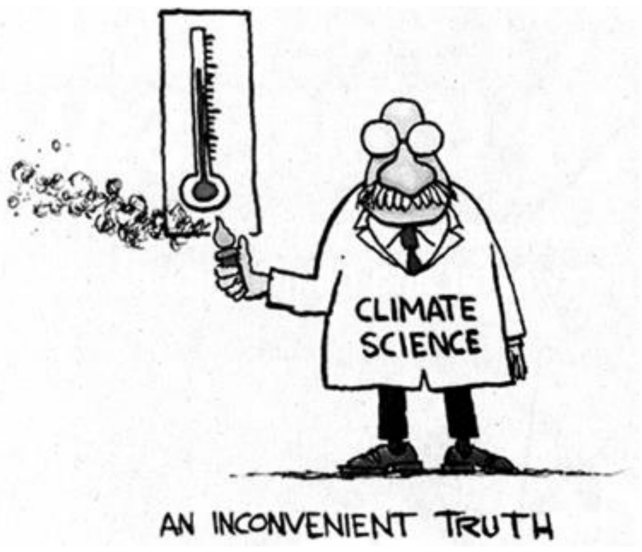
Climate.now with built environment focus

5 credits

25.4.2023: Environmental State of the World



UNIVERSITY OF ICELAND
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING

Welcome

- Climate.now course with the emphasis on the built environment
- Course staff:
  - Jukka Heinonen, Professor, University of Iceland / Adjunct, Aalto University, heinonen@hi.is
  - Áróra Árnadóttir, Adjunct, University of Iceland / CEO, Green Building Council Iceland, arora@hi.is
- Visiting lecturers
- Course languages: Finnish / English

Course outline

- 5 (2+3) credits: 2 from completing the online climate.now course, 3 from the built environment focus component
- Lectures once a week on Tuesdays except for the final lecture on Thursday June 1st
  - 14:15-15:45
  - In-person and online lectures – check from the syllabus!
    - Link to the online lectures: Click here to join the meeting
  - Non-mandatory, but highly encouraged
- Weekly assignment (5x)
- Project report

Schedule

Date	Topic	Where	Lecturer	Assignment paper
25.04.	Introduction - environmental state of the world	In-person, R003F239a Auditorio	Jukka Heinonen	
02.05.	Carbon budgets, construction materials and emissions	Online Click here to join the meeting	Áróra Árnadóttir	Müller et al. (2013) Carbon Emissions of Infrastructure Development, Environmental Science & Technology 2013 47 (20), 11739-11746
09.05.	LCA, Carbon spike and WLC perspective	In-person, R003F239a Auditorio	Jukka Heinonen	Säynäjoki et al. (2012) A scenario analysis of the life cycle greenhouse gas emissions of a new residential area, Environ. Res. Lett., 7 (3), 034037
16.05.	Carbon storing potential of the built environment	Online Click here to join the meeting	Áróra Árnadóttir	Churkina et al. (2020) Buildings as a global carbon sink, Nature Sustainability, 3, 269–276
23.05.	Circular construction	Online Click here to join the meeting	Katarzyna Jagodzińska, GBCI	TBD
01.06.	Density and low-carbon illusion	In-person, R030C105 T2	Jukka Heinonen	Heinonen et al. (2013) Situated lifestyles I: How lifestyles change along with the level of urbanization and what are the greenhouse gas implications, a study of Finland, Environ. Res. Lett., 8 (2), 025003.

Climate.now online course

- Take the online climate.now course at:
  - https://climateuniversity.fi/portfolio-items/climate-now/?fbclid=IwAR0krjWMixXfIli6ClXTfTwmo437UxA5lEDQHzsvIAUlc_5OMWmMGdccXZ8
- Deliver to heinonen@hi.is the certificate of successful completion
  - Deadline June 1st
  - Highly encouraged to take the online course early during to make it as useful as possible
- 2 credits / 40% of the course

Weekly assignments

- Related to the topic of the next lecture, DL before each lecture
- Instructions: Read carefully the assignment article, and answer briefly the following questions:
  1. What were the main results of the paper?
  2. How are these results relevant to climate mitigation in the built environment?
- 300-400 words
- deliver by email to heinonen@hi.is before the next lecture
- Papers can be found from mycourses
  - https://mycourses.aalto.fi/course/view.php?id=35098
- Can be written in Finnish, but highly encouraged to write in English

Final report

Choose a topic based on your own interests and write an essay following the four rules below.

1) The built environment is in a central role somehow
2) Focus on something that would radically improve the climate profile in comparison to the current typical option AND would be an important improvement
3) At least 10 academic sources using a proper academic referencing style
4) 2000-3000 words in an essay format

- Deadline June 1st 23:59
- Can be written in Finnish, but highly encouraged to write in English

Grading

1) Completion of the climate.now online course mandatory requirement
2) Assignments: pass/fail, 10% each, 3/5 minimum to pass
3) Final report 50% (0-50 points), 25 points minimum to pass

Late delivery of assignments or the final report reduce the grade by 0,25 per day.

Time-budget

5 credits, ~140 hours of work

1) climate.now online course 56 hours
2) weekly assignments 5x5 = 25 hours
3) final report 59 hours

Environmental State of the World

Environmental State of the World

- Planetary boundaries
- Interconnections between the major environmental problems
- Some basic issues to understand about the use and development of the built environment
  - Overshoot
  - Increasing impacts vs. tipping points (points of no return)
  - Direct vs. indirect impacts
- Carbon budgets

IPCC 6th assessment report

„Recent changes in the climate are widespread, rapid, and intensifying, and unprecedented in thousands of years“

- C02 concentration the highest in the atmospehere in at least 2 million years
- Sea level rise fastest rates in at least 3000 years
- Arctic sea ice area lowest level in at least 1000 years
- Glaciers retreat unprecendented in at least 2000 years

„Unless there are immediate, rapid, and large-scale reductions in greenhouse gas emissions, limiting warming to 1.5°C will be beyond reach“ (the goal of the paris agreement)

„It is indisputable that human activities are causing climate change, making extreme climate events, inclusing heat waves, heavy rainfall, and droughts, more frequent and severe“

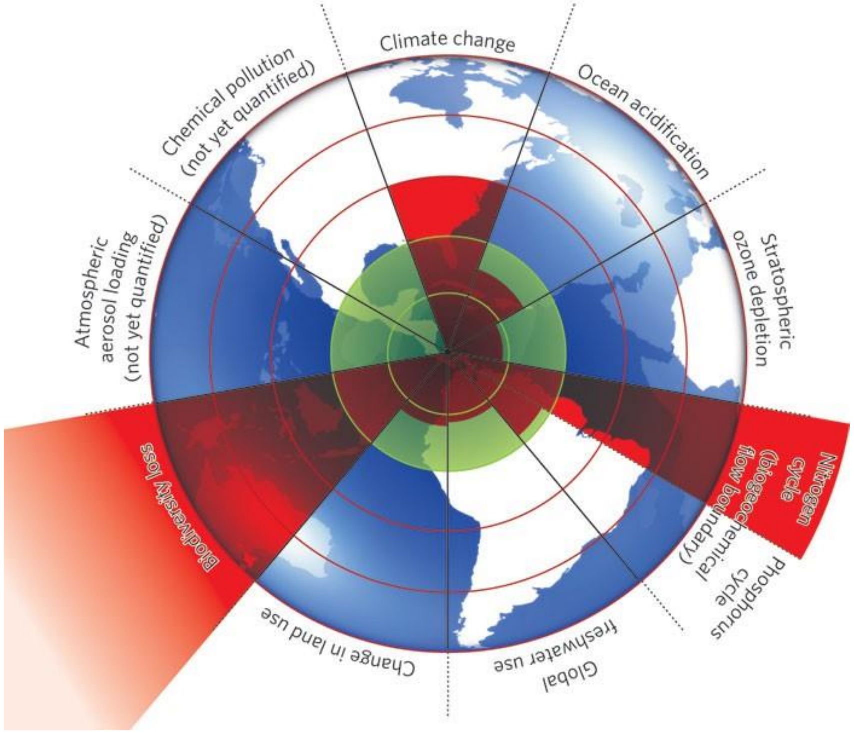
https://interactive-atlas.ipcc.ch
https://sealevel.nasa.gov/data_tools/17

