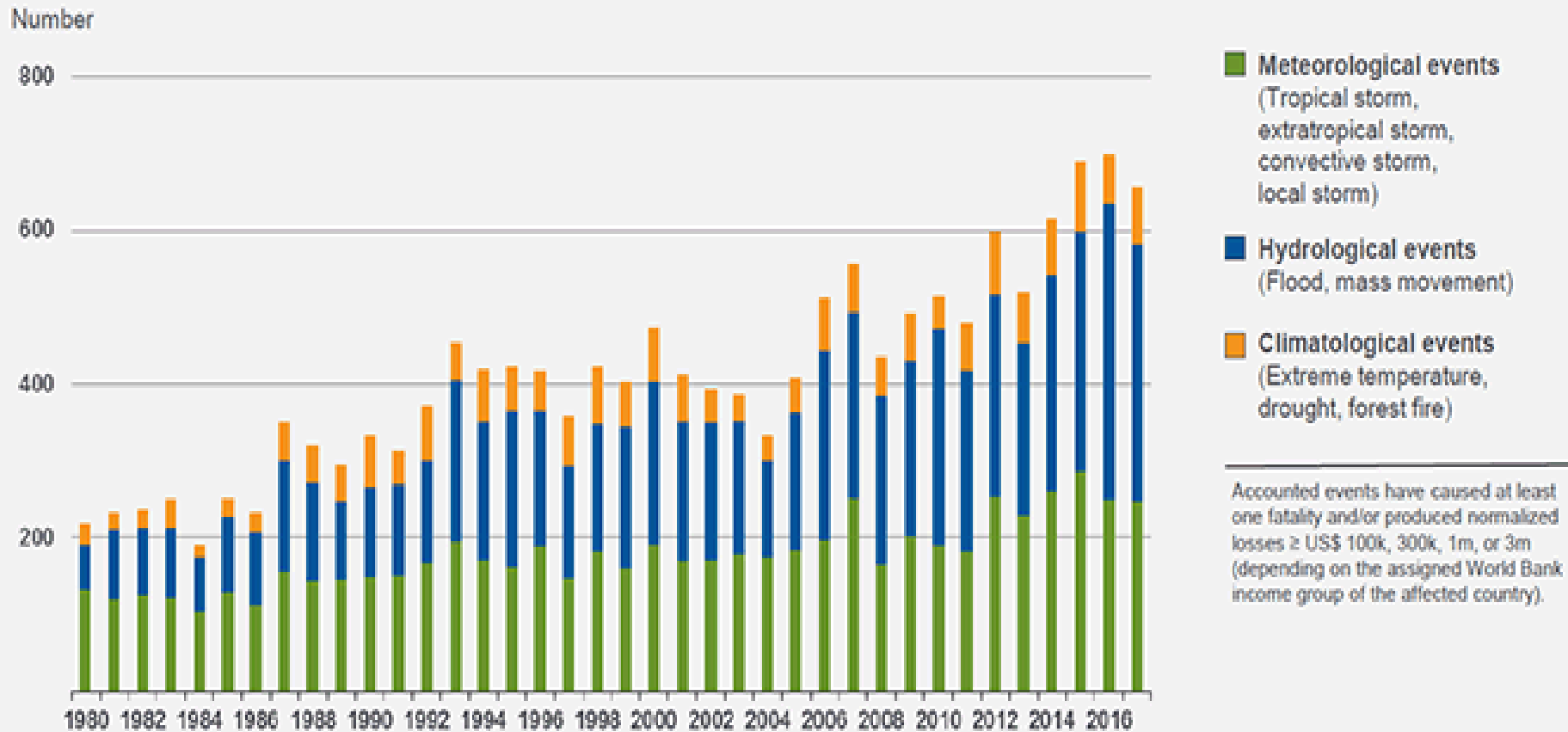
Globally averaged N₂O mole fraction (a) and its growth rate (b) from 1984 to 2017. Increases in successive annual means are shown as the shaded columns in (b). The red line in (a) is the monthly mean with the seasonal variation removed, in this plot it is overlapping with the blue dots and line that depict the monthly averages. Observations from 96 stations have been used for this analysis.

Present-day warming

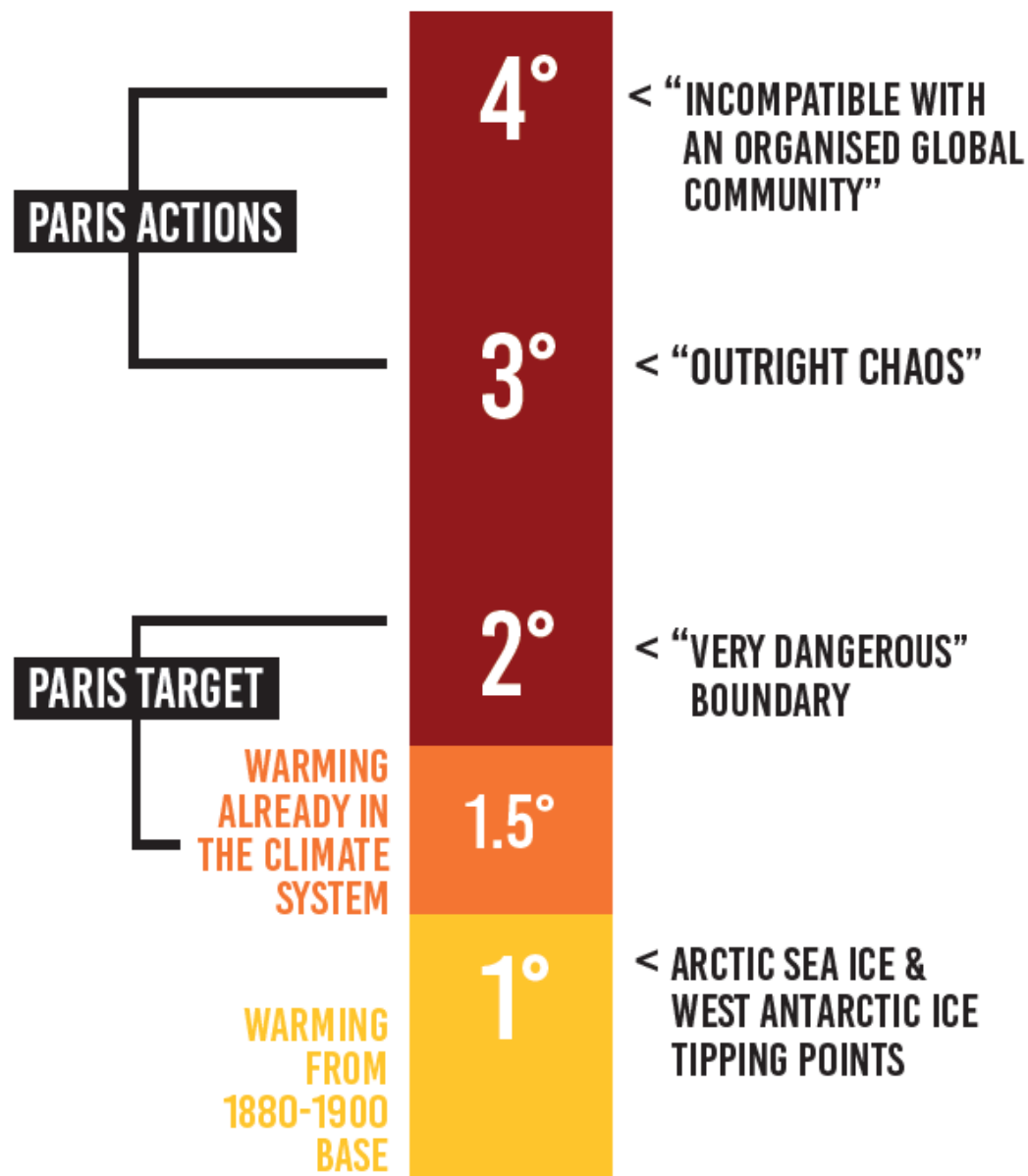
Regional warming in the decade 2006–2015 relative to 1850–1900



Number of world natural catastrophes 1980-2017



PARIS EMISSIONS PATH & CLIMATE RISKS



1.5°C in the Paris Agreement

- Paris Agreement included the aim to hold the increase in the global temperature to well below 2 °C and to pursue efforts to limit the temperature increase to 1.5 °C above preindustrial levels.
- New science outlines how the risks and impacts of climate change increase between 1.5°C and 2°C .

