

Research relevant to support the development of new nationally determined contributions

Prof. Sonia I. Seneviratne, ETH Zurich

IPCC AR7 Working Group I Vice-chair; IPCC AR6 Coordinating lead author

sonia.seneviratne@ethz.ch



@SISeneviratne

We are in a climate crisis: And the situation worsens every year...



61'000 deaths

Europe,
2022



>1'700 deaths
~\$30 billion flood damage and
economic losses

Pakistan,
2022



Burnt area: 4x CH
CO₂ Emissions: 3x Canada

Canada,
2023



Heatwaves, March-May:
25'000 heat strokes*, >49°C**

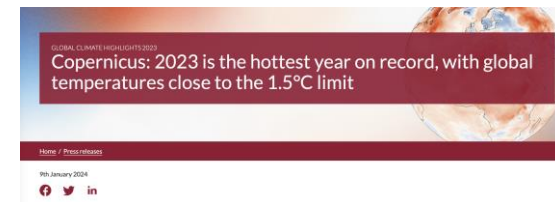
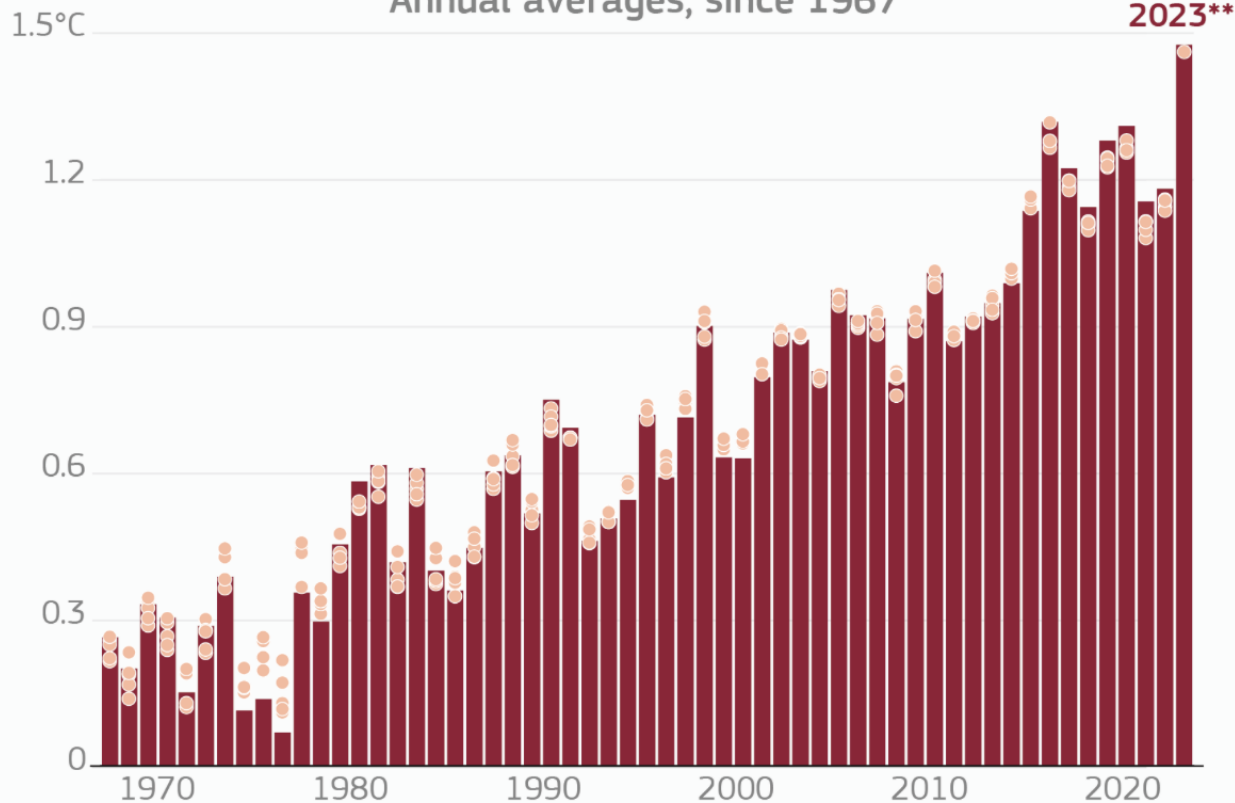
India,
2024