Planetary Boundaries 2009

The Holocene

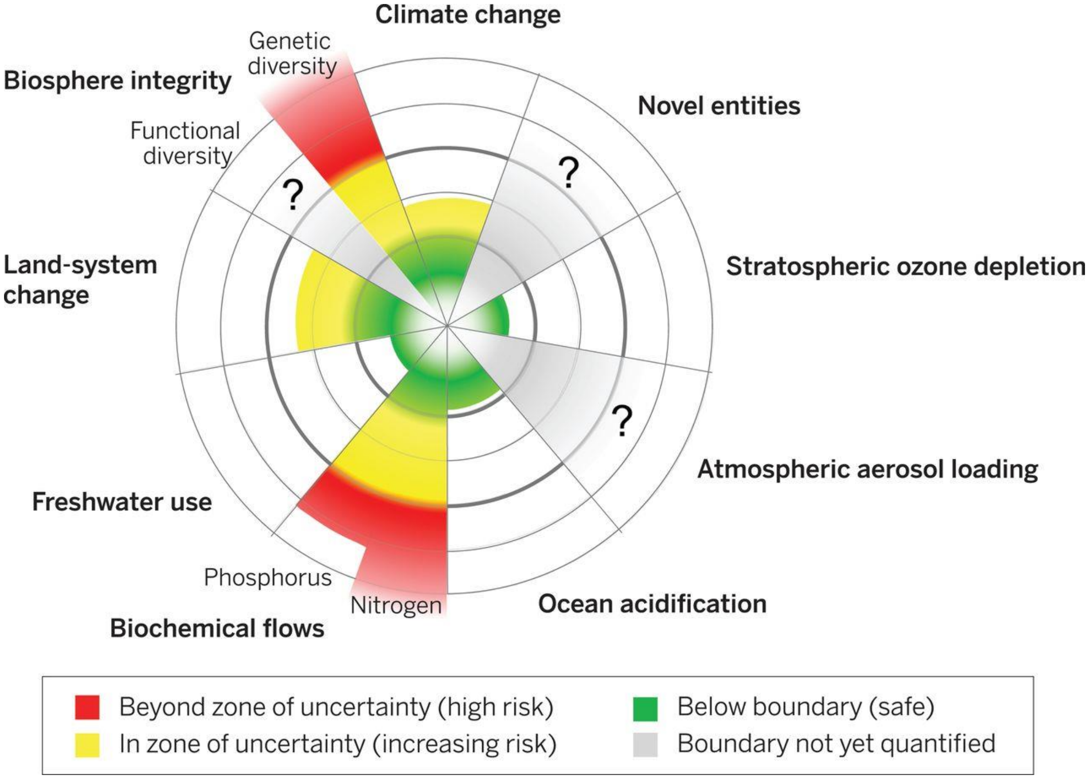
3 boundaries crossed

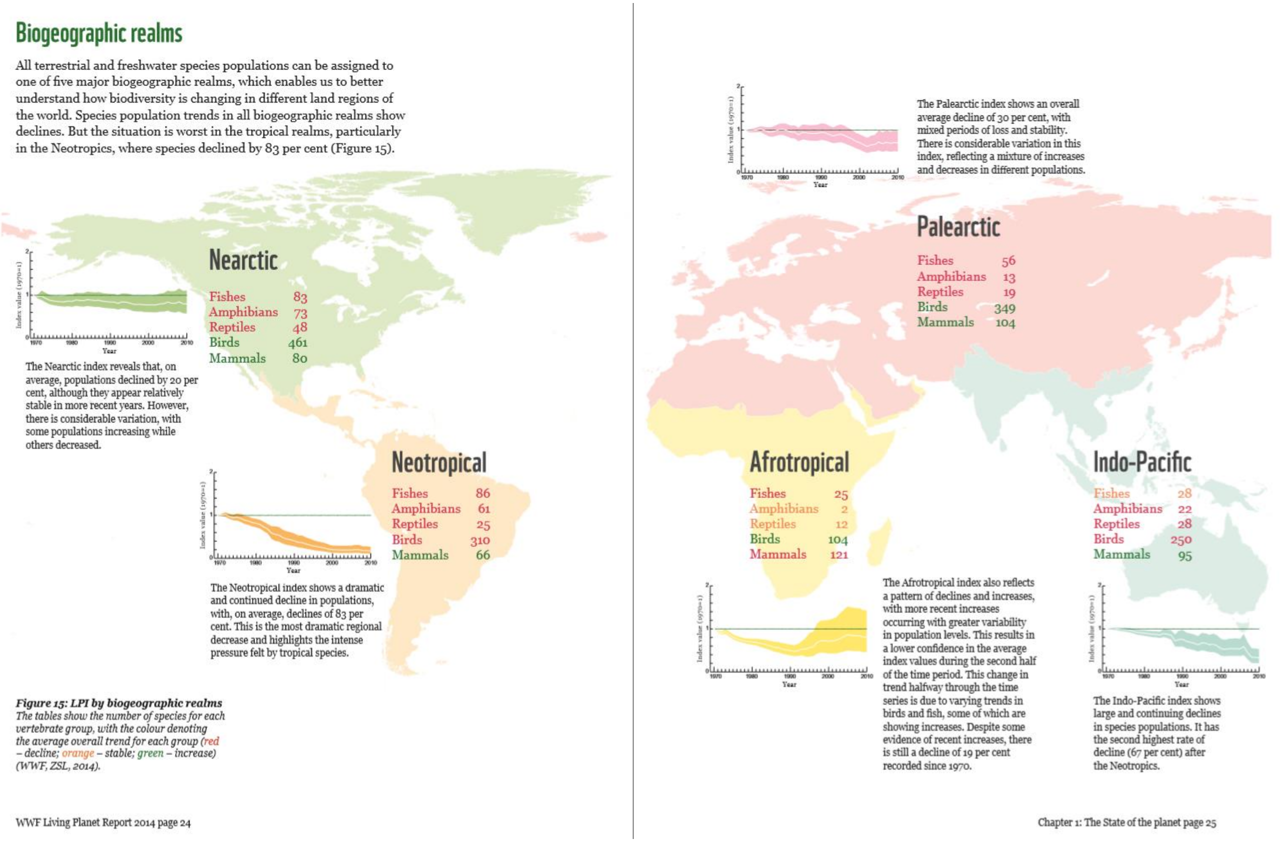
- Biodiversity loss
- Nitrogen cycle
- Climate change



Update of Planetary Boundaries

- Genetic diversity, nitrogen and phosphorus biochemical flows beyond zone of uncertainty (high risk)
- Climate change, land-system change in the zone of uncertainty (increasing risk)
- Ocean acidification entering zone of uncertainty





Biogeographic realms

All terrestrial and freshwater species populations can be assigned to one of five major biogeographic realms, which enables us to better understand how biodiversity is changing in different land regions of the world. Species population trends in all biogeographic realms show declines. But the situation is worst in the tropical realms, particularly in the Neotropics, where species declined by 83 per cent (Figure 15).

