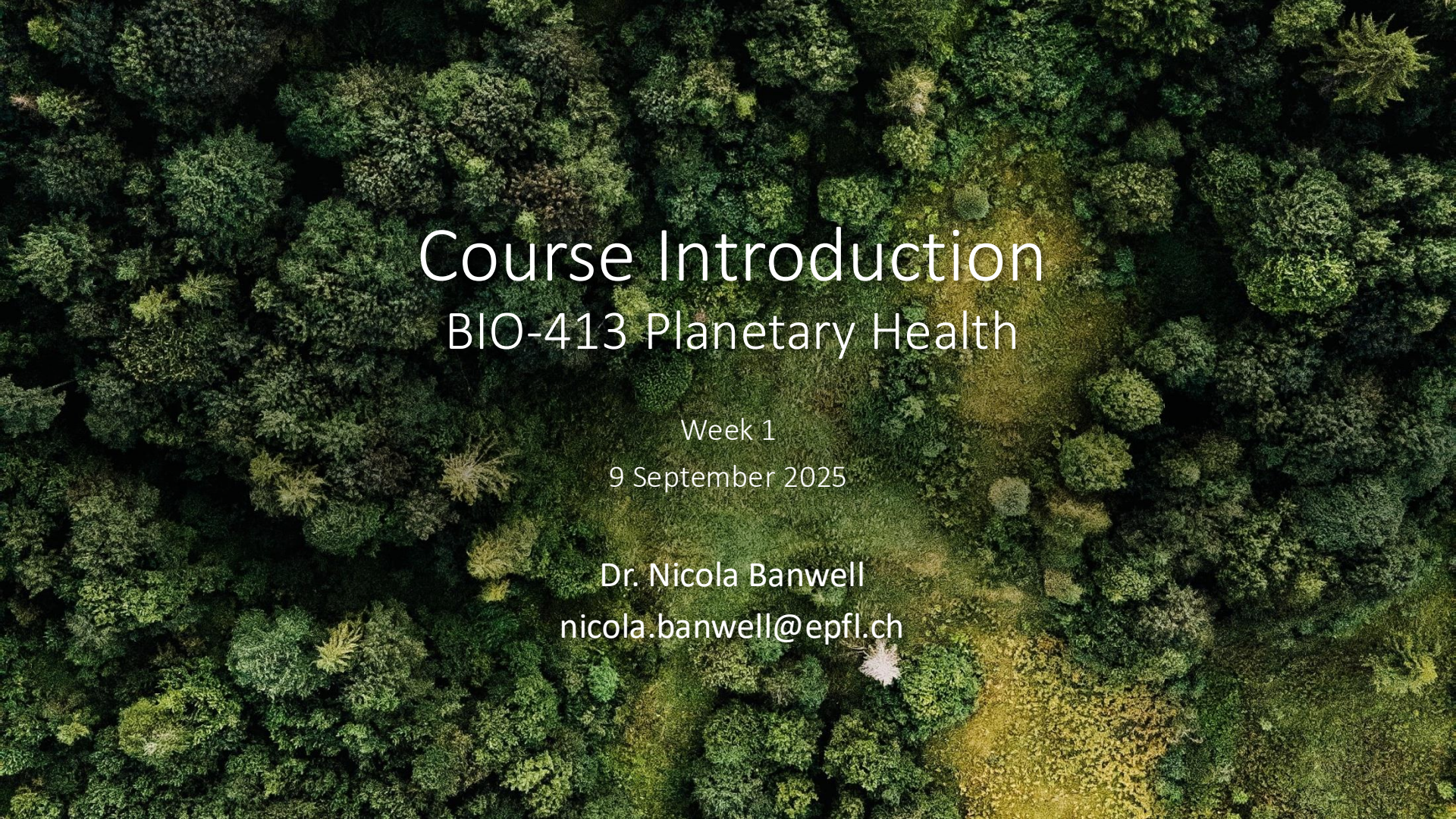


Course Introduction

BIO-413 Planetary Health

Week 1

9 September 2025

Dr. Nicola Banwell

nicola.banwell@epfl.ch

Today's agenda

- **Lecture (9:15-11:00):**
  - Course Introduction
  - Introduction to Planetary Health and Sustainability
- **Exercise (11:15-13:00):**
  - Collective mapping of planetary boundaries and health

