What is Green House Gas effect / Global Warming?

Lecture 4 ; 9th January 2024

Recap

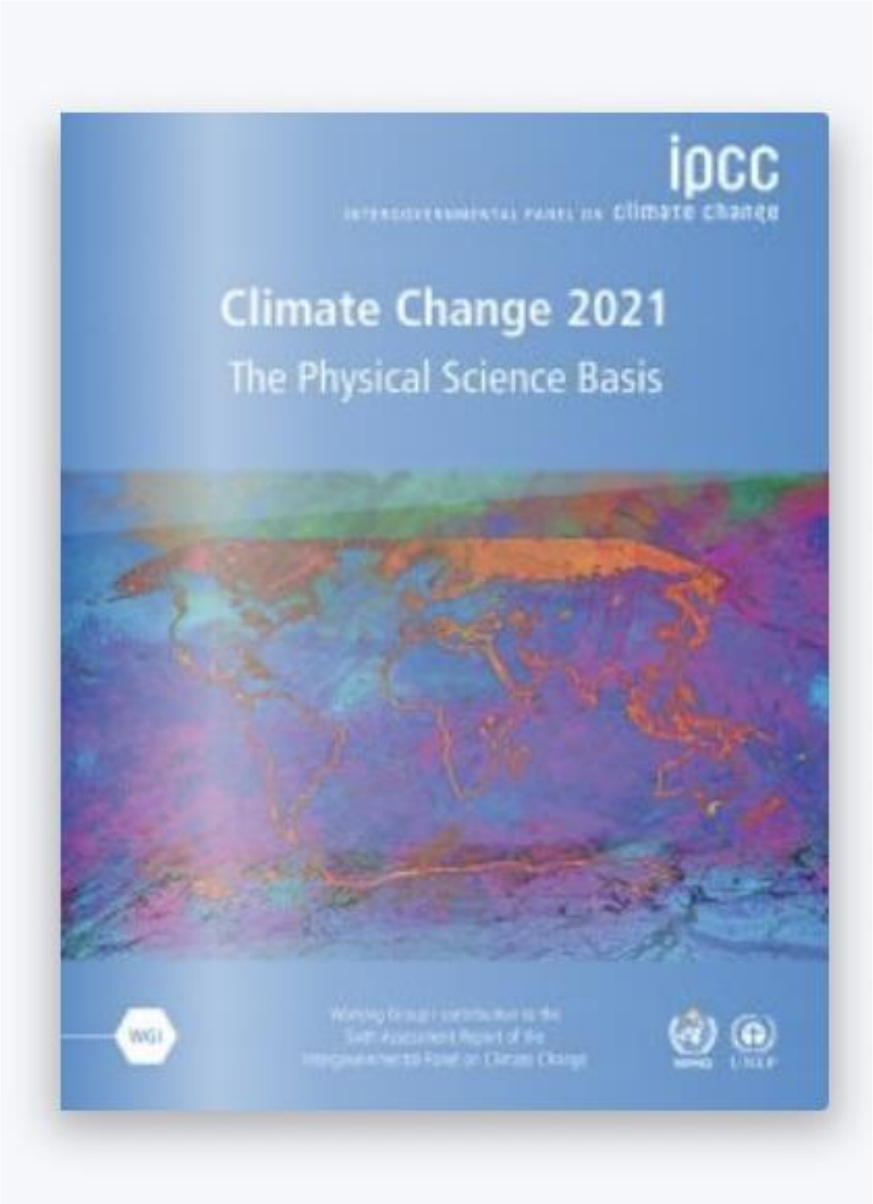
- What is science and why there is an uncertainty for every scientific problem
- Climate change and degree of uncertainty
- Hokey stick diagram
- Intergovernmental panel for climate change (IPCC)