What is the difference between a 2°C world and a 4°C world?

+2°

PROBLEMATIC

- 1 - 2 billion additional people with water stress
- Impacts on cereal productivity
- Increased coastal flooding and storms
- Greater depth of seasonal permafrost thaw

+4°

DISASTROUS

- Up to 3.2 billion additional people with water stress
- Risk of major extinctions around the globe
- Substantial global impact on major crops
- Long-term prospect of sea level rise
- There is no certainty that adaptation to a 4 C world is possible

What is the difference between
a 2°C world and a 4°C world?

+2°

Reply in just 2 words

“Human civilisation”.

+4°

Prof. Hans Joachim Schellnhuber

PARIS AGREEMENT RUSSIAN ROULETTE



Probability to
survive

5/6 or 83 %

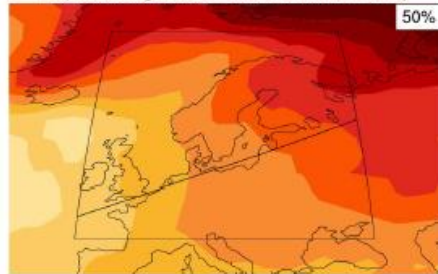
The Paris agreement emissions path has a
50% chance of exceeding 4°C

(probability to “survive” 50%)

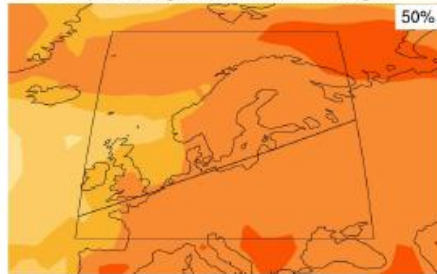
Projections Europe (RCP4.5) 2081-2100 versus 1986-2005

Temperature (°C)

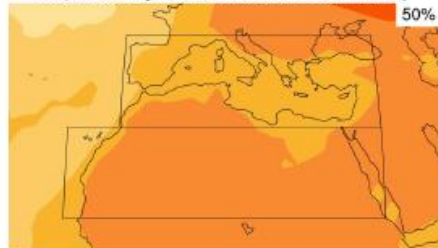
Temperature change RCP4.5 in 2081-2100: December-February



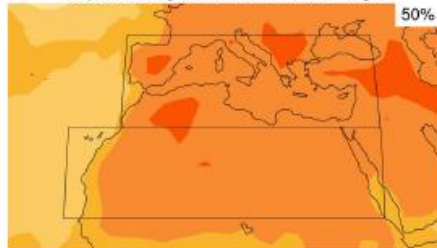
Temperature change RCP4.5 in 2081-2100: June-August



Temperature change RCP4.5 in 2081-2100: December-February



Temperature change RCP4.5 in 2081-2100: June-August



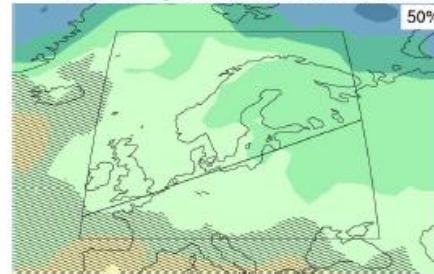
-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 3 4 5 7 9 11

winter

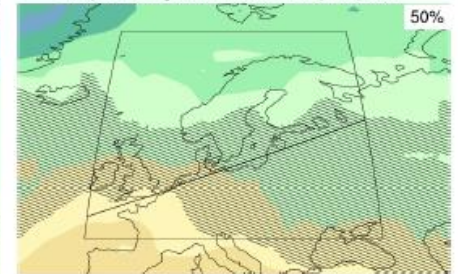
summer

Precipitation (%)

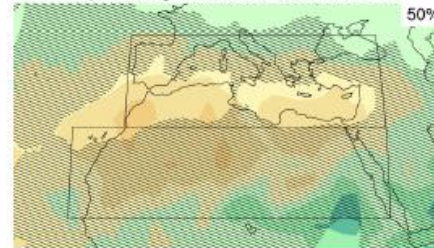
Precipitation change RCP4.5 in 2081-2100: October-March



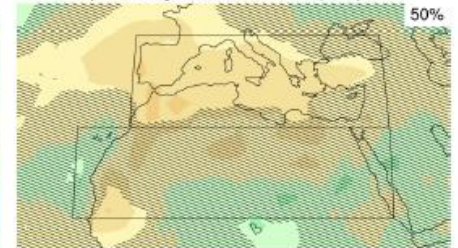
Precipitation change RCP4.5 in 2081-2100: April-September



Precipitation change RCP4.5 in 2081-2100: October-March



Precipitation change RCP4.5 in 2081-2100: April-September



-50 -40 -30 -20 -10 0 10 20 30 40 50

winter half

summer half

HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

	1.5°C	2°C	2°C IMPACTS
EXTREME HEAT Global population exposed to severe heat at least once every five years	 14%	 37%	2.6x WORSE
SEA-ICE-FREE ARCTIC Number of ice-free summers	 AT LEAST 1 EVERY 100 YEARS	 AT LEAST 1 EVERY 10 YEARS	10x WORSE
SEA LEVEL RISE Amount of sea level rise by 2100	  0.40 METERS	  0.46 METERS	.06M MORE

HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

	1.5°C	2°C	2°C IMPACTS
SPECIES LOSS: VERTEBRATES Vertebrates that lose at least half of their range	 4%	 8%	2x WORSE
SPECIES LOSS: PLANTS Plants that lose at least half of their range	 8%	 16%	2x WORSE
SPECIES LOSS: INSECTS Insects that lose at least half of their range	 6%	 18%	3x WORSE

HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

	1.5°C	2°C	2°C IMPACTS
ECOSYSTEMS Amount of Earth's land area where ecosystems will shift to a new biome	 7%	 13%	1.86x WORSE
PERMAFROST Amount of Arctic permafrost that will thaw	 4.8 MILLION KM ²	 6.6 MILLION KM ²	38% WORSE
CROP YIELDS Reduction in maize harvests in tropics	 3%	 7%	2.3x WORSE

HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

1.5°C

2°C

2°C IMPACTS

CORAL REEFS

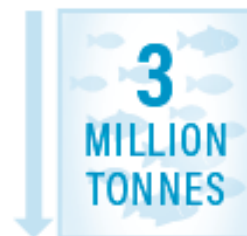
Further decline in coral reefs



UP TO
29%
WORSE

FISHERIES

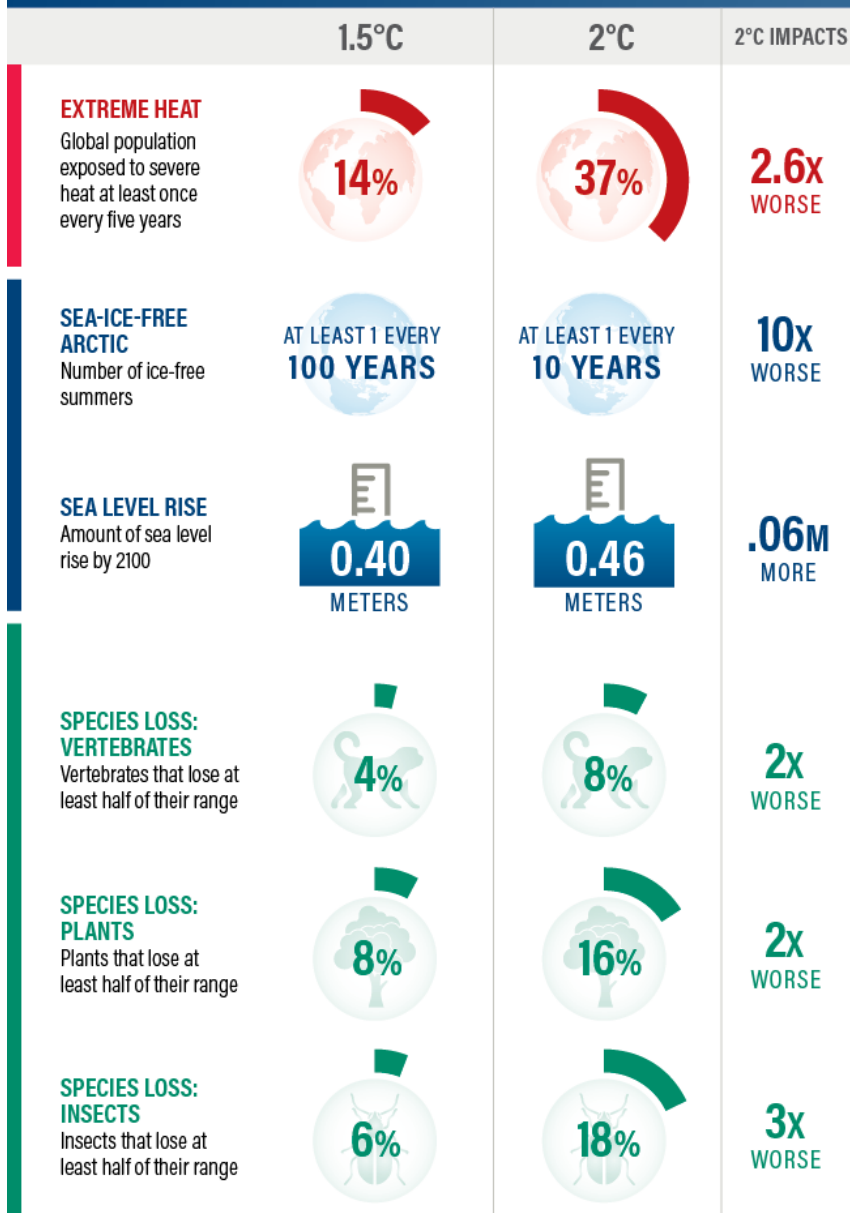
Decline in marine fisheries



2x
WORSE

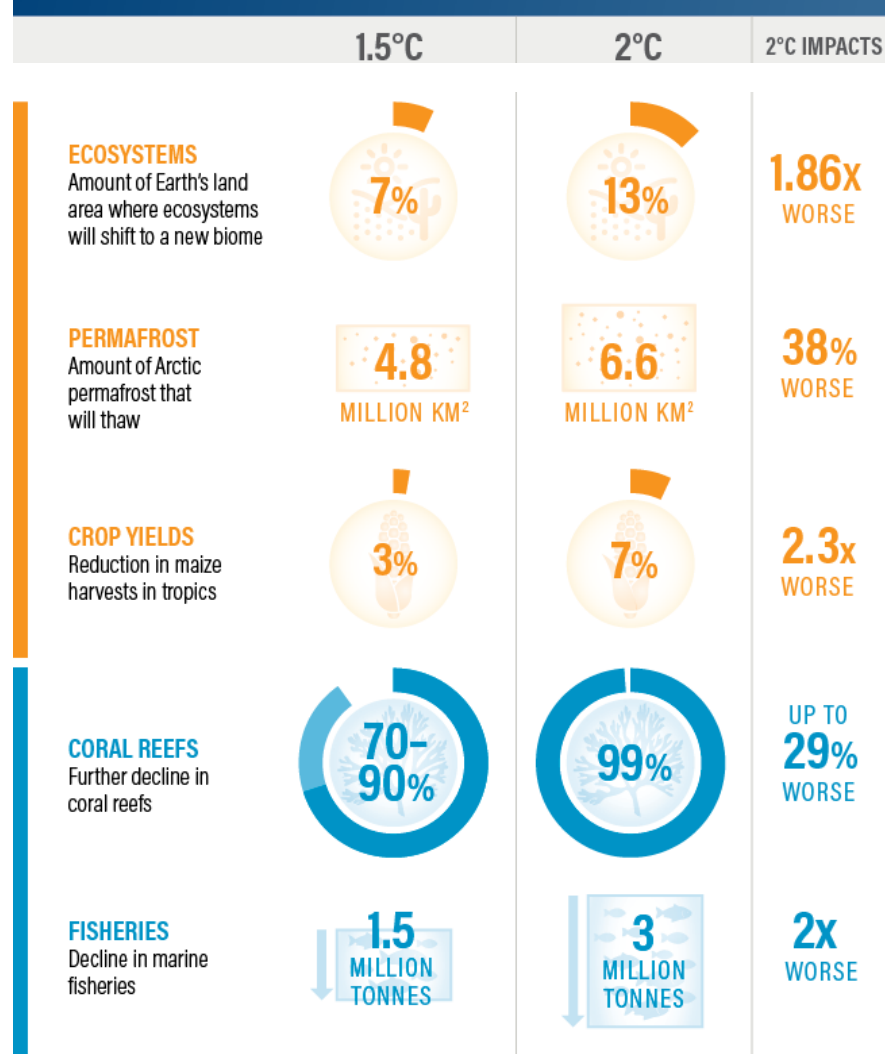
HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT



HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT



The Mediterranean is regarded as a climate change hot spot

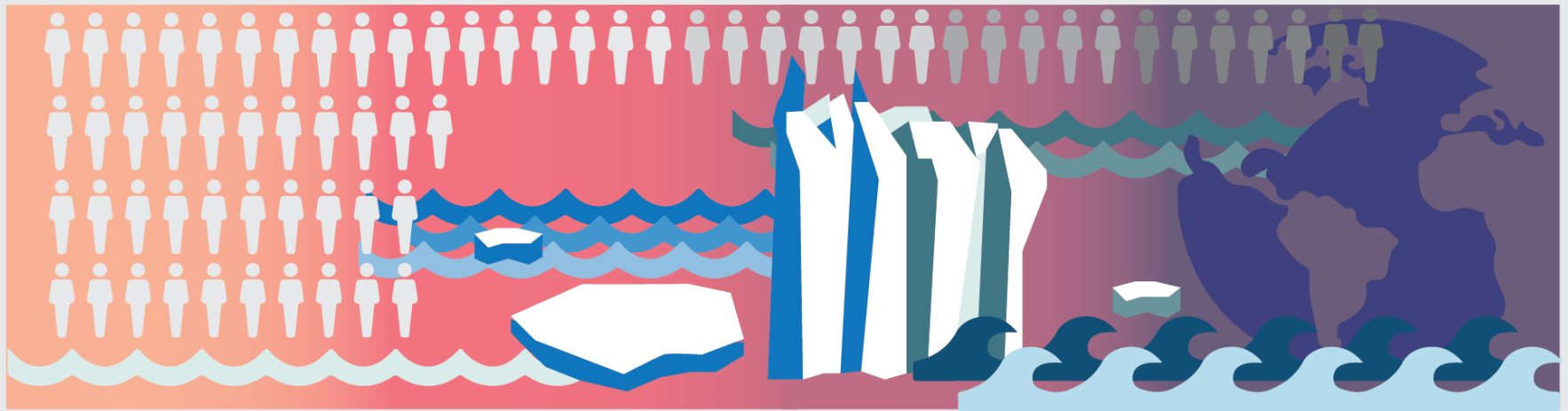
2 main reasons

- **stronger warming** of the regional land-based hot extremes compared to the mean global temperature warming
- **substantial decreases in mean precipitation** with associated substantial increases in dry spells.

The Mediterranean is regarded as a climate change hot spot

	Warming of 1.5°C or less	Warming of 1.5°C -2°C	Warming of 2°C - 3°C
dry-spells	Increase (about 7%) in dry-spells	High confidence of further increases (11%) in dry spells	Substantial reductions in precipitation very likely
runoff	Reduction in runoff of about 9% (likely range: 4.5–15.5%)	High confidence of further reductions (about 17%) in runoff (likely range 8–28%)	Substantial reductions runoff very likely
water deficit	Risk of water deficit	Higher risks for water deficit	Very high risks for water deficit

IMPACTS ON SEA LEVEL RISE...