Nearctic

Fishes	83
Amphibians	73
Reptiles	48
Birds	461
Mammals	80

The Nearctic index reveals that, on average, populations declined by 20 per cent, although they appear relatively stable in more recent years. However, there is considerable variation, with some populations increasing while others decreased.

Neotropical

Fishes	86
Amphibians	61
Reptiles	25
Birds	310
Mammals	66

The Neotropical index shows a dramatic and continued decline in populations, with, on average, declines of 83 per cent. This is the most dramatic regional decrease and highlights the intense pressure felt by tropical species.

Figure 15: LPI by biogeographic realms
The tables show the number of species for each vertebrate group, with the colour denoting the average overall trend for each group (red – decline; orange – stable; green – increase) (WWF, ZSL, 2014).

WWF Living Planet Report 2014 page 24

The Palearctic index shows an overall average decline of 30 per cent, with mixed periods of loss and stability. There is considerable variation in this index, reflecting a mixture of increases and decreases in different populations.

Palearctic

Fishes	56
Amphibians	13
Reptiles	19
Birds	349
Mammals	104

Afrotropical

Fishes	25
Amphibians	2
Reptiles	12
Birds	104
Mammals	121

The Afrotropical index also reflects a pattern of declines and increases, with more recent increases occurring with greater variability in population levels. This results in a lower confidence in the average index values during the second half of the time period. This change in trend halfway through the time series is due to varying trends in birds and fish, some of which are showing increases. Despite some evidence of recent increases, there is still a decline of 19 per cent recorded since 1970.

Indo-Pacific

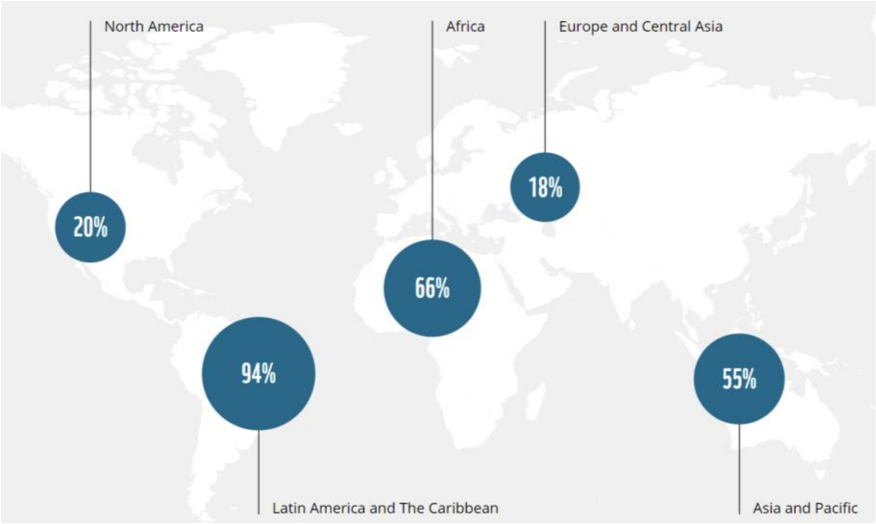
Fishes	28
Amphibians	22
Reptiles	28
Birds	250
Mammals	95

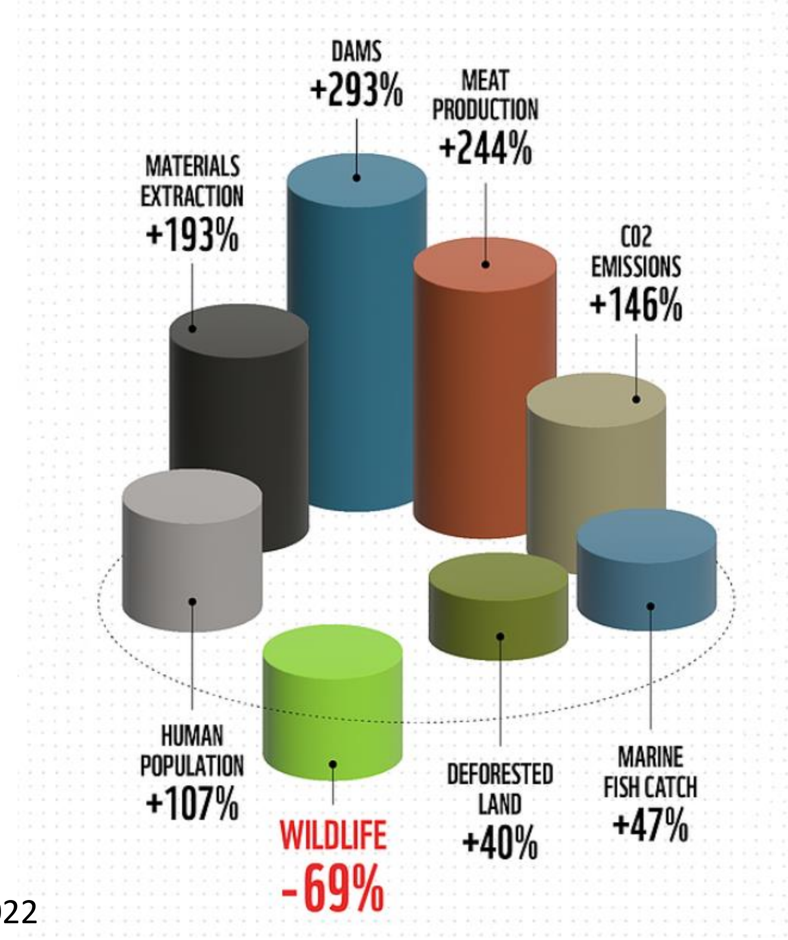
The Indo-Pacific index shows large and continuing declines in species populations. It has the second highest rate of decline (67 per cent) after the Neotropics.

