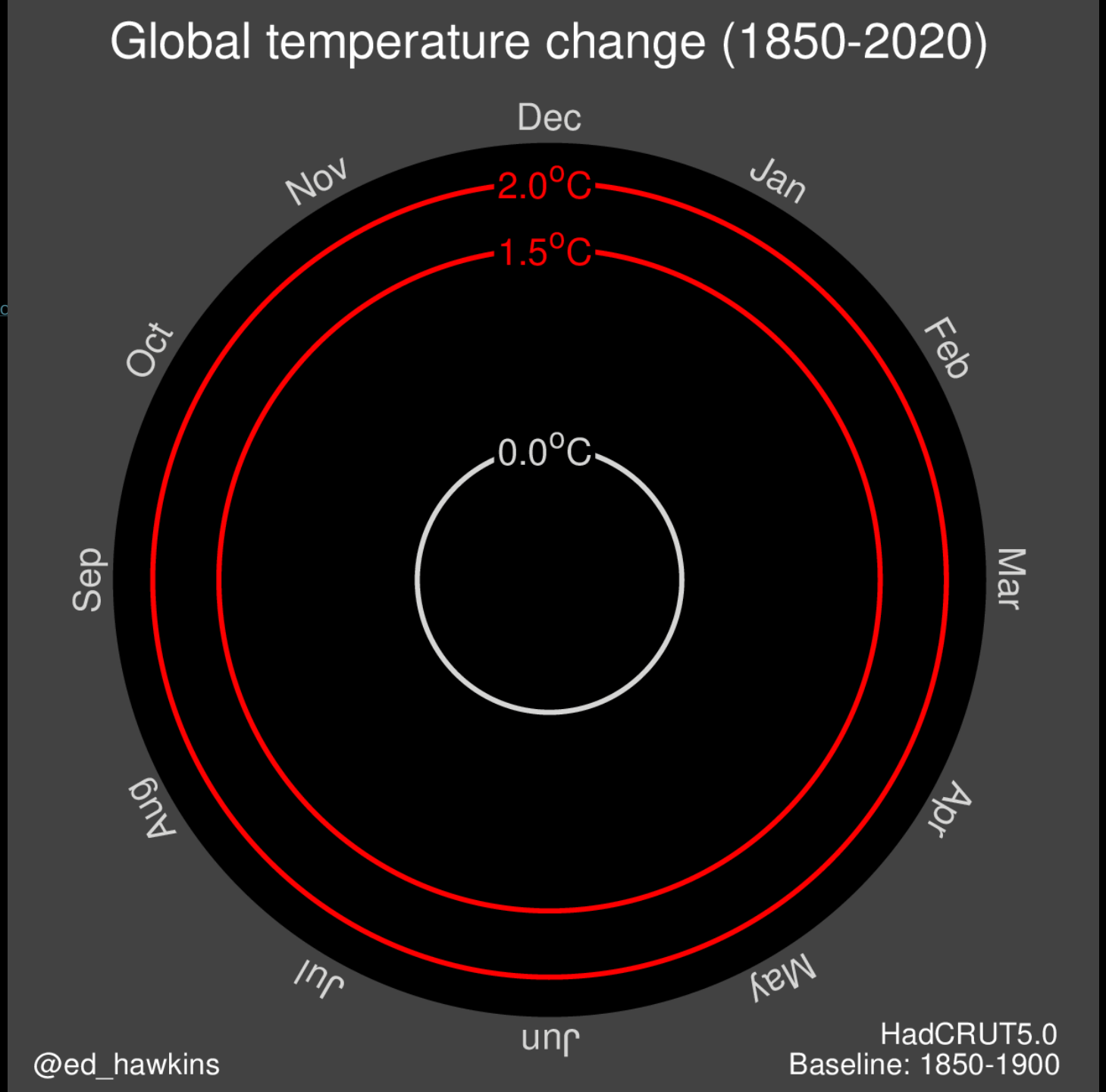
UC Sustentabilidade
Climate Change
Framing the problem

FCUL

S1 2026/27

October 28th, 2026

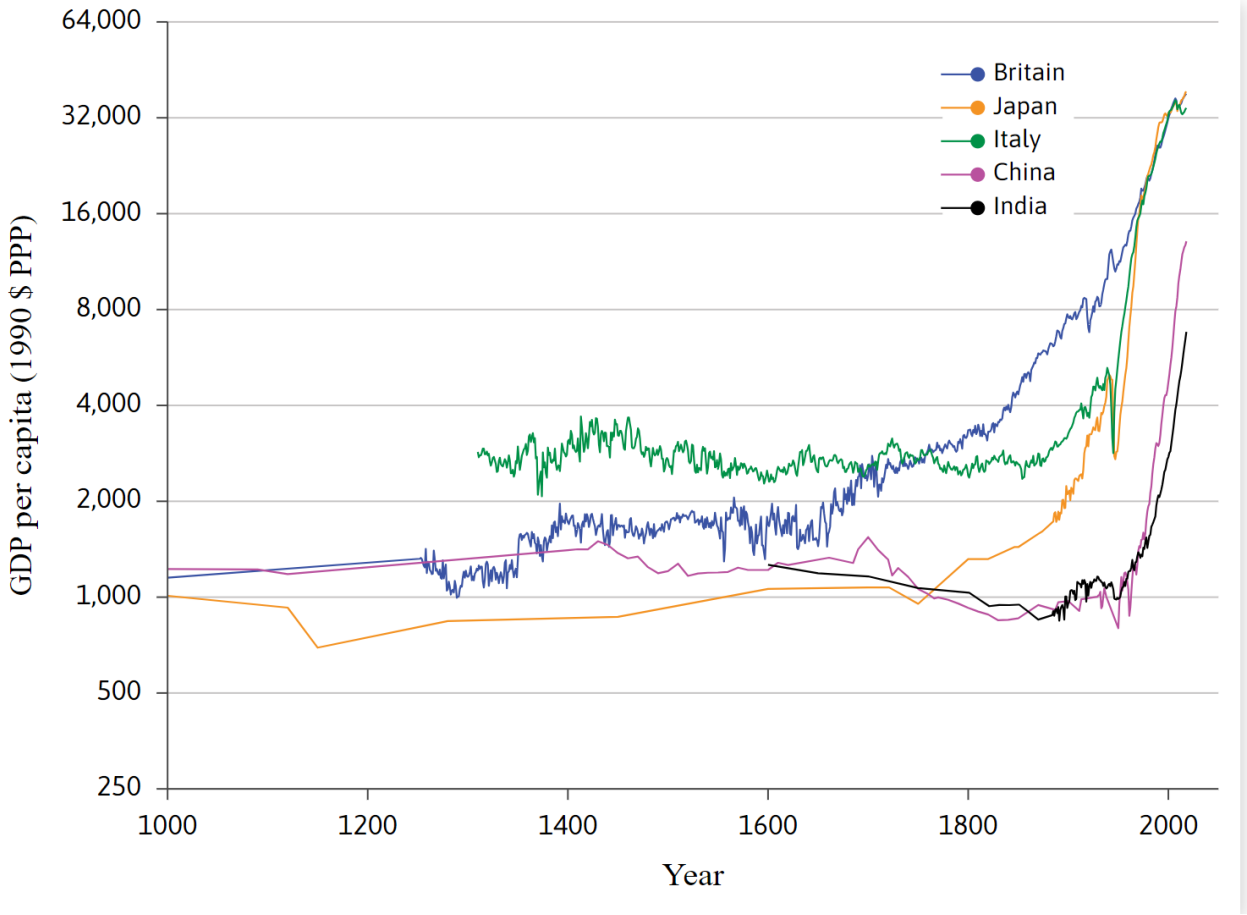
https://cpb-eu-w2.wpmucdn.co

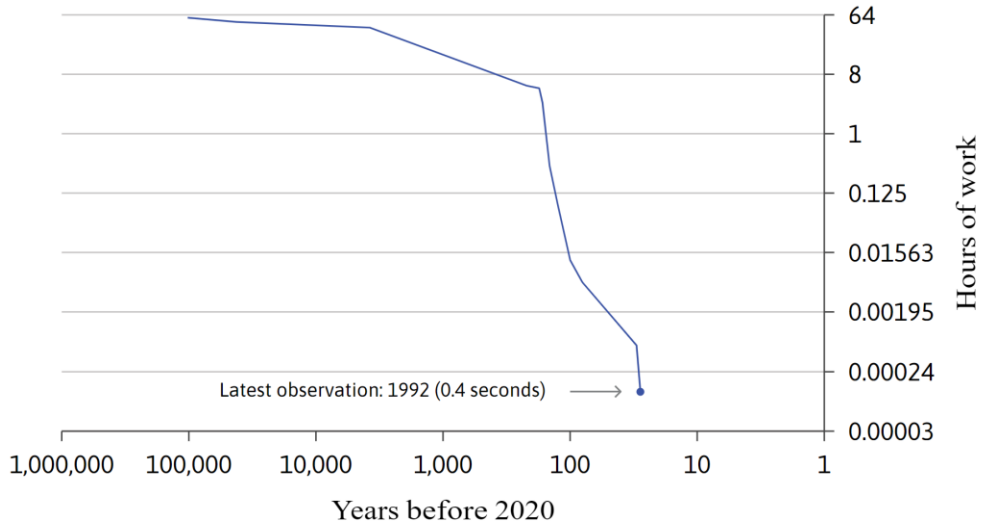


Economic Development and Emissions

- Hockey sticks: GDP, population, income (GDP/cap), energy consumption, LUC, CO2 emissions
- Malnutrition, life expectancy, child mortality, obesity & overweight
- Emissions & Climate change: Tyndall, Arrhenius, Mauna Loa, ice cores

Economic growth, innovation and welfare...

