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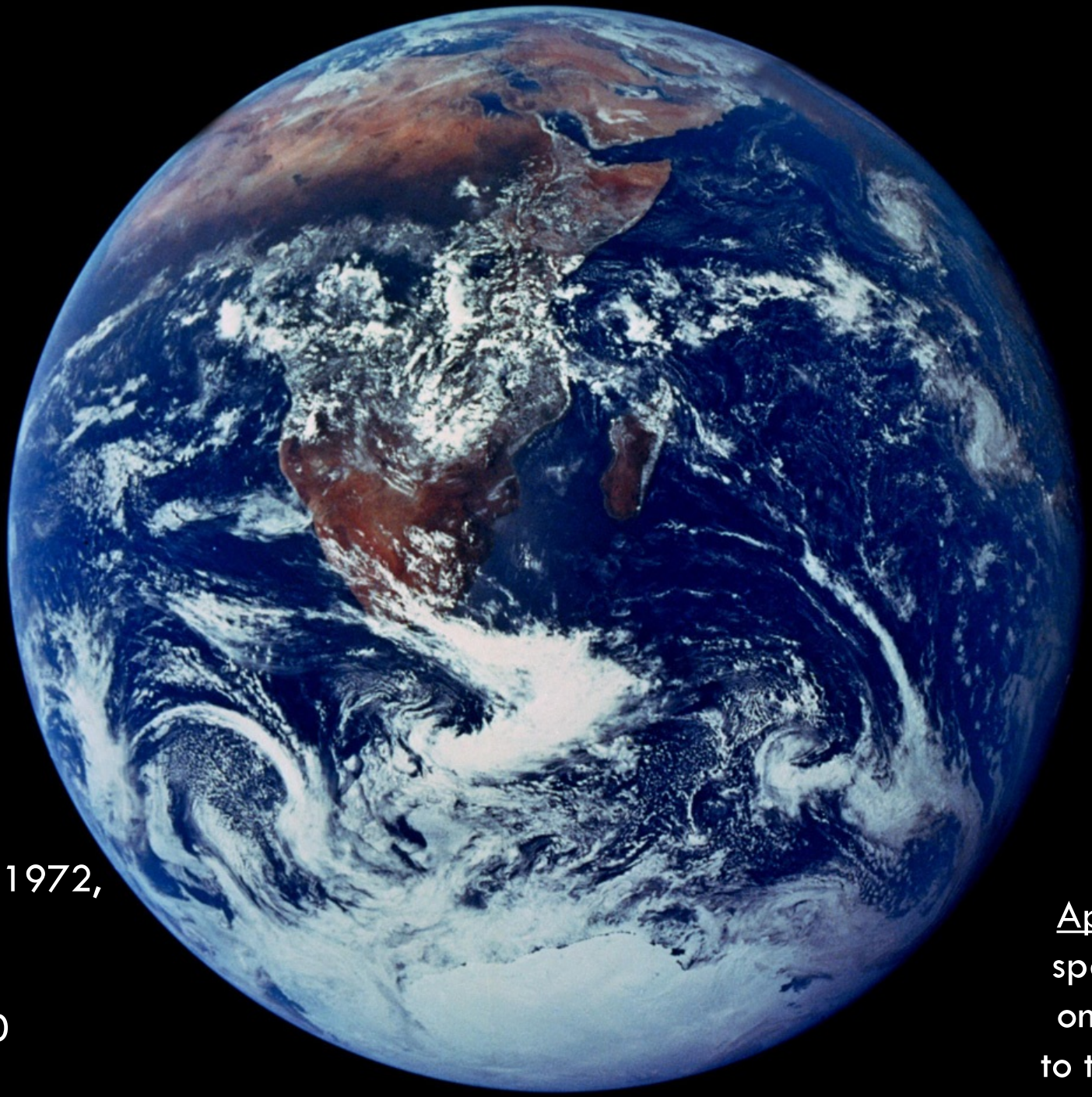
MUNI | RECETOX SCI

# CLIMATE CHANGE AND CRISIS: MYTH OR FACT?

https://pollev.com/lindan443



December 7, 1972,
from
a distance of
about 29,000
kilometers

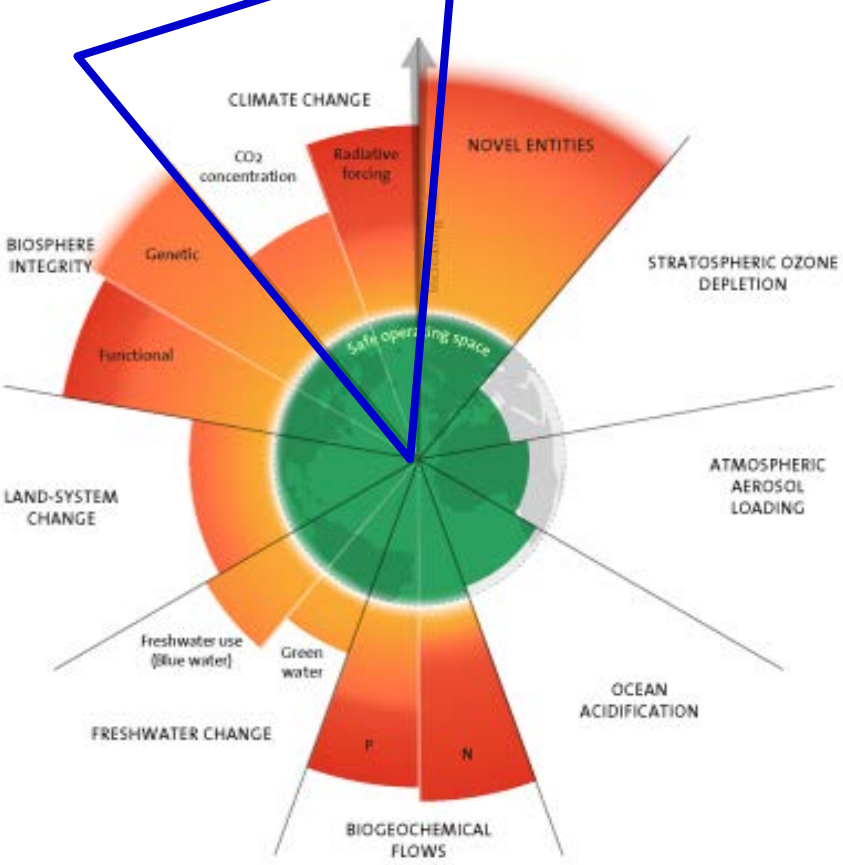
Apollo 17
spacecraft
on its way
to the Moon

## What comes to your mind when I say "Climate Change"?

Nobody has responded yet.

Hang tight! Responses are coming in.

# II. Climate Change (CC)




| Earth System process | Control variable | Threshold avoided or influenced by slow variable | Planetary Boundary (zone of uncertainty) | State of knowledge* |
|---|---|---|---|---|
| Climate change | Atmospheric $CO_2$ concentration, ppm;<br><br>Energy imbalance at Earth's surface, W $m^{-2}$ | Loss of polar ice sheets. Regional climate disruptions. Loss of glacial freshwater supplies. Weakening of carbon sinks. | Atmospheric $CO_2$ concentration: 350 ppm (350–550 ppm)<br><br>Energy imbalance:+1 W $m^{-2}$ (+1.0–+1.5 W $m^{-2}$) | 1. Ample scientific evidence.<br>2. Multiple sub-system thresholds.<br>3. Debate on position of boundary. |

# How would you define concept of planetary boundaries?

The lowest layer of the troposphere where wind is influenced by friction.

0%

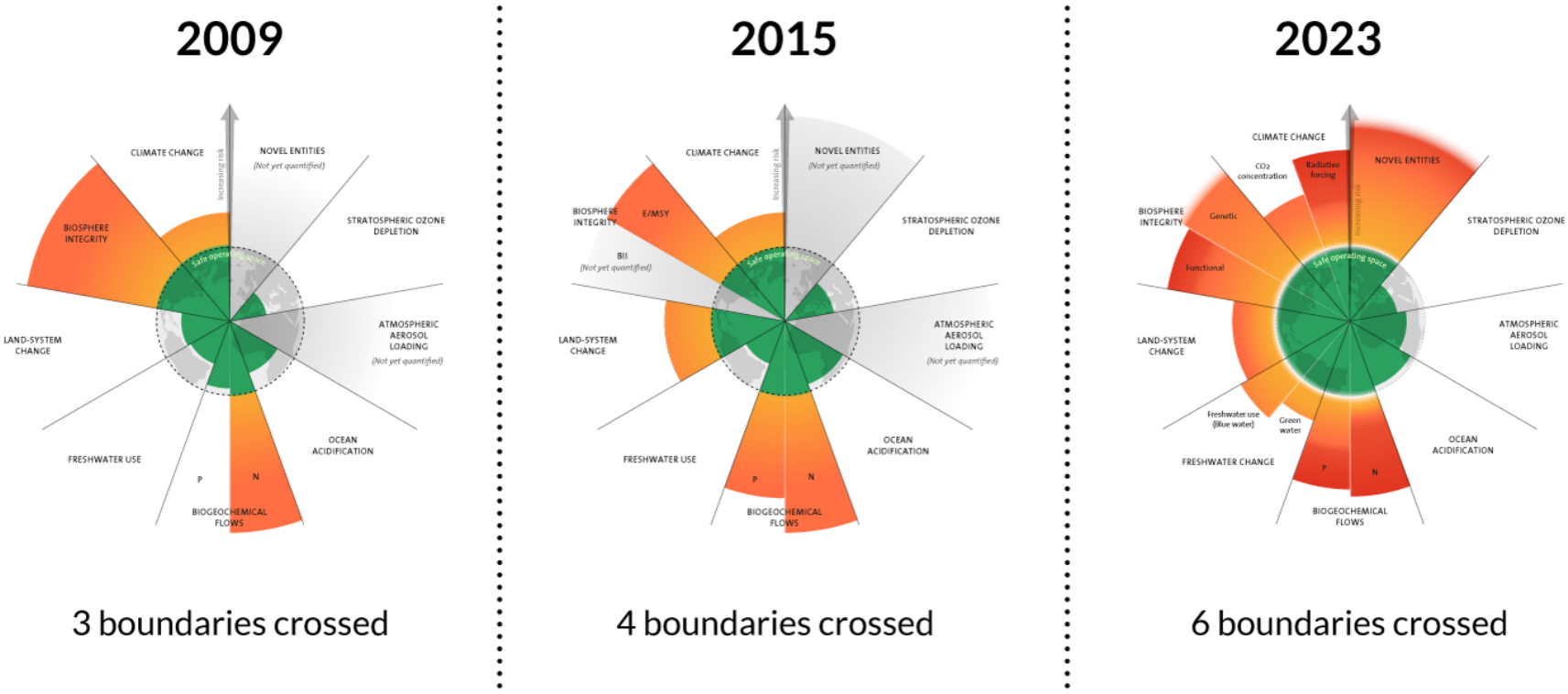
Crossing boundaries increases the risk of generating large-scale abrupt or irreversible environmental changes.

0%

Crossing boundaries decreases the risk of Earth´s vulnerability.

0%

"Safe operating space' SEE MORE ity.




According to the WWF's *Living Planet Report*, if we haven't changed our habits by 2050, we would need 2.5 planet Earths to sustain our activity. Things like deforestation, unsustainable agriculture and illegal exploitation of resources have widened the biodiversity gap. For instance, the number of vertebrate species in nature has declined by 68% since 1970.

# II. Climate Change (CC)

| Earth System process | Control variable | Threshold avoided or influenced by slow variable | Planetary Boundary (zone of uncertainty) | State of knowledge* |
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**Boundary:** Atmospheric $CO_2$ concentration no higher than 350 ppm

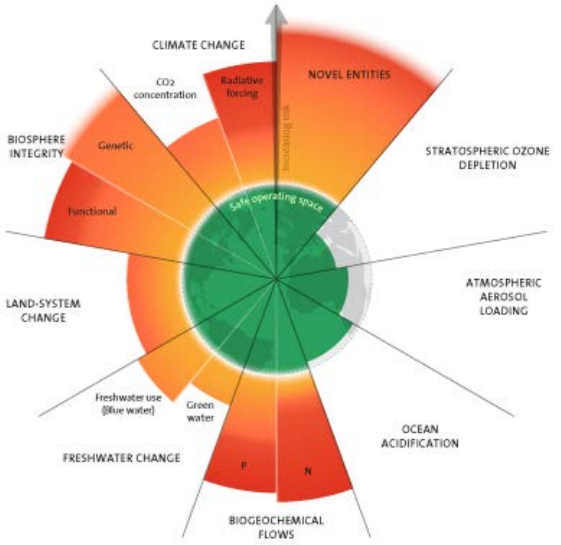
**Pre-industrial level:** 280 ppm

**Current level :** **Oct. 28, 2024:** **422.72 ppm**

**Mauna Loa** **Oct 28, 2023:** **418.84 ppm**

**Oct. 28, 2014** **399.97 ppm**

**Diagnosis:** Boundary exceeded

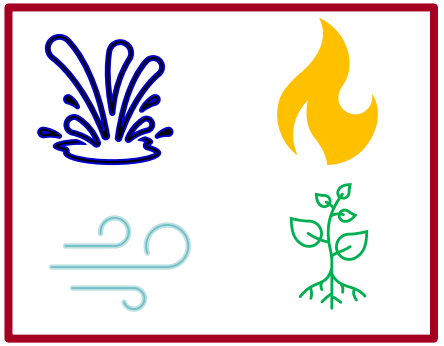



**August 2024 Temperature** **+ 1.56°C relative to 1880-1920**

**(The warmest Aug since 1800)**

# History of climate change and research

- The earliest interest in “climate” was of a rather pragmatic nature
- Greek *klinein* – „*to incline, at an angle*“
- *Aristoteles (384-322 BC) – Meterologica - VALID FOR ROUGHTLY 2000 YEARS*




Climate

=

Long-term weather condition

Greenhouse effect | Greenhouse gases | Climate change | Global change

## Can you guess the year when the greenhouse effect was DISCOVERED?

Nobody has responded yet.

Hang tight! Responses are coming in.