Course Introduction

- Course structure
- Teaching team
- Key information
  - Learning Objectives
  - Modes of Communication
  - Assessment methods

Course structure

Structure of the course

1. **Introduction to Planetary Health and sustainability**
   - Lecturer: Dr. Nicola Banwell
2. **Global metabolism and food industry impact on Planet Health**
   - Lecturer: Prof. Giovanni D'Angelo
   - Teaching Assistant: Gary Dominiconi
3. **Bioengineering strategies to reduce environmental impacts**
   - Lecturer: Prof. John McKinney
4. **Impact of environmental factors in cancer development and economical sustainability in anti-cancer drug**
   - Lecturer: Prof. Elisa Oricchio

Teaching team

Teaching team

Dr. Nicola Banwell
Centre for Interdisciplinary Research in Ethics
Teaching: Introduction to Planetary Health & sustainability

Prof. Giovanni D'Angelo
Lipid Cell Biology Laboratory
Teaching: Global metabolism and food industry impact on Planet Health

Teaching team

Prof. John McKinney
Lab. of Microbiology & Microtechnology
Teaching: Bioengineering strategies to reduce environmental impacts

Prof. Elisa Oricchio
ISREC UPORICCHIO
Teaching: Impact of environmental factors in cancer development and economical sustainability in anti-cancer drug

Teaching assistant

Gary Domeniconi
Doctoral Assistant

About myself…

2009 - 2011	Griffith University, School of Public Health, Bachelor of Public Health (Environmental Health and Sustainability)
2012	Research on floods and resilience in Beijing, China
2013	United Nations Office for Disaster Risk Reduction (UNISDR) in Kobe, Japan
2014	Disaster Risk Reduction work with a local NGO in Dhaka, Bangladesh
2015	Junior consultant, United Nations Institute for Training and Research, Geneva
2015 - 2019	Griffith University, School of Environment, PhD on disaster and climate change risks in health in the Philippines
2017	Climate change and health Team, WHO, Geneva
2019-2021	EPFL – Postdoc, Disaster Risk Reduction and Sustainable Development, EPFL Sustainability
2021-Now	UNIL, CIRE – Research Fellow Sustainability and Ethics
2023-Now	EPFL, SV – Part-time lecturer Planetary Health
2025-Now	UNIL, CCD – Project coordinator Research and Education teams

Dr. Nicola Banwell

Key information

Origins of this course

- To include a sustainability course at Masters level in SV & for those taking the interdisciplinary Minor in Engineering for Sustainability
- 3rd year of this course – Still in ‘experimentation’ mode
- Open to feedback:
  - Increased the content
  - Reduced the number of exams

Is this course for you?

Aim: provides an overview of global environmental change through the perspective of the planetary boundaries and examines how human health is interlinked with social and ecological contexts

- Designed as an interdisciplinary and introductory course
- Geared toward those unfamiliar with sustainability issues
- Will *NOT* provide specialist ‘technical knowledge’ on sustainability and planetary health challenges and solutions, rather an introduction
- Large components of the course are theoretical
- The group project is designed to be the more ‘practical’ part of the course

Things to keep in mind

- New emerging field
- Highly complex topic associated with “wicked problems”
- Teachers are experts in their respective disciplines, and are not experts in sustainability or environmental science
  - *This means we may not always have the answer for you!*
  - *Requires a pro-active learning attitude from you*
- You may also find that our opinions vary (within the teaching team) about sustainability pathways

Learning Objectives

- Explain **key concepts** relevant to planetary health and sustainability.
- Analyze the **interdependencies** between human health and environmental sustainability using a systems thinking approach.
- **Formulate appropriate questions**, **conceive sustainable solutions** to these questions, and justify their choices in the context of planetary health and sustainability.