Green house effect/ Global Warming

- https://www.youtube.com/watch?v=XFCdxppTsu0

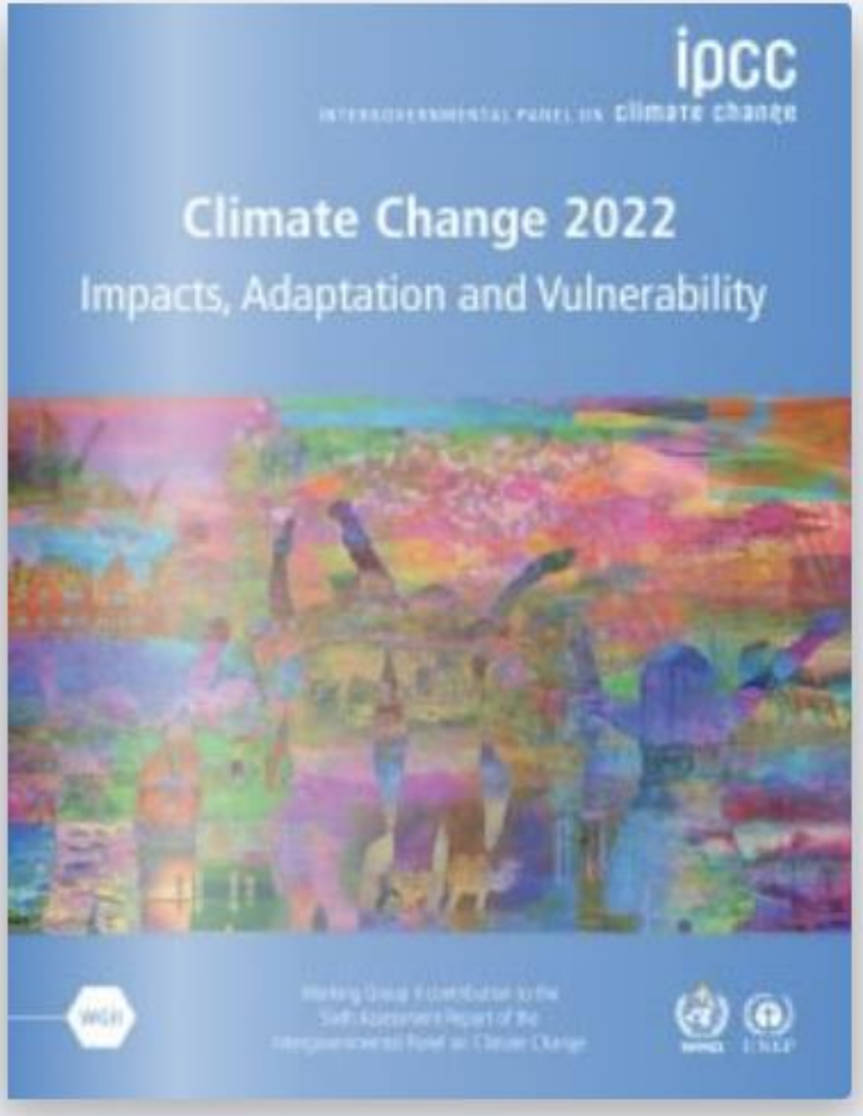
The IPCC report 2021/22 Working Group I

- “unequivocal” and “indisputable” that humans have warmed the planet, causing “widespread and rapid” changes to Earth’s oceans, ice, and land surface
- new estimates of the chances of crossing the global warming level of 1.5°C in the next decades,
- Requires immediate, rapid and large-scale reductions in greenhouse gas emissions
- We are already experiencing climate change, including more frequent and more extreme weather events,” and that “the consequences will continue to get worse for every bit of warming, and for many of these consequences, there’s no going back”.



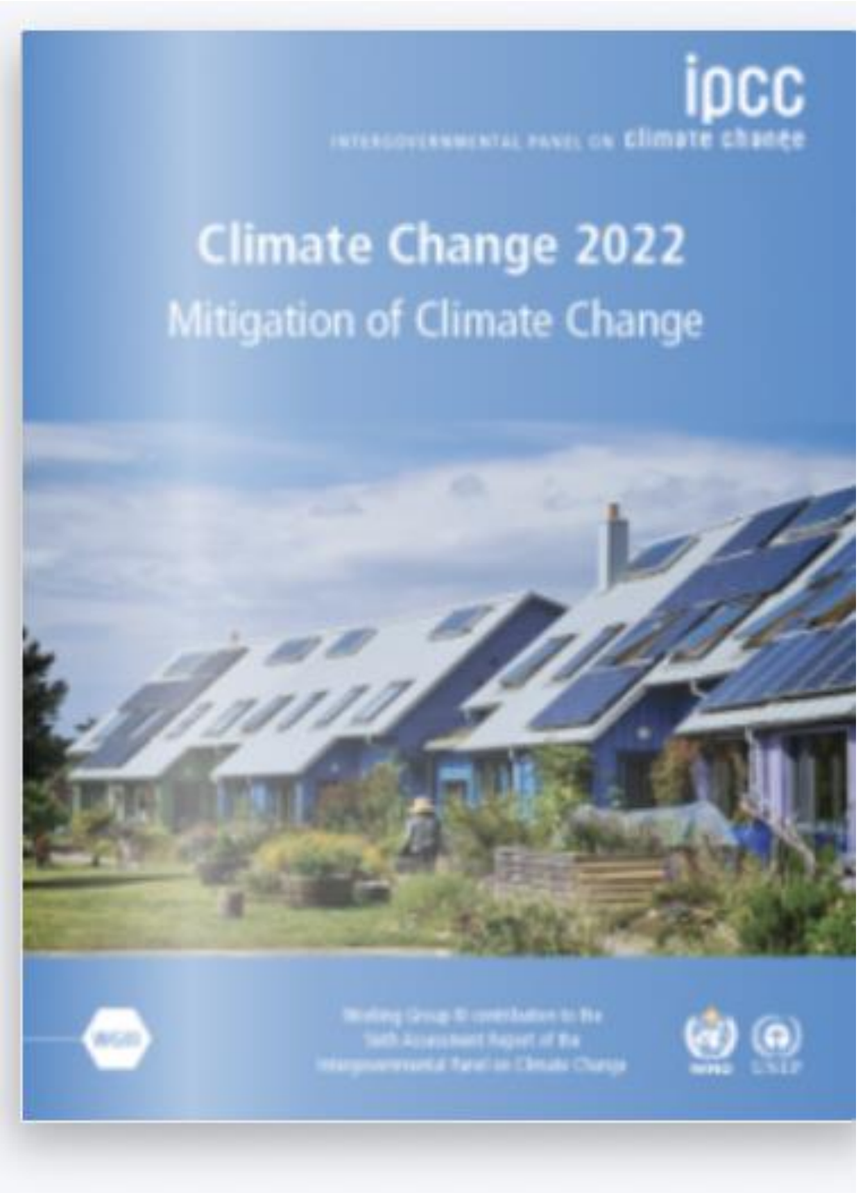
Working Group II

- 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)
- The vulnerability of ecosystems and people to climate change varies – across regions, **socio-economic development, unsustainable ocean and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism, and governance.**
- Climate change including increases in frequency and intensity of extremes have reduced food and water security, hindering efforts to meet Sustainable Development Goals
- Leading to humanitarian crises where climate hazards interact with high vulnerability
- Regions and people with considerable development constraints have high vulnerability to climatic hazards