# CC - history

**1753** – discovery of $CO_2$ (heating of $CaCO_3$)

**1824** – Joseph Fourier - greenhouse effect in the atmosphere

**TEMPERATURE RELATED!**

Tyndall Centre for Climate Change Research

**1861** – John Tyndall - water vapour and other gases are **GREEN HOUSE GASSES**

**1896** – Svante Arhenius – hypothesis on enhancement of GH effect due to increase of $CO_2$ in the atmosphere as a consequence of fosil fuels combustion (HOTHOUSE)

- the prognosis on increase of the temperature by several °C when GHG concentration doubles is still valid

**1937** – term **„GREENHOUSE EFFECT“** (Trewartha)

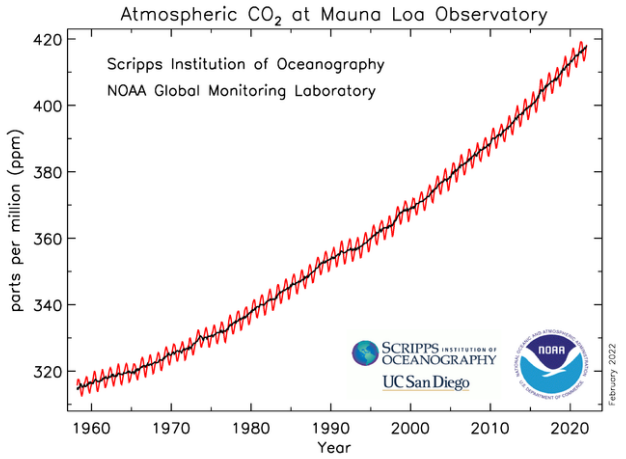
# CC - history

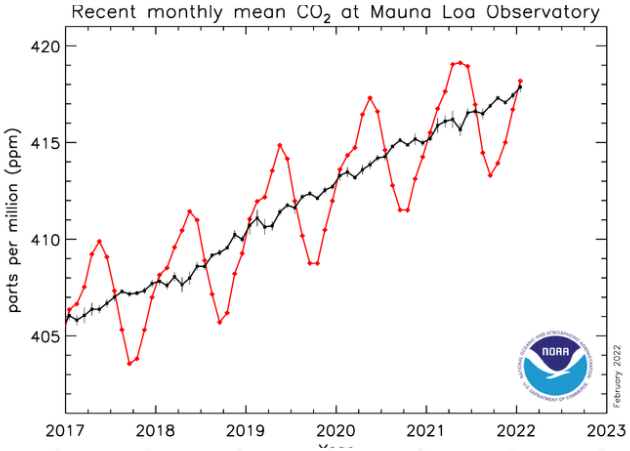
**1957** – oceanographer **Roger Revelle** and chemist **Hans Suess** shown that oceans **can not absorb entire $CO_2$ produced by people**

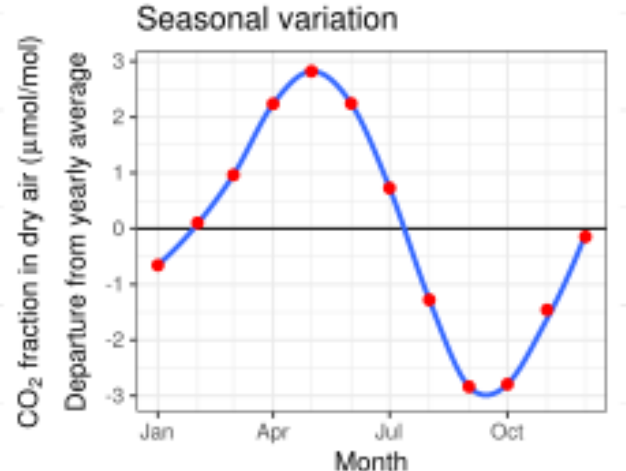
"*Human beings are now carrying out a large scale geophysical experiment.„*

# 1950 – Charles David Keeling

continuous measurements taken at the **Mauna Loa Observatory** since 1950 (till now)

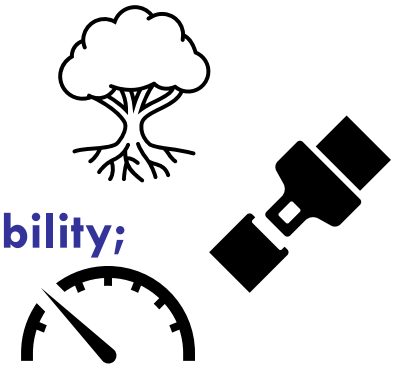



ipcc

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

- **The international body for assessing the science related to climate change.**
- Created in 1988
- To provide governments at all levels with scientific information that they can use to develop climate policies
- **Hundreds of people** from all over the world contribute to the work of the IPCC. For the assessment reports, experts volunteer their time as IPCC authors to **assess the thousands of scientific papers** published each year to provide a comprehensive summary of what is known about the **drivers of climate change, its impacts and future risks, and how adaptation and mitigation can reduce those risks.**
- **The IPCC does not conduct its own research.**



- **Working Group I: the Physical Science Basis;**
- **Working Group II: Impacts, Adaptation and Vulnerability;**
- **Working Group III: Mitigation of Climate Change**

# CC… and politics

**1972 – UNCHE (The United Nations Conference on the Human Environment)**, *Stockholm*. CC becomes one of the global priorities

- Creation of **United Nations Environment Programme (UNEP)**

**1990** – 1st IPCC report – *„Temperature increase by 0.3-0.6 °C is caused also by the human activities“*

**1992 –** *Earth summit* – **United Nations Framework Convention on CC**,

*Rio de Janeiro*

**2005 – Kyoto Protocol (1997)**

! CHINA – developing country, USA – did not ratify!

**2013** - 5th IPCC report *„Scientists are 95% certain that humans are the "dominant cause" of global warming since the 1950s“*

**2016 – Paris Treaty came** into force

**2021-2022 -** 6th IPCC report

Nov 2024 – United Nations Climate Change Conference, *Baku*

# Greenhouse Effect and Global Climate Change

- Greenhouse effect (GE) – natural atmospheric effect essential for life on the Earth

- GE dampens temperature fluctuation between day and night and thus provides favorable conditions for life


How Do Greenhouse Gases Actually Work?

**RADIATIVE FORCING**

($Wm^{-2}$)

A measure of the influence a given climatic factor has on the amount of downward-directed radiant energy impinging upon Earth's surface.

+/-

# What is an average temperature on the Earth?

26 °C  0 °C  15 °C  -2 °C

# Greenhouse Gasses (GH) in the atmosphere

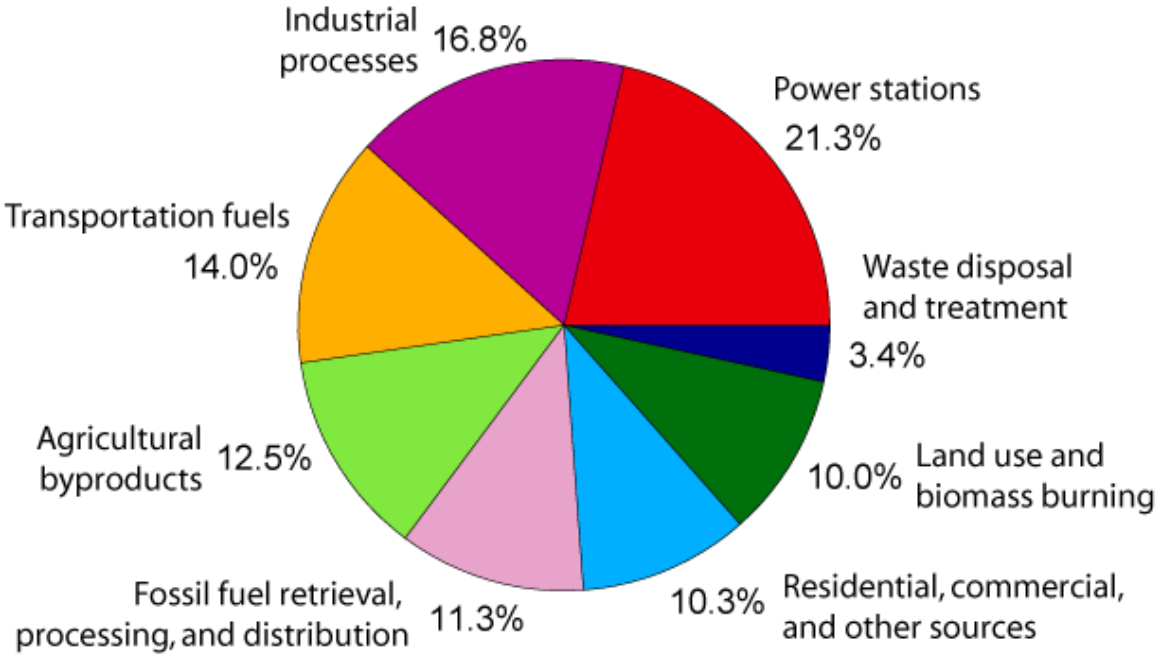
- the most important GHG is water vapour - $H_2O(g)$ that creates 2/3 of greenhouse effect
- however $H_2O(g)$ concentration in the atmosphere **is not significantly influenced** by human activities
- second most important GHG is **$CO_2$** (~ 25 % GH effect)
- last 8 % of GH effect – mainly gases like $CH_4$, $N_2O$, CFC

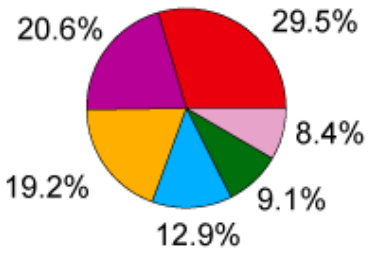
| | Water | Carbon Dioxide | Methane | Nitrous Oxide |
|---|---|---|---|---|
| |  |  |  |  |
| Atmospheric Concentration | 0.01–4%* | 385 ppm | 1797 ppb | 322 ppb |
| Rate of Increase | n/a | 1.5 ppm/yr | 7.0 ppb/yr | 0.8 ppb/yr |
| Atmospheric Lifetime | Very short 1–5 days | Variable 5–200 yr | 12 yr | 120 yr |
| Global Warming Potential (GWP) | n/a† | 1 | 21 | 310 |

* The amount of water vapor in the air varies according to temperature and density of air (usually ~1–3% of troposphere)

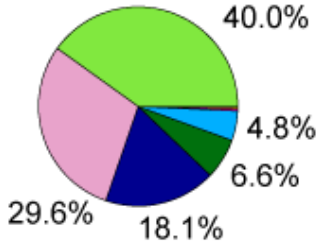
† Water vapor levels vary strongly according to region, so rates of change and warming potential cannot be assessed

# Annual Greenhouse Gas Emissions by Sector

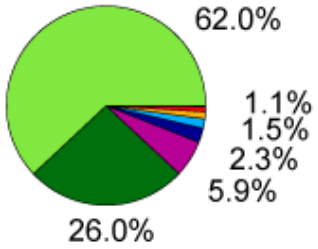



**Carbon Dioxide**
(72% of total)



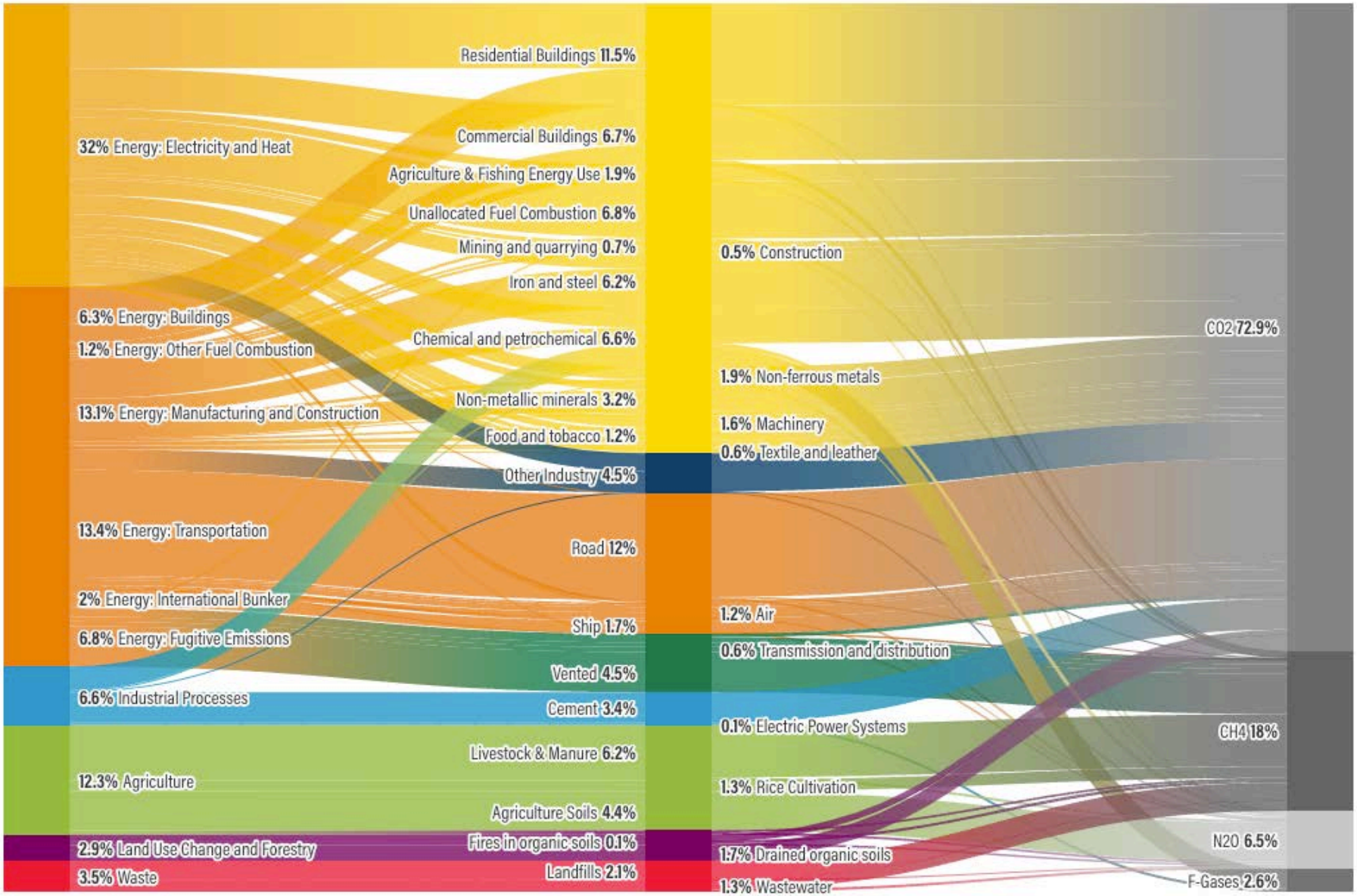

**Methane**
(18% of total)




**Nitrous Oxide**
(9% of total)

# World Greenhouse Gas Emissions in 2020 (Sector | End Use | Gas)

**Total: 47.5 GtCO2e**

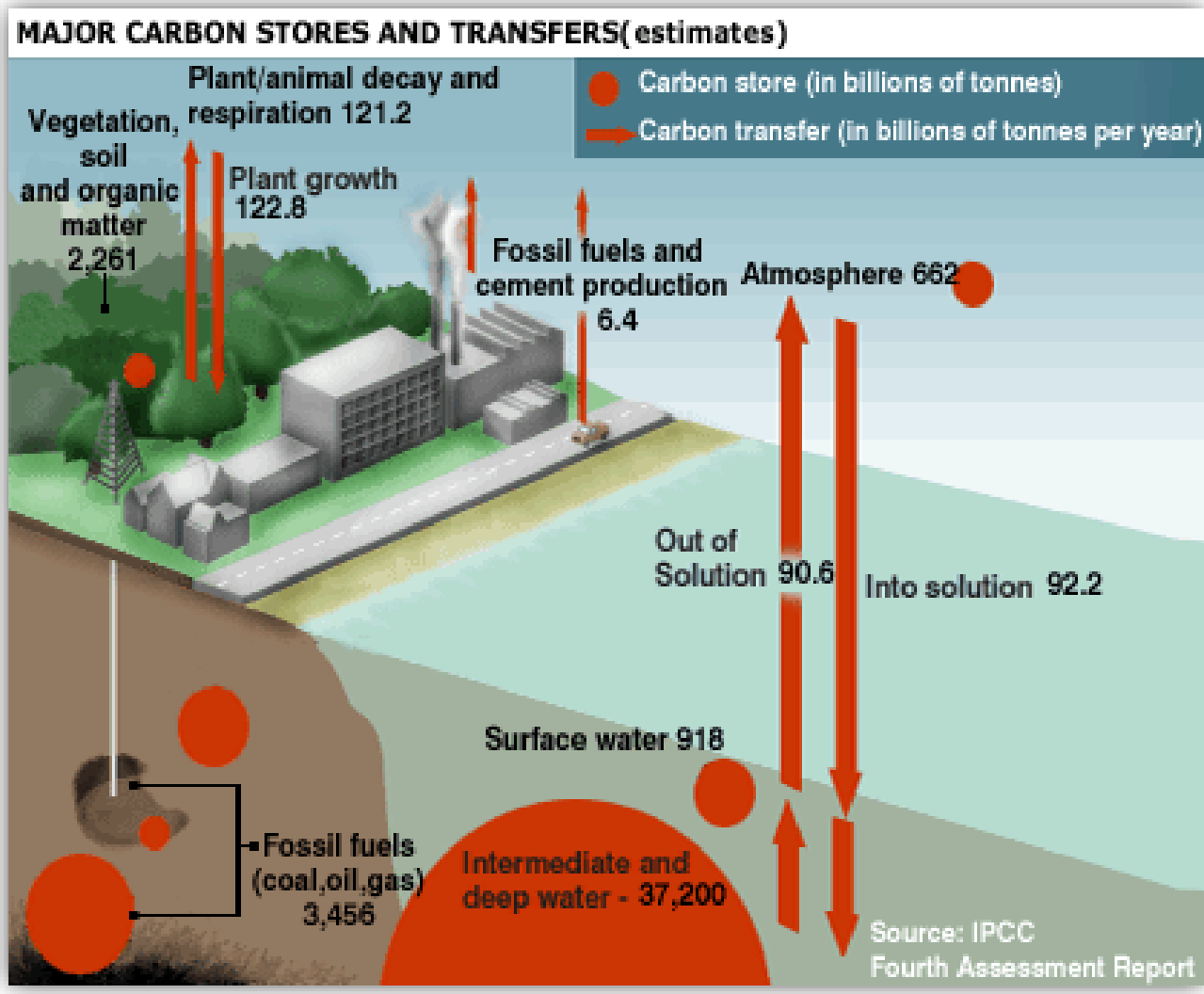



Source: Climate Watch, based on raw data from IEA (2022), GHG Emissions from Fuel Combustion, www.iea.org/statistics; modified by WRI.