Transversal Skills

- Take account of the **social and human dimensions** of the engineering profession.
- Take responsibility for **environmental impacts** of her/ his actions and decisions.
- Demonstrate the capacity for **critical thinking**
- Make an **oral presentation**

Course schedule

Time: 09:15-13:00

Room: BC 04

Wk	Date	Teacher	Topic
1	09.09	Banwell	Introduction to course & planetary health
2	16.09	Banwell	Climate change, biodiversity loss & health
3	23.10	Banwell	Sustainability solutions: a critical reflection
4	30.09	D'Angelo	Global Metabolism the impact of Food Systems on Planetary health
5	07.10	D'Angelo	Global Metabolism the Impact of Food Systems on Human Health
6	**14.10**	Banwell & D'Angelo	**Exam 1 (09:15-11:00) & project work (11:15-13:00)**
	21.10	*Semester break*	
7	28.10	McKinney	Sustainable agriculture: the future of food
8	04.11	McKinney	Sustainable environments: bioremediation
9	11.11	McKinney	Sustainable energy: biofuels (T.B.C)
10	18.11	Oricchio	T.B.A
11	25.11	Oricchio	T.B.A
12	**02.12**	McKinney & Oricchio	**Exam 2 (09:15-11:00) & project work (11:15-13:00)**
13	09.12	-	Independent work to finalize group projects
14	**16.12**	**All**	**Project Presentations**

Modes of communication

- Ask questions directly to the teachers during and after class
- You can also ask questions via Moodle to the teaching assistant

Mandatory Reading

- Each teacher will make the mandatory and recommended reading available on the course Moodle at the beginning of each Module

Assessment (1)

Continue controlled exams: 60% (individual, during the semester)

- Content from modules will be assessed by written exams
- The exams will be carried out in two sessions:
  - **Exam 1: 14.10.2025** (Modules 1 & 2)
  - **Exam 2: 02.12.2025** (Modules 3 & 4)
- Taken together, the **two exams will count for 60%** of the overall grade *(content from each module corresponds to 15% of the overall grade)*

Assessment (2)

Oral presentation of group project: 40% (group, end of the semester)

Students work in groups on a real-world planetary health challenge and propose a potential solution to this challenge

- **Groups will be established & topics assigned in class week 3 (23.09.2025)**
- Each group will be assigned to a specific teacher according to the topics
- You are expected to reach out to your teacher and set up a meeting
- Time scheduled for group work in class during the semester (see Moodle)
- **Final presentation: 16.12.2025 from 09:15-13:00**


Questions?

Introduction to Planetary Health

BIO-413 Planetary Health

9 September 2025

Dr. Nicola Banwell
nicola.banwell@epfl.ch

Mandatory Reading

Available on Moodle under week 1

- Butler, C. D., Higgs, K., & McFarlane, R. A. (2019). Environmental health, planetary boundaries and Limits to Growth. *Encyclopedia of Environmental Health*, 533.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223), 1259855.
- Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A. G., de Souza Dias, B. F., ... & Yach, D. (2015). Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *The lancet*, *386*(10007), 1973-2028.

Recommended Reading

Available on Moodle under week 1

- Romanello, M., Walawender, M., Hsu, S. C., Moskeland, A., Palmeiro-Silva, Y., Scamman, D., ... & Costello, A. (2024). The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action. The Lancet, 404(10465), 1847-1896.
  - *Executive summary only*
- WHO. (2015). Connecting global priorities: biodiversity and human health: a state of knowledge review. World Health Organistion/Secretariat of the UN Convention on Biological Diversity.
  - *Chapter 2 only*
- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: the great acceleration. *The Anthropocene Review*, *2*(1), 81-98.