*<https://www.reuters.com/world/india/heat-wave-kills-least-56-india-nearly-25000-heat-stroke-cases-march-may-2024-06-03/>

**<https://www.reuters.com/world/india/india-says-delhis-record-529-celsius-temperature-last-week-was-wrong-by-3-c-2024-06-01/>

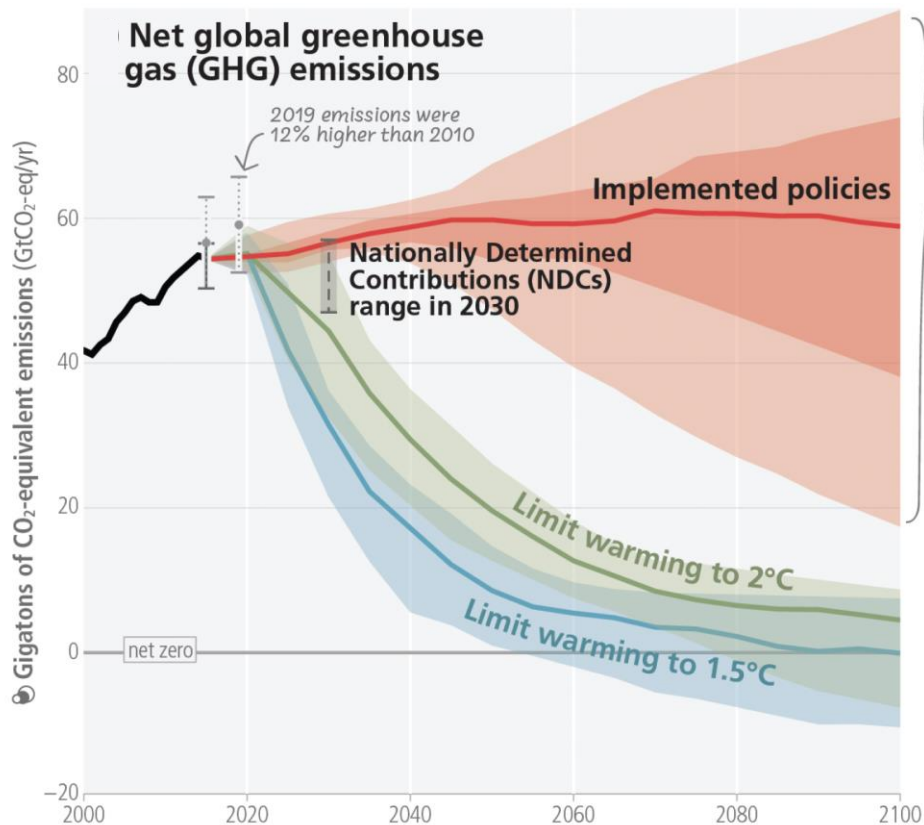
We are in a climate crisis: And the situation worsens every year...

Annual averages, since 1967



<https://climate.copernicus.eu/copernicus-2023-hottest-year-record>

We are not on track!



“Global GHG emissions are projected to peak between 2020 and at the latest before 2025 in global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot” (IPCC AR6 WG3)