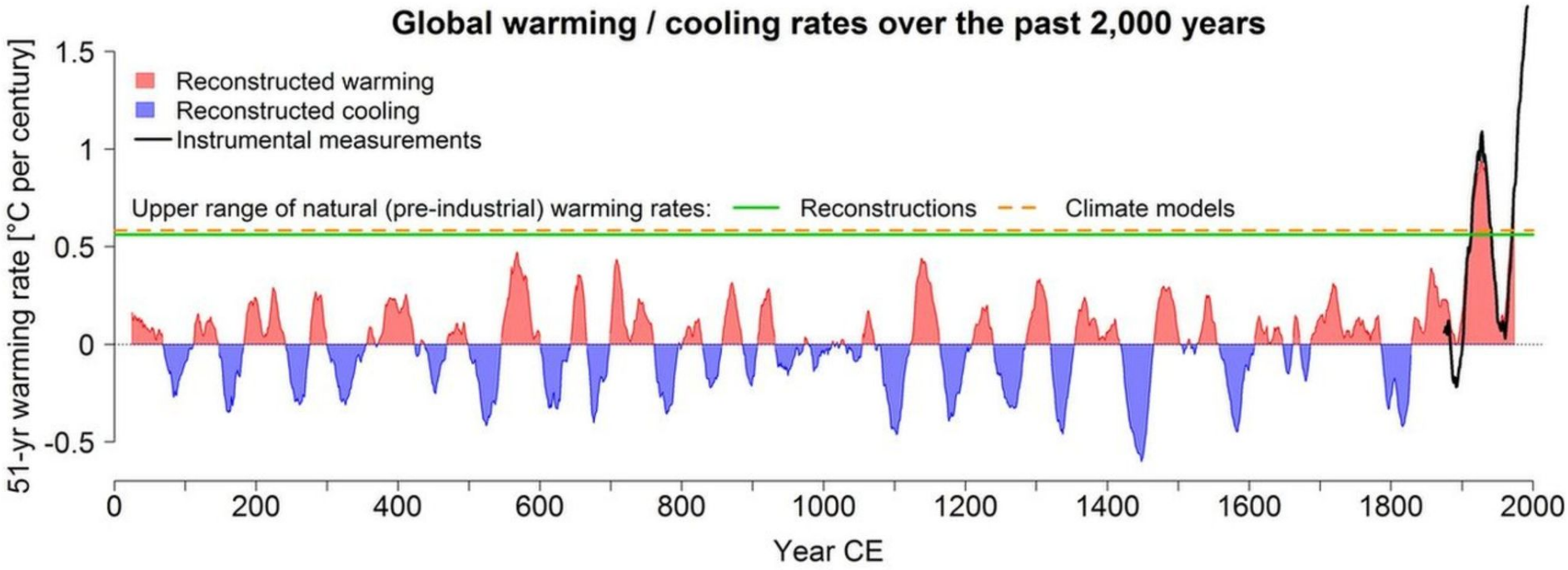
WORLD RESOURCES INSTITUTE

# ….. Problem?

- **increase of $CO_2$** level in the atmosphere due to the **antropogenic action** - disruption of the balance between **release and absorption of $CO_2$** in the carbon geochemical cycle

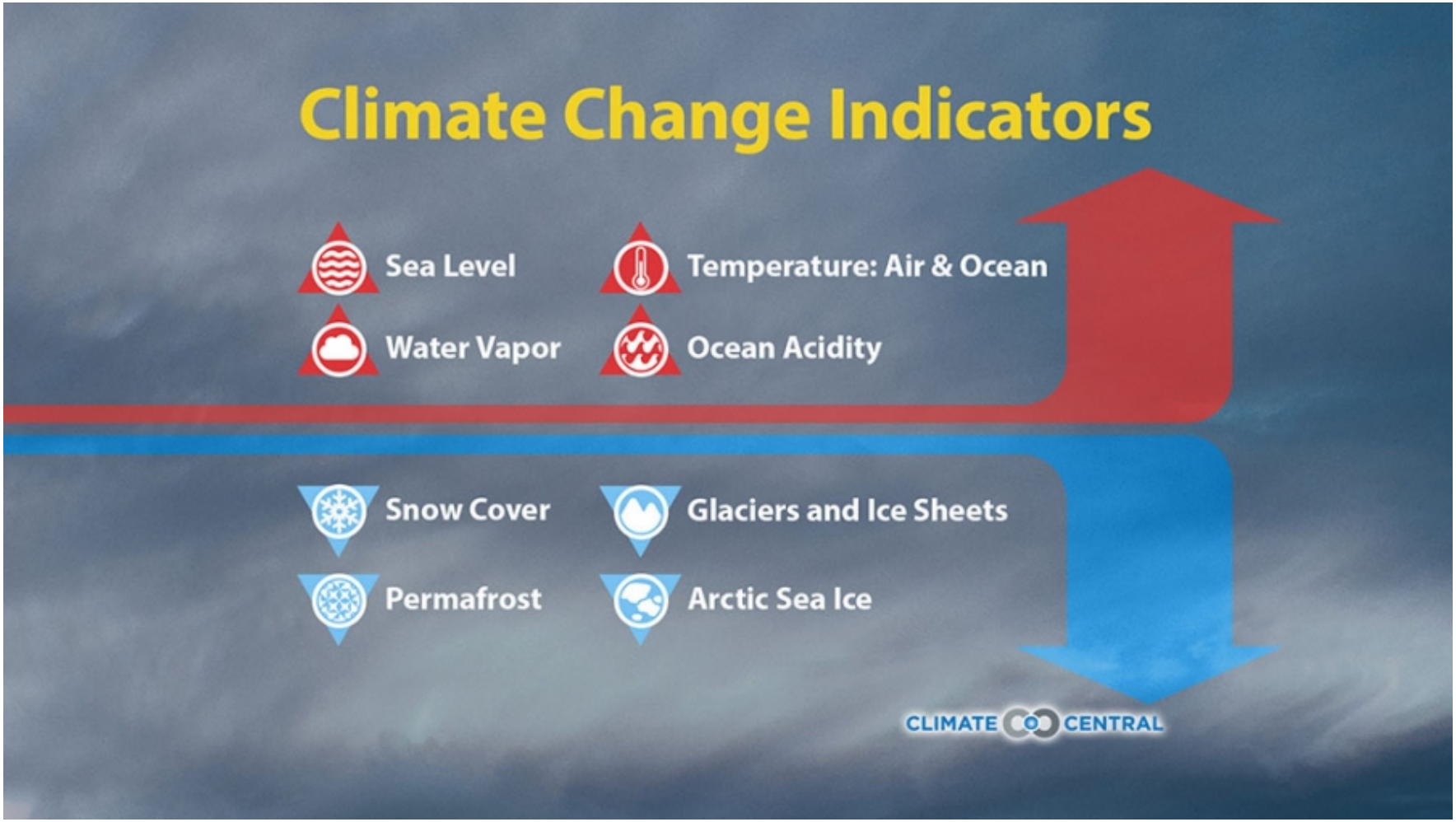



Fossil fuel combustion is responsible for approximately **80%** of this increase




GLACIAL/INTERGLACIAL PERIOD

# CC indicators

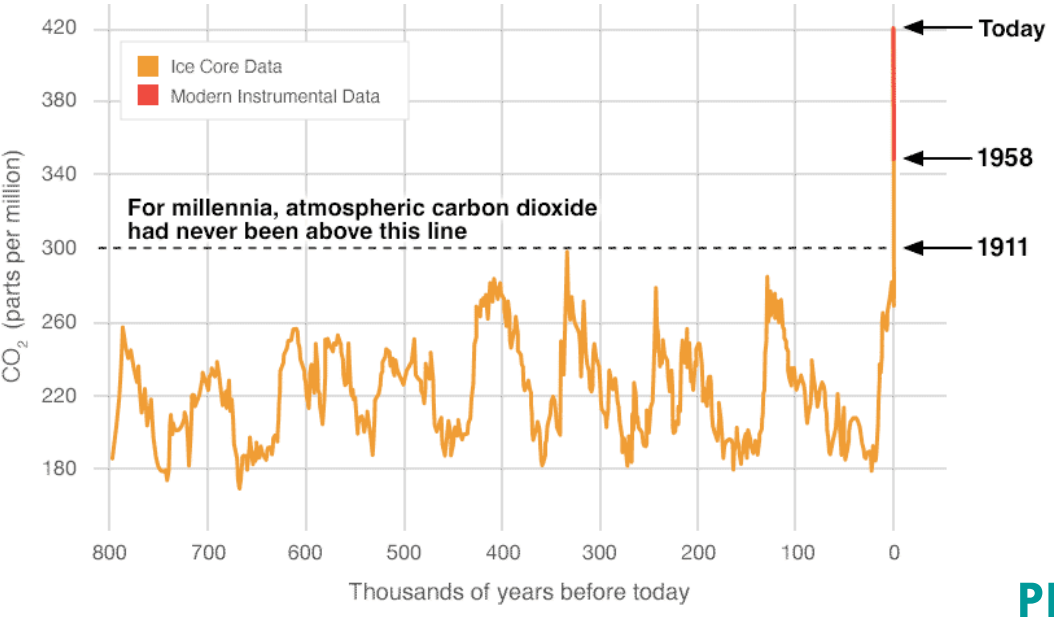


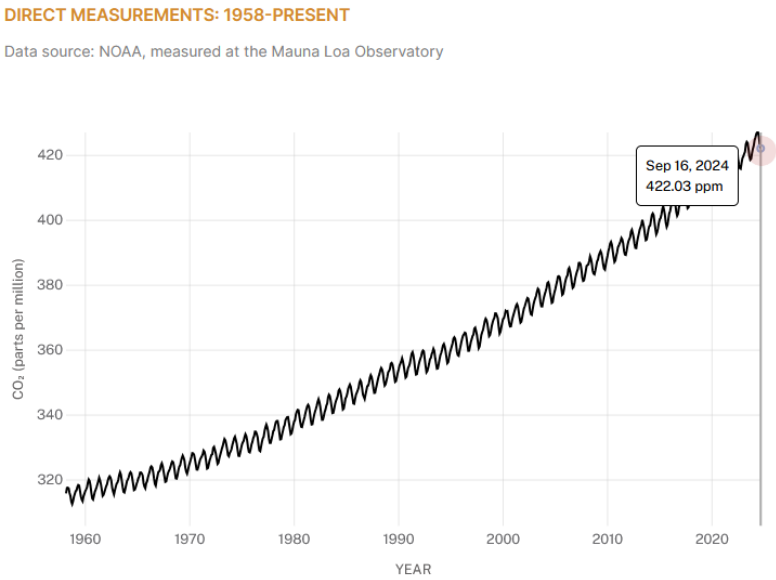
# Increase of $CO_2$ level

- **$CO_2$ level increased more than >40 % since pre-industrial level**

- level of other greenhouse gases increases as well

- main source of this increase is **fossil fuels combustion + deforestation**




## PROXY

**Historical**: memos, newspaper, diaries
**Biological:** tree rings, corals, ice cores
**Geological:** ocean sediments,
ice sheets, past glaciers, stalactites

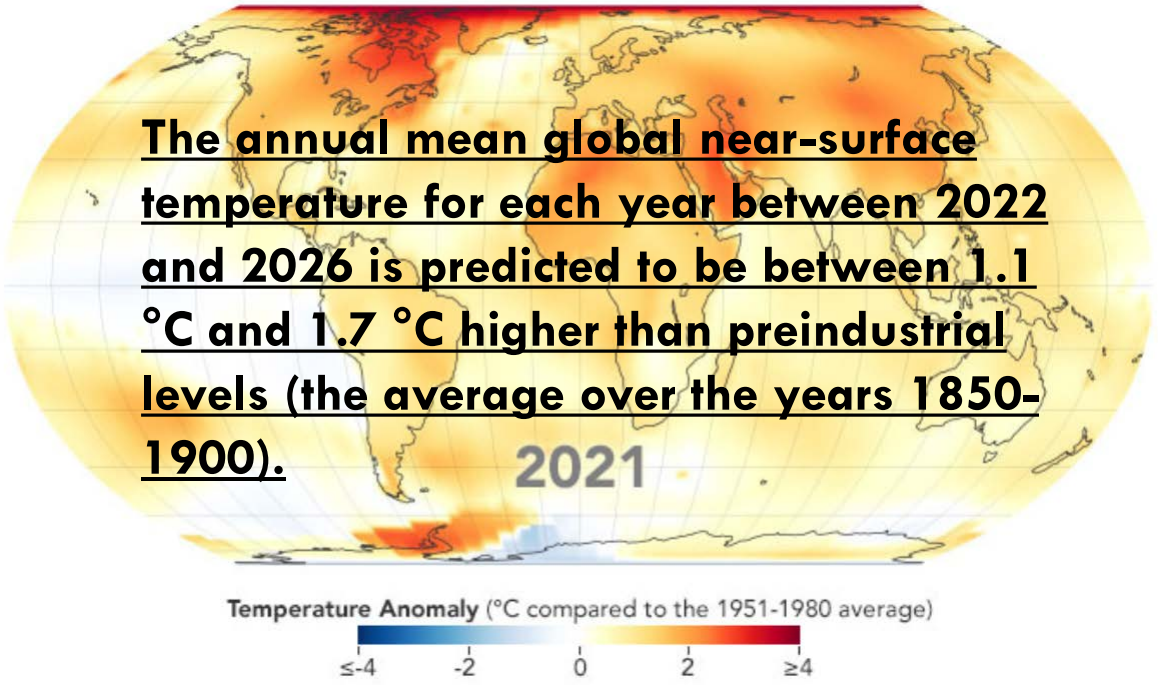
## What about other CC indicators?

Nobody has responded yet.

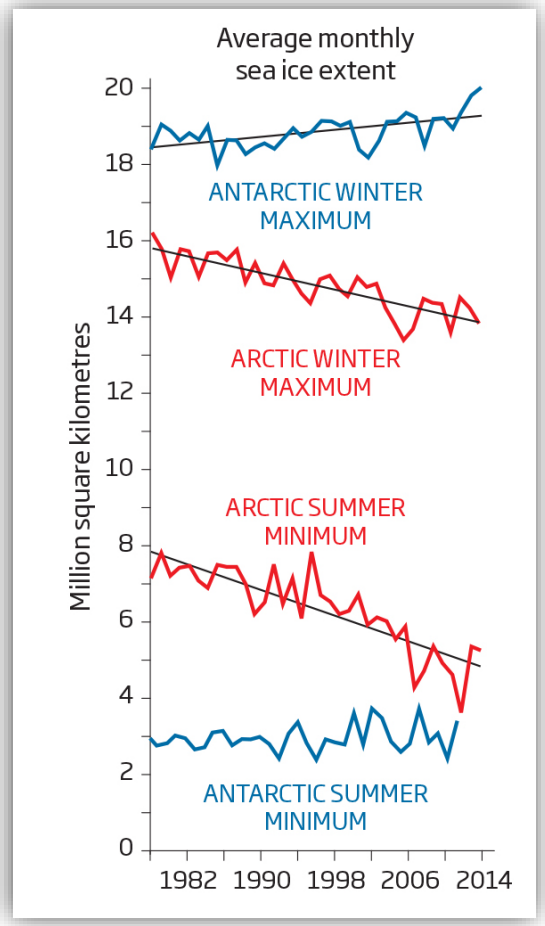
Hang tight! Responses are coming in.