Learning Objectives for today

- Explain **key concepts** relevant to planetary health and sustainability
- Analyse the **interdependencies** between human health and environmental sustainability using a **systems thinking approach**

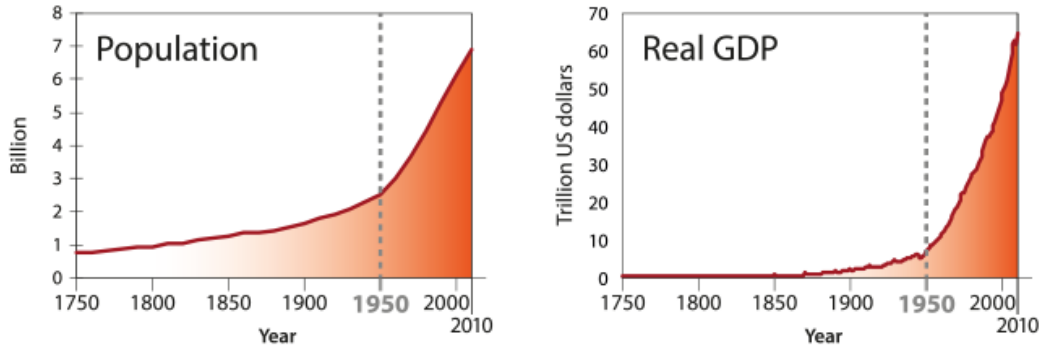
Outline

- Global environmental change:
  - Drivers
  - Planetary boundaries
- Key concepts:
  - Health
  - Sustainability
- Integrated health-environment approaches
  - Planetary health
  - One Health
  - Critical reflection
- Exercise session (11:15-13:00):
  - System mapping of planetary boundaries and human health

Global Environmental Change

The Great Acceleration – Population growth

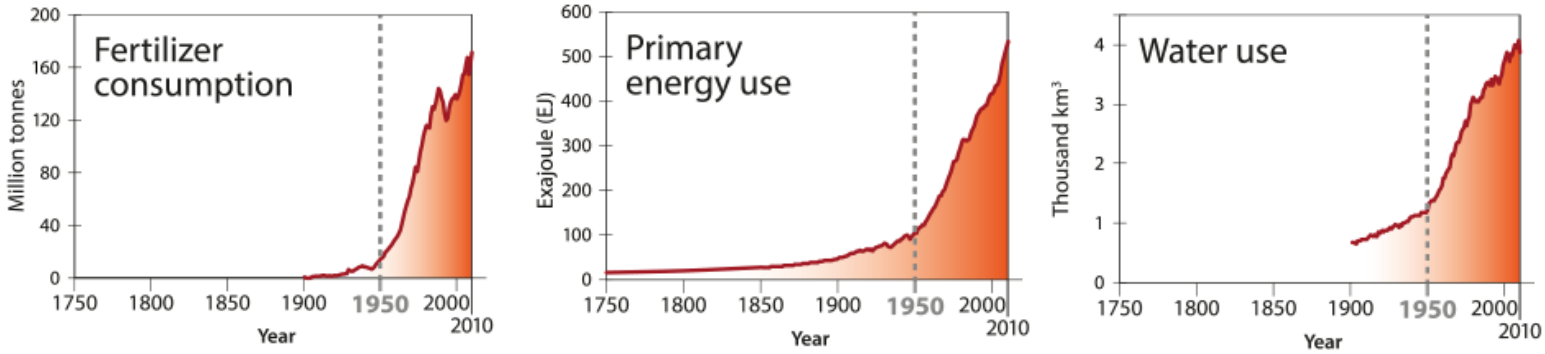
Since 1950



(Steffen et al., 2015)