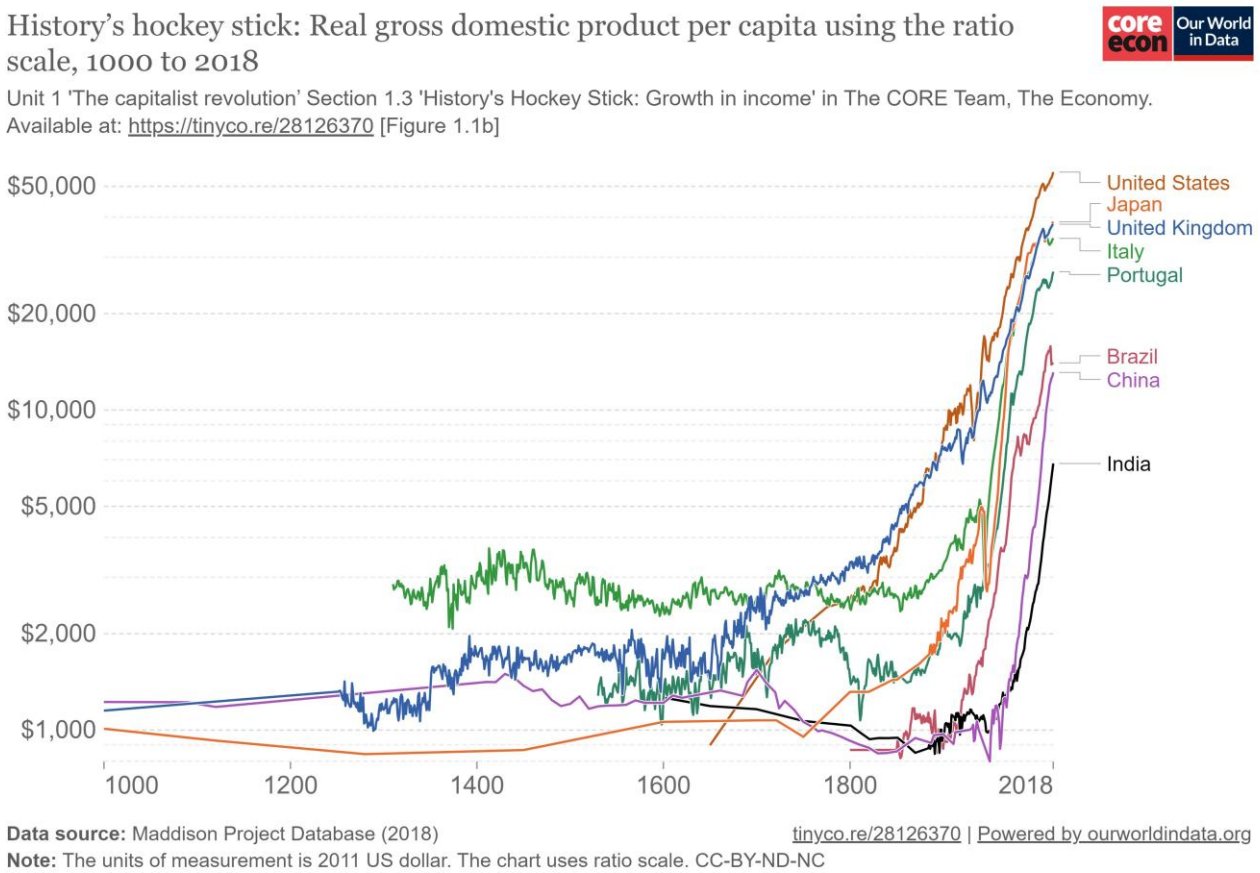




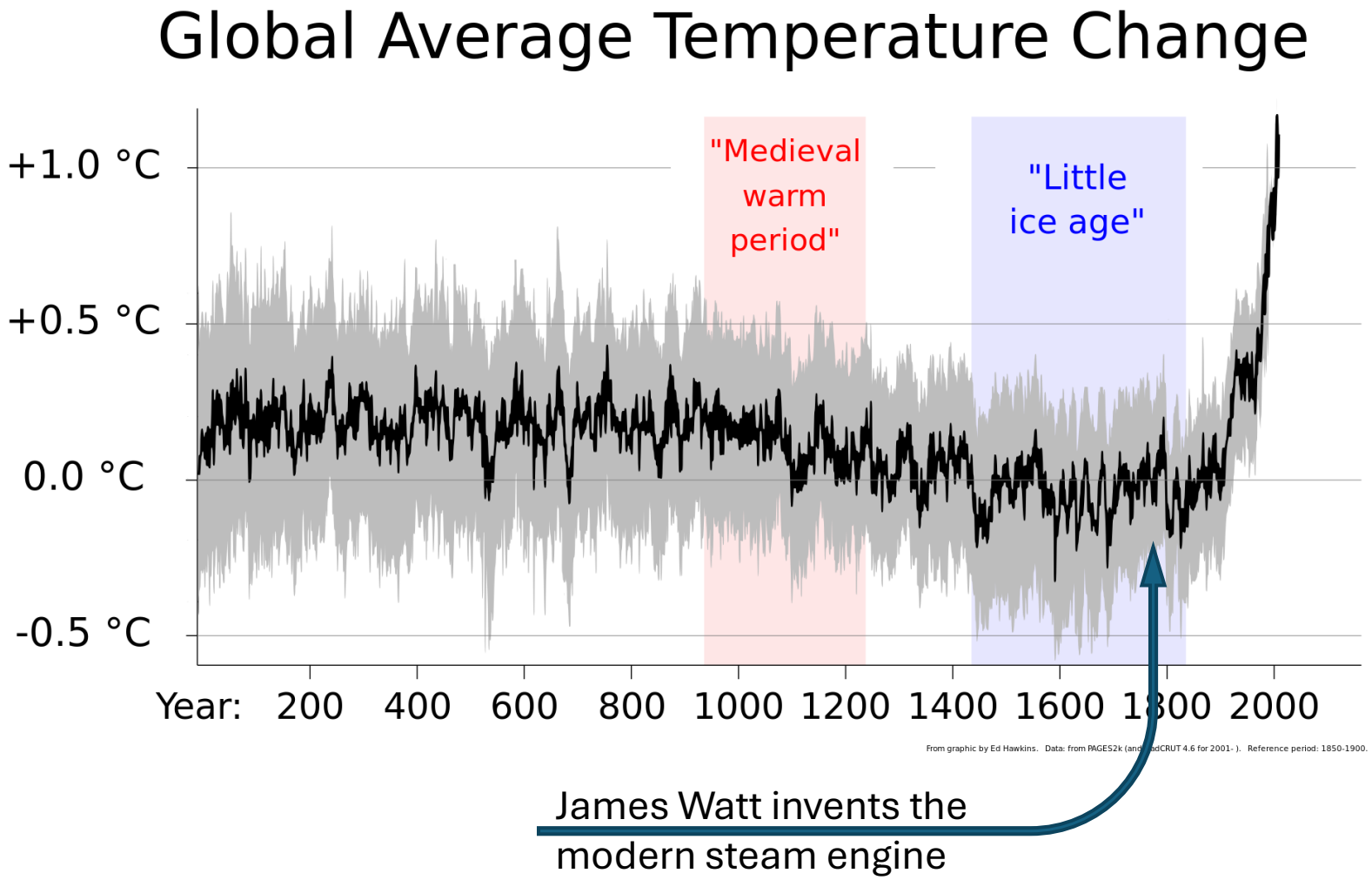
Hours of work required to produce 1,000 lumen-hours