1.5°C

Rising sea levels displace
46 million people;
Sea level rise of 48cm

2.0°C

Fewer opportunities for
infrastructure adaptation;
Sea level rise of 56cm

3.0°C

Near-complete melting of the
Greenland ice sheet;
Sea level rise of 7+ meters

4.0°C

470-760 million people at risk;
Sea level rise of nearly
9 meters

IMPACTS ON WATER AT...



1.5°C

Water shortages in the
Mediterranean, Australia,
Brazil and Asia

2.0°C

8% of the global
population faces severe
water shortages

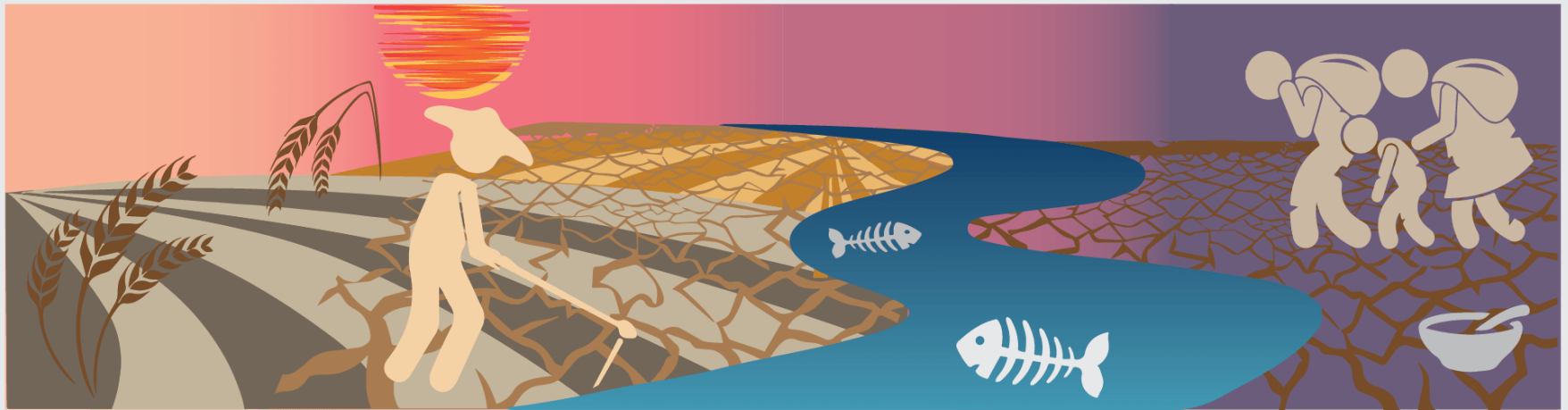
3.0°C

Almost half of
Himalayan high mountain
glaciers lost

4.0°C

More frequent
and severe extreme
droughts

IMPACTS ON FOOD AT...