Human Population Through Time
https://www.youtube.com/watch?v=PUwmA3Q0_OE

The Great Acceleration – Consumption



(Steffen et al., 2015)

Linear model of consumption

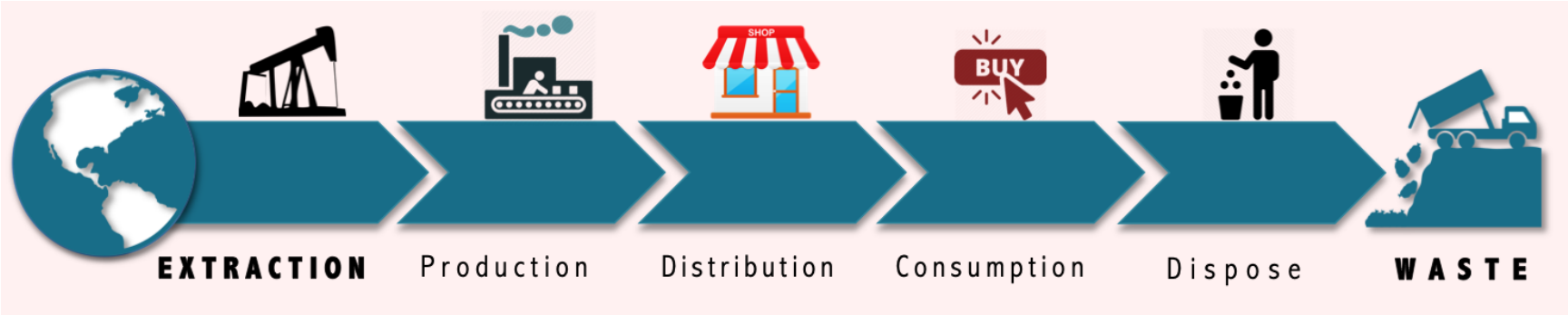