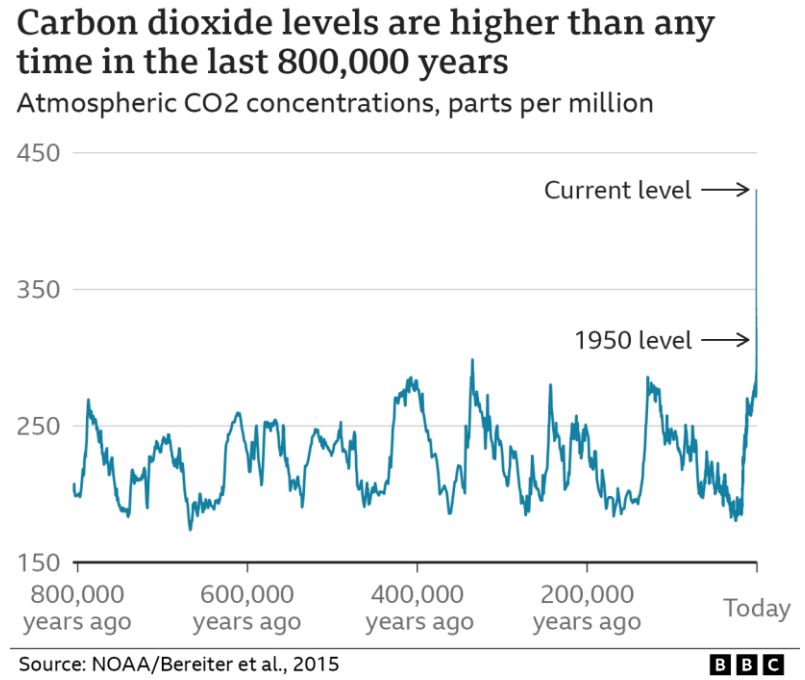
https://www.core-econ.org/project/core-espp/