# Other indicators (variables) of CC

- changes in temperature (land/ocean)
- changes in ice cover in Arctic ocean
- changes in ice cover in North and South pole
- sea level rise (102 mm/1993-2023)
- humidity rise
- melting of permafrost




**The annual mean global near-surface temperature for each year between 2022 and 2026 is predicted to be between 1.1 °C and 1.7 °C higher than preindustrial levels (the average over the years 1850-1900).**



# Less ice in the Arctic ocean

new naval routes
from Europe to Asia

Japan from Rotterdam - Suez Canal - **30 days**
- Northern Sea Route - **18 days**

WORLD ECONOMIC FORUM

Global Agenda | Arctic | Future of the Environment | Geo-economics

## The final frontier: how Arctic ice melting is opening up trade opportunities

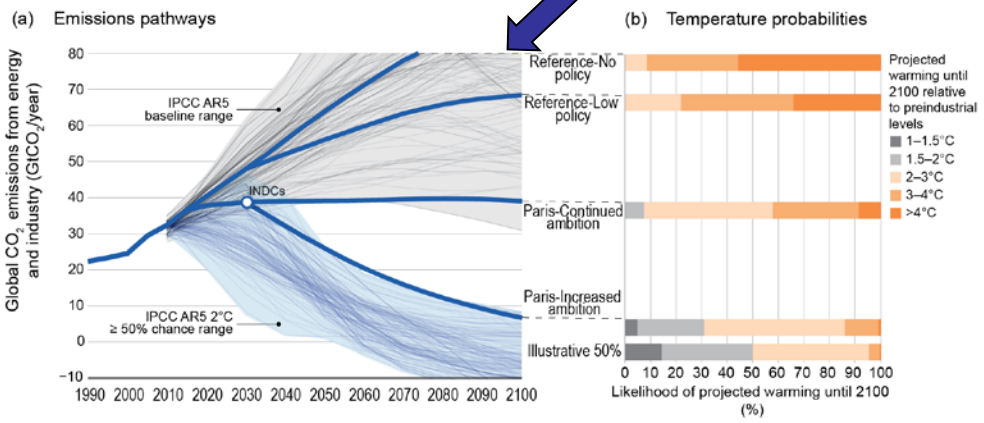
With financial gains to be exploited, will the world have enough restraint to resist damaging this landscape? Image: Unsplash/Valeriia Bugaiova

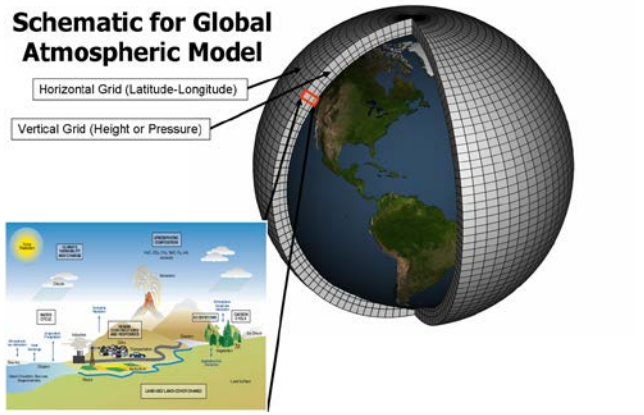
„The United States Geological Survey estimates that the Arctic contains approximately **13%** of the world's **undiscovered oil resources** and about **30% of its undiscovered natural gas resources.**"

# Glacier calving in Arctic ocean


"CHASING ICE" captures largest glacier calving ever filmed - OFFICIAL VIDEO

# Scenario vs model?



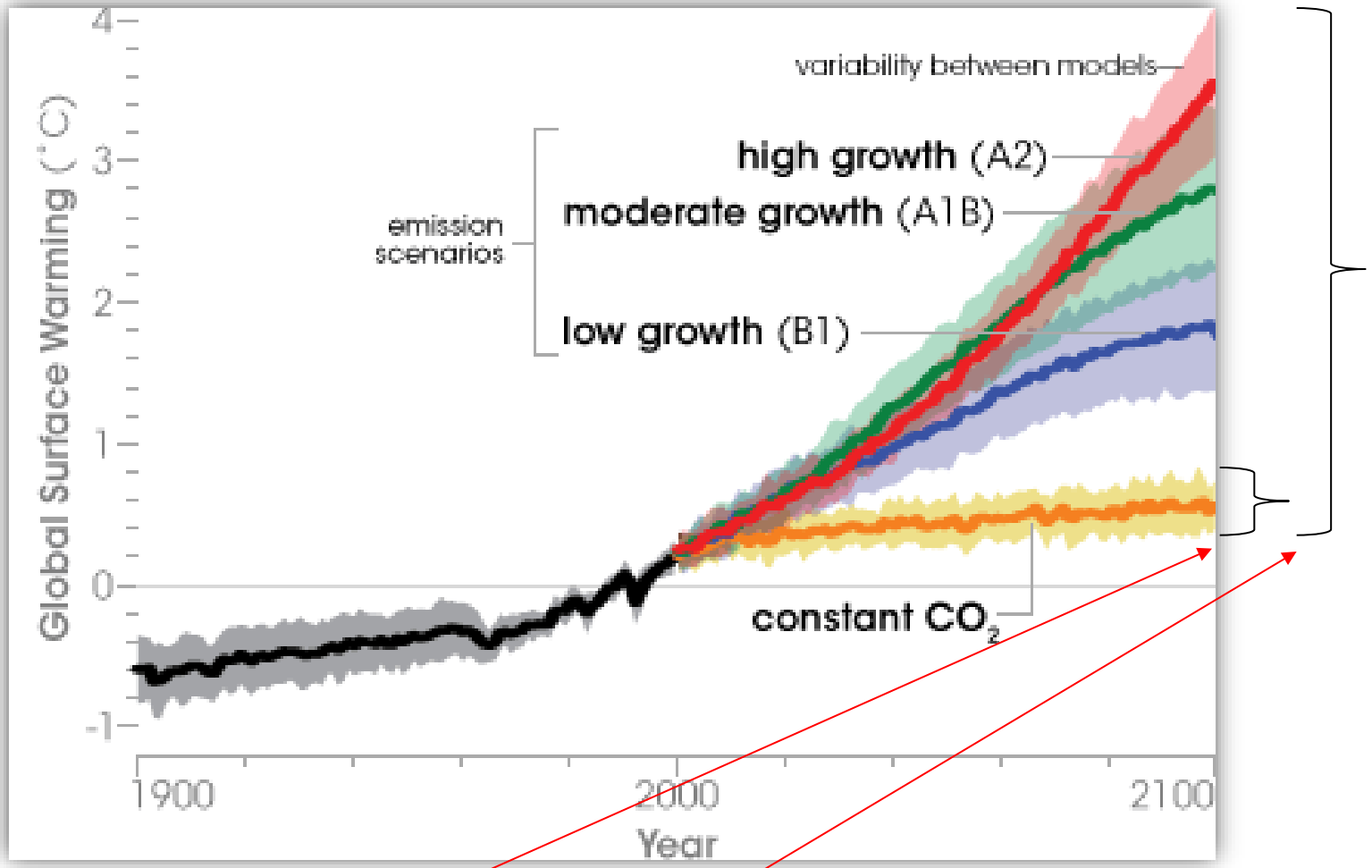




- plausible and **often simplified** description of how the future **may develop**, based on a coherent and internally consistent set of assumptions about driving forces and key relationships
- the impact of humans on the environment

- the climate models describe how the earth's **climate functions**
- based on physical laws and equations, approximation needed!

If the climate **models** are combined with the **emission scenarios**, it is possible to predict with a certain amount of **probability** how the climate will **be in the future.**

# Temperature rise scenarios to 2100




- scientific vs. political uncertainty

# CC consequences

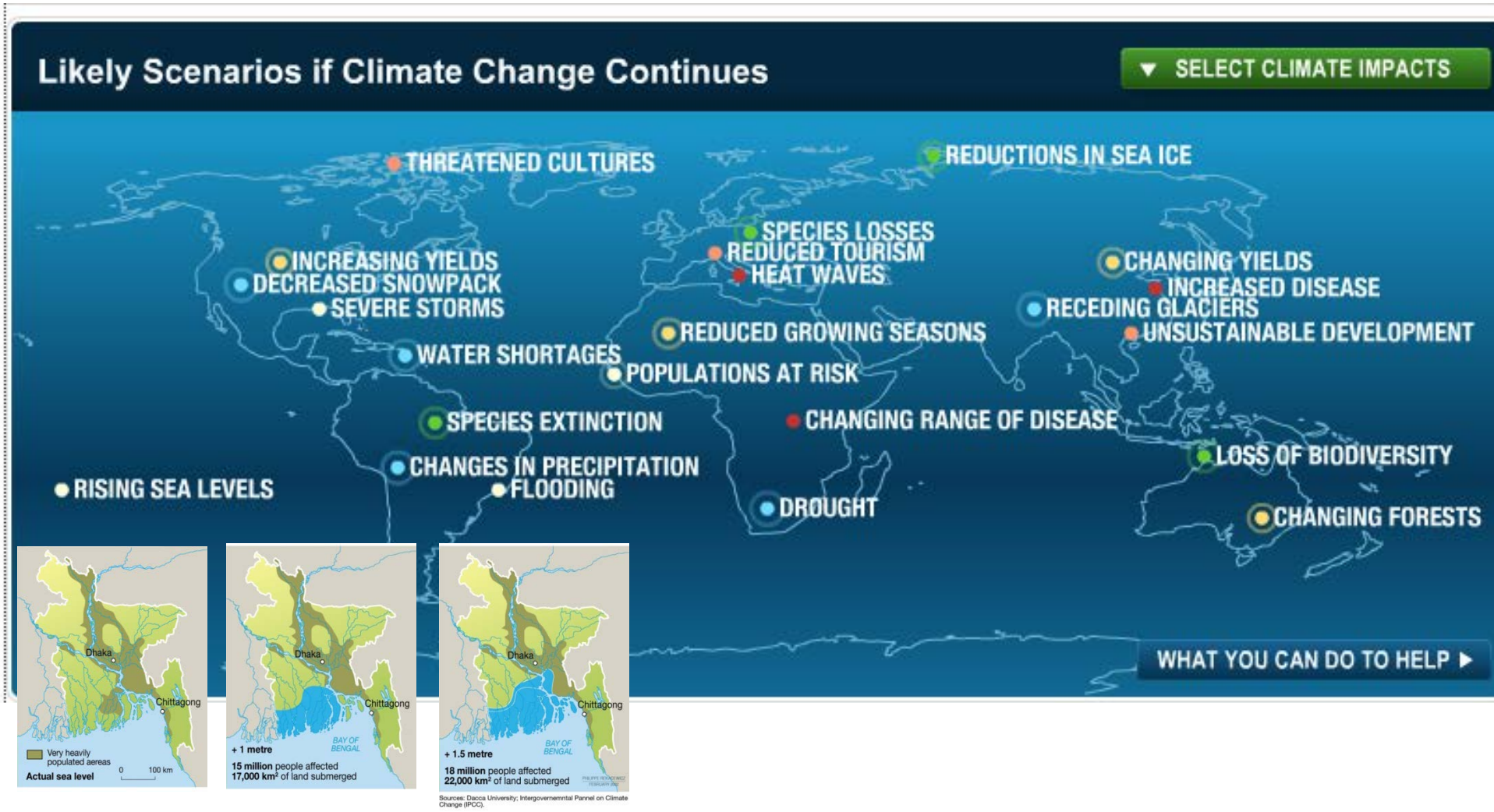
## Do you personally feel any consequences of CC? If yes, which ones?

Nobody has responded yet.

Hang tight! Responses are coming in.

# Consequences of CC

- **regionally specific**
- e.g. increasing vs. decreasing yields in some regions



# Main consequences of CC - summary

| Phenomena<br>Present trends | Confidence level |
|---|---|
| The rise in weather and climate extremes has led to some irreversible impacts as natural and human systems are pushed beyond their ability to adapt.<br>(increases in the frequency and intensity of climate and weather extremes, including hot extremes on land and in the ocean, heavy precipitation events, drought and fire weather) | **High confidence** |
| Warm-water coral bleaching and mortality and increased drought-related tree mortality | **High confidence** |
| Increased heat-related human mortality | **Medium confidence** |
| Impacts in natural and human systems from ocean acidification, sea level rise or regional decreases in precipitation have also been attributed to human induced climate change | **High confidence** |
| Roughly half of the world's population currently experience severe water scarcity for at least some part of the year due to climatic and non-climatic drivers | **Medium cofidence** |
| Climate change including increases in frequency and intensity of extremes have reduced food and water security, hindering efforts to meet Sustainable Development Goals | **High confidence** |
| Climate change has adversely affected physical health of people globally and mental health of people in the assessed regions | **Very high confidence!!!** |
| Hot extremes including heatwaves have intensified in cities | **High confidence** |

| Phenomena<br>Future trends | Confidence level |
|---|---|
| Biodiversity loss and degradation, damages to and transformation of ecosystems are already key risks for every region due to past global warming and will continue to escalate with every increment of global warming | **Very high confidence!!!** |
| Risks in physical water availability and water-related hazards will continue to increase by the mid- to long-term in all assessed regions, with greater risk at higher global warming levels | **High confidence** |
| Increases in frequency, intensity and severity of droughts, floods and heatwaves, and continued sea level rise will increase risks to food security | **High confidence** |
| Climate change and related extreme events will significantly increase ill health and premature deaths | **High confidence** |
| In the mid- to long-term, displacement will increase with intensification of heavy precipitation and associated flooding, tropical cyclones, drought and, increasingly, sea level rise | **Medium confidence** |

Scientific language is very **brief** and talking in the words of **probability and confidence**

*„...more heat will damage crop growth in many warmer climates, but it means better agricultural production in cold countries. And, $CO_2$ is a fertiliser — commercial greenhouses pump in extra $CO_2$ to grow bigger tomatoes. So overall, we can expect agriculture to gain from global warming in the short and medium term...“ B. Lomborg*

## Let's discuss!

Nobody has responded yet.

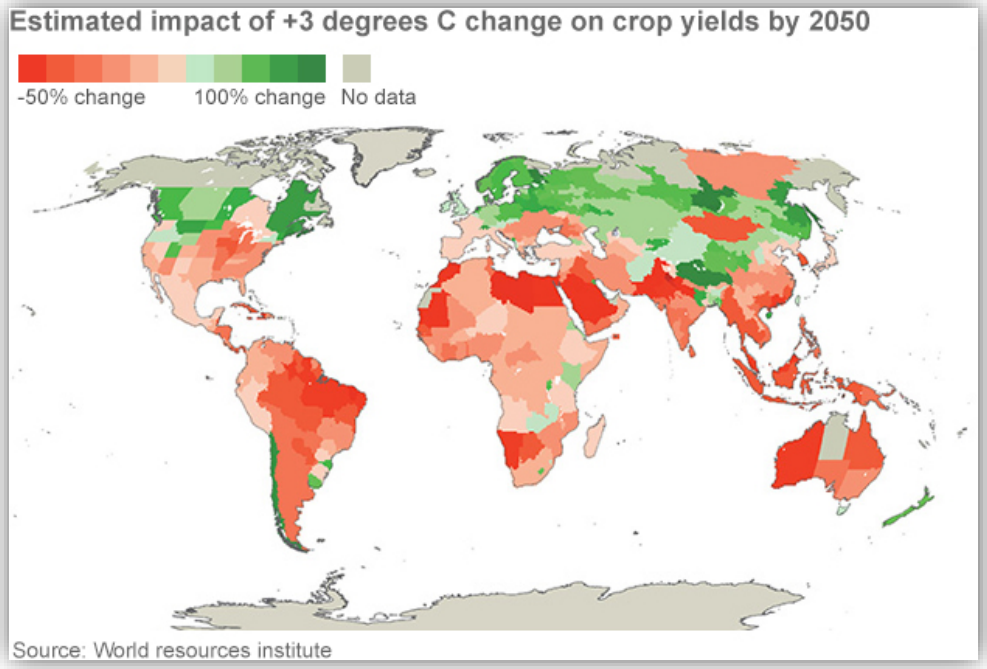
Hang tight! Responses are coming in.