Chapter 1: The State of the planet page 25

Living Planet Index 1970-2010, WWF 2014

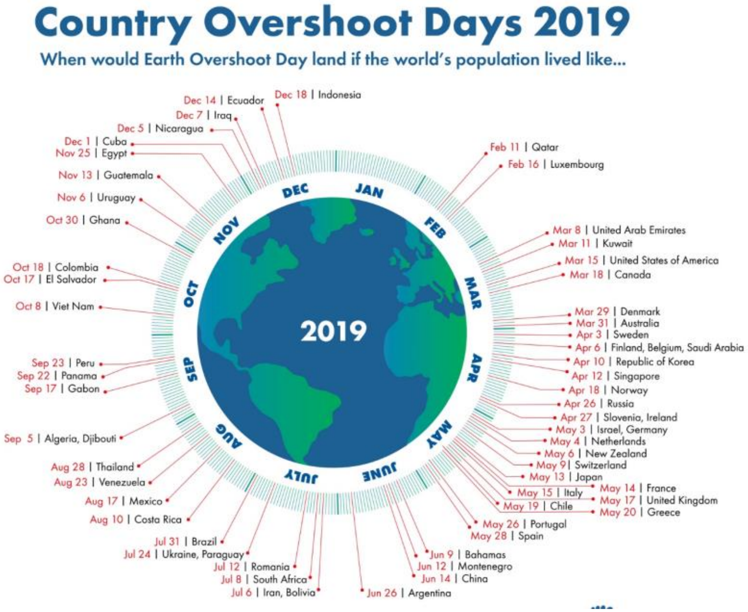
Biodiversity decline 2022

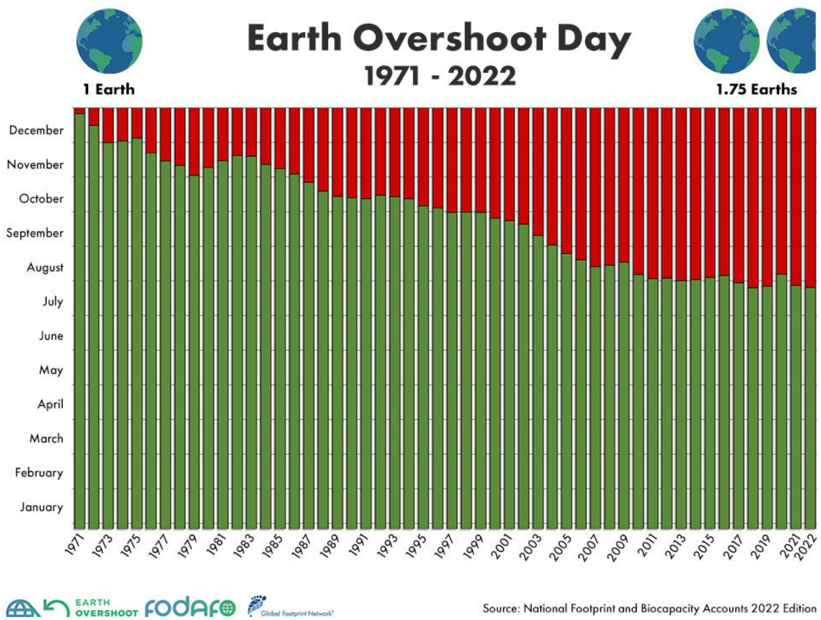




Living Planet Report, WWF 2022

Planet Earth Overshoot Day 2022 lands on July 28



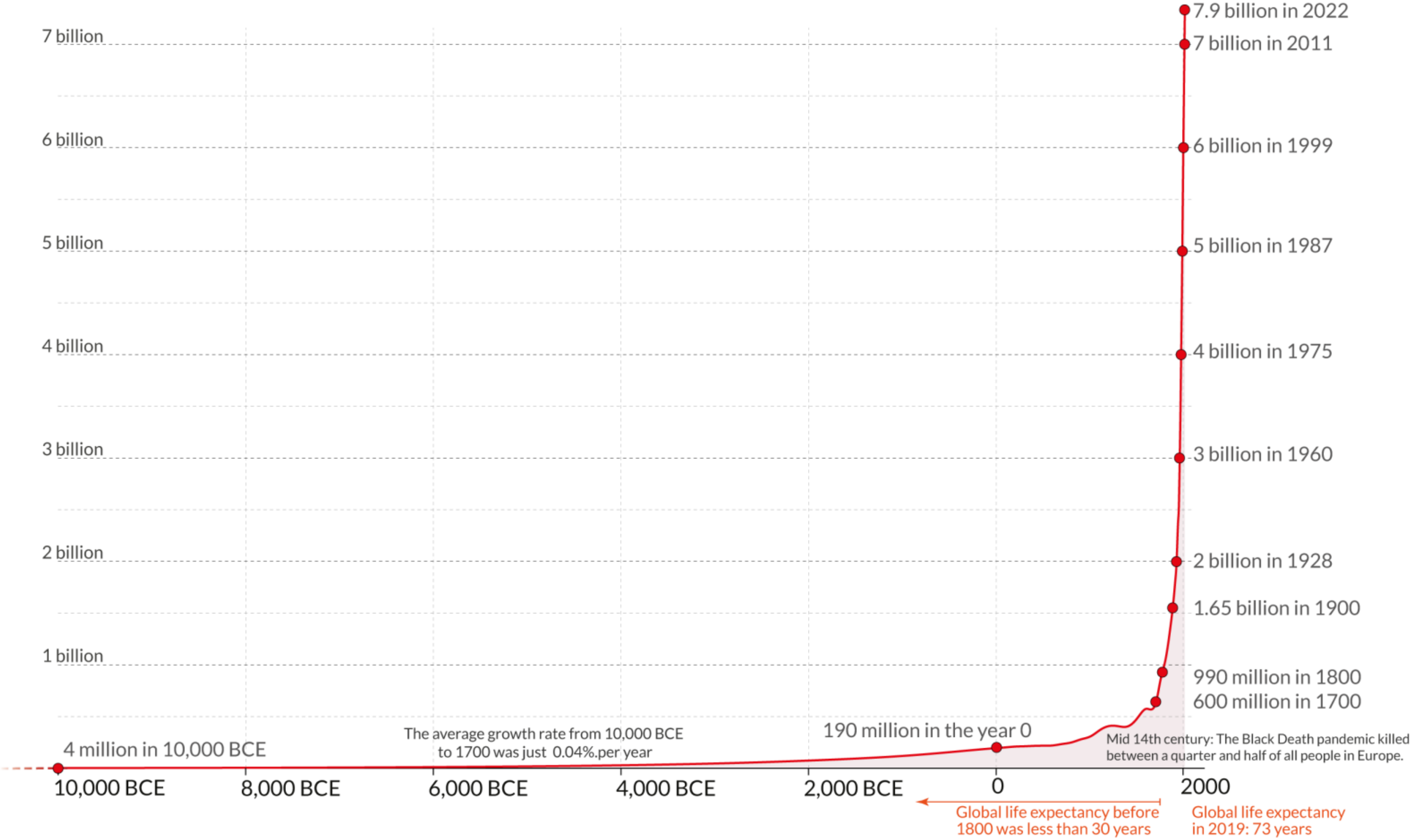


KEY ISSUES WHICH CAUSE THE SITUATION AND NEED TO BE OVERCOME ONE WAY OR ANOTHER

Our World in Data

The size of the world population over the last 12.000 years

Demographers expect rapid population growth to end by the end of the 21st century. The UN demographers expect a population of about 11 billion in 2100.



Based on estimates by the History Database of the Global Environment (HYDE) and the United Nations. On OurWorldinData.org you can download the annual data.
This is a visualization from OurWorldinData.org.

Regional and national Ecological Footprints

A regional assessment of humanity's Ecological Footprint in 1961 and 2010 (Figure 22) shows that the global supply of and demand for renewable resources have changed over the past half-century – largely due to population growth.