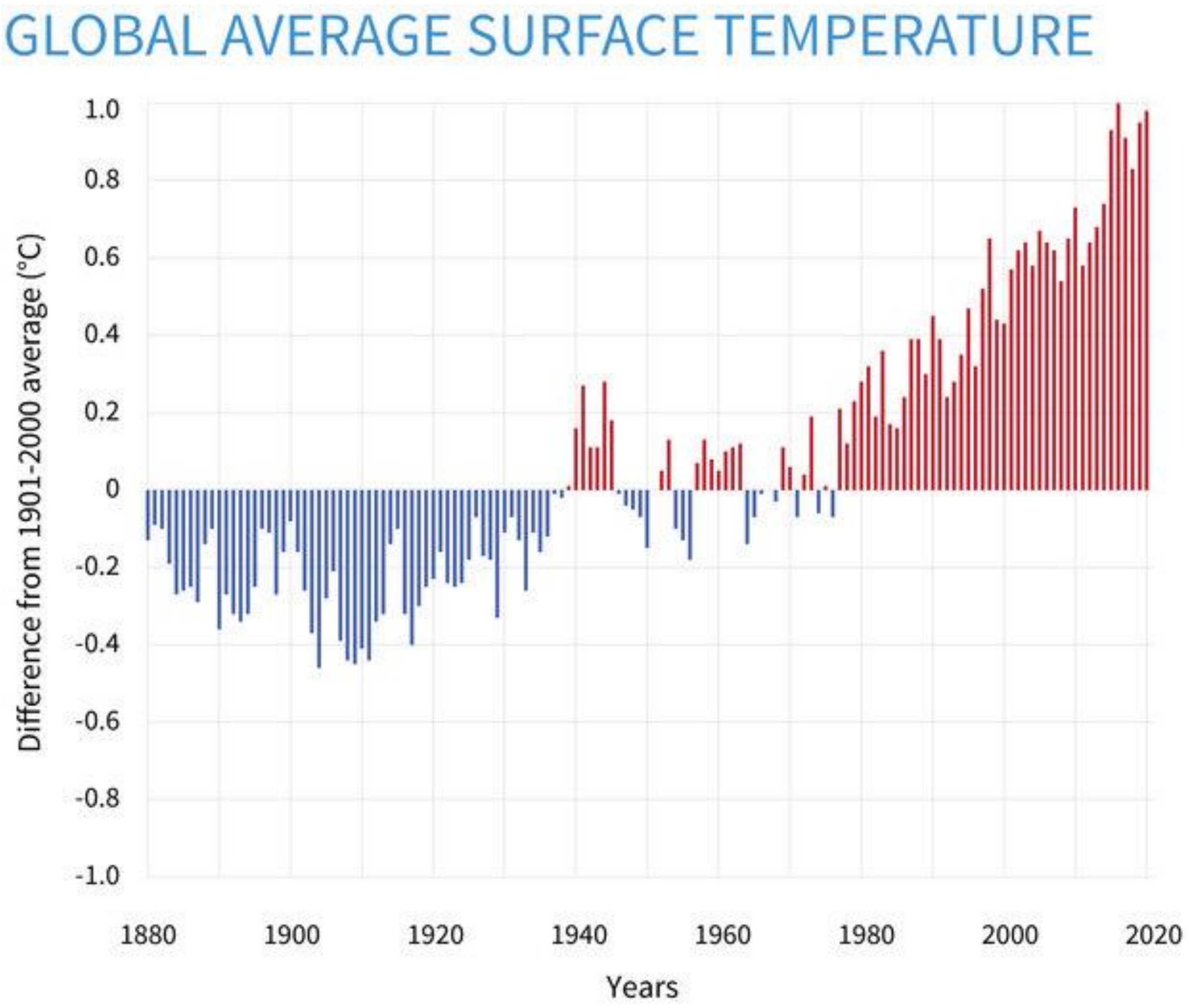
Working Group III

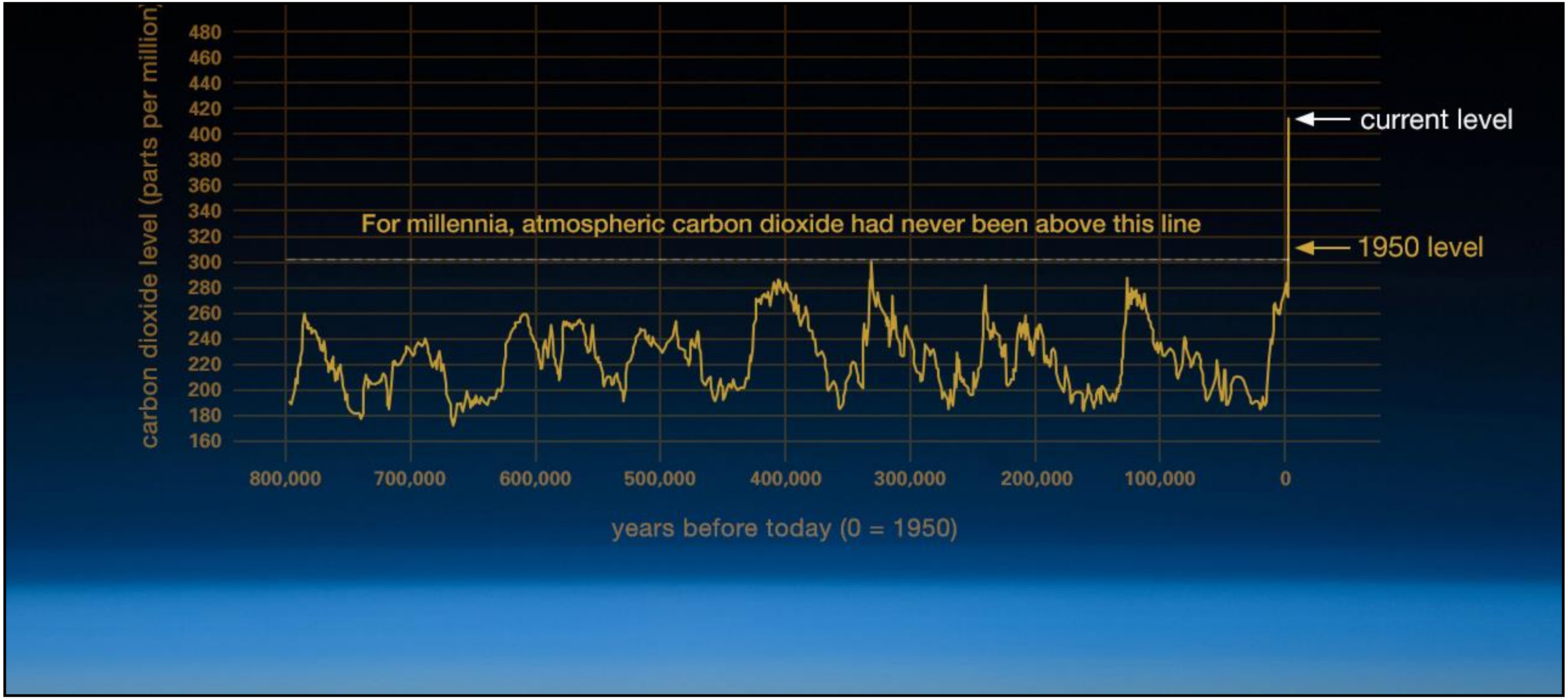
- The decisions we make now can secure a liveable future.
- There are policies, regulations and market instruments that are proving effective, need to be scaled up
- Need right policies, infrastructure and technology in place to enable changes to our lifestyles and behaviour.
- **The next few years are critical -** limiting warming to around 1.5°C (2.7°F) requires global greenhouse gas emissions to peak before 2025 at the latest, and be reduced by 43% by 2030
- For 1.5°C (2.7°F), this means achieving net zero carbon dioxide emissions globally in the early 2050s; for 2°C (3.6°F), it is in the early 2070s.
- Accelerated and equitable climate action in mitigating and adapting to climate change impacts is critical to sustainable development