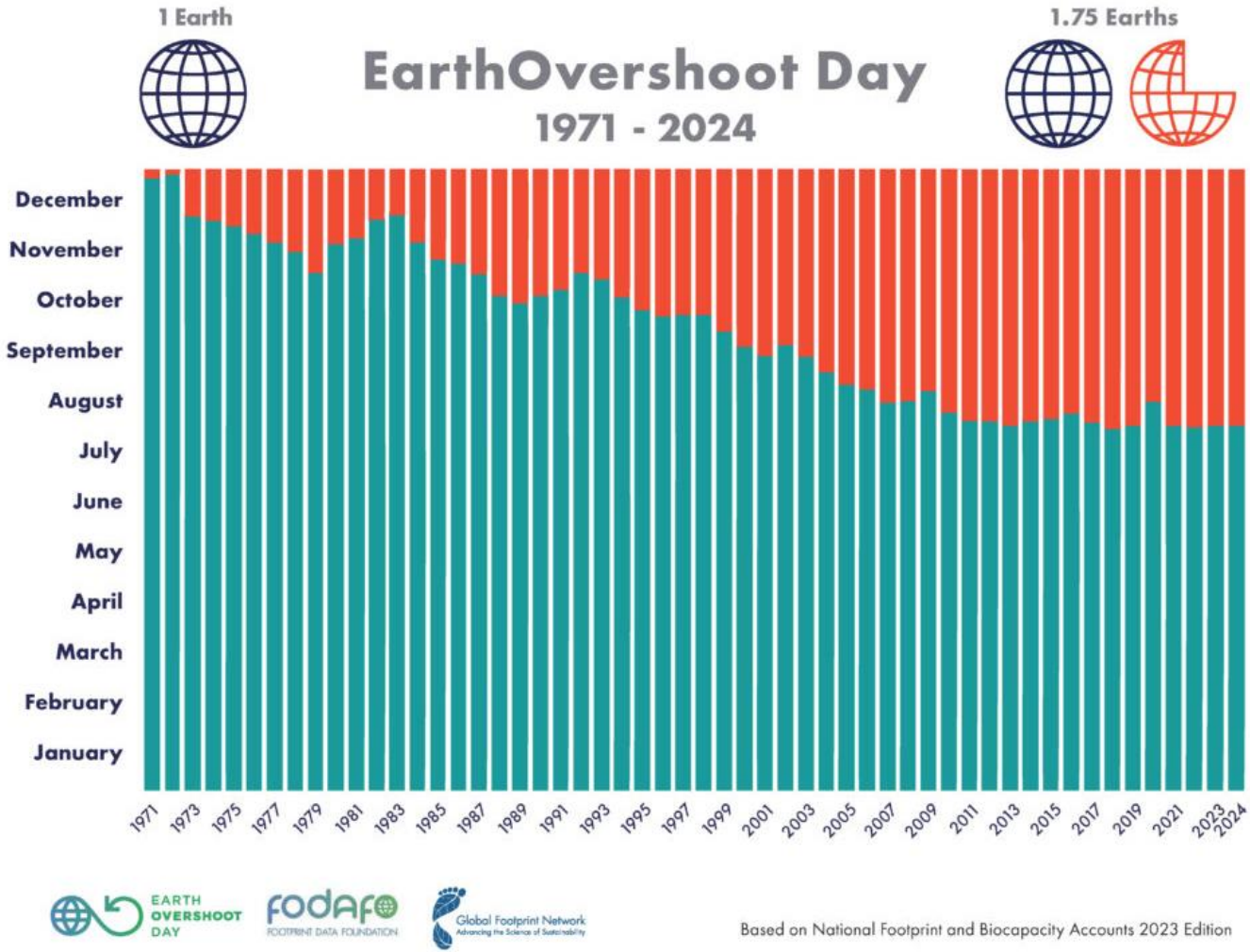
Image source: www.ciee.org

We ‘take, make and dispose’ –
Depletion of natural resources

The Story of Stuff
https://www.youtube.com/watch?v=9GorqroigqM