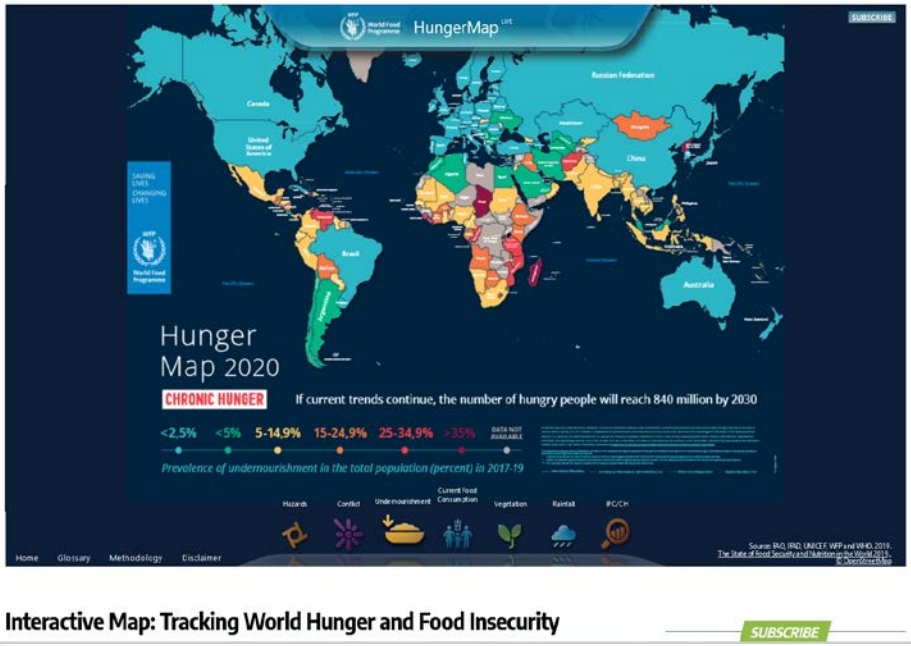
# Moral dimension of CC

*„...more heat will damage crop growth in many warmer climates, but it means better agricultural production in cold countries. And, $CO_2$ is a fertiliser — commercial greenhouses pump in extra $CO_2$ to grow bigger tomatoes. So overall, we can expect agriculture to gain from global warming in the short and medium term..." B. Lomborg*

**yes, increasing yields, but mainly in countries with the actual overproduction, while the agrarian countries in developing world (with significant hunger) will experience even drop in the production**

**RESPONSIBILITY?**



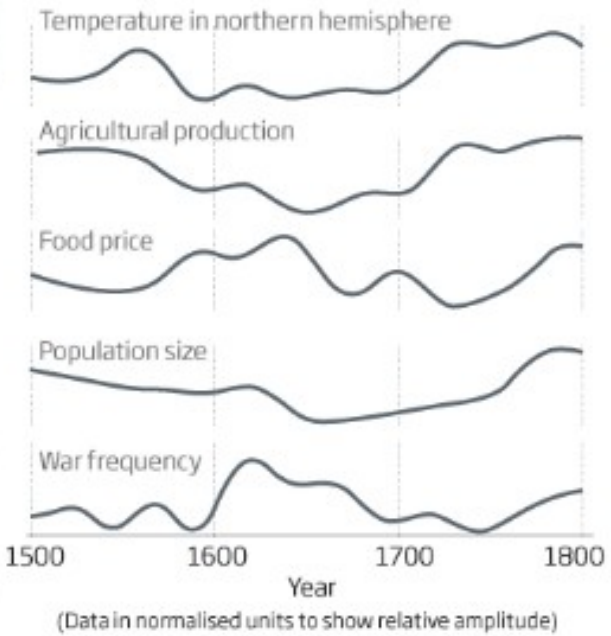
# Climate change: The great civilisation destroyer?

War and unrest, and the collapse of many mighty empires, often followed changes in local climes. Is this more than a coincidence?

## More than coincidence?



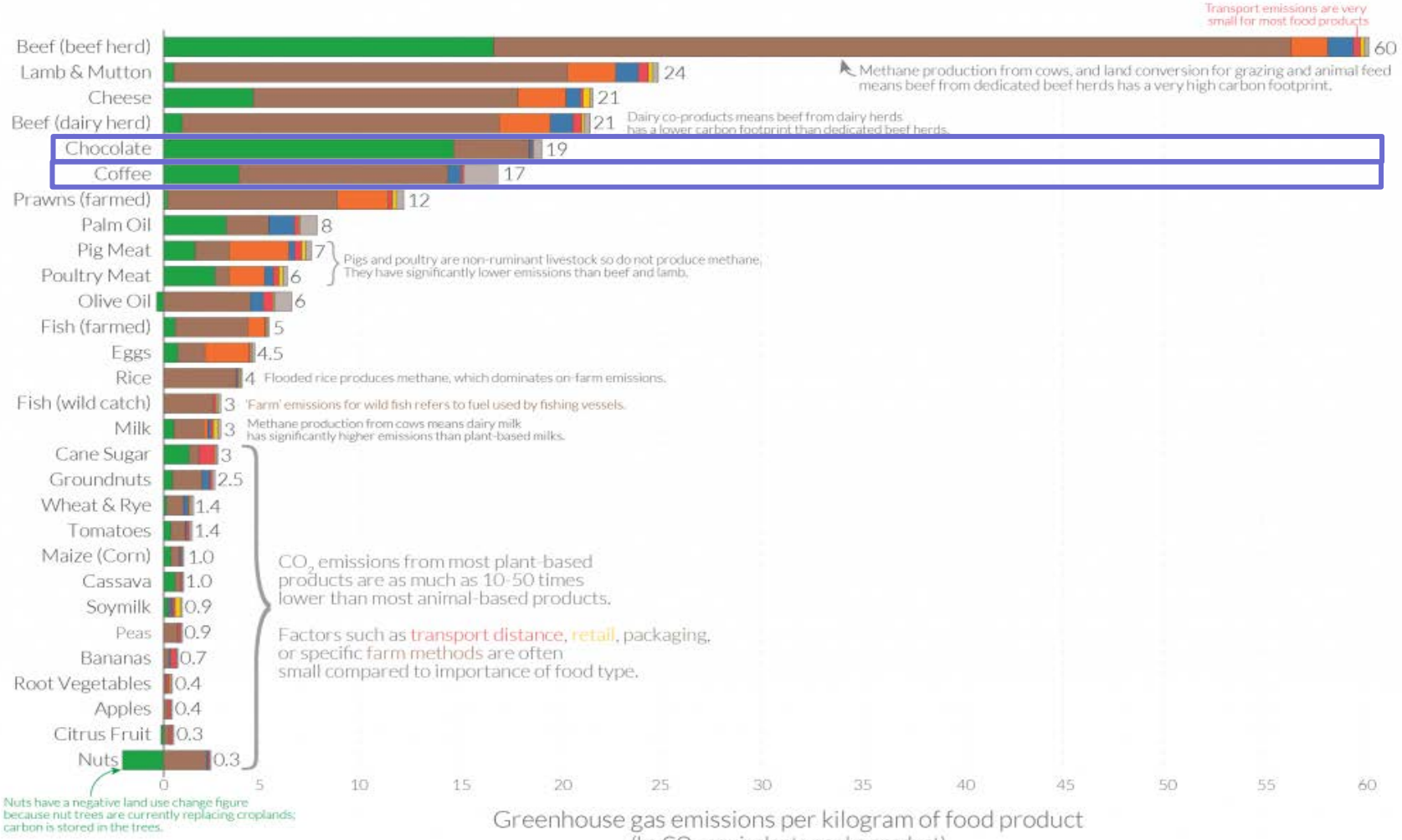
The decline and fall of many civilisations coincided with periods of climate change, and there are also correlations between climate change, population size and the frequency of wars, as data from Europe shows (right)

# Food: greenhouse gas emissions across the supply chain

Our World in Data

| Land Use Change | Farm | Animal Feed | Processing | Transport | Retail | Packaging |
|---|---|---|---|---|---|---|
| Aboveground changes in biomass from deforestation, and belowground changes in soil carbon | Methane emissions from cows, methane from rice, emissions from fertilizers, manure, and farm machinery | On-farm emissions from crop production and its processing into feed for livestock | Emissions from energy use in the process of converting raw agricultural products into final food items | Emissions from energy use in the transport of food items in-country and internationally | Emissions from energy use in refrigerators and other retail processes | Emissions from the production of packaging materials, material transport and end-of-life disposal |




Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries.
Data source: Poore and Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*. Images sourced from the Noun Project.

# Cocoa and Coffee Prices Have Surged. Climate Change Will Only Take Them Higher.

## Some chocolatiers and coffee makers say they will have to pass on the extra cost to consumers

Harvesting of Robusta coffee in Central Java, Indonesia. Extreme droughts in Southeast Asia—particularly in Vietnam and Indonesia—are resulting in lower coffee bean harvests, hurting producers' output and global exports. DASRIL ROSZANDI/ZUMA PRESS

*By Joseph Hoppe and Giulia Petroni*

April 11, 2024 1:18 pm ET | WSJ PRO

Share Resize Listen (1 min)

Global prices for cocoa and coffee are surging as severe weather events hamper production in key regions, raising questions from farm to table over the long-term damage climate change could have on soft commodities.

Cultivating cocoa and coffee requires very specific temperature, water and soil conditions. Now, more frequent heat waves, heavy rainfalls and droughts are damaging harvests and crippling supplies amid ever growing demand from customers worldwide.

"Adverse weather conditions, mostly in the Southern Hemisphere, have played an important role in sending several food commodities sharply higher," said Ole Hansen, head of commodity strategy at Saxo Bank.

The spikes in prices are a threat to coffee and chocolate makers across the globe.

Swiss consumer-goods giant Nestlé was able to pass only a fraction of the cocoa price increase to customers last year, and it may need to adjust pricing in the future due to persistently high prices, a spokesperson said.


Solutions of CC?

## Solutions?

Nobody has responded yet.

Hang tight! Responses are coming in.

# THE NOBEL PRIZE IN PHYSICS 2021

Illustrations: Niklas Elmehed

**Syukuro Manabe**

**Klaus Hasselmann**

**Giorgio Parisi**

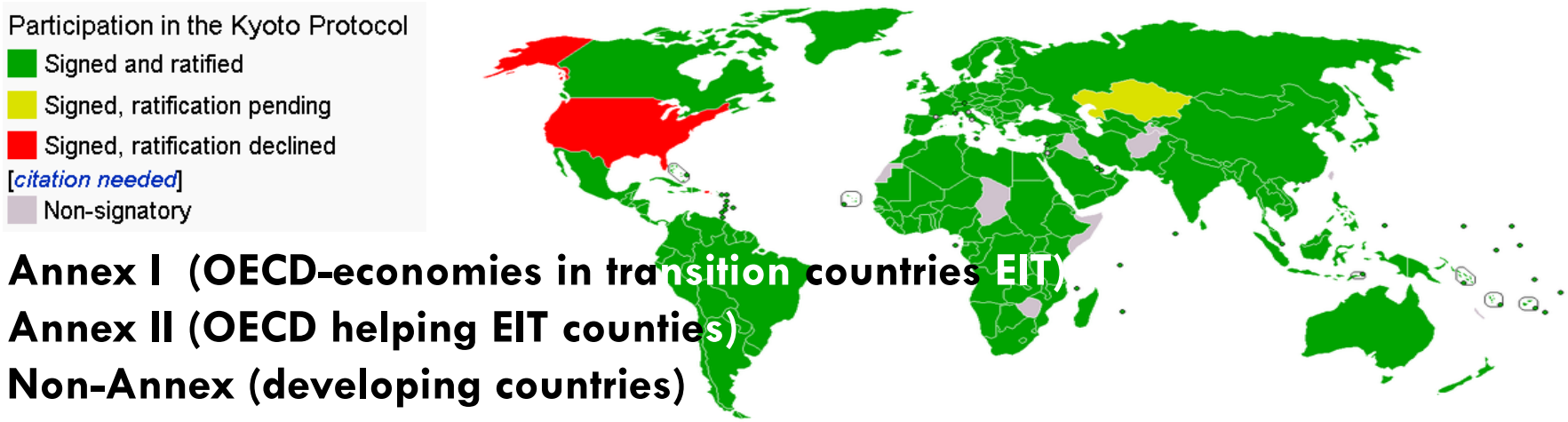
"for the physical modelling of Earth's climate, quantifying variability and reliably predicting global warming"

"for the discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

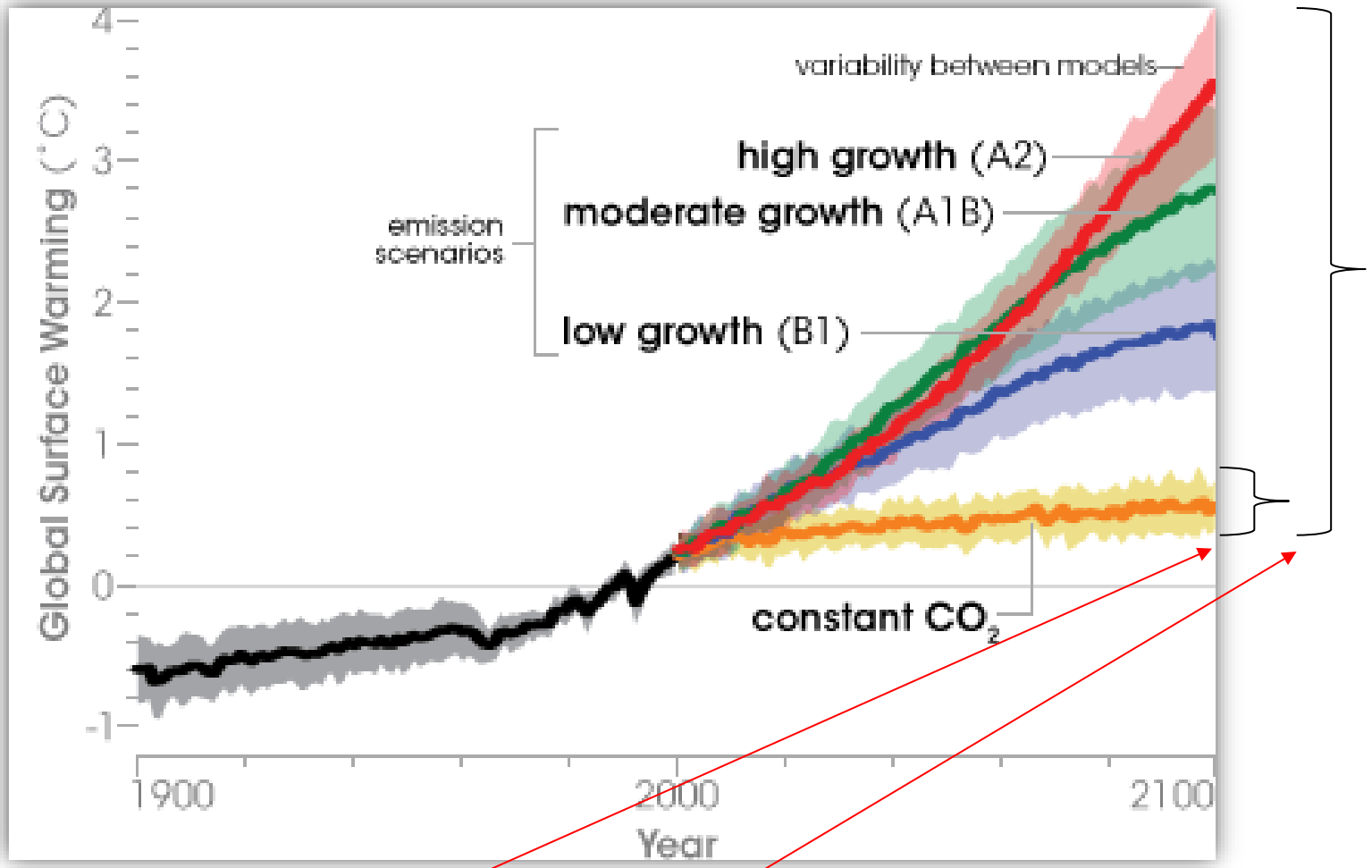
# Politics on CC

- main aim – decrease the GHG emissions, mainly $CO_2$
- 1992: **UN Framework Convention on Climate Change**
  - The signatories undertake to make efforts to reduce $CO_2$ emissions
- 1997: **Kyoto protocol** (in force from 2005, 37 countries)
  - **industrial countries should decrease their GHG emissions until the year 2012 by 5.2% compared to the year 1990**
  - different threshold for different countries (e.g. EU 8%)
  - however, industrial countries (Annex I countries with Kyoto targets) contributed „only“ with 24 % of global $CO_2$ emission (2010)