1.5°C

Wheat, rice, maize
and soybean production
suffers

2.0°C

Agricultural yields
fall rapidly

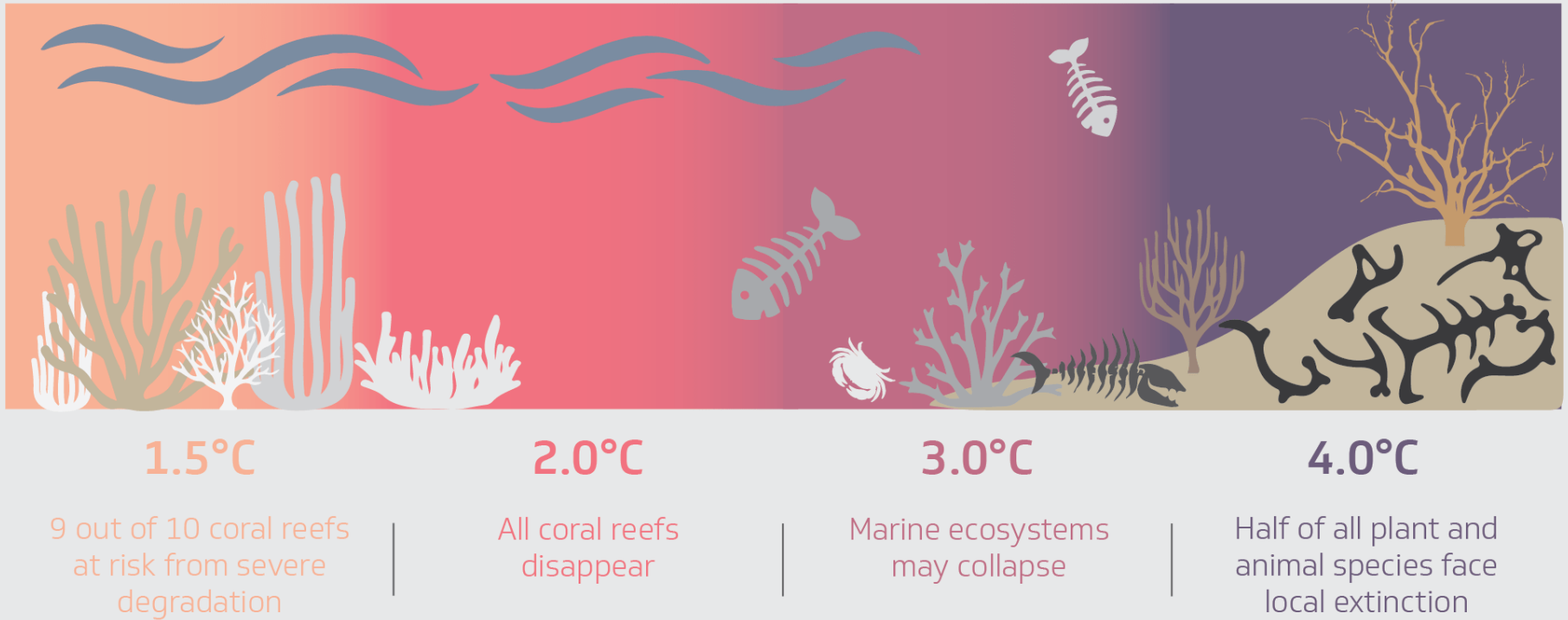
3.0°C

Fish species go
extinct locally

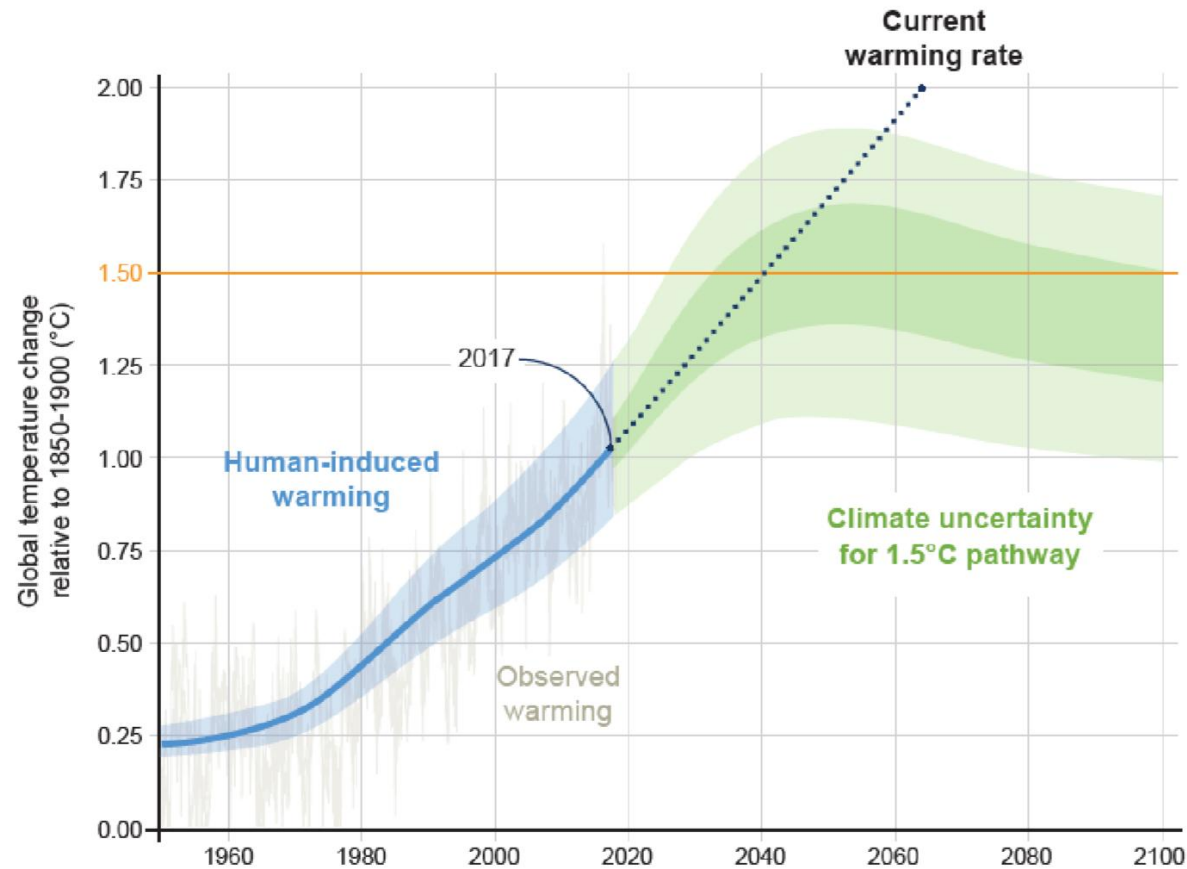
4.0°C

High levels of food
insecurity, development
path reversed

IMPACTS ON FLORA & FAUNA AT...

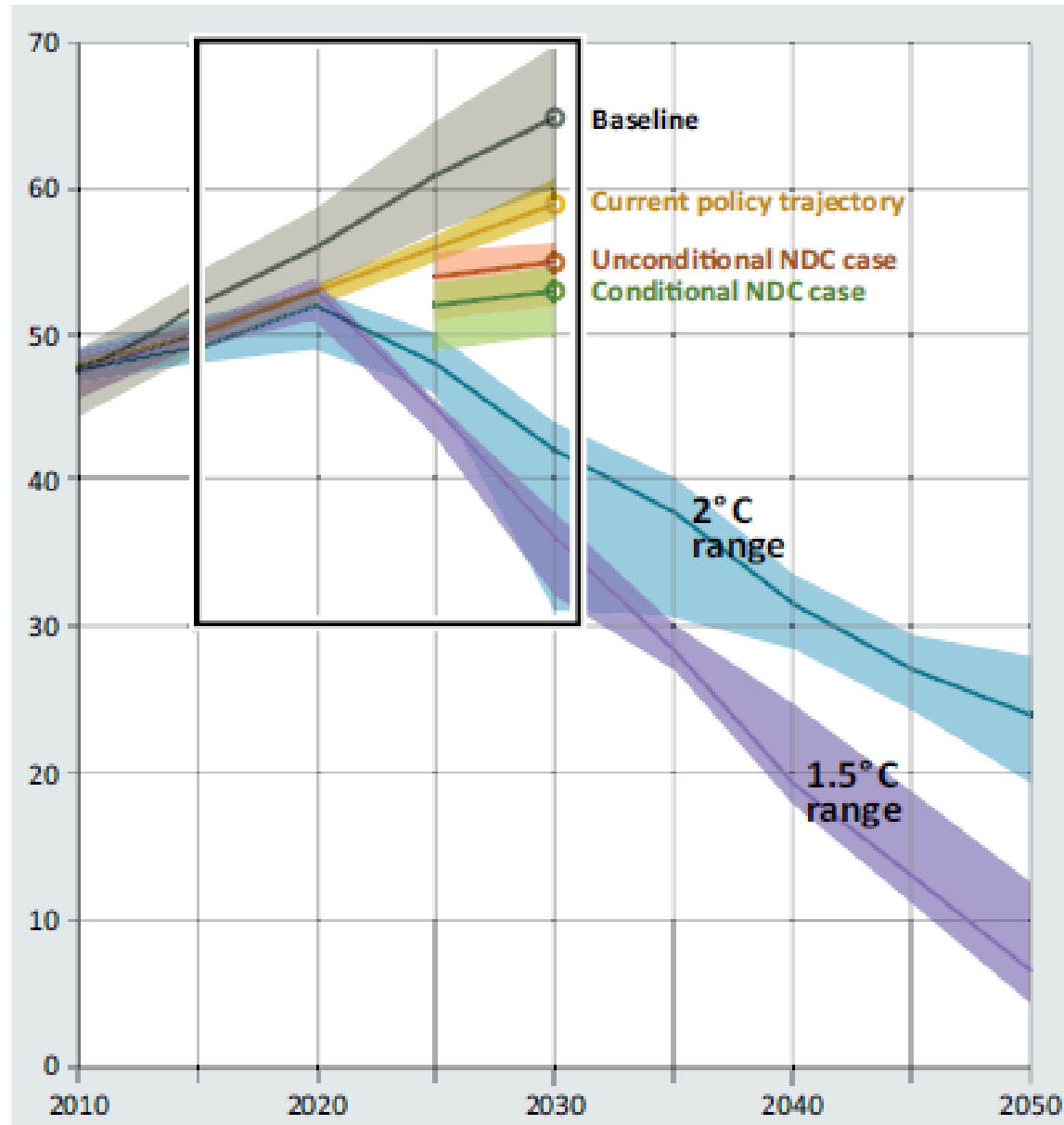


How Close Are We to 1.5°C?



If the current warming rate continues, the world would reach human-induced global warming of 1.5°C around 2040

The view to 2050 and beyond



Source: UNEP

For limiting global warming to below...

1,5°C

- global net anthropogenic CO₂ emissions must decline by about 45% (40-60%) from 2010 levels by 2030,
- reaching net **zero by 2050** (2045–2055)

2°C

- CO₂ emissions should decline by about 20% (10-30%) by 2030 and
- reach net **zero around 2075** (2065–2080)

All pathways that limit global warming to 1.5°C...

- project the use of carbon dioxide removal on the order of 100–1000 GtCO₂ over the 21st century.
- require rapid and far-reaching transitions in energy, land, urban and infrastructure and industrial systems.
- These systems transitions are unprecedented in terms of scale and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options

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£8.6 million UK research programme on greenhouse gas removal

20 April 2017

New research will investigate ways to remove greenhouse gases from the atmosphere to counteract global warming.