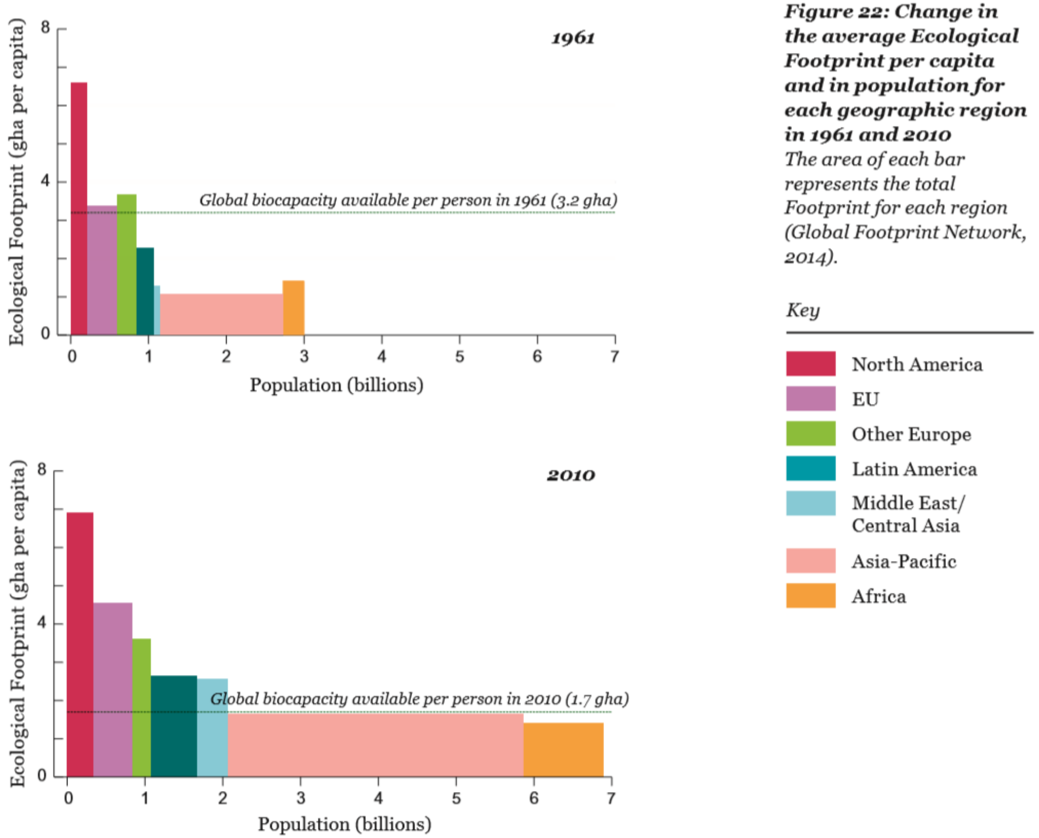


Figure 22: Change in the average Ecological Footprint per capita and in population for each geographic region in 1961 and 2010
The area of each bar represents the total Footprint for each region (Global Footprint Network, 2014).

Figure: Seppo Leinonen, www.seppo.net

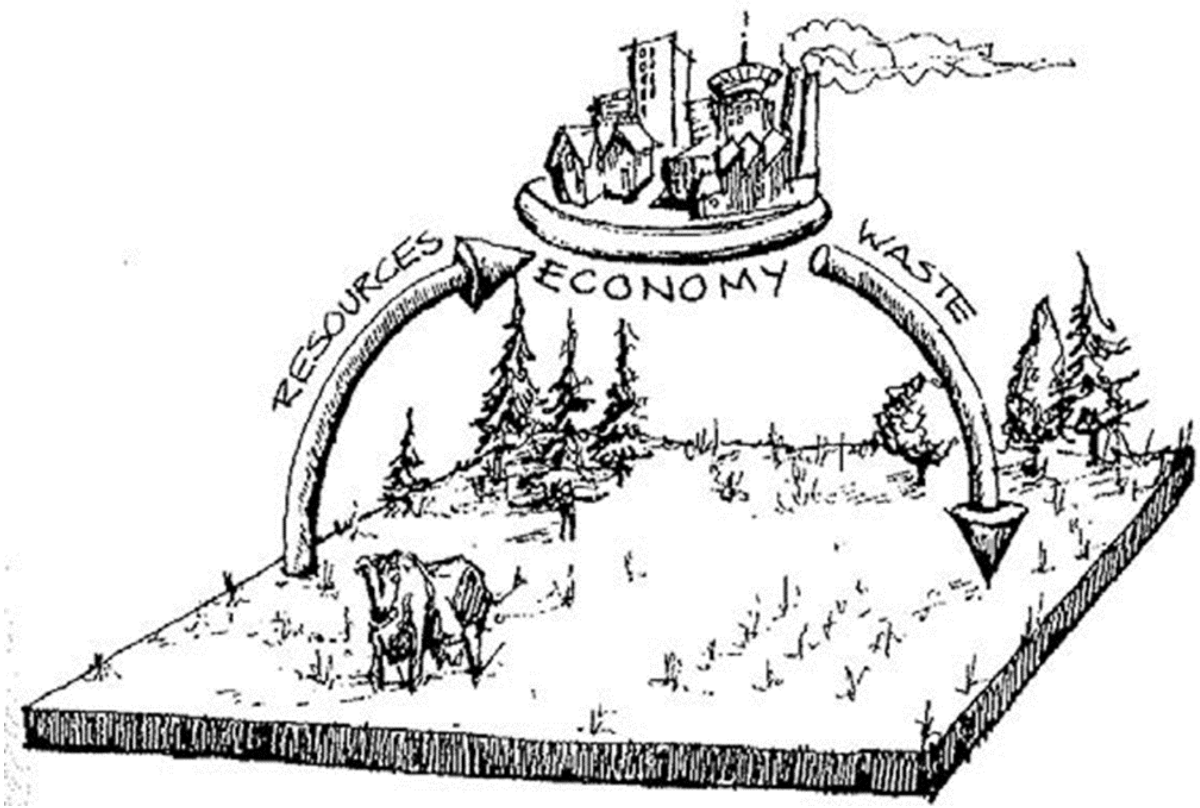


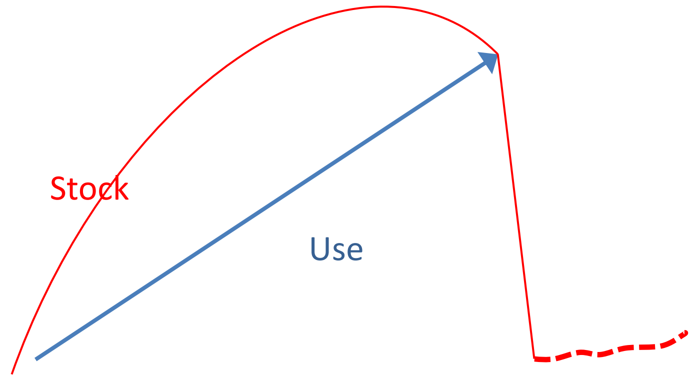
Figure: William Rees & Mathis Wackernagel (1996) Urban Ecological footprints: Why cities cannot be sustainable – and why they are a key to sustainability