**Annex I (OECD-economies in transition countries EIT)**
**Annex II (OECD helping EIT counties)**
**Non-Annex (developing countries)**

# Temperature rise scenarios to 2100




- scientific vs. political uncertainty

# Kyoto protocol – result (2012)

- industrial countries (Annex I countries with Kyoto targets) **reduced their emissions for 24.2 % !** (much more than promissed target 5.2 %)
- however, emission in other countries have risen so fast, that global $CO_2$ emissions **increased by 32 %** from 1990 to 2010 ☹ (**by 51%** by 2014!!!)
- extension of the Kyoto Protocol until 2020 (Doha)
- certain countries (the EU and a few other countries) have committed themselves to further reducing $CO_2$ emissions.
- EU e.g. by 20-30% compared to 1990
- Average – **18% - generally achieved**


ALL THE NEWS WITHOUT FEAR OR FAVOR

The Japan Times

Friday, December 12, 1997

5TH EDITION ¥160

TODAY

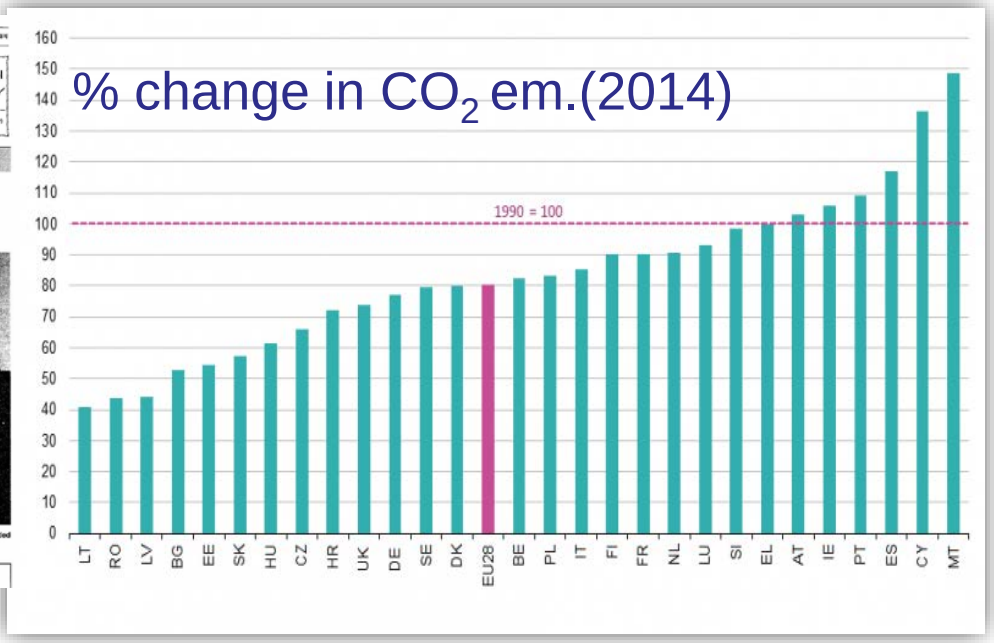
160 nations adopt Kyoto Protocol

Developed countries to cut their gas emissions by 5.2%

KYOTO COP3

Hashimoto vows efforts

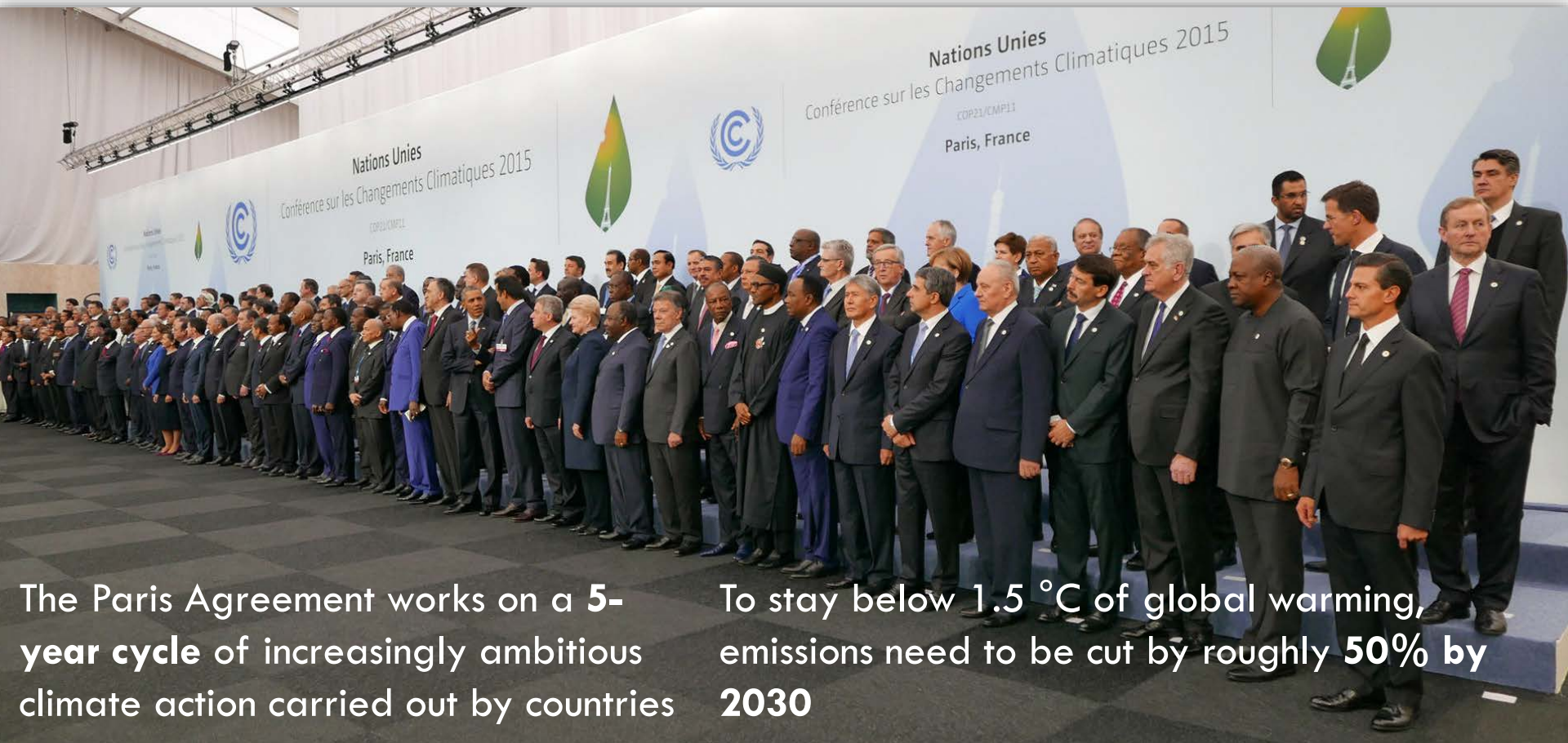
Gist of Kyoto Protocol



# Paris treaty (2015)

- continuation of the prolonged Kyoto protocol (2020)
- aim: **Limit the temperature rise not more than 2 °C compared to pre-industrial era, ideally below 1.5 °C**
- came into force in November 4th 2016

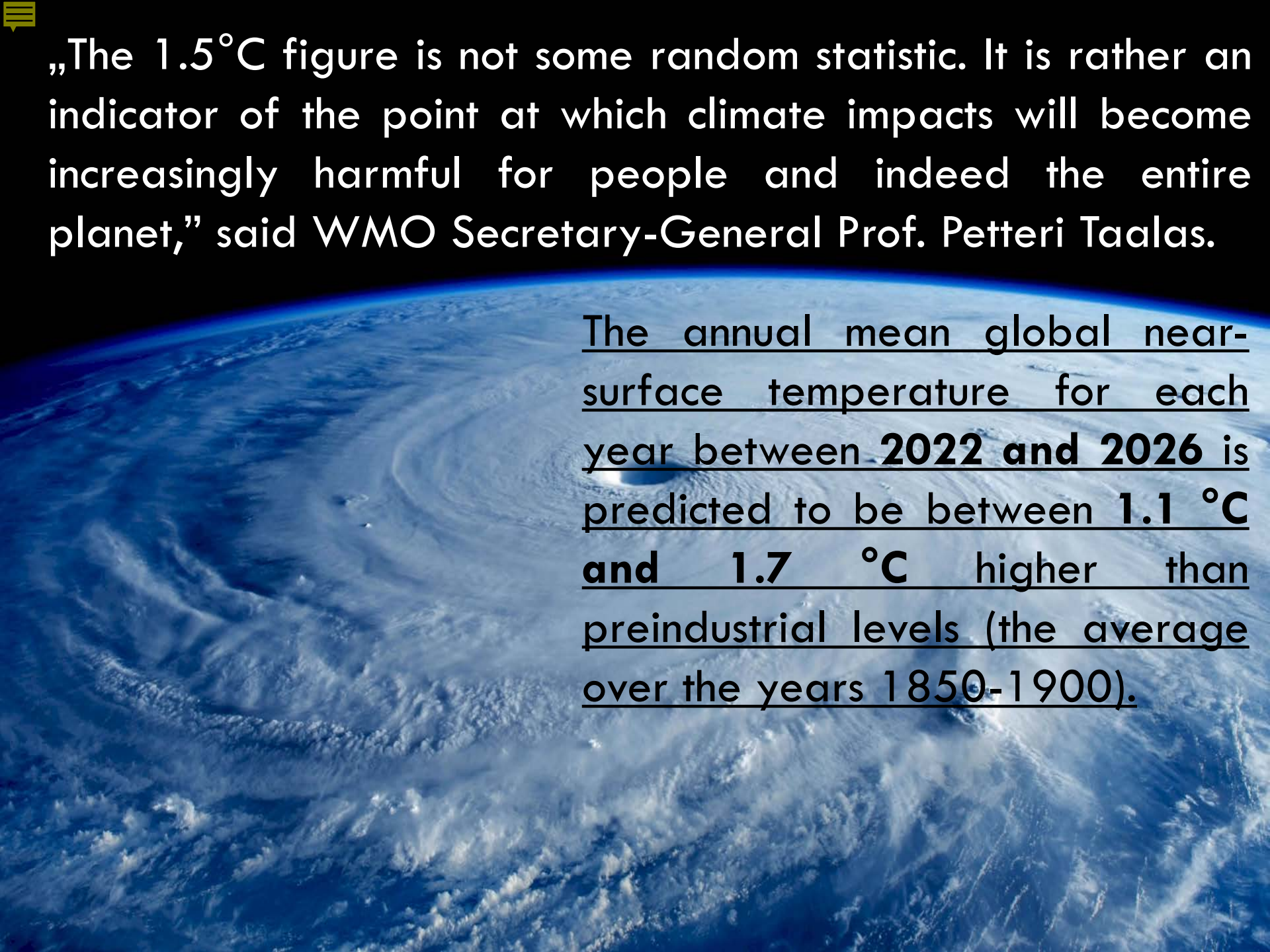
Shift in the rhetoric!




The Paris Agreement works on a **5-year cycle** of increasingly ambitious climate action carried out by countries

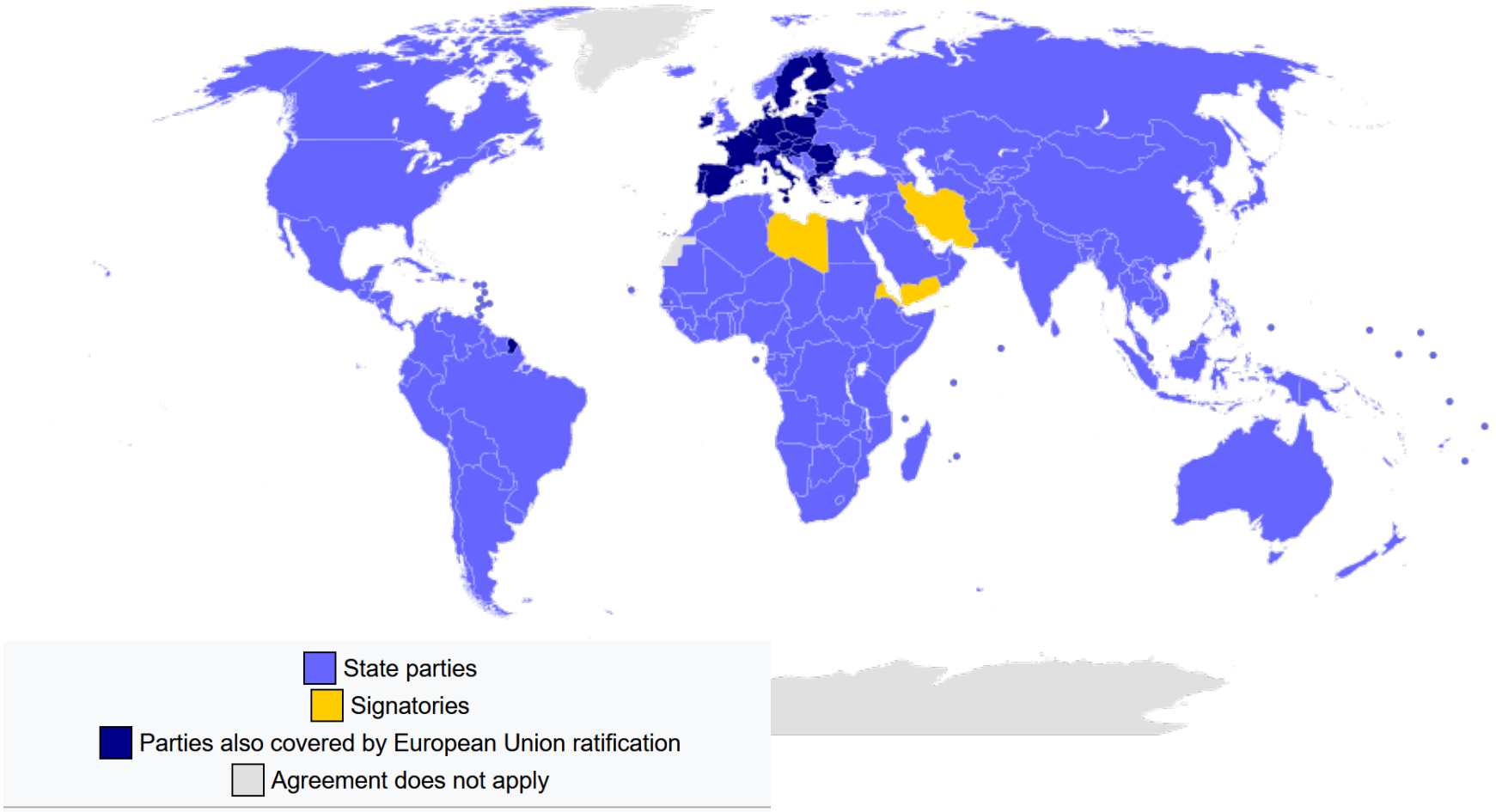
To stay below 1.5 °C of global warming, emissions need to be cut by roughly **50% by 2030**

„The 1.5°C figure is not some random statistic. It is rather an indicator of the point at which climate impacts will become increasingly harmful for people and indeed the entire planet," said WMO Secretary-General Prof. Petteri Taalas.