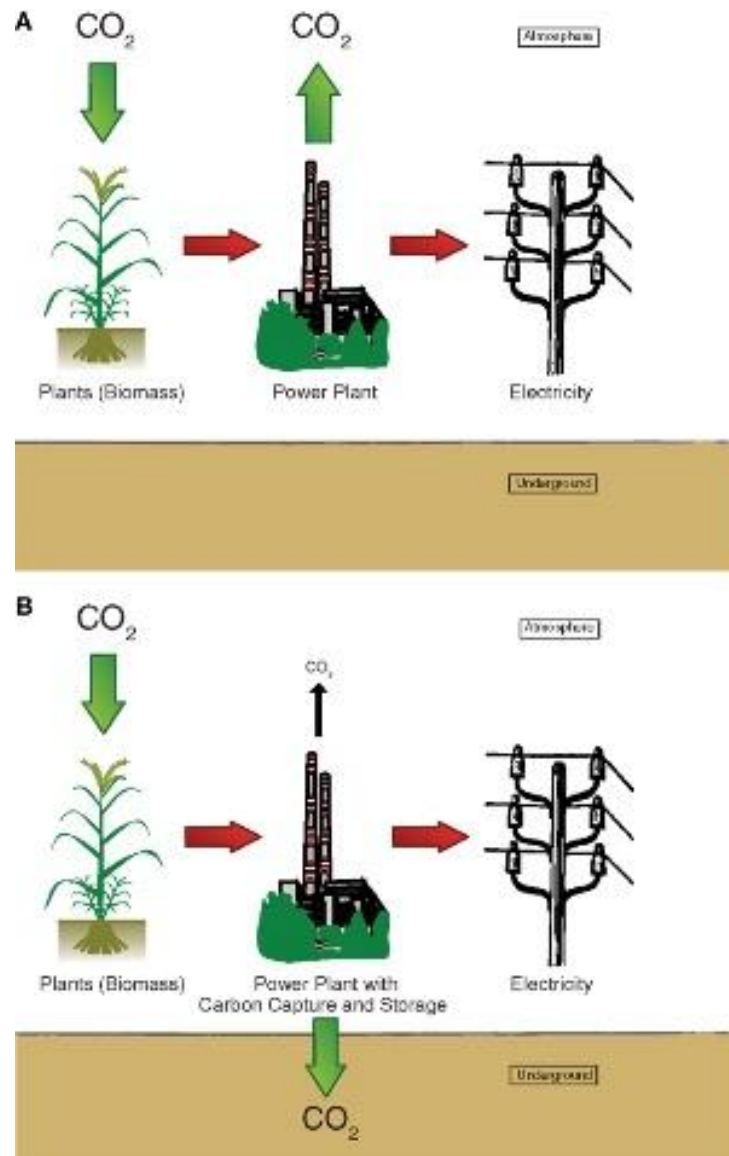
The UK is committed to the 2015 Paris Agreement to keep global temperature rise well below 2°C and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. Alongside significant emission reductions, large-scale removal of greenhouse gases from the atmosphere could considerably increase the likelihood of achieving this goal. Researchers know there are ways to approach this challenge but they have yet to be demonstrated on scales that are climatically-significant. Major questions remain around their feasibility, as well as impacts on society and public attitudes.

The active removal of GHGs from the atmosphere

„Negative emissions“, could be achieved using a variety of techniques. The most promising include:

- Enhancing natural land sinks. Increasing tree cover and improving forest management, increasing the amount of carbon stored in soil, restoring peatlands .
- Transferring CO₂ to geological storage. CO₂ can be taken from the atmosphere, directly or via plants, and pumped into underground storage in geological formations.

Bioenergy with carbon capture and sequestration (BECCS) power plant



Ten options for negative emissions technologies

1

Direct air capture (DAC)

Sucking carbon dioxide out of the air and either burying it underground or using it in chemical processes to make anything from plastic to fuel.



2

Cloud treatment to increase alkalinity

Adding alkali to clouds or the ocean to enhance the reaction that sees CO₂ dissolve in water, removing it from the air.



3

Enhanced weathering

Spreading pulverized rocks onto soils and/or the ocean to ramp up the natural rock weathering process that takes up CO₂ from the atmosphere and eventually sees it washed into the ocean as bicarbonate.



4

Enhanced ocean productivity

Adding iron or nitrogen to the ocean to increase the rate at which tiny microscopic plants photosynthesise, thus accelerating their take up of atmospheric CO₂.



5

'Blue carbon' habitat restoration

Conservation and restoration of degraded coastal and marine habitats, such as salt marshes, mangroves, and seagrass beds, so they continue to draw CO₂ out of the air.



6

Afforestation and reforestation

Planting trees where there were previously none (afforestation) or restoring areas where the trees have been cut down or degraded (reforestation).



7

Bioenergy with carbon capture and storage (BECCS)

Farming bioenergy crops, which extract CO₂ from the atmosphere as they grow, and then burning them for energy and sequestering the resulting emissions underground.



8

Building with biomass

Using plant-based materials in construction, storing carbon and preserving it for as long as the building remains standing.



9

Biochar

Burning biomass to create biochar and adding it to soils where it holds on to its carbon for hundreds or thousands of years.



10

Soil carbon sequestration

Using measures, such as modern farming methods, grassland restoration and creation of wetlands and ponds, to reverse past losses of soil carbon and sequester CO₂.