Economic growth and welfare…



...has happened in a period of stable climate

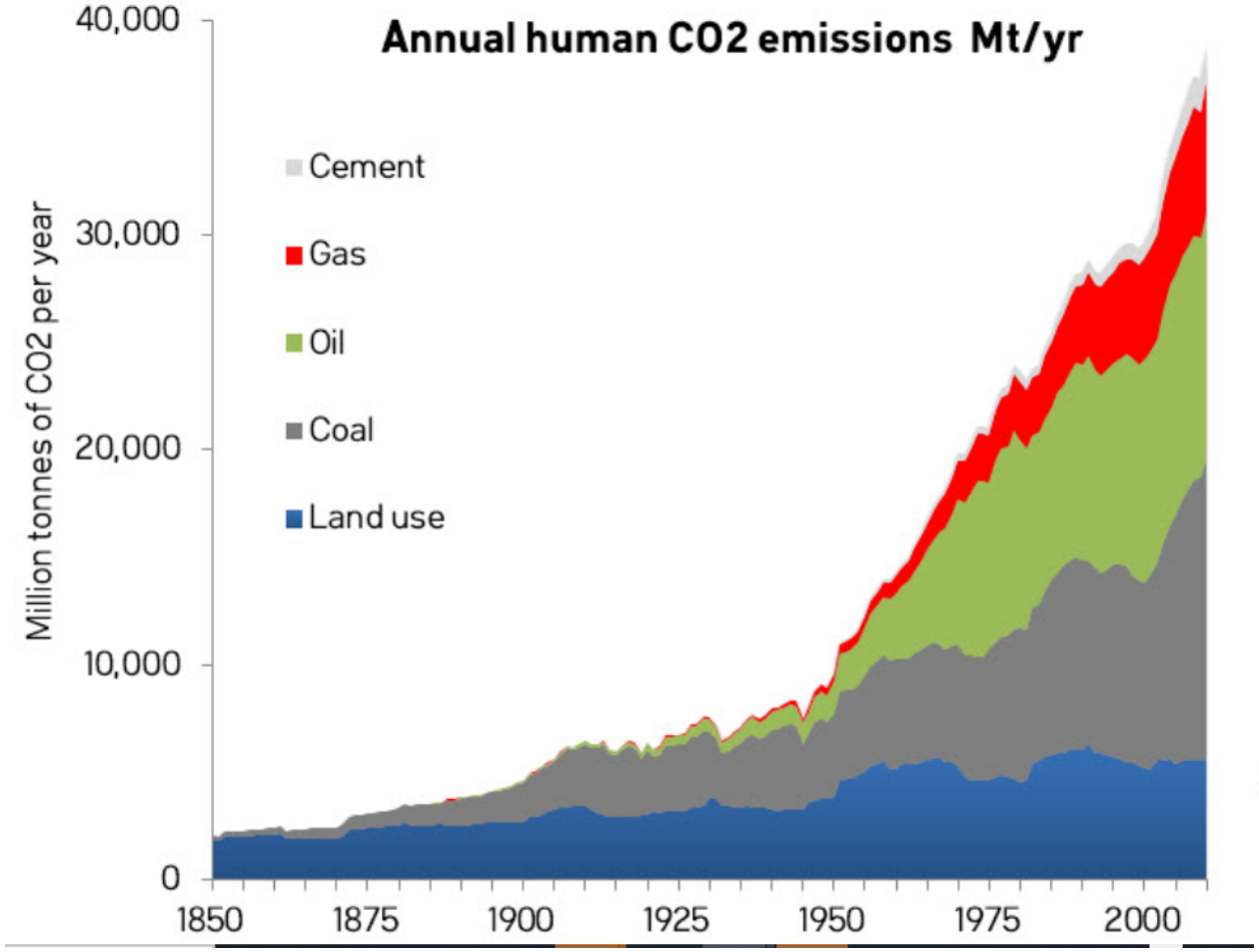


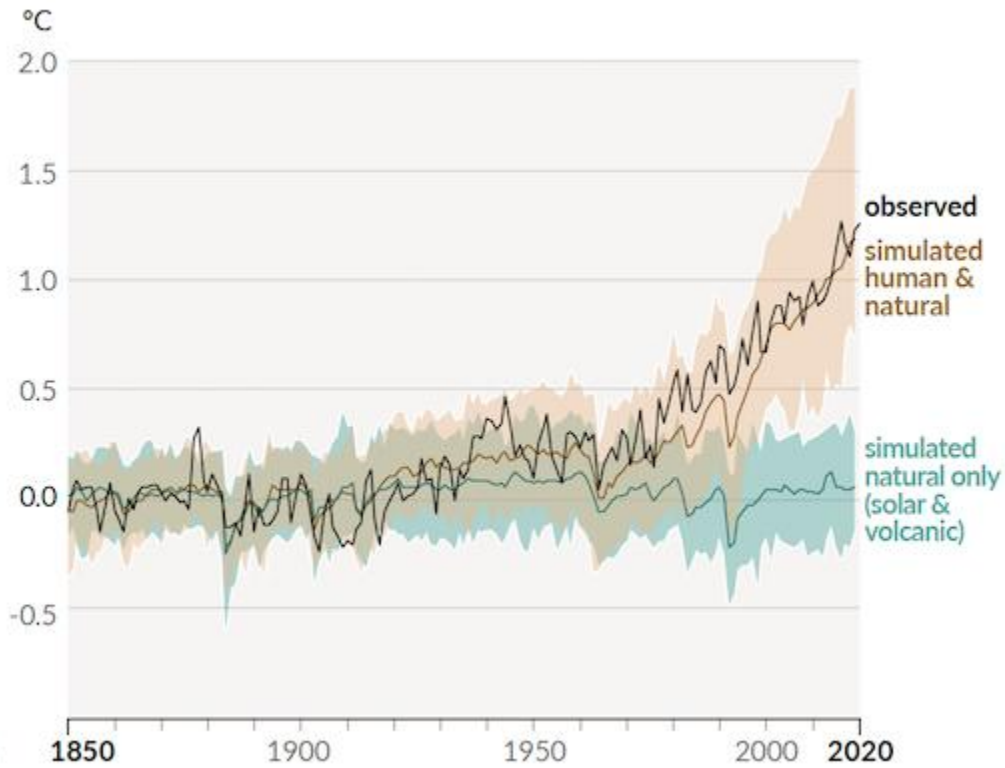


James Watt invents the modern steam engine

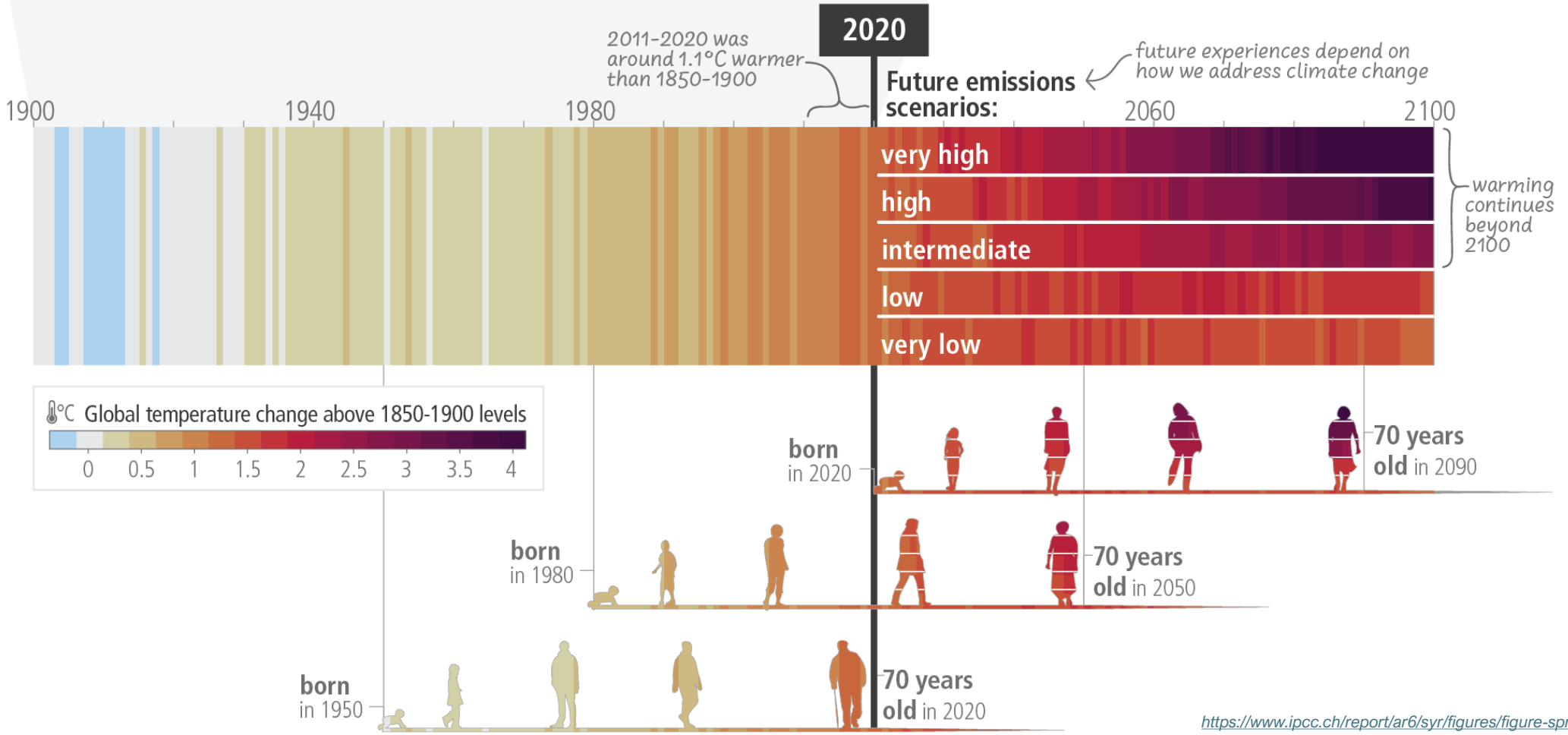
By RCraig09 - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=87832845

Anthropogenic GHG emissions and CC





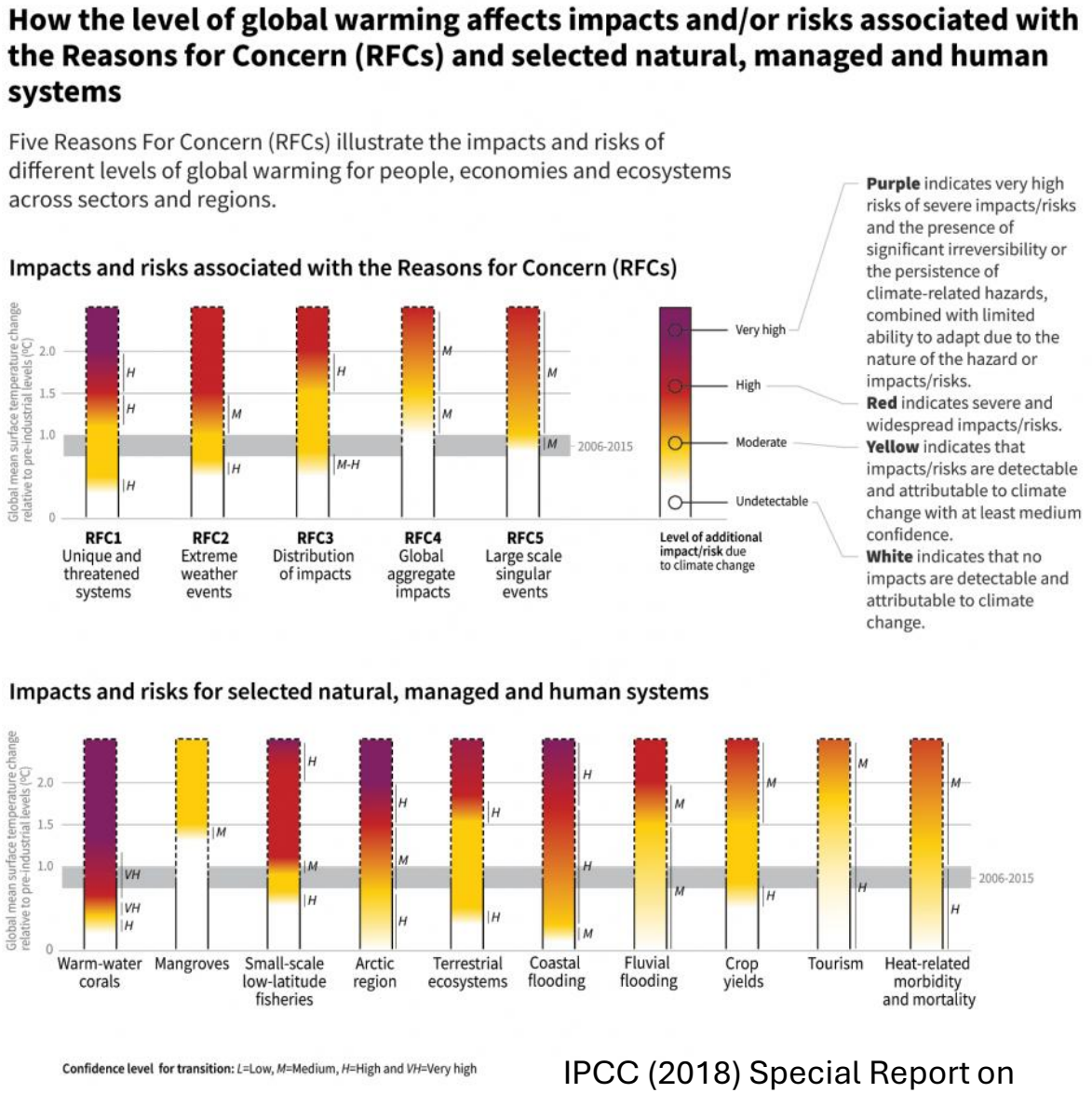
c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term



https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-1

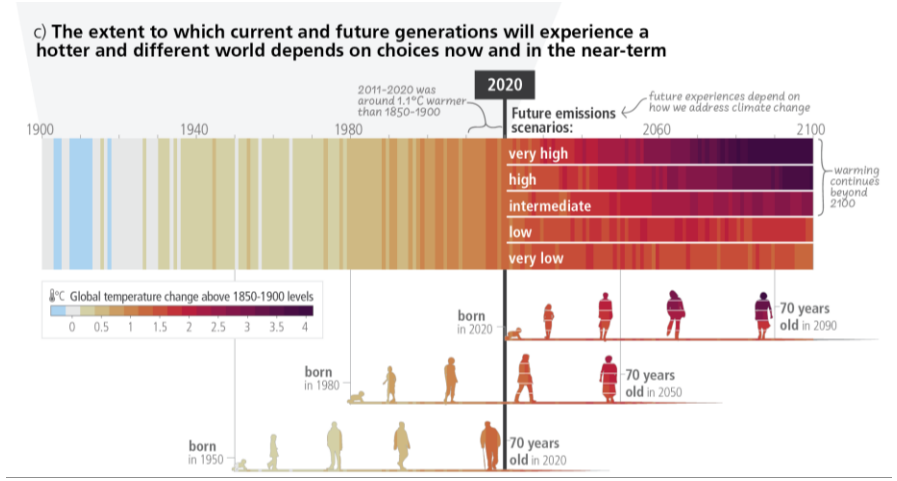
Projected impacts of climate change

- We will learn more about IPCC next week
- Climate change is happening already
- Current temperature already 1.1°C above pre-industrial average
- Impacts already felt across systems
- With more warming comes more risk
- Avoiding dangerous climate change requires climate action