Current Climate Change

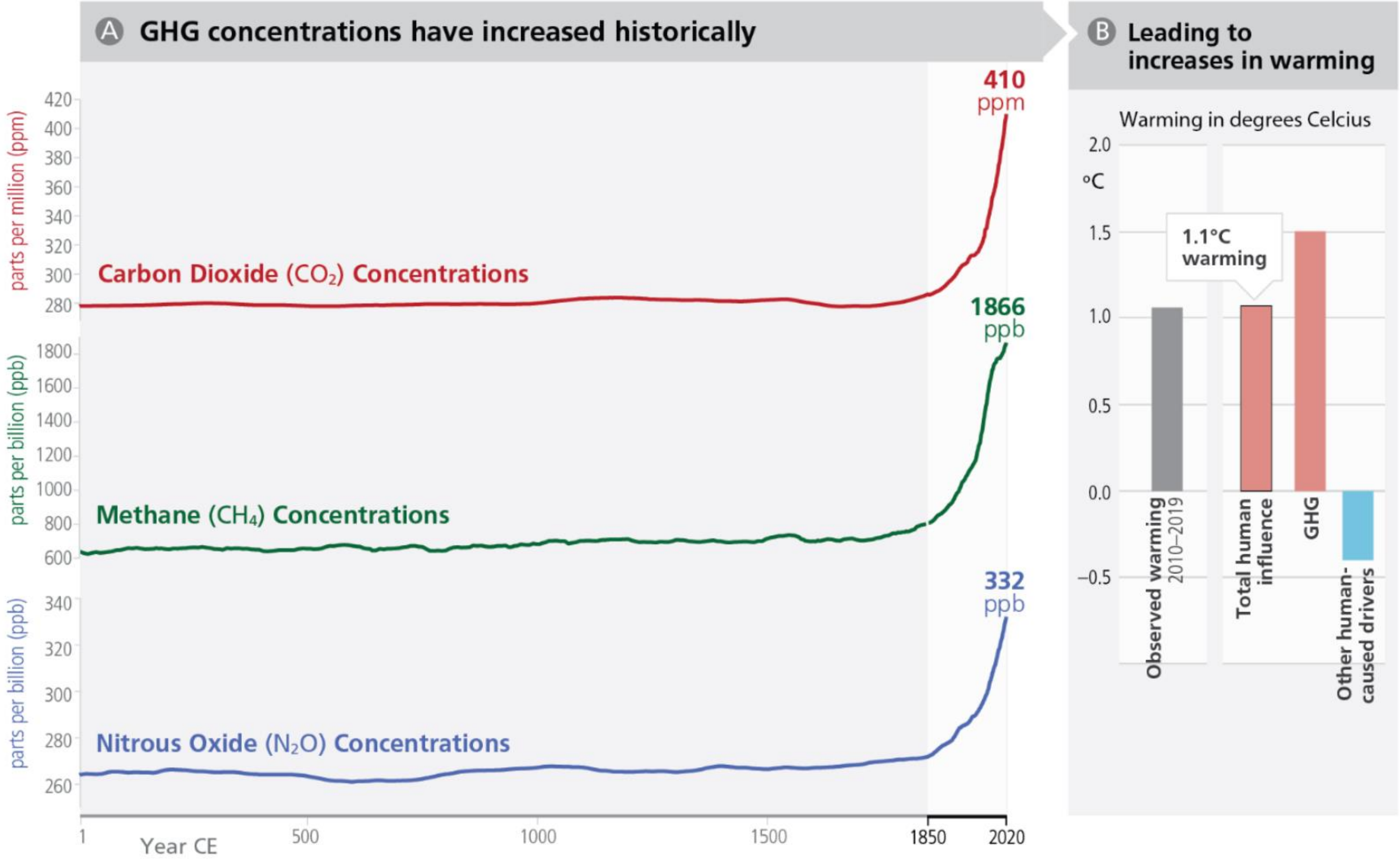
- an **average rate of 0.13 degrees Fahrenheit (0.08 degrees Celsius) per decade** since 1880;
- 2021 was consistent with the long-term **human-caused global warming trend of about 0.2 °C (0.36 °F) per decade**.