Population x Consumption

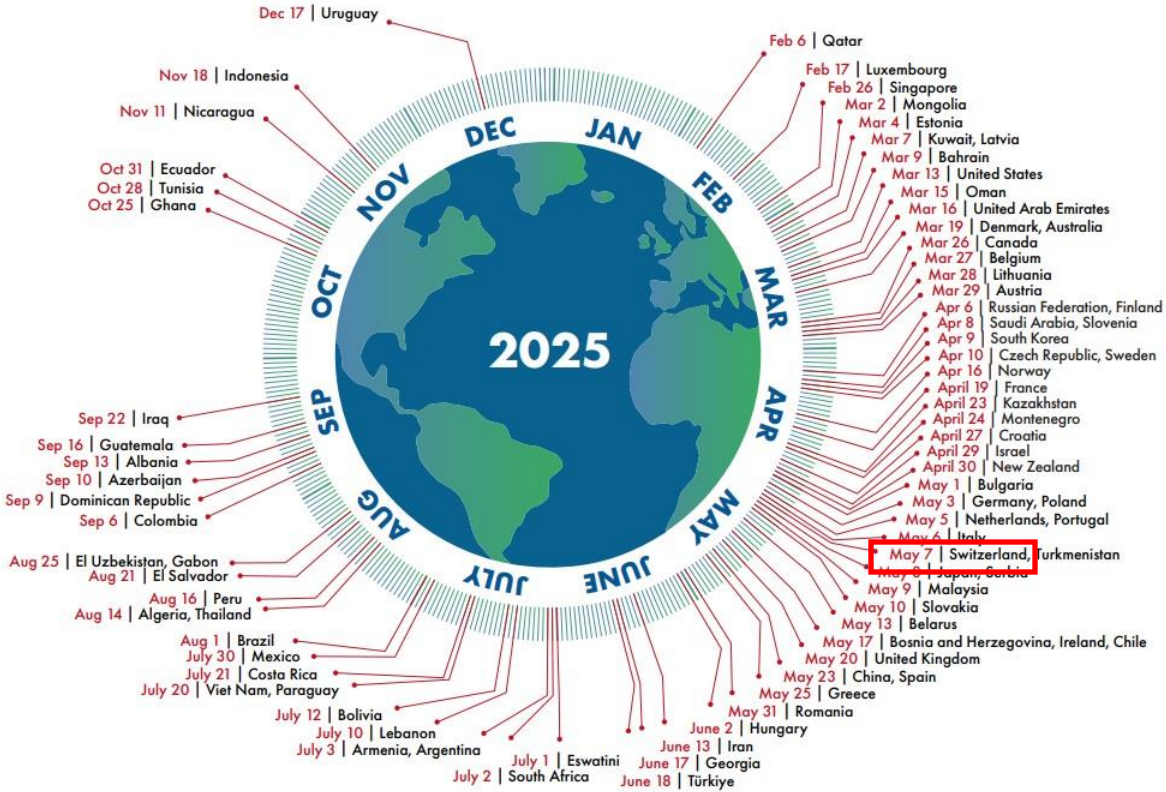
≠ 1 Planet



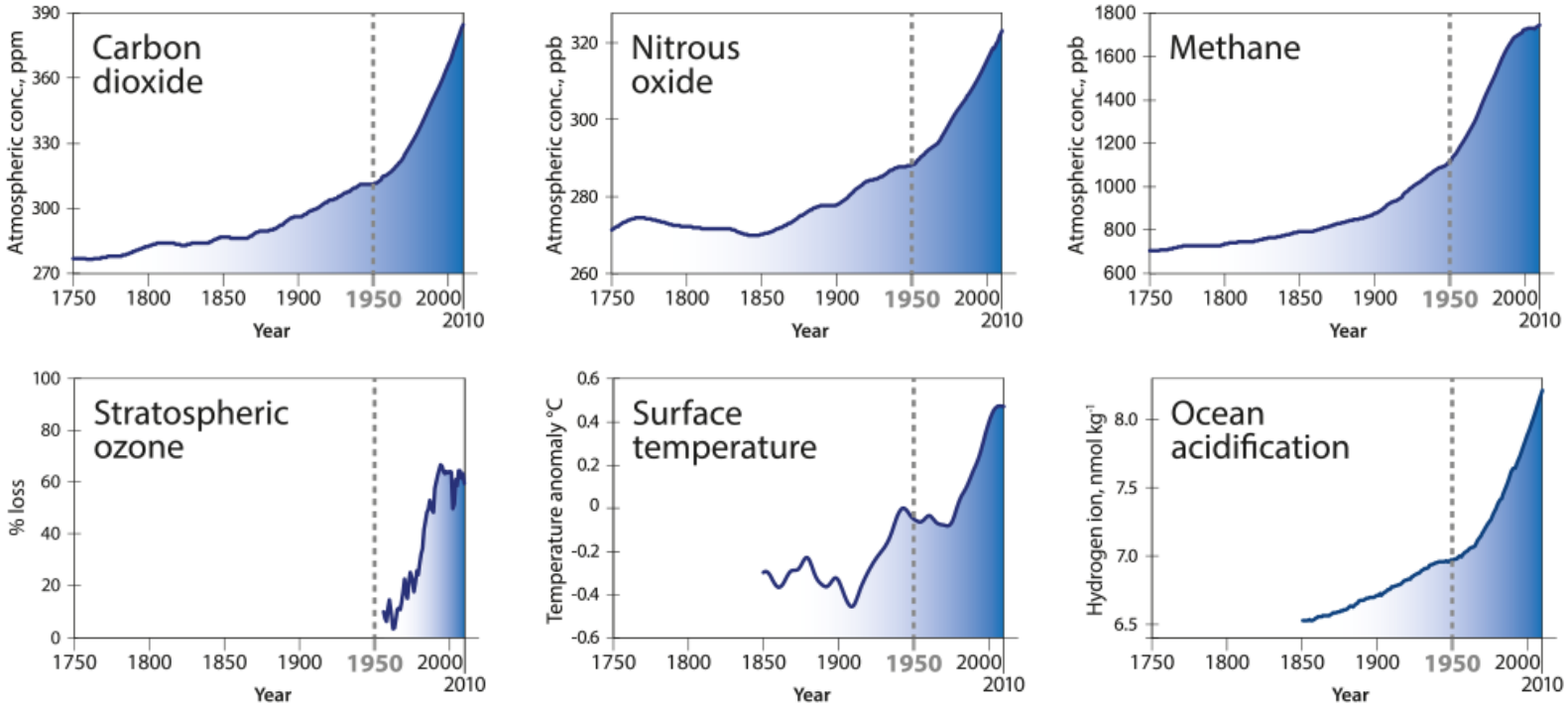
EARTH OVERSHOOT DAY

Country Overshoot Days 2025