IPCC (2018) Special Report on 1.5C

Work in pairs



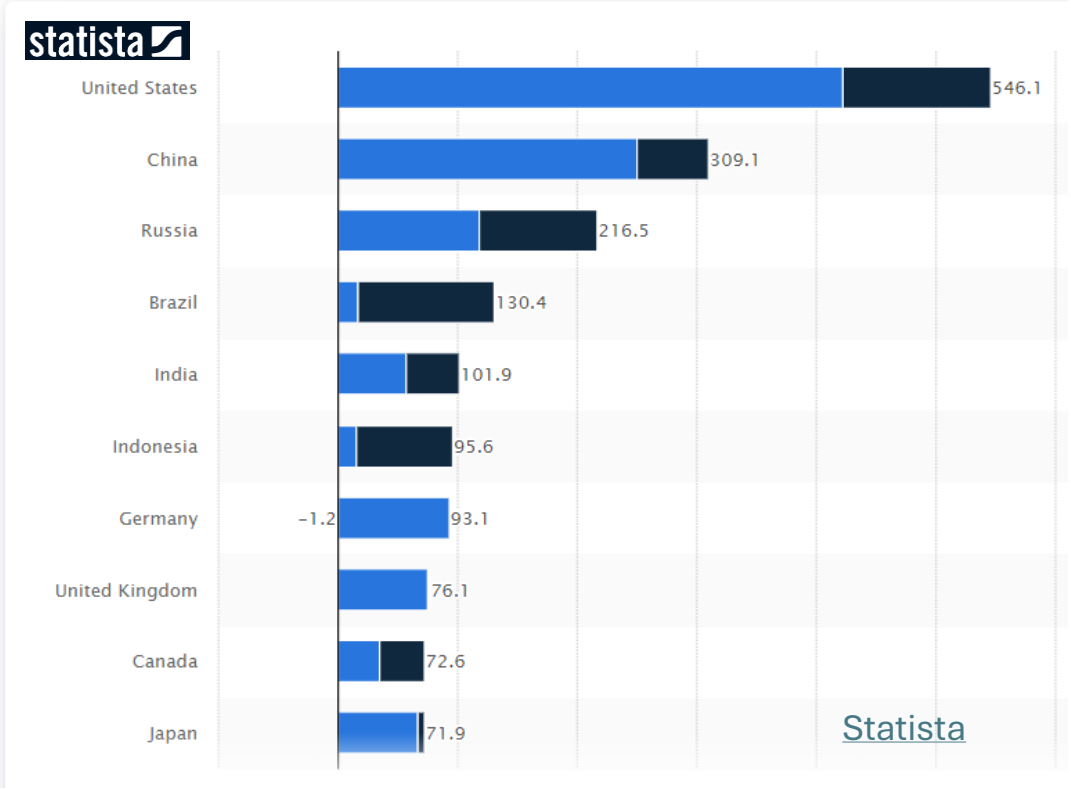
- What does this figure mean to you, for your life?

- Discuss for 10 mins, report back

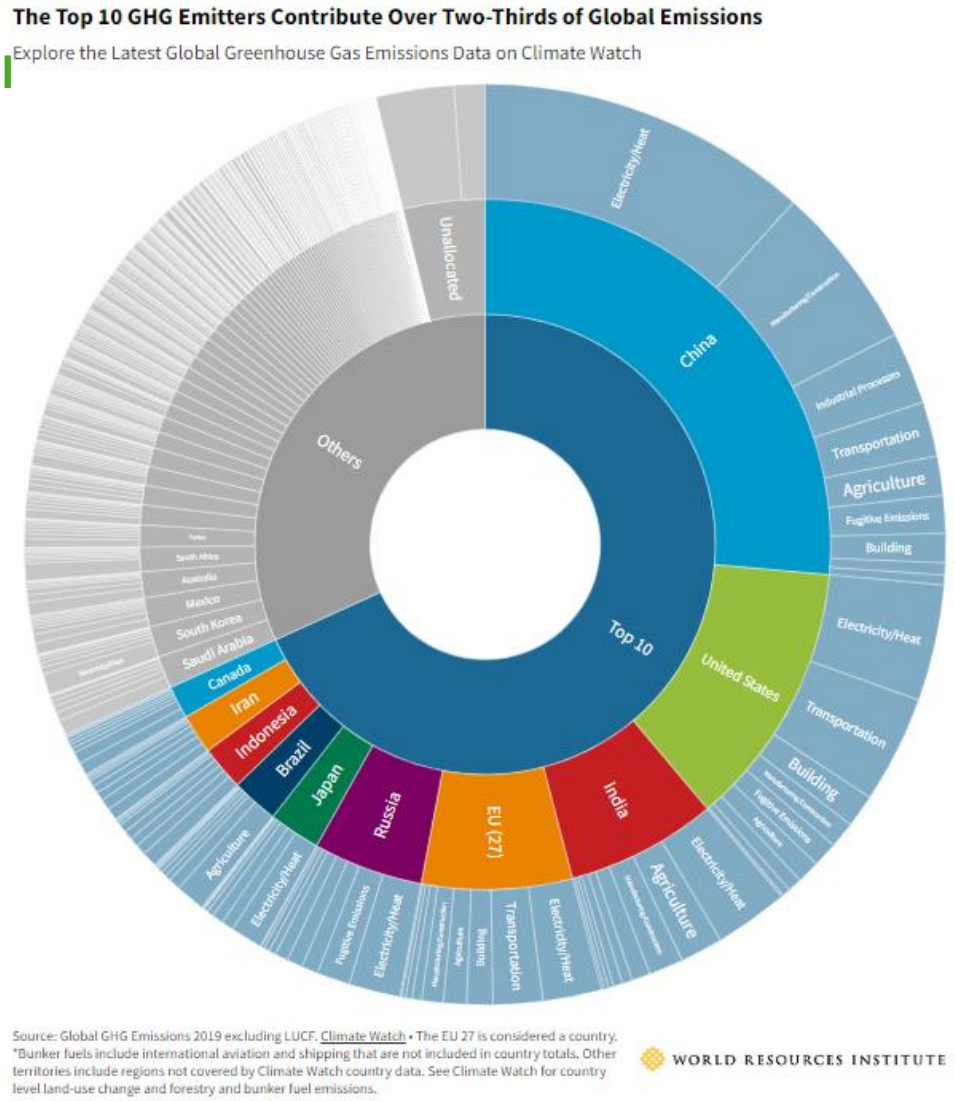
Highest emitters: fairness and ambition

Cumulative carbon dioxide emissions from fossil fuels and land use from 1850 to 2021, by country

(in billion metric tons)



Annual



The Paris Agreement

- The Paris Agreement is a **legally binding international treaty on climate change**. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016.
- It works on a **five-year cycle** of increasingly ambitious climate action -- or, ratcheting up -- carried out by countries.
  - Countries have submitted their national climate action plans, known as **nationally determined contributions (NDCs)** in 2020.
  - Each successive NDC is meant to reflect an increasingly higher degree of ambition compared to the previous version.
  - NDCs include both mitigation and adaptation pledges (reduce GHG emissions and build emissions
- Countries are invited (not obliged) to formulate and submit **long-term low greenhouse gas emission development strategies** (LT-LEDS) to provide the **long-term horizon to the NDCs**.
  - Net-zero targets (mid-century and beyond)
  - Also referred to as countries' long-term strategies (LTS)