The annual mean global near-surface temperature for each year between **2022 and 2026** is predicted to be between **1.1 °C and 1.7 °C** higher than preindustrial levels (the average over the years 1850-1900).

In contrast to the 1997 Kyoto Protocol, the distinction between developed and developing countries is blurred, so that the latter also have to submit plans for emission reductions.



# Why the Global Stocktake is Important for Climate Action this Decade.


The first global stocktake of the Paris Agreement concluded at the UN Climate Change Conference (COP28) in December 2023 with the adoption of a decision. The global stocktake is a process for countries and stakeholders to see where they're collectively making progress towards meeting the goals of the Paris Climate Change Agreement – and where they're not. The first global stocktake affirmed that we are not on track to limit global warming to 1.5 degrees Celsius and the window for meaningful change quickly closing. It outlines bold actions for Governments and stakeholders to urgently undertake in this critical decade to keep 1.5 within reach, securing lives and livelihoods. The global stocktake decision, provides benchmarks and outlines guidance for countries to consider in the next round of climate action plans due in 2025.

„The first global stocktake affirmed that we are not on track to limit global warming to 1.5 degrees Celsius and the window for meaningful change quickly closing."

„IPCC indicates that **greenhouse gas emissions must peak before 2025** at the latest and decline 43% by 2030 to limit global warming to 1.5°C."

Tripling renewable energy and doubling energy efficiency by 2030; moving away from fossil fuels; low-emission technologies; sustainable behaviors and nature-based actions. **Adaptation efforts should be scaled up significantly.**

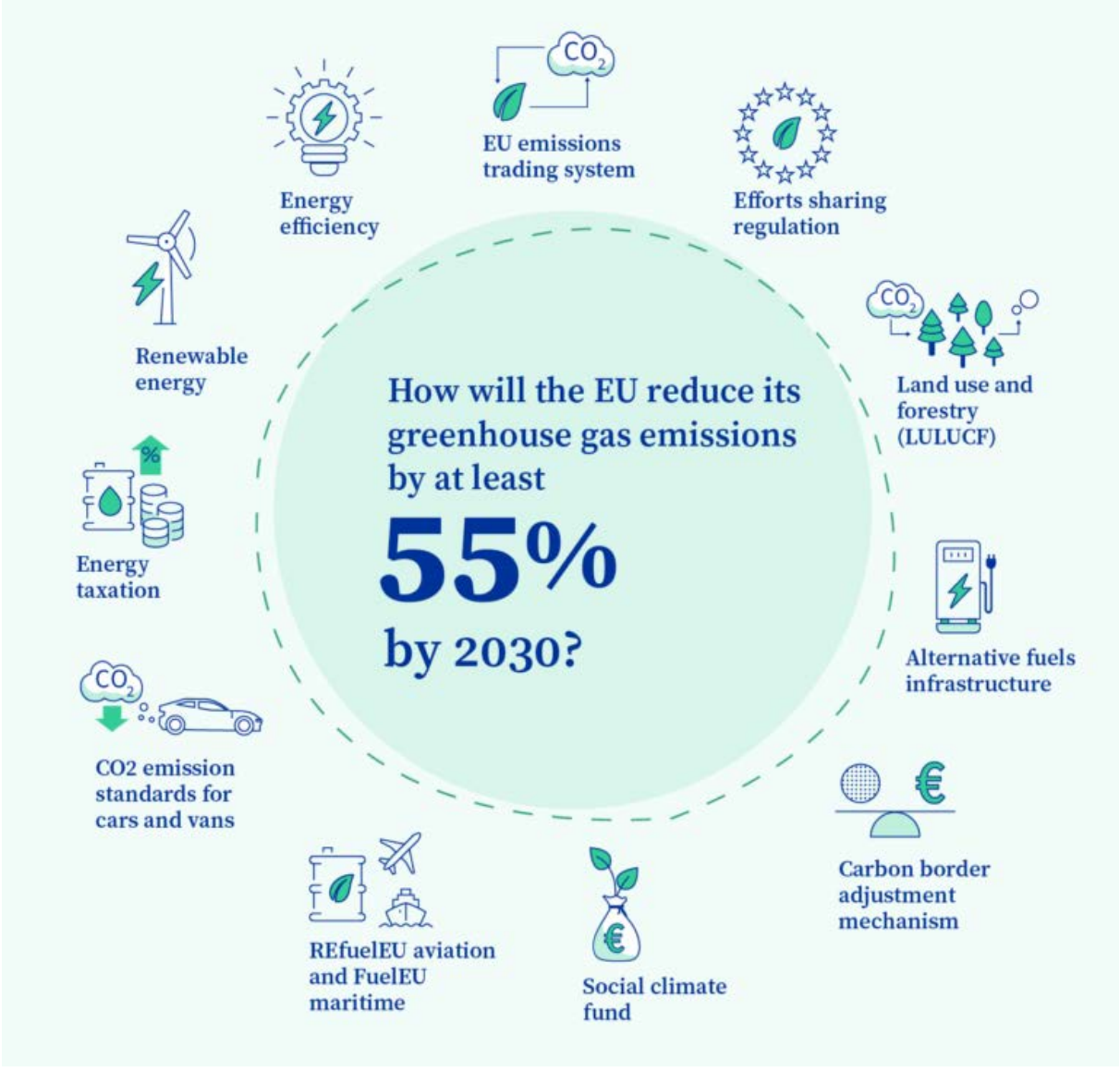
# European Green Deal (December 2019)

## Striving to be the **first climate-neutral continent**


The European Commission adopted a set of proposals to make the EU's climate, energy, transport and taxation **policies fit for reducing net greenhouse gas emissions by at least 55% by 2030**, compared to 1990 levels and become first climate-neutral continent by 2050.

# An important iniciatives of Green Deal are:

The European Commission has adopted a package of proposals to help the EU achieve a **55% reduction in greenhouse gas emissions by 2030 compared to 1990 levels**




**Fit to 55**

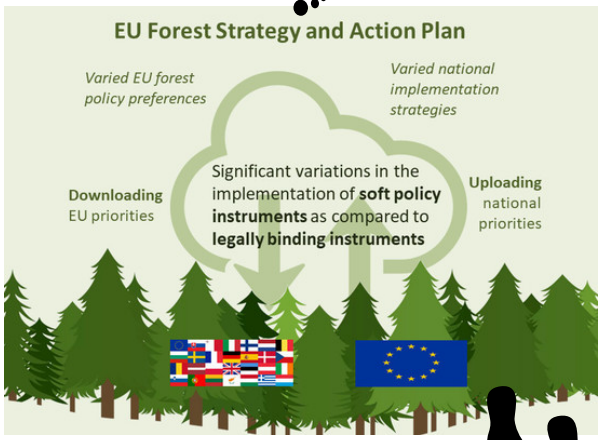

EUROPEAN
CLIMATE
LAW
2050
$CO_2$


Food Loss
& Waste
Prevention
Sustainable
Food Production
Farm
to Fork
Sustainable
Food
Processing &
Distribution
Sustainable
food consumption


EU Strategy on Adaptation to Climate Change.
INFOGRAPHIC ELABORATED BY FASTER H2020
1.
improve knowledge
of climate impacts and
adaptation solutions
2.
step-up adaptation
planning and climate
risk assessments
3.
accelerate
adaptation action
4.
help to strengthen
resilience to climate
resilience on a global scale


European
Commission
Bringing nature
back into our lives
EU 2030 Biodiversity strategy
May 2020
#EUGreenDeal


RAW MATERIAL
EXTRACTION
PRODUCT DESIGN
CIRCULAR
ECONOMY
WASTE
MANAGEMENT
PRODUCTION AND
REMANUFACTURING
RESIDUAL WASTE
CONSUMPTION

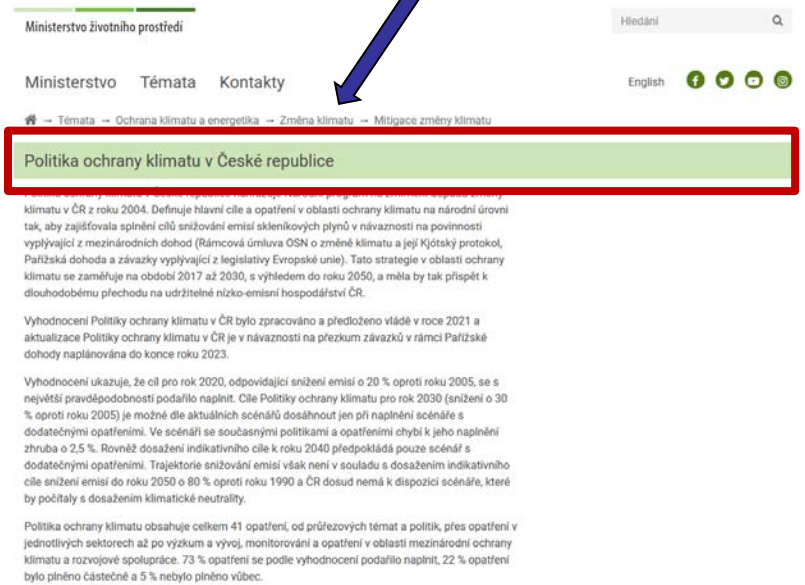

EU Forest Strategy and Action Plan
Varied EU forest
policy preferences
Varied national
implementation
strategies
Downloading
EU priorities
Significant variations in the
implementation of soft policy
instruments as compared to
legally binding instruments
Uploading
national
priorities


A EUROPEAN INDUSTRIAL STRATEGY
A new Industrial Strategy
for a globally competitive,
green and digital Europe


EU Chemicals Strategy
for Sustainability
#ChemicalsStrategy
#EUGreenDeal

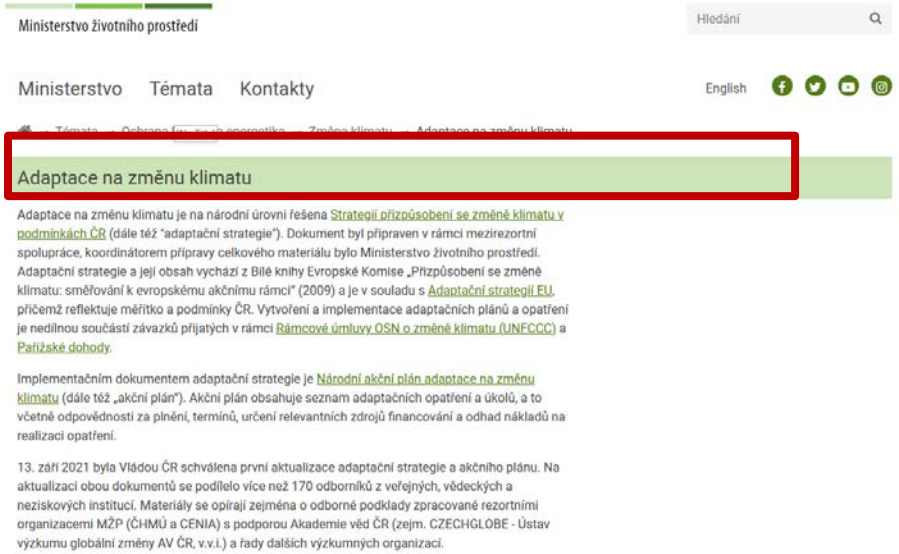
# What about CR?

Mitigation





Adaptation



~~Solution~~

# Adaptation and mitigation



**Many options available now in all sectors are estimated to offer substantial potential to reduce net emissions by 2030. Relative potentials and costs will vary across countries and in the longer term compared to 2030.**

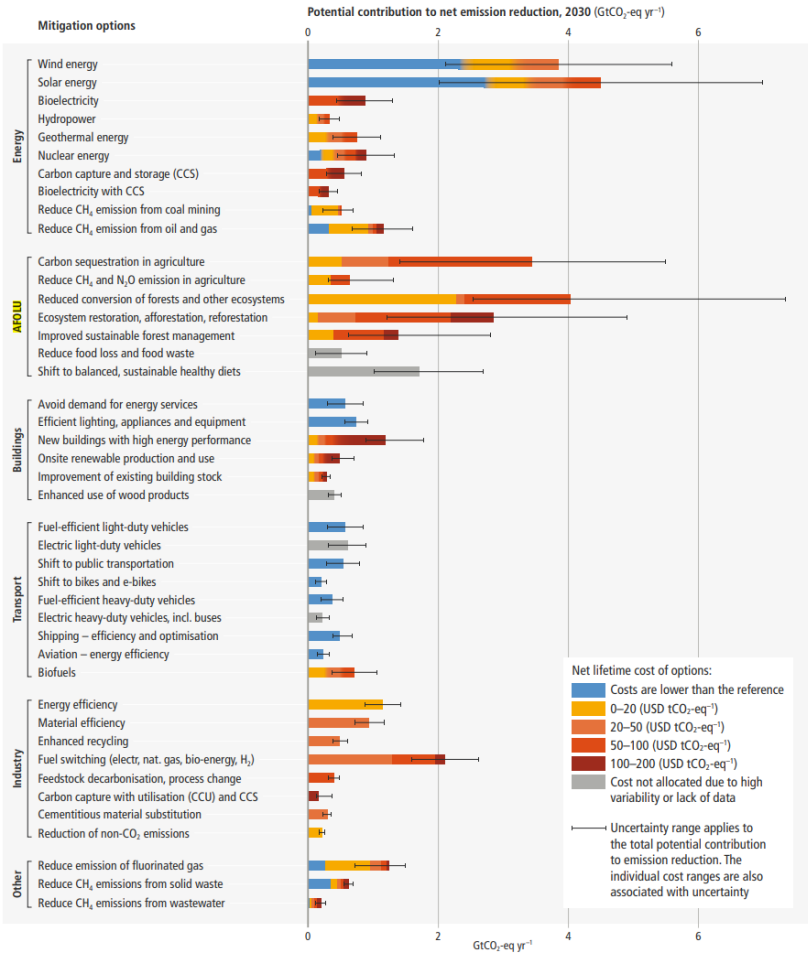



**Figure SPM.7 | Overview of mitigation options and their estimated ranges of costs and potentials in 2030.**

**Mitigation options have synergies with many Sustainable Development Goals, but some options can also have trade-offs. The synergies and trade-offs vary dependent on context and scale.**

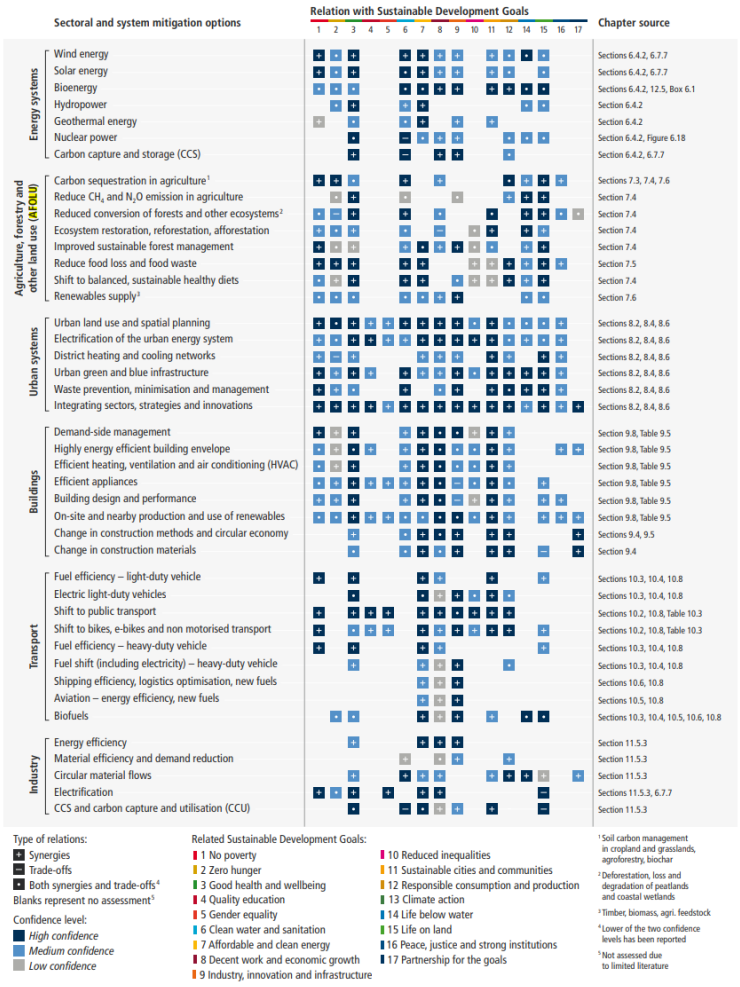



**Figure SPM.8 | Synergies and trade-offs between sectoral and system mitigation options and the SDGs.**

# How to decrease $CO_2$ emmisions?

- decrease the fossil fuels consumption
  - increase efficiency of the industr. production
  - end the non-effective industr. production
  - save the energy and material

- economic tools to decrease $CO_2$ - EU Emissions Trading System (EU ETS)

  makes polluters pay for their greenhouse gas emissions, helps bring emissions down and generates revenues to finance the EU's green transition

- bio-fuels? Probably not...