AND OF COURSE, UNDERLYING EVERYTHING IS OUR RELIANCE ON NON-RENEWABLE RESOURCES, PARTICULARLY FOSSIL FUELS

Tipping points

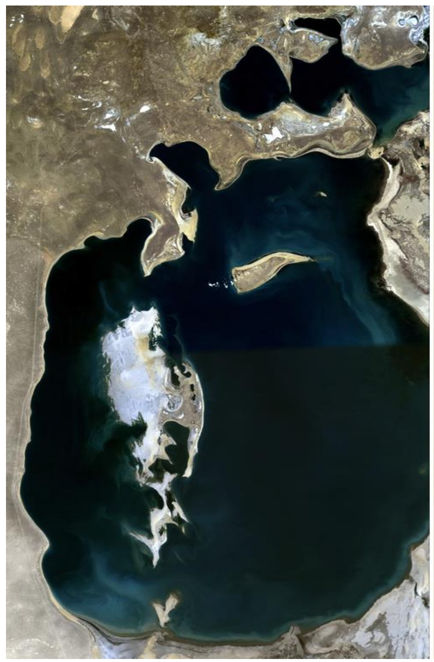
= points of no return (or at least no quick return)

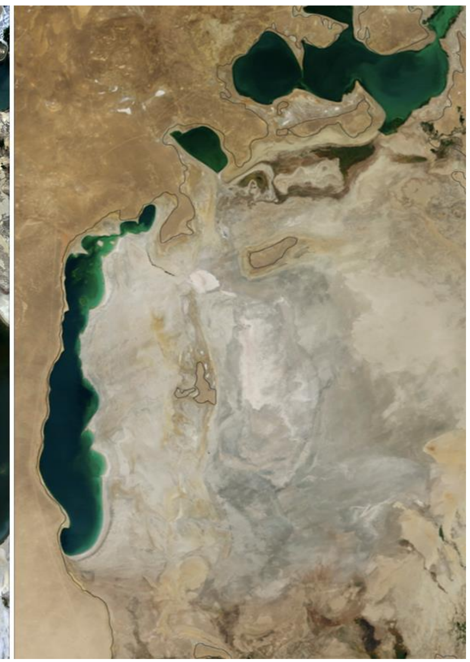
- Plenty of well-known small scale examples
- Can happen for the whole globe / global ecosystem
- Are we currently approaching a global tipping point – or have we exceeded one?



Tipping point anatomy

Lake Aral
1989





Lake Aral
2014

Tipping point anatomy

Amazon rainforest

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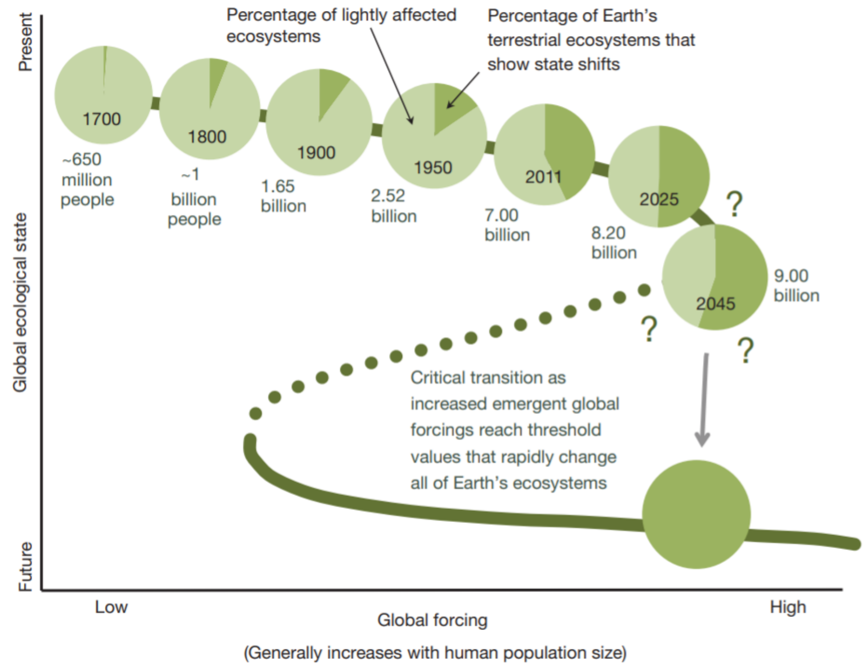
Tipping point anatomy