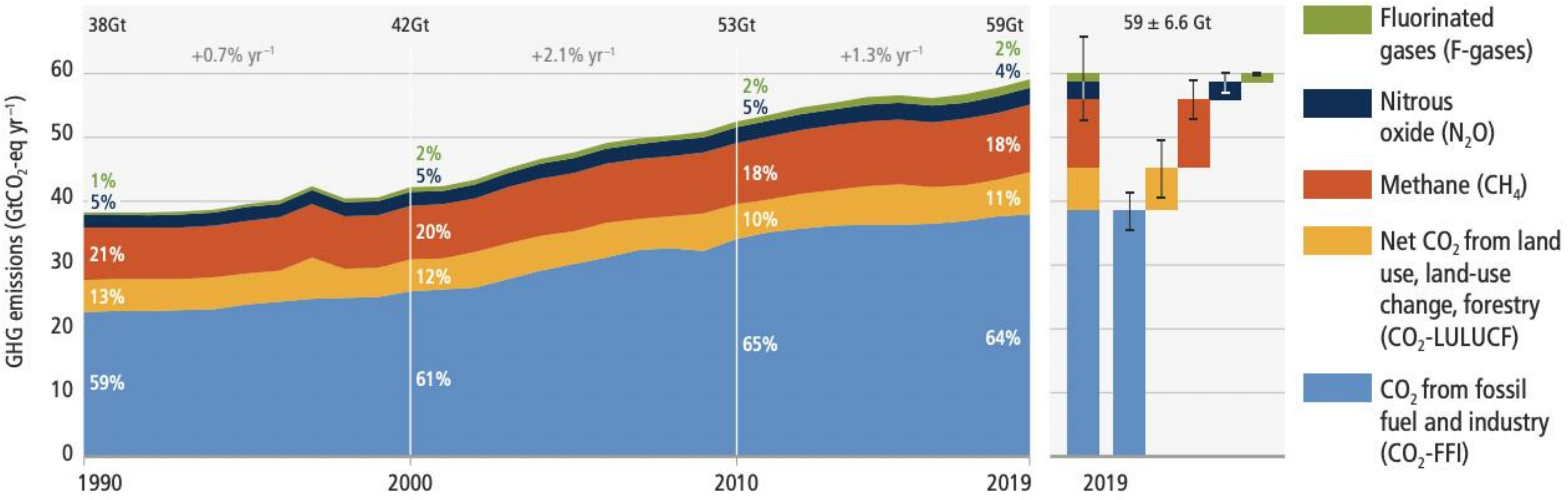
Carbon Di Oxide level

We caused current warming and our future emissions will determine future warming

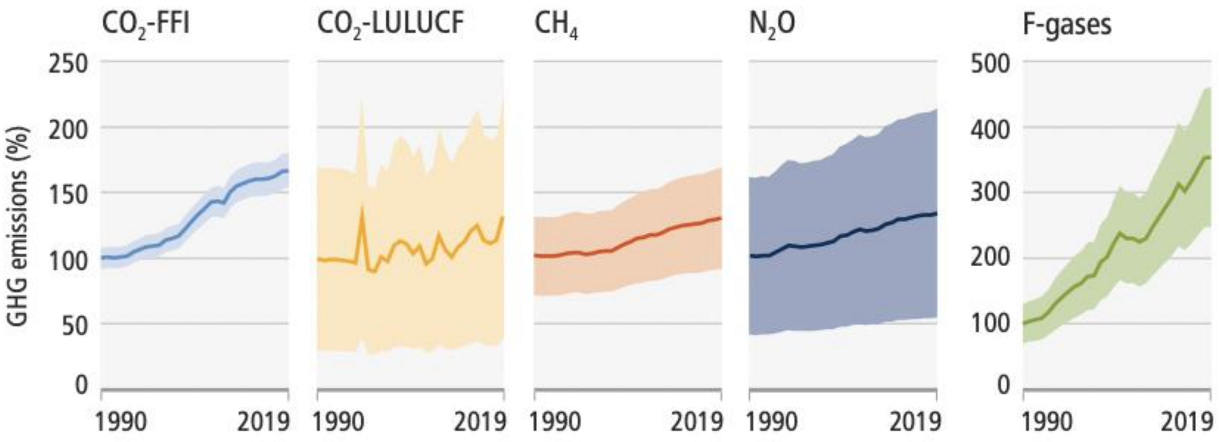


Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.

a. Global net anthropogenic GHG emissions 1990–2019 (5)