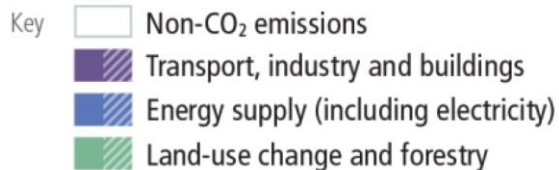
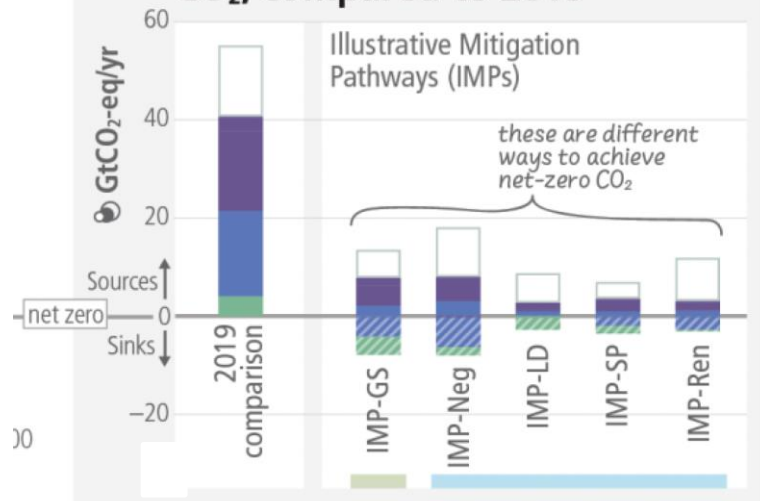
Implemented policies result in projected emissions that lead to warming of 3.2°C, with a range of 2.2°C to 3.5°C (medium confidence)

Key

- Implemented policies (median, with percentiles 25-75% and 5-95%)
- Limit warming to 2°C (>67%)
- Limit warming to 1.5°C (>50%) with no or limited overshoot
- Past emissions (2000–2015)
- Model range for 2015 emissions
- Past GHG emissions and uncertainty for 2015 and 2019 (dot indicates the median)

(IPCC AR6 SYR, Figure SPM.5a)

Greenhouse gas emissions by sector at the time of net zero CO₂, compared to 2019



“Zero” is more important than “net”!!

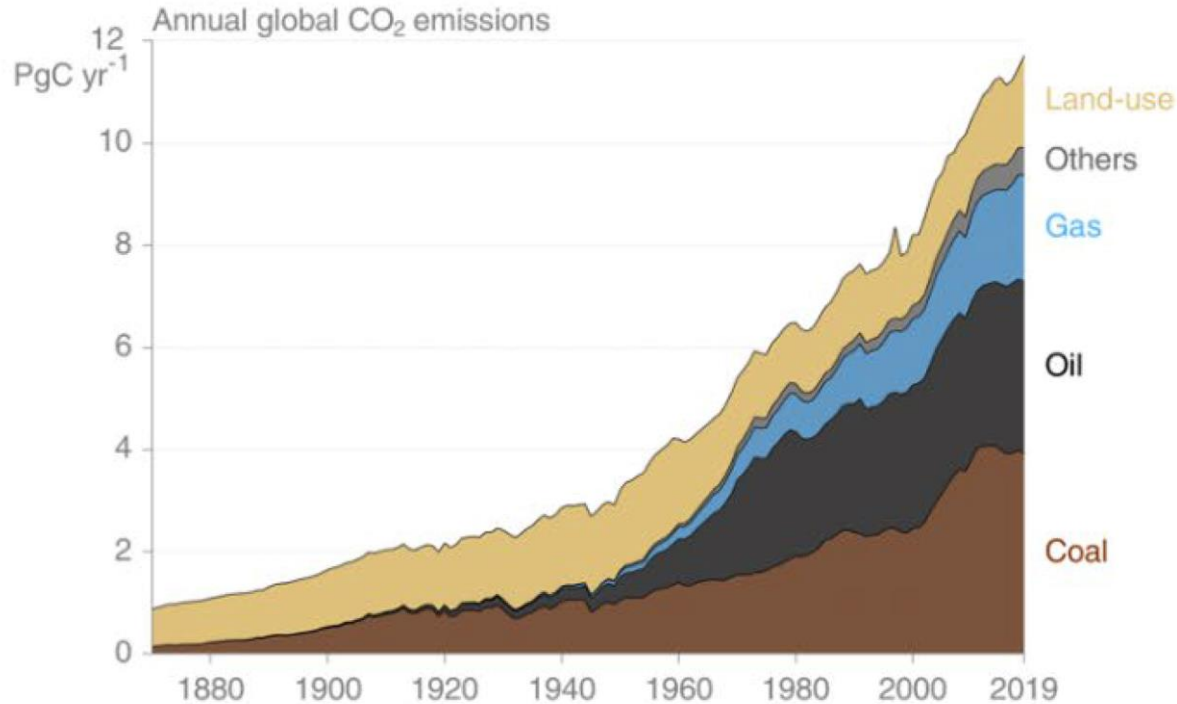
CO₂ emissions, rule of thumb:

- -90% decrease of emissions
- 10% remaining emissions
- -10% negative emissions (carbon dioxide removal: afforestation, technologies)

Getting to “Net-zero” is primarily about reducing CO₂ emissions and the consumption of fossil fuels

(IPCC AR6 SYR)

The main cause of human-induced global warming is the burning of fossil fuels
(~90% of CO₂ emissions)



(IPCC AR6 WGI, Chapter 5: Fig. 5.5)

Sources of CO₂ emissions:

- Burning of fossil fuels
- Land use (deforestation)

To reach net-zero CO₂, and stabilize global warming at about 1.5°C a **phase out of most fossil fuel uses** is necessary*

Research needs: Where do we stand? How do we do it? What are the options and implications?

*IPCC SR15, Figure SPM3b (no and low overshoot scenarios)

1) Where are we?



2) What are possible mitigation pathways and their limitations?



3) What is the extent of potential impacts and limits to adaptation at global warming levels between 1.5°C and 2°C?



4) New climate research fields



Where are we?

- Monitoring of climate evolution: CO₂ emissions & concentrations, global warming, changes in extremes, nearing of regional & global biophysical tipping points

What are possible mitigation pathways and their limitations?

- New emissions scenarios:
 - Integration of climate feedbacks in development of mitigation pathways (e.g. impacts of climate extremes on afforestation, agriculture, infrastructure, economy)
 - Fast computation of regional climate projections for new emissions scenarios with chains of global and regional emulators
 - Limits of nature-based and technological options for carbon dioxide removal (CDR) (competition for land, water demand, trade-offs)
 - Regional differentiations (short-lived climate forcers, differences in development and capabilities, justice and equity)
 - Economic and social development in a net-zero CO₂ world, risks for country development with continued use of fossil fuels (local pollution and health impacts, impacts on economy, being left behind in a new innovation era, liability)

What is the extent of potential impacts and limits to adaptation at global warming levels between 1.5°C and 2°C?

- Global and regional tipping points in climate system and society:
 - Greenland/ Antarctic ice melt, Amazon rainforest becoming a carbon source, global shortage of food supplies, high-impacts low-likelihood events (1-5%), compound and cascading events
- Overshoot pathways and their impacts
- Irreversible losses and damages (deaths, health, biodiversity, coastal regions and SIDS, mountainous areas)
- Event and impact attribution, methodologies to assess loss and damage

New climate research fields

- Social sciences and humanities (psychology, ethics, philosophy, sociology)
- Law (climate litigation); Finance and economy
- Communication; Art (music, dance, films)
- Integration of social and natural sciences; storylines and narratives of the future

We are moving to a new era in human history

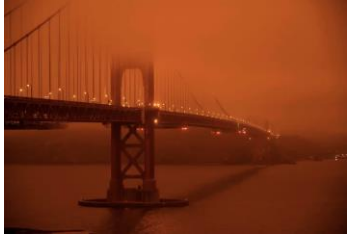


Fossil fuel combustion era



Transition away from/
Phase out of fossil fuels*

*IPCC SR15: chapter 2, pp. 118, 122; IPCC AR6 WGII: chapter 5, p. 829; IPCC AR6 WGIII: chapter 3, pp. 305, 309, 358; chapter 4, p. 440; chapter 6, pp. 690, 691, 705; chapter 10, p. 1110; chapter 12, p. 1308; chapter 16, p. 1658; chapter 17, p. 1742; Index: p. 1980



OR





EVERY ACTION MATTERS
EVERY BIT OF WARMING MATTERS
EVERY YEAR MATTERS
EVERY CHOICE MATTERS