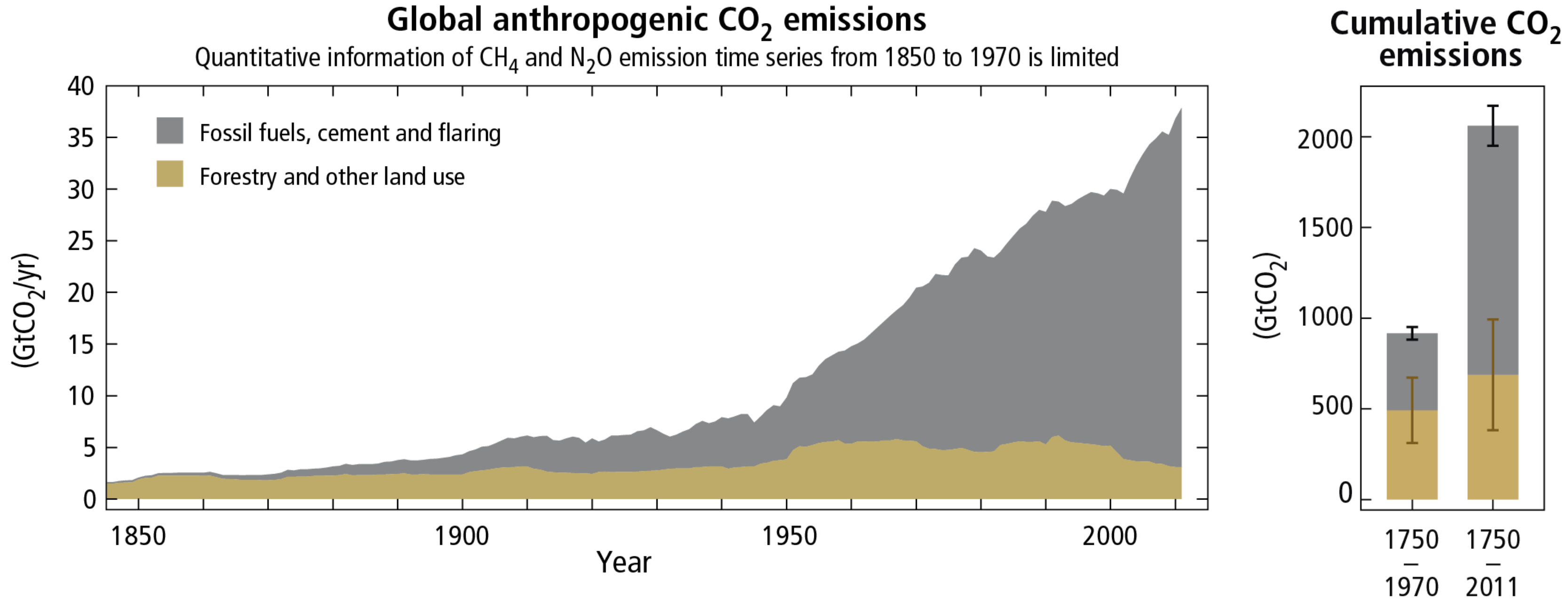
Agincourt Reef Australia

A planetary state shift

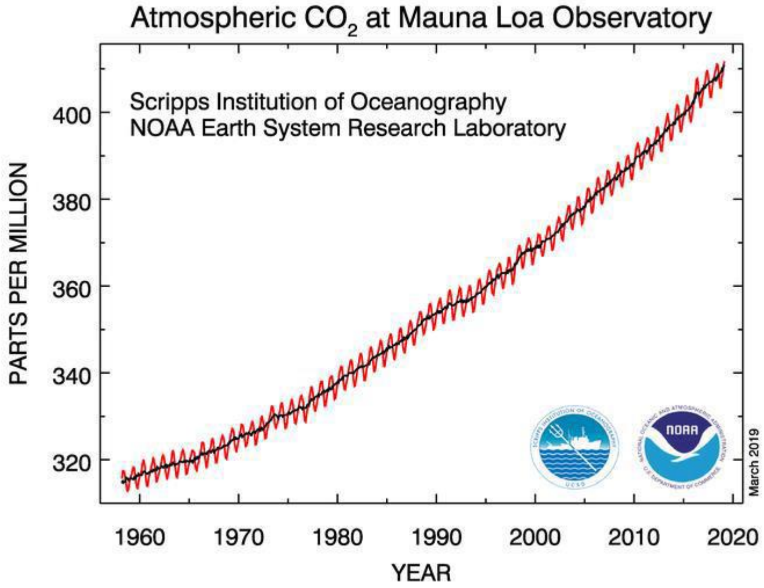


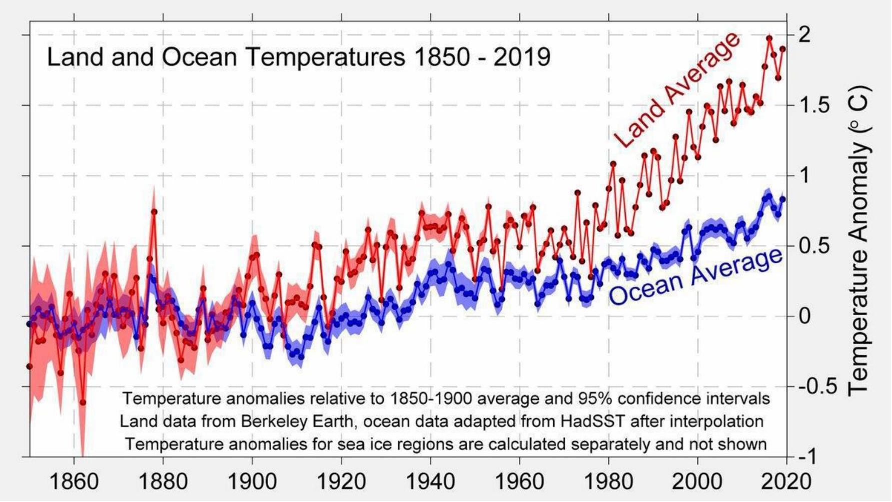
Barnosky et al. (2012). Approaching a State Shift in Earth‘s Biosphere. *Nature*, 486.