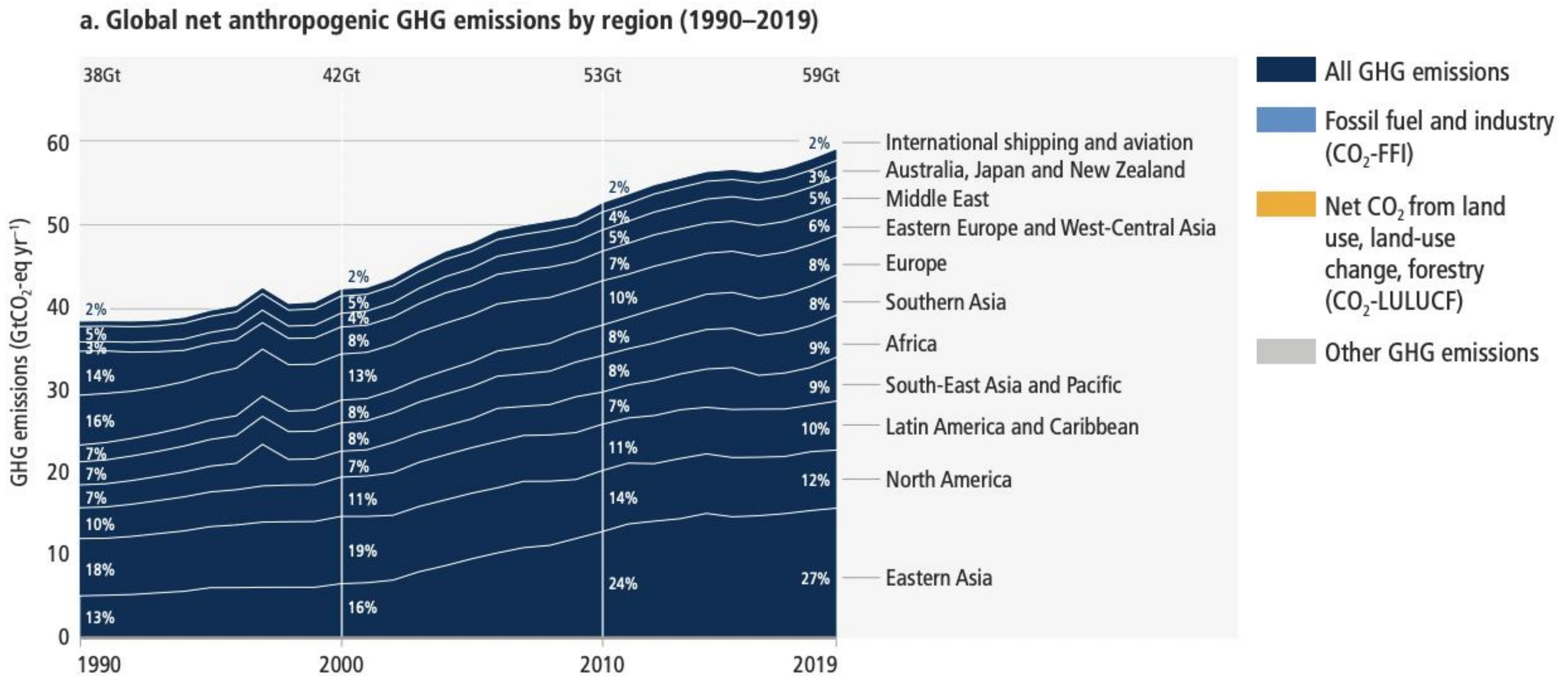
b. Global anthropogenic GHG emissions and uncertainties by gas – relative to 1990



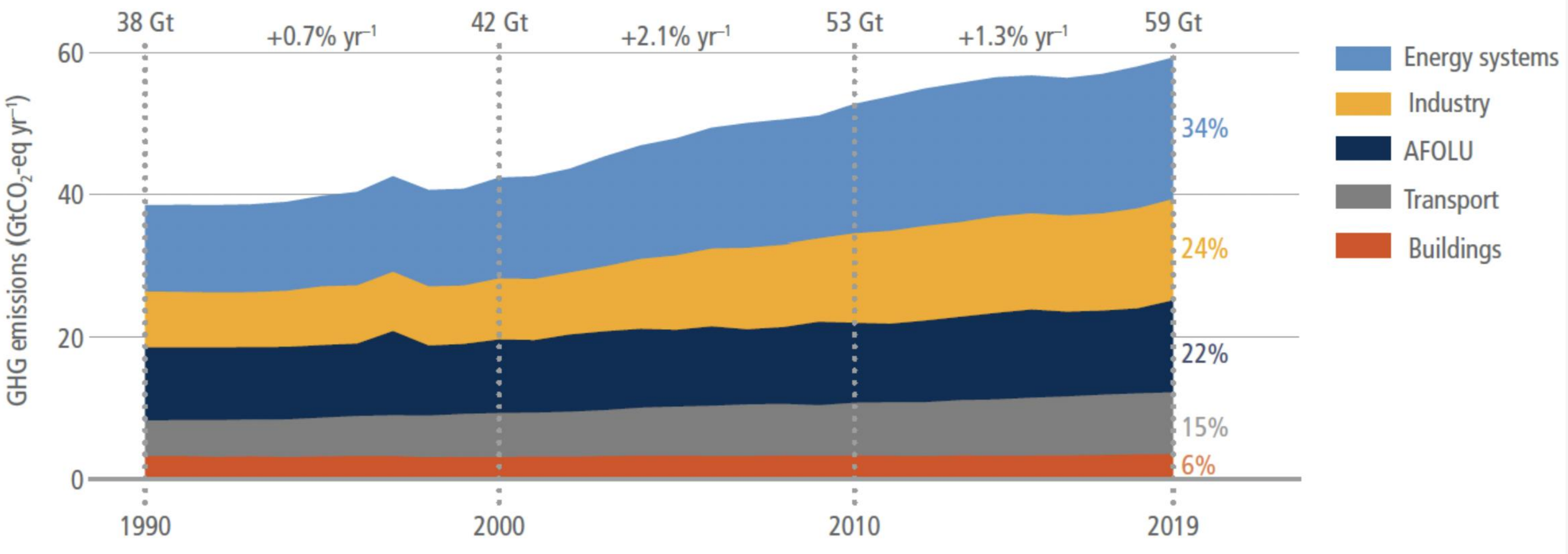
	2019 emissions ($GtCO_2$-eq)	1990–2019 increase ($GtCO_2$-eq)	Emissions in 2019, relative to 1990 (%)
CO_2-FFI	38 ± 3	15	167
CO_2-LULUCF	6.6 ± 4.6	1.6	133
CH_4	11 ± 3.2	2.4	129
N_2O	2.7 ± 1.6	0.65	133
F-gases	1.4 ± 0.41	0.97	354
Total	59 ± 6.6	21	154