https://unfccc.int/process-and-meetings/the-paris-agreement

Paris Agreement Article 2

1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

(a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

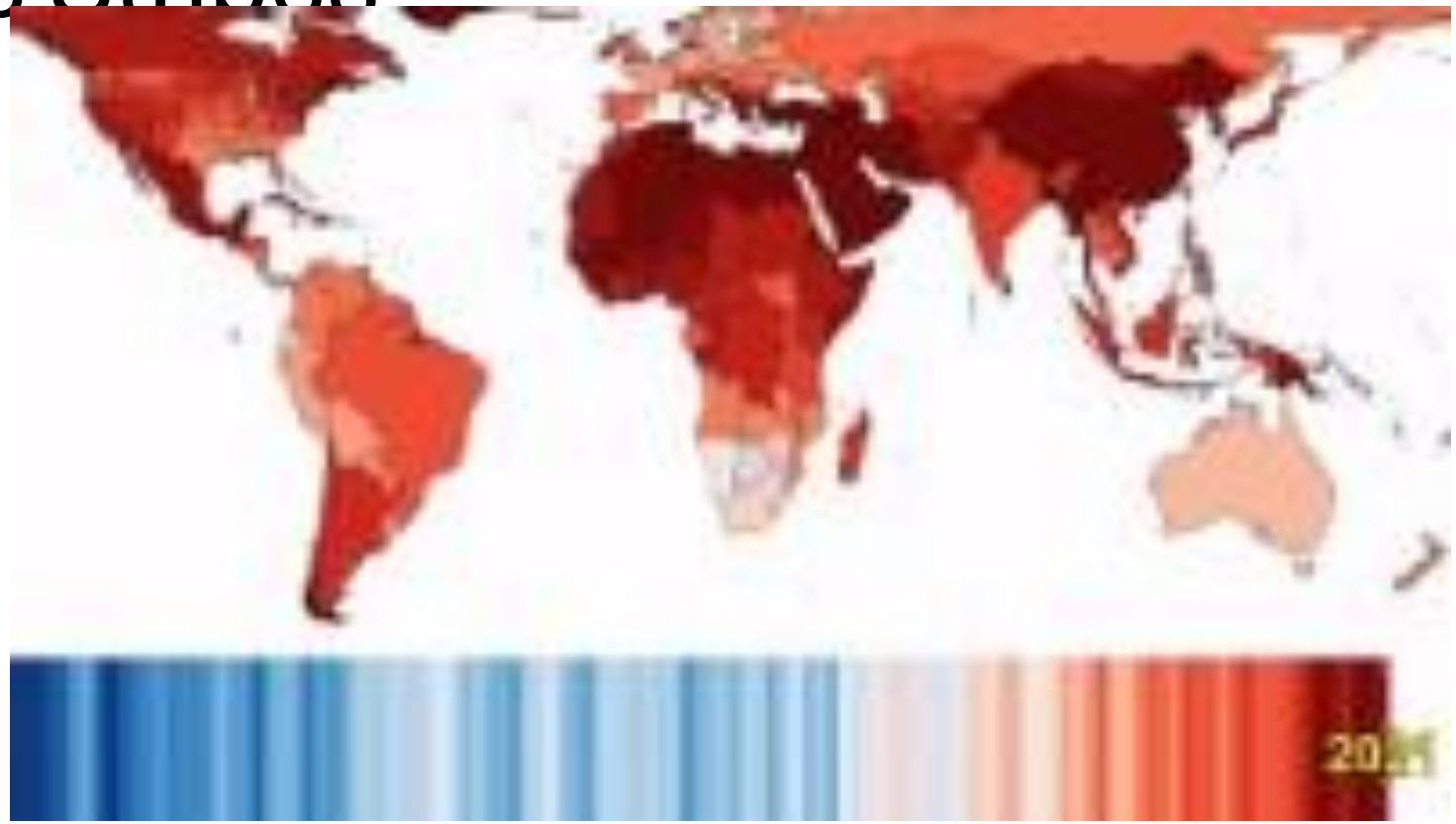
(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and

(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

2. This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

https://unfccc.int/sites/default/files/english_paris_agreement.pdf

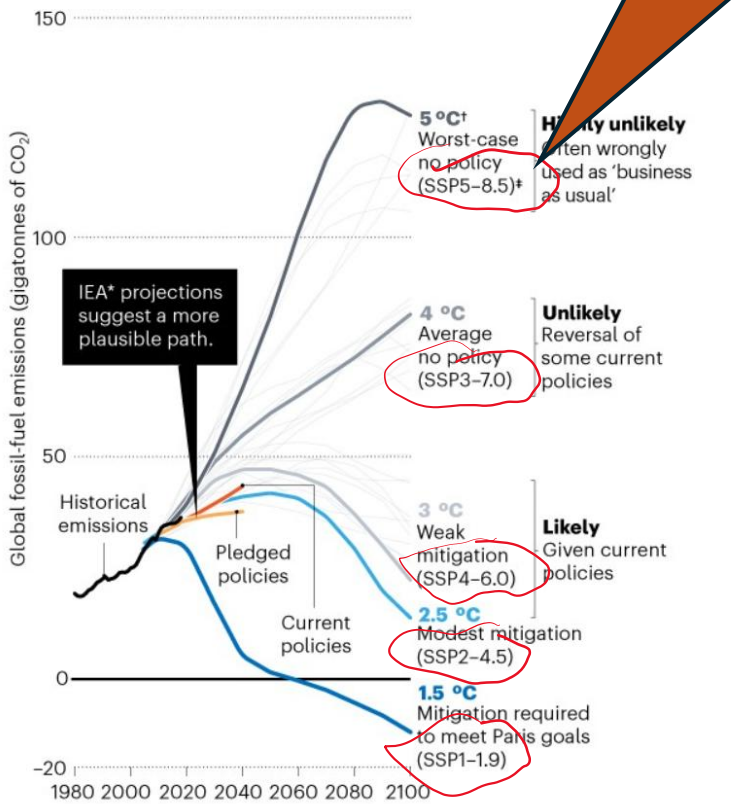
Climate Stripes



https://www.youtube.com/watch?v=jI4G3JqezGs

Where are we headed?

Now you know what these numbers mean



[Hausfather and Peters (2020)]

No more business-as-usual

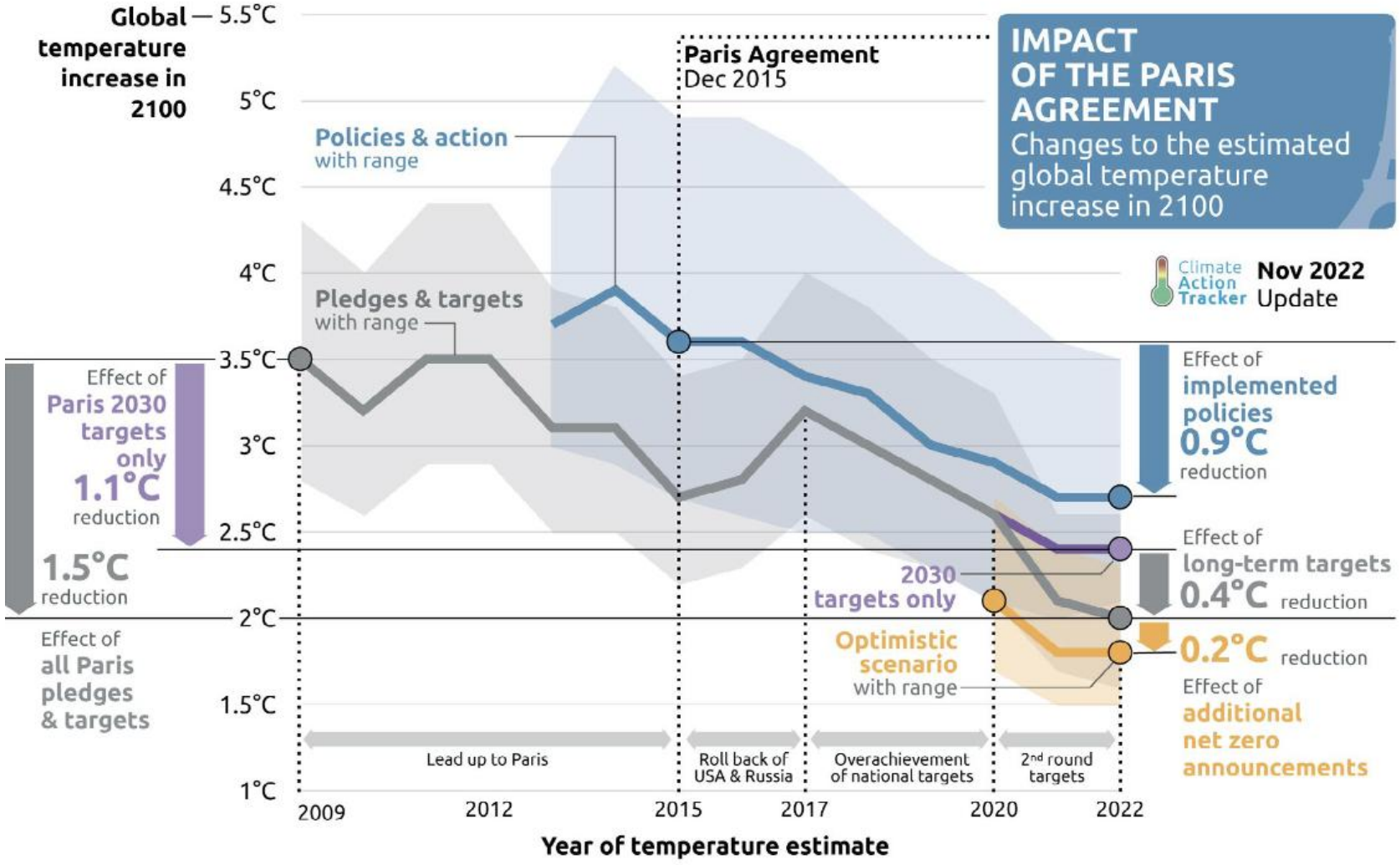
High physical risks
Low transition risks