Atmos. Chem. Phys. Discuss., 7, 11191–11205, 2007
www.atmos-chem-phys-discuss.net/7/11191/2007/


Atmospheric Chemistry and Physics Discussions

**$N_2O$ release from agro-biofuel production negates global warming reduction by replacing fossil fuels**

P. J. Crutzen[1,2,3], A. R. Mosier[4], K. A. Smith[5], and W. Winiwarter[3,6]

[1]Max Planck Institute for Chemistry, Department of Atmospheric Chemistry, Mainz, Germany
[2]Scripps Institution of Oceanography, University of California, La Jolla, USA
[3]International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
[4]Mount Pleasant, SC, USA
[5]School of Geosciences, University of Edinburgh, Edinburgh, UK
[6]Austrian Research Centers – ARC, Vienna, Austria

Received: 28 June 2007 – Accepted: 19 July 2007 – Published: 1 August 2007

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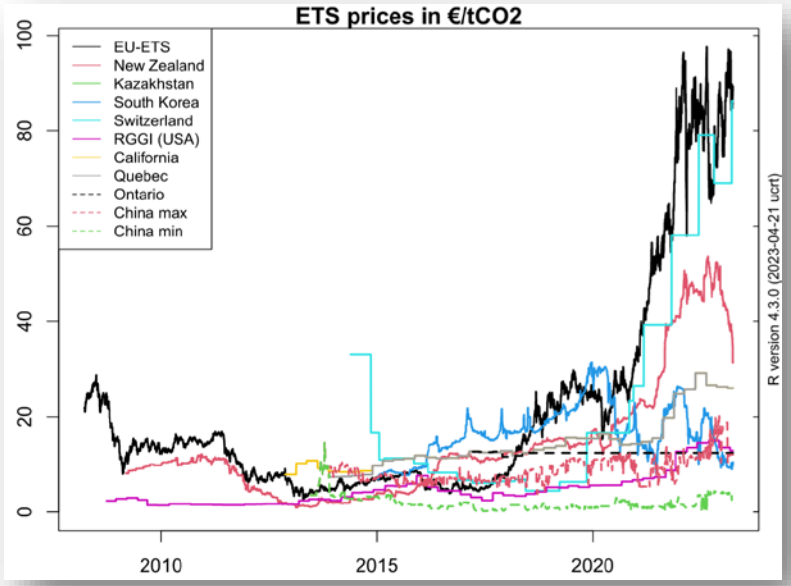
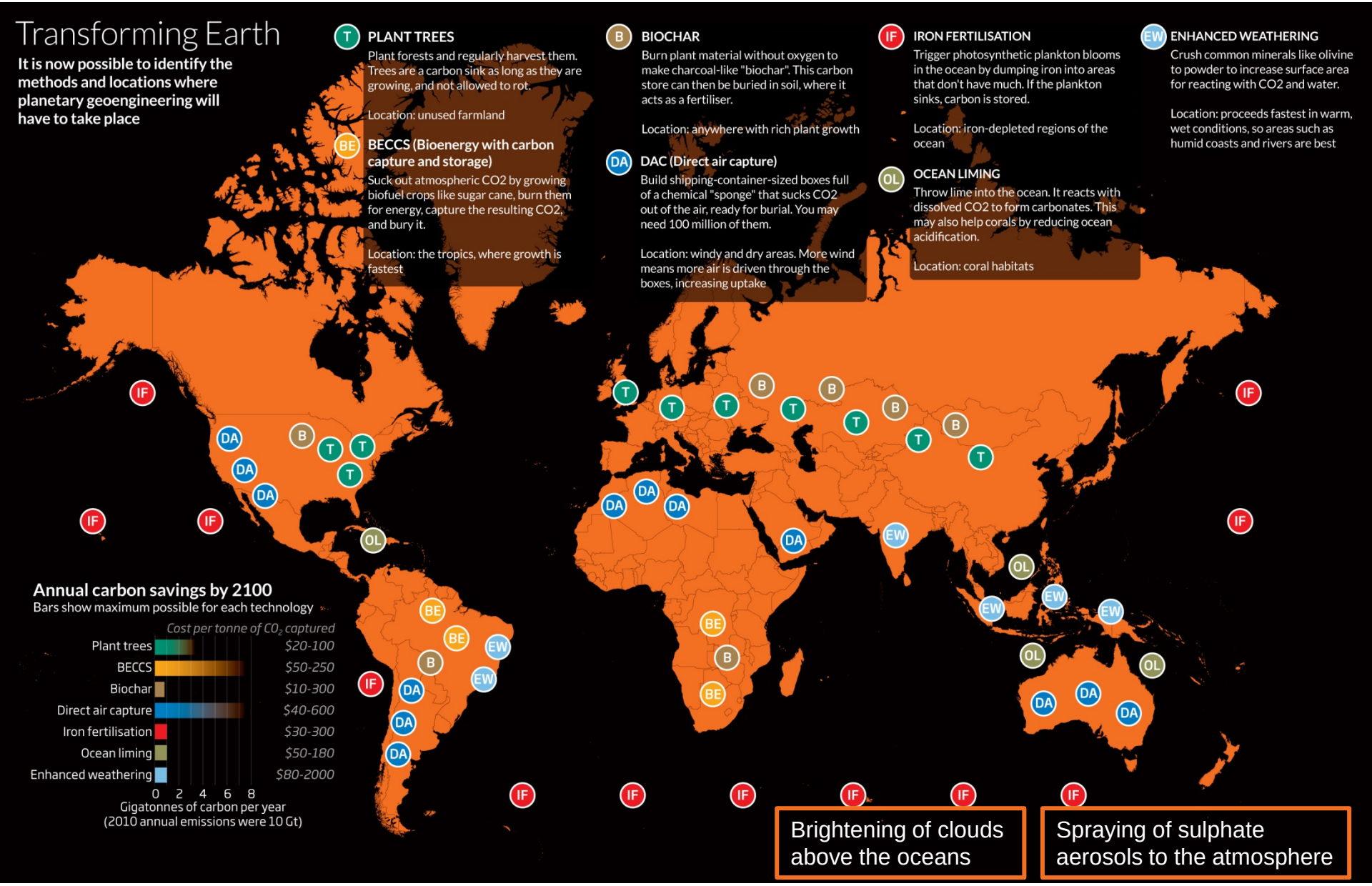


# Do you know what is geo-engineering?

Nobody has responded yet.

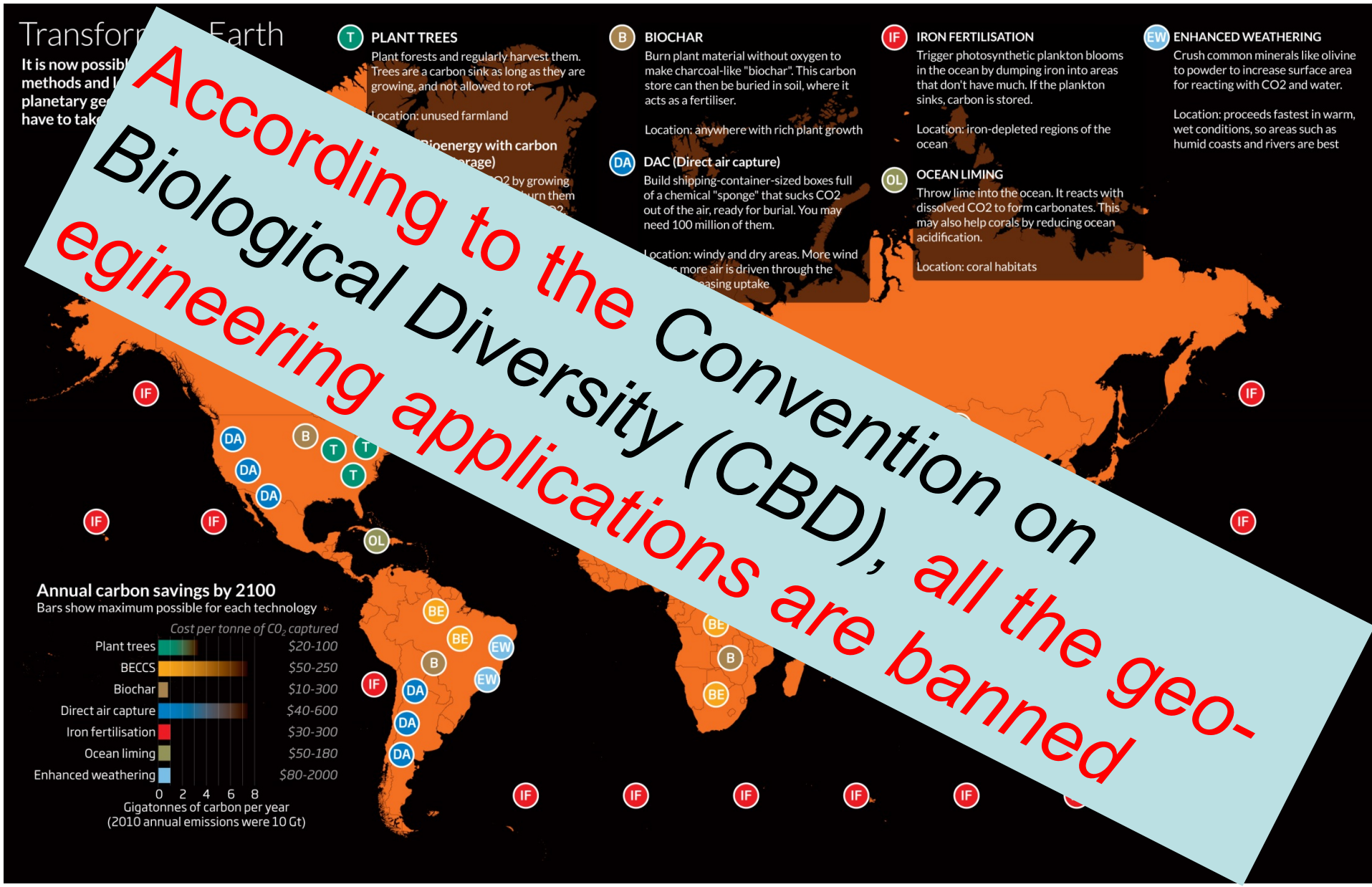
Hang tight! Responses are coming in.

# Geo-egineering – types and opportunities




Brightening of clouds above the oceans

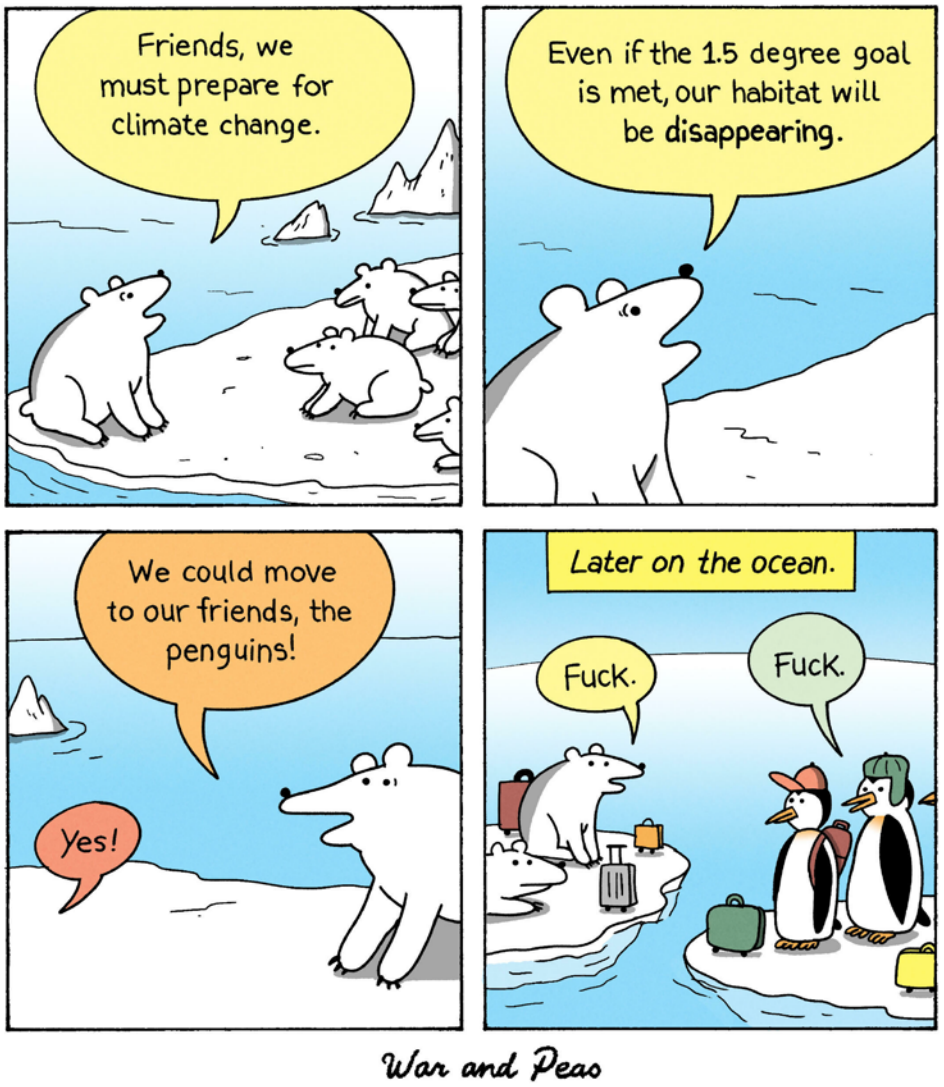
Spraying of sulphate aerosols to the atmosphere




According to the Convention on Biological Diversity (CBD), all the geo-egineering applications are banned

# Criticism

- Link between **global warming and human activity**
- **Uncertainity of consequences**, their form, pros/cons
- **Fear of solutions** such as tradable emissions permits, subsisies for renewable energy and geoingeneering (carbon capture and storage)
- **"climate sceptics„** (material prosperity is more important than maintaining a stable and predictable environment)



# SYSTEM CHANGE NOT CLIMATE CHANGE

## „CHANGE OUR OWN PRACTICES OF HOW WE WORK WITH KNOWLEDGE“