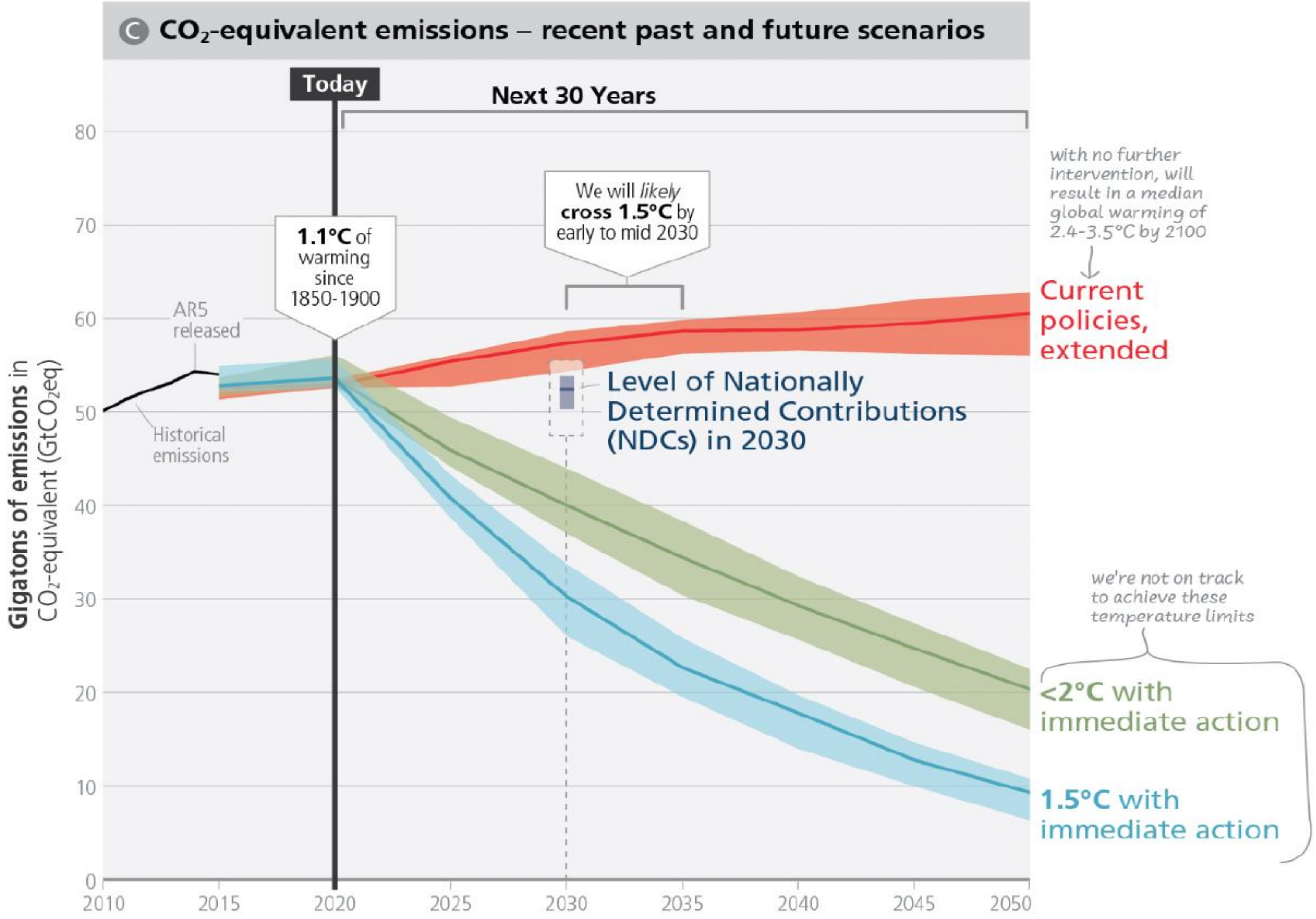
The solid line indicates central estimate of emissions trends. The shaded area indicates the uncertainty range.