Unambitious emissions reductions → High temperature outcomes → Climate change impacts are high

Ambitious emissions reductions → Deep structural changes → Socioeconomic challenges are high

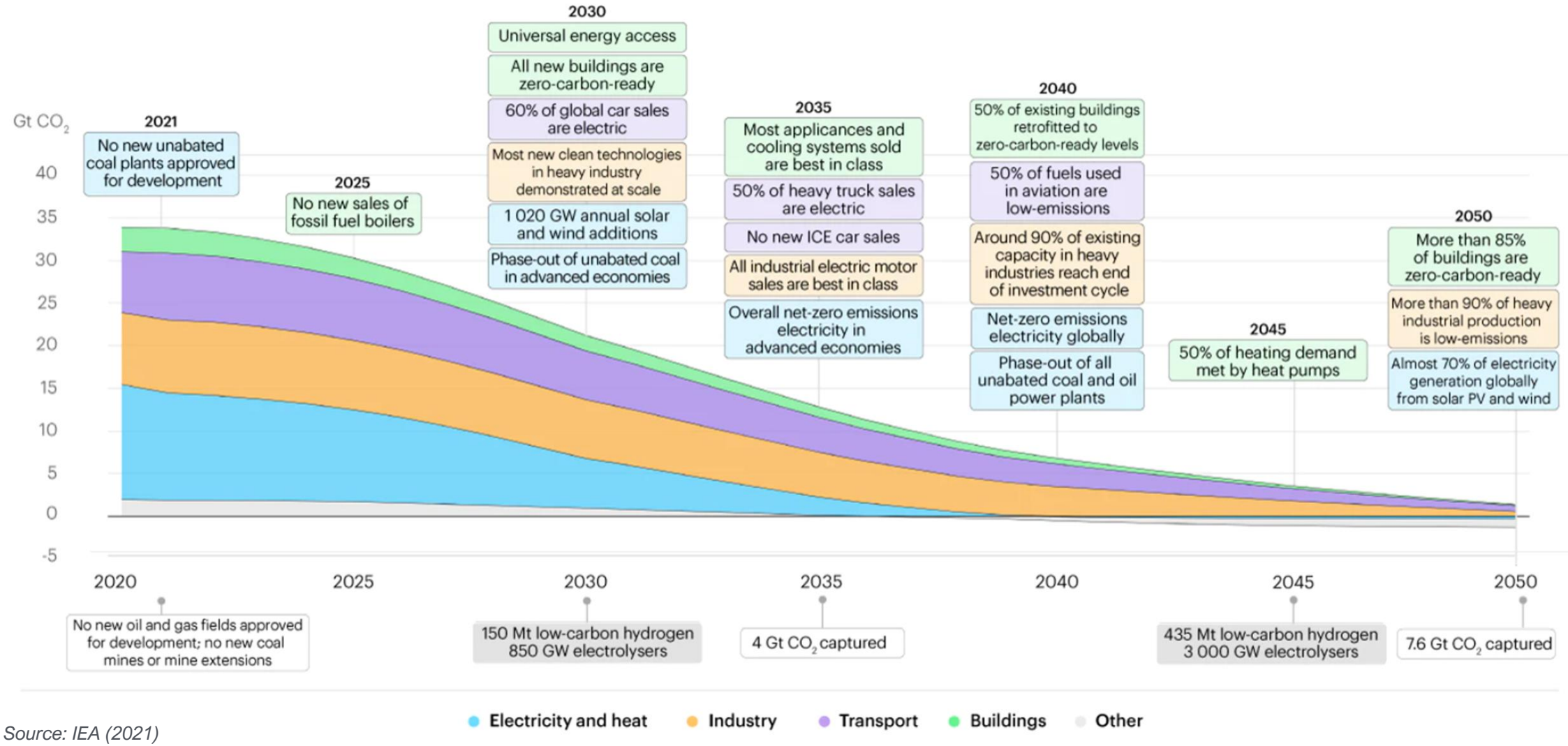
Low physical risks
High transition risks

An evolving policy landscape



Mitigation of Climate Change

IEA Net Zero roadmap



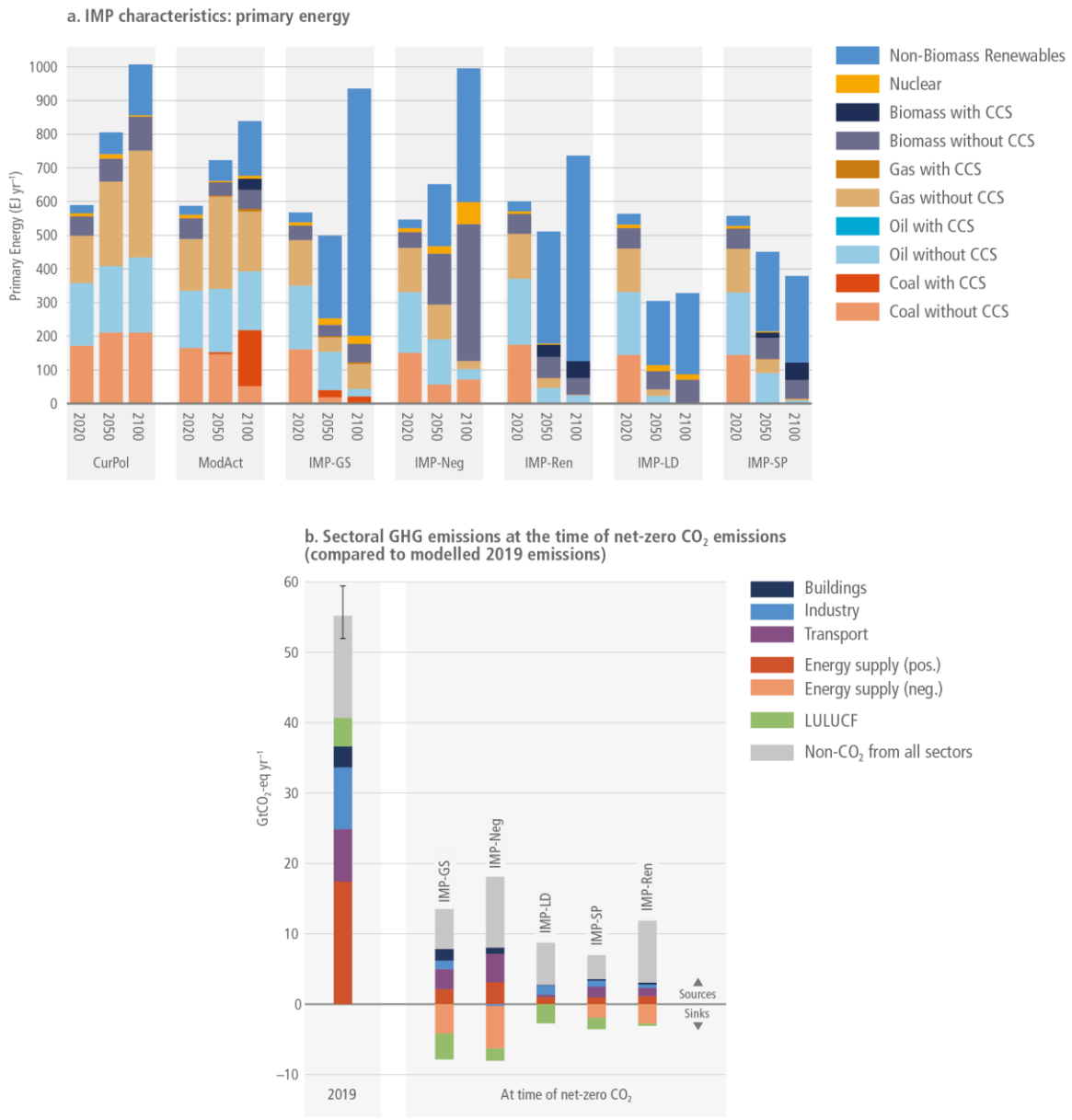
Source: IEA (2021)

Structural change in IMPs

- Deep structural changes in production and consumption patterns
- Reduction in fossil fuel use
- Increase in renewables
- Net-negative LULUCF (and energy)

- Profound changes in PEC
- Early retirement of GHG-intensive assets can lead to asset stranding
- Important source of financial risk

Figure 3.16 | Primary energy use and net emissions at net zero year for the different IMPS. Source: AR6 Scenarios Database.