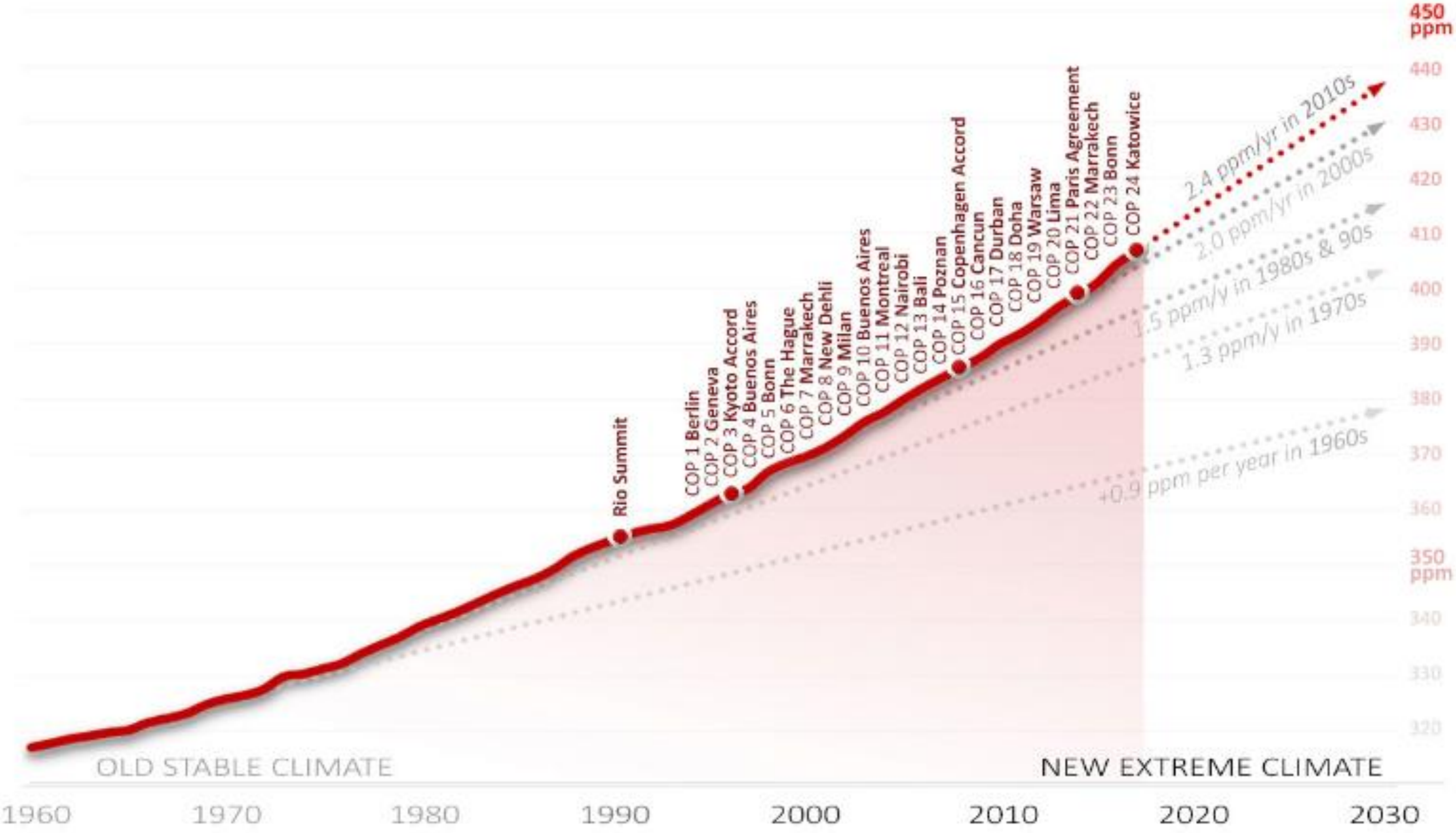
CO2 emissions



$C0_2$ ppm & temperature increases

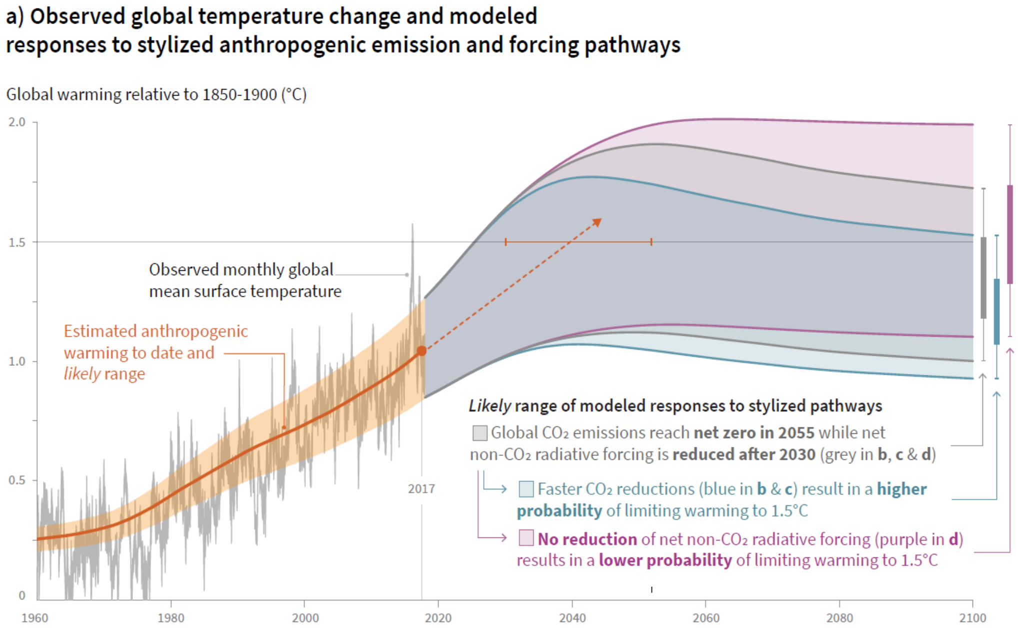






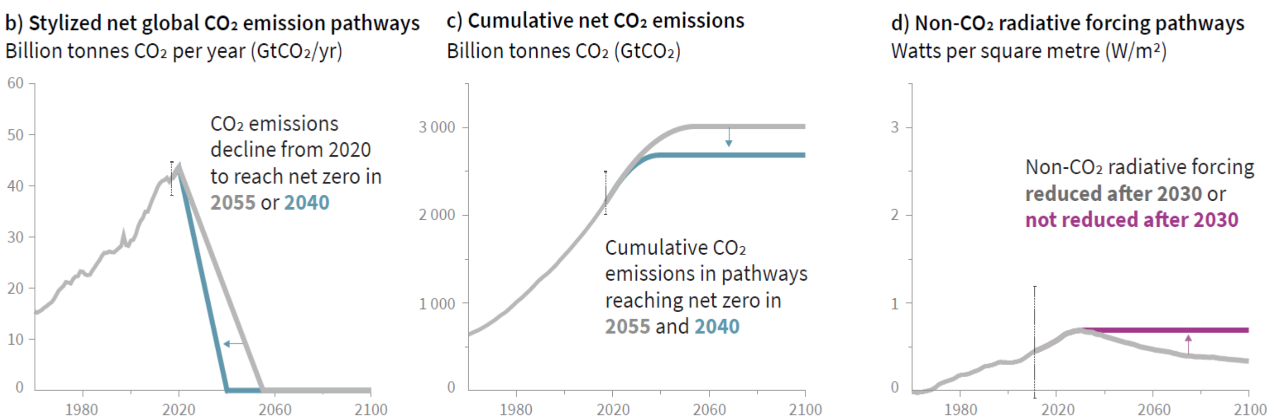
CO2 IN OUR ATMOSPHERE

Climate change



IPCC 2018

Climate change



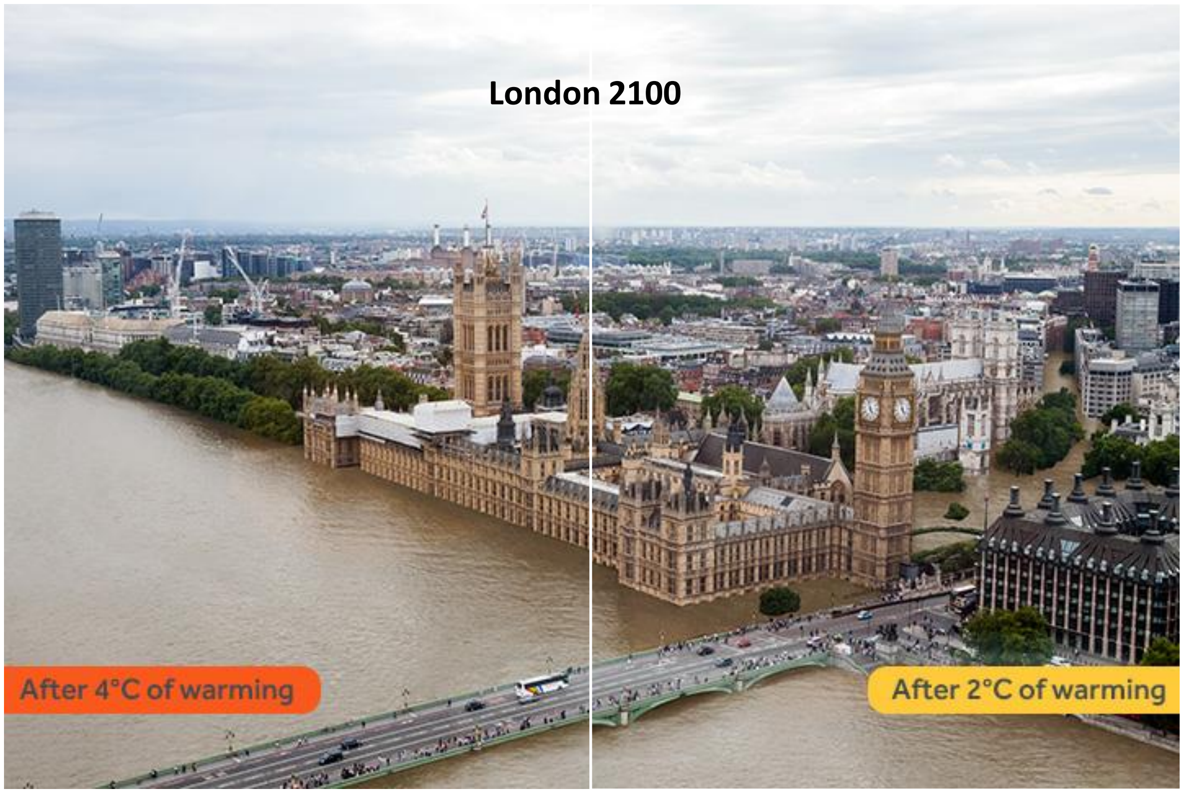
Faster immediate CO_2 emission reductions limit cumulative CO_2 emissions shown in panel **(c)**.

Maximum temperature rise is determined by cumulative net CO_2 emissions and net non-CO_2 radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

IPCC 2018

Some consequences of climate change

- Sea level rise up to tens of meters (over a long time)
  - Disappearing agricultural areas
  - Drowning major cities
- Large-scale desertification
  - Relocation of billions of people
- Accelerating biodiversity loss
  - Collapses of global ecosystems
- Freshwater shortages
  - Conflicts and wars over water reserves



http://www.climatecentral.org

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