Emissions have grown in most regions but are distributed unevenly



(a) Total global GHG emission trends by sectors





Intergovernmental Panel for Climate Change (IPCC) 2022

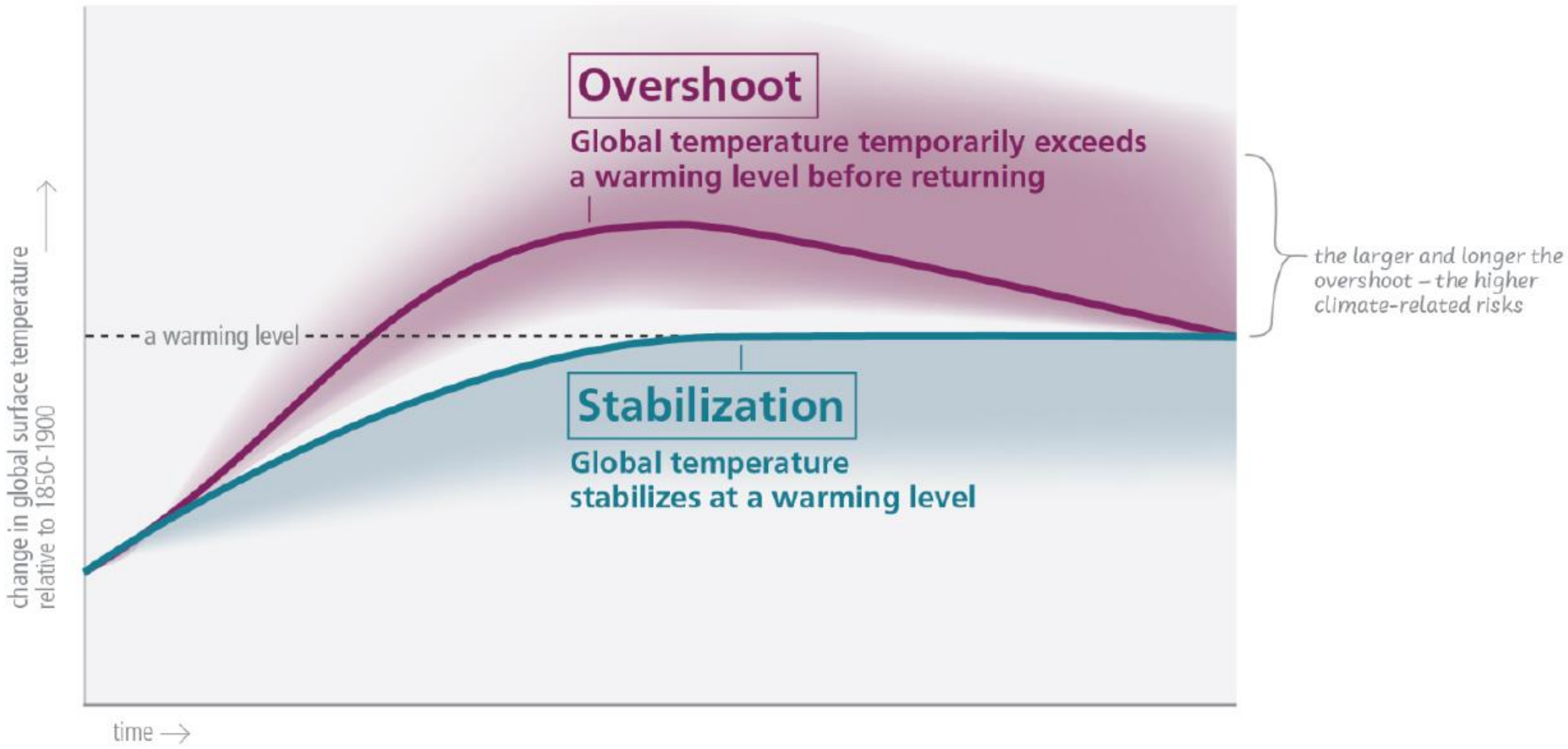
What is 1.5 degree?

- limiting global temperature to 1.5°C" refers to the goal of preventing the average global temperature from rising more than 1.5°C above pre-industrial levels (typically considered the average temperature between 1850 and 1900).
- This target is outlined in the **Paris Agreement** adopted in 2015, where nations committed to limit warming to **"well below 2°C"** and to **"pursue efforts to limit the temperature increase to 1.5°C."**
- The 1.5°C threshold was set based on scientific studies indicating that warming beyond this level would lead to severe and potentially irreversible impacts on ecosystems, human systems, and the planet.

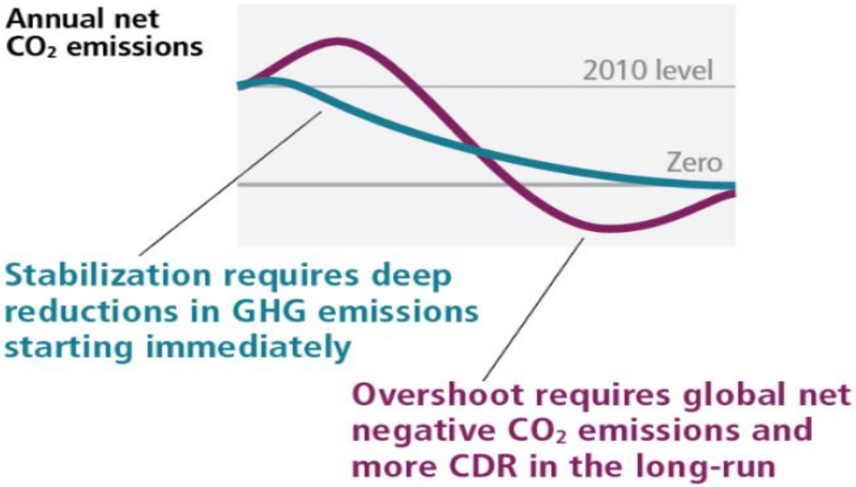
differences between a 1.5°C and a 2°C rise:

- **Extreme Weather Events**:
- At 1.5°C: Fewer heatwaves, droughts, and heavy rainfall events.
- At 2°C: These events become more frequent and severe, increasing risks to lives and livelihoods.
- **Sea Level Rise**:
- At 1.5°C: Sea levels would rise by about 0.4 meters by 2100, putting fewer coastal communities and ecosystems at risk.
- At 2°C: The rise would be higher, increasing the risk of flooding and displacement for millions.
- **Ecosystems and Biodiversity**:
- At 1.5°C: Up to 70% of coral reefs could be lost.
- At 2°C: More than 99% of coral reefs could be destroyed.

Overshooting and coming back to a warming level will have consequences –some irreversible



Emissions reduction and feasibility



Physical responses during overshoot

- Increased **heatwaves** (frequency and intensity)
- Increased **droughts** (frequency and intensity)
- Increased **heavy precipitation** (frequency and intensity)
- Decreased **seasonal snow cover**
- Decreased **sea-ice**

Immediate impacts

Immediate impacts are higher in overshoot pathways than in stabilization pathways.

For example:

- additional **ecosystem degradation**
- additional **deaths from heatwaves**
- **economic and non-economic impacts** from other extreme events
- additional **vector-borne diseases** and **malnutrition**
- increased **risk to livelihoods** and **cultures**

Long term risks and impacts

Many physical responses and impacts from overshoot pathways, even above 1.5°C, are expected to be irreversible on time scales from centuries to millennia.

For example:

- **ice sheet melt**
- **permafrost thaw**
- **loss of coastal habitats**
- **loss of coral reefs**
- **species extinctions**
- **loss of cultural heritage**
- **higher global sea level rise**