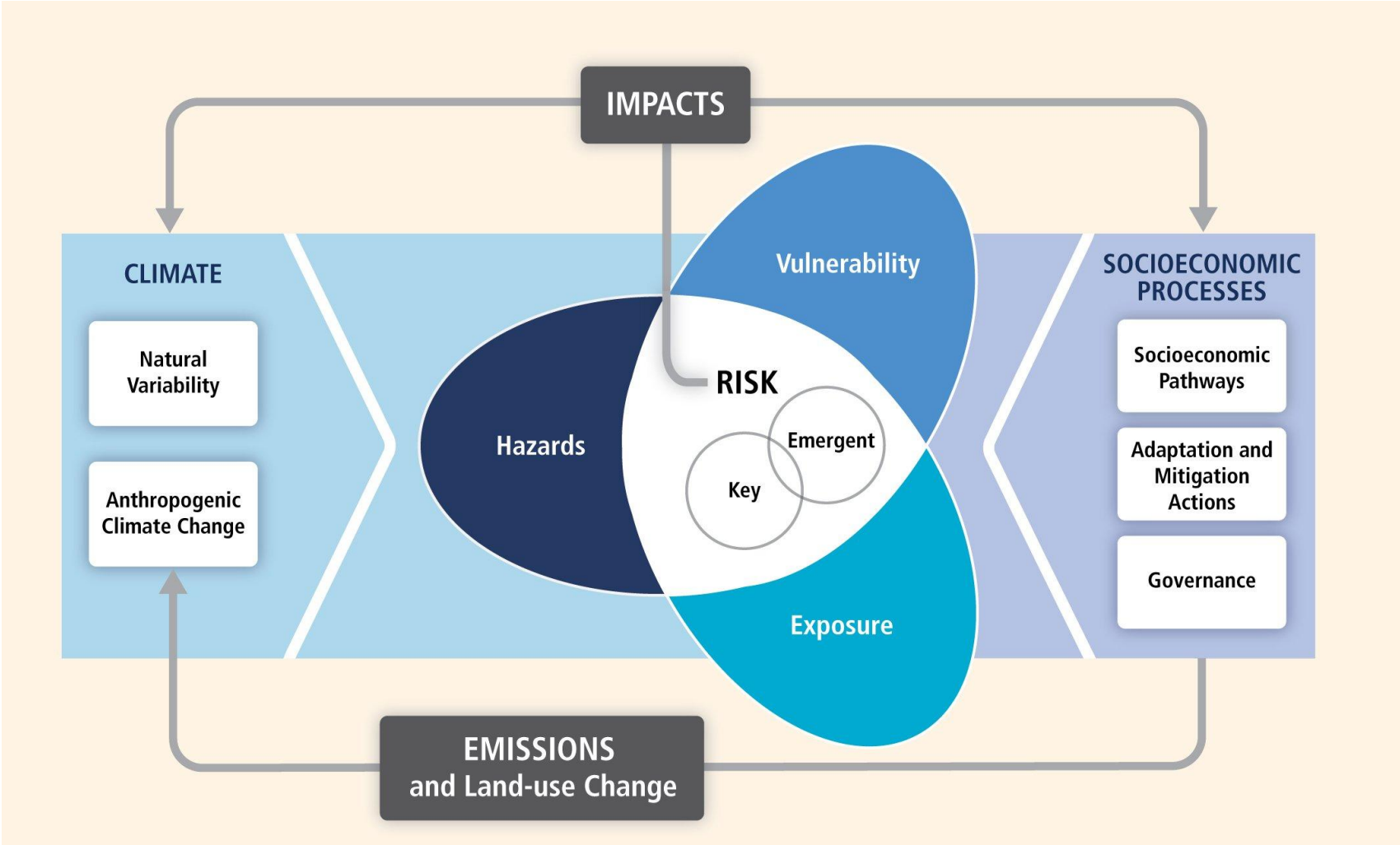


https://www.ipcc.ch/report/ar6/wg3/

Adaptation to Climate Change

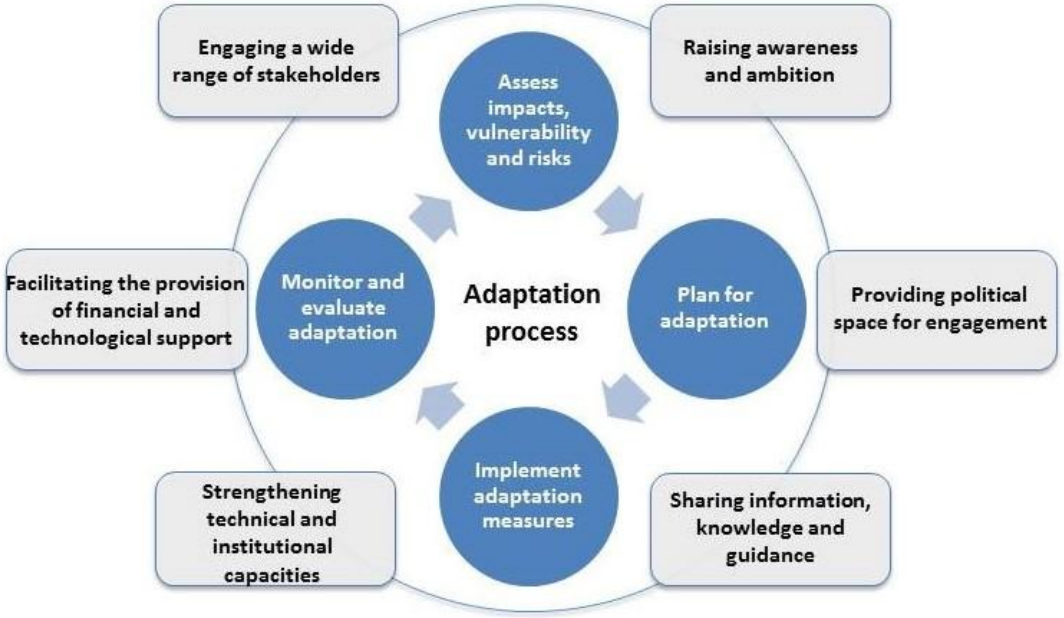
IPCC framing of climate risk

- IPCC risk framing as a combination of:
  - hazards
  - exposure
  - vulnerability



What is adaptation and how to undertake it?

*"**Adaptation refers to adjustments** in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices and structures **to moderate potential damages or to benefit from opportunities** associated with climate change. In simple terms, countries and communities need to develop adaptation solutions and implement actions to respond to current and future climate change impacts."*



https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction

IPCC definition of resilience

- **Resilience**: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.
- [Footnote: This definition builds from the definition used by Arctic Council (2013).]
- See also Hazard, Risk, and Vulnerability.

https://www.ipcc.ch/site/assets/uploads/2018/11/sr15_glossary.pdf

What are some examples of climate adaptation around the world?

- In the Pacific, the small island state of Tuvalu has drawn on the best available science – and around 270,000 cubic meters of sand – to reclaim a 780m-long, 100m-wide strip of land to protect against sea level rise and storm waves beyond 2100. This is an important initiative for a low-lying atoll country comprised of only around 26 square kilometres of land.

- Other countries such as Malawi and Pakistan are modernizing the capture and use of climate data and early warning systems, equipping communities, farmers and policy makers with the information they need to protect lives and livelihoods.

- Cuba and Colombia are leading the way on nature-based approaches, restoring crucial ecosystems – mangroves, wetlands and more – to protect against floods and drought. In this process, Colombia is capitalising on the knowledge of its Indigenous Peoples, who have invaluable expertise in adapting to extreme environmental changes.

- Bhutan, the world's first carbon-negative country, and Chad are among the world's Least Developed Countries (LDCs) to finalize National Adaptation Plans. The result of years of meticulous planning and rigorous consultation, the plans are crucial roadmaps for adaptation in the years ahead. In Bhutan's case, the plan is deeply rooted in the country's unique ethos of Gross National Happiness.

UNDP (2024) What is climate change adaptation and why is it crucial?

Conclusions

- Climate change impacts are happening now
- Mitigate vs adapt
- We can do something either way
- The worst cases have been avoided (so far)
- The next decade is critical
- Big challenges remain, but there is a lot we can do.

Thank you.

Obrigado.

ackoberle@ciencias.ulisboa.pt