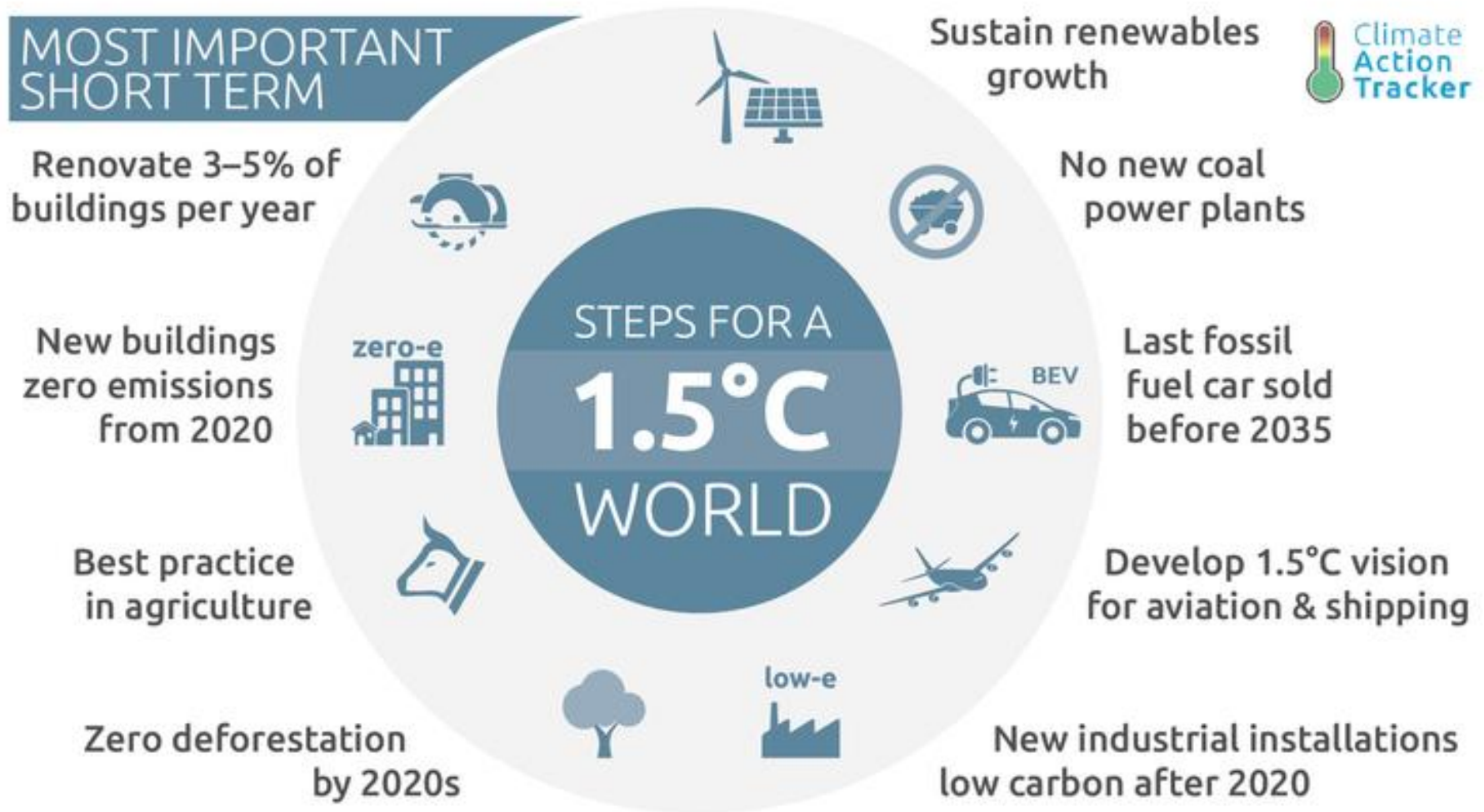


Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

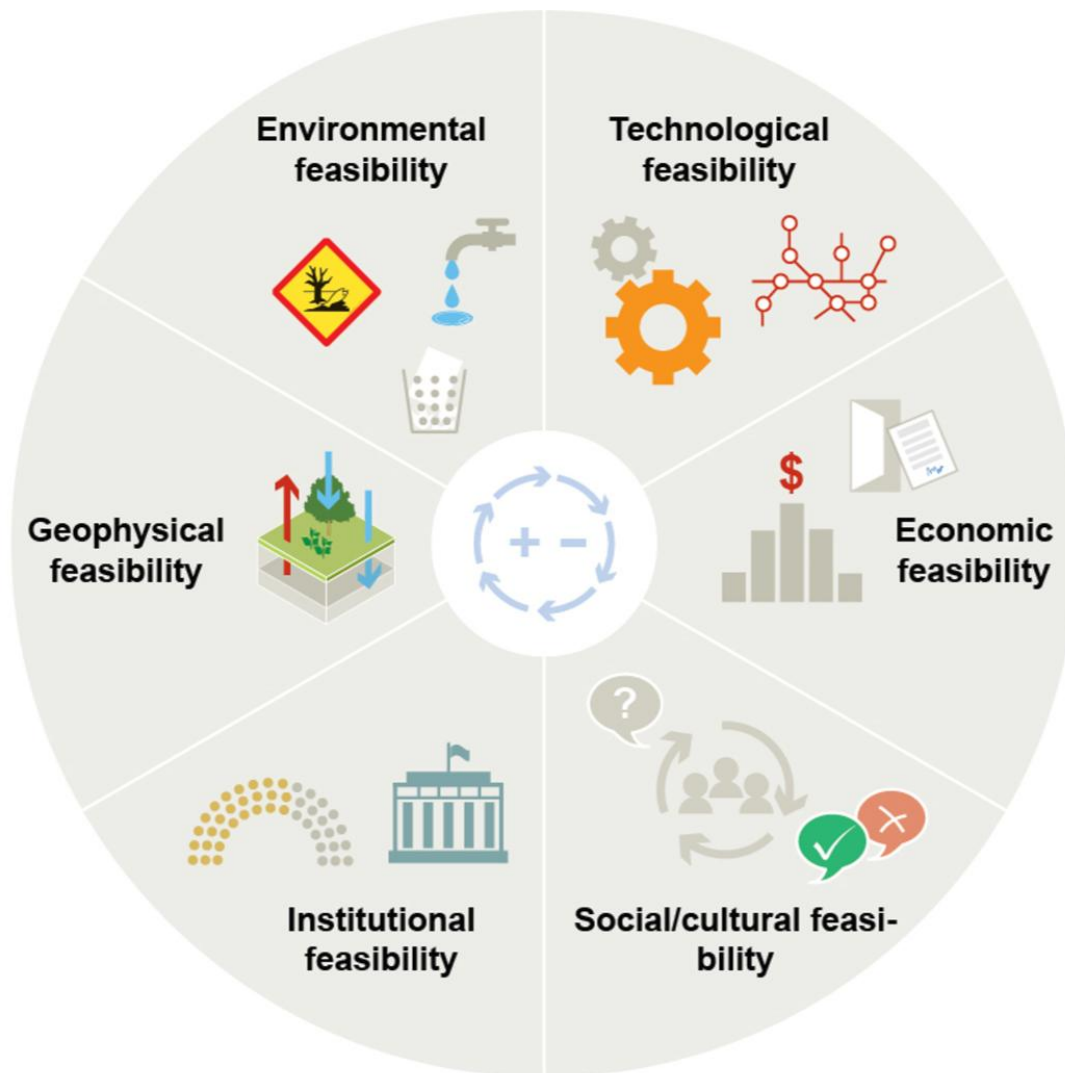
- Mitigation options consistent with 1.5°C pathways are associated with **multiple synergies and trade-offs** across the Sustainable Development Goals (SDGs).
- The total number of possible synergies exceeds the number of trade-offs.
- Sustainable development supports, and often enables, the fundamental societal strengthening the capacities for climate action of national authorities, civil society, the private sector, indigenous peoples and local communities
- **International cooperation can provide an enabling environment** for this to be achieved and is a critical enabler for developing countries and vulnerable regions.

How we can limit global warming to 1.5°C

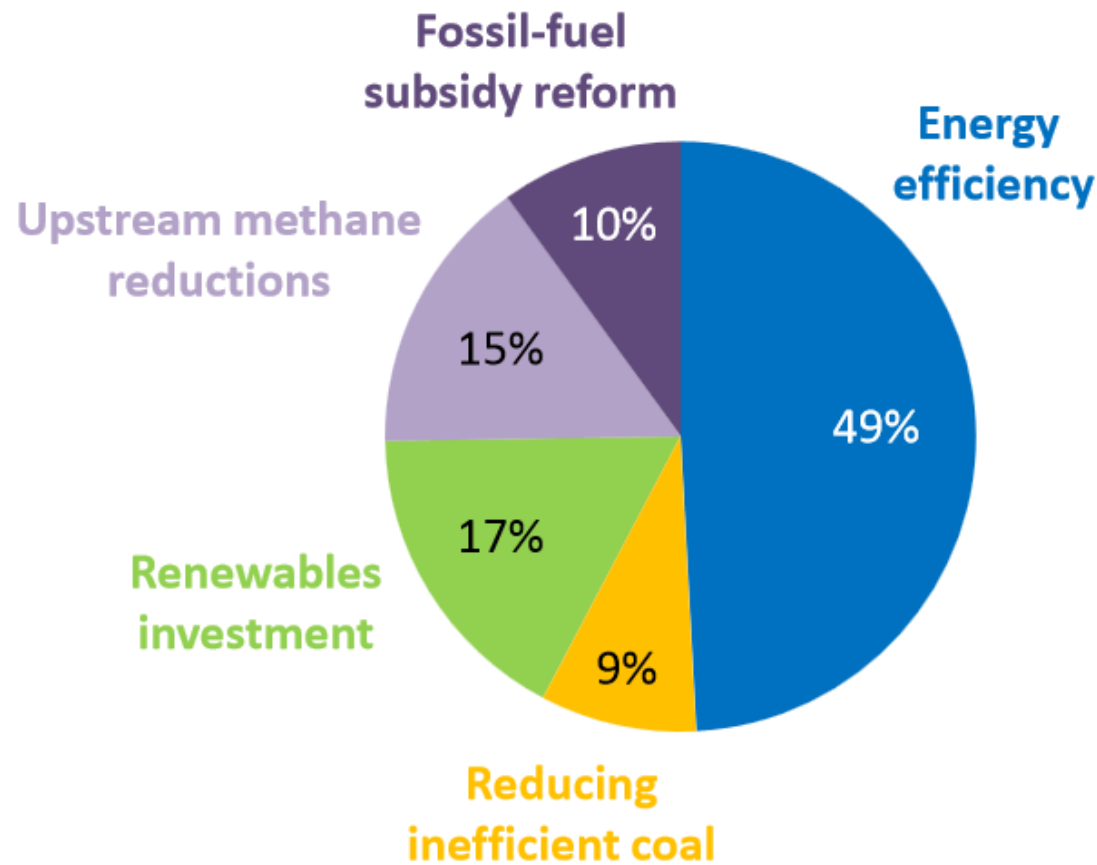
The most important things to do in the next 5 to 10 years



There are many factors that affect the feasibility of different adaptation and mitigation options



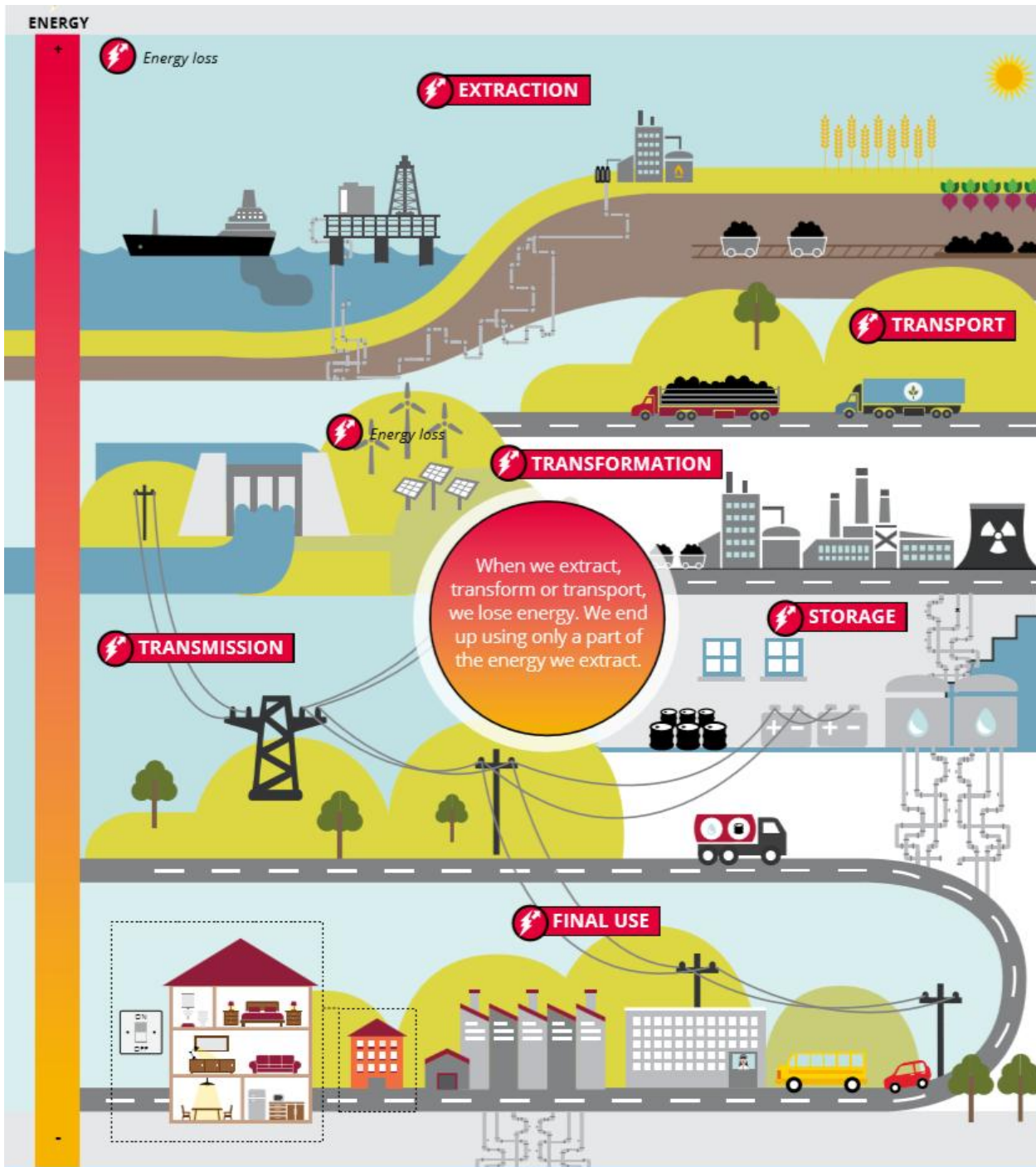
How to invest in mitigation



IEA, 2015

EU Energy Efficiency strategy

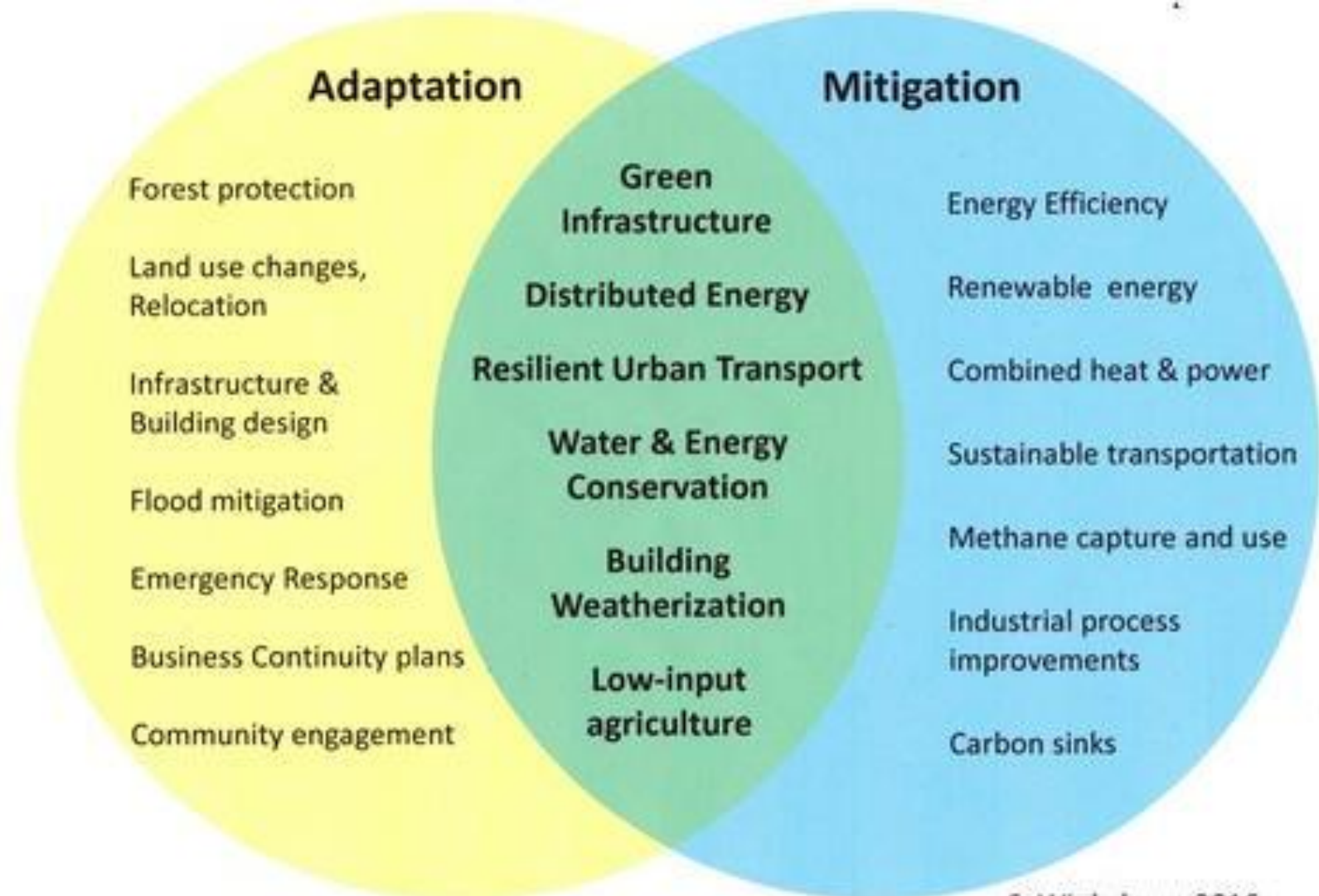
- 2015, the Energy Union strategy set five objectives including ‘**putting energy efficiency first**’ in order to lower the demand for energy.
- 2016, the European Commission put forward the Clean Energy for All Europeans proposals (**binding target of 30% improvement** in EU energy efficiency)
- April 2018, the European Parliament adopted new parts of the package, specifically “energy performance of buildings”, “renewable energy” and “energy efficiency”.
- July 2018 the revised **Energy Performance of Buildings Directive** came into force (huge potential for energy efficiency gains in the EU building sector, includes measures that advance the rate of building renovation and enhance the energy performances of new buildings, investing in smart technology)



Energy efficiency: tackling energy loss is essential

Innovative solutions must fundamentally change the way we produce, store, transport and use energy

Adaptation + Mitigation Synergies



If we are serious about “saving the planet”, then this will require a fundamental rethinking in economy model

- Reduction of resource consumption
- Management that emphasize optimization, not maximization
- Behavioural changes