When Earth Overshoot Day would land if all the people around the world lived like...

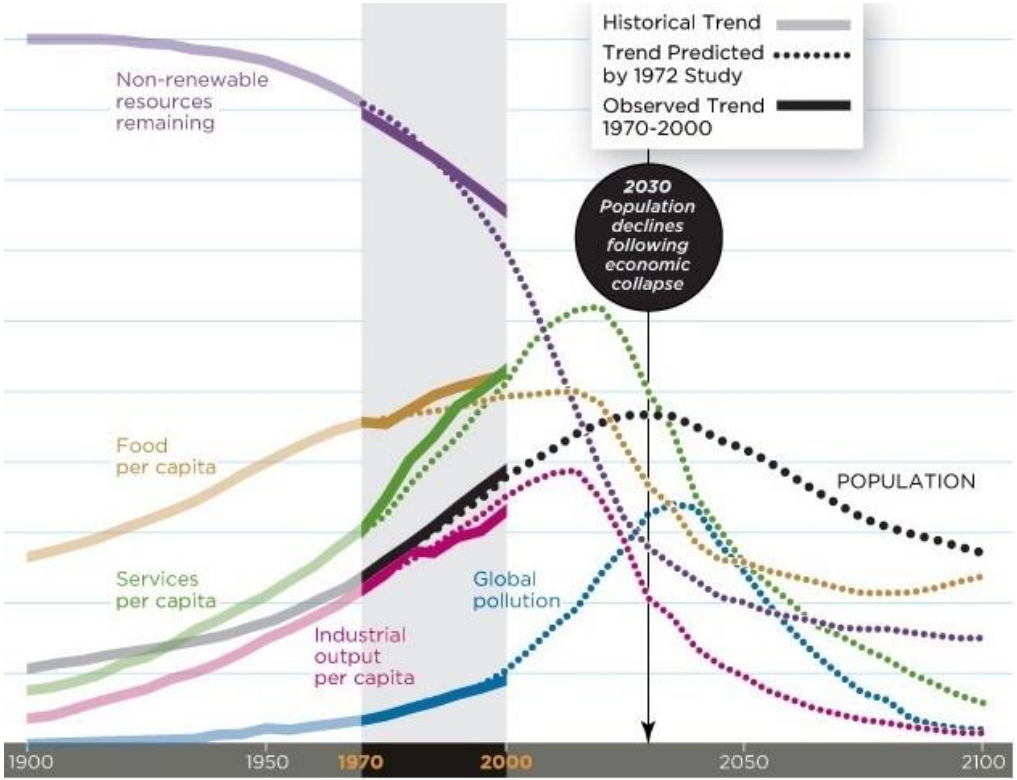


Impacts of the Great Acceleration



(Steffen et al., 2015)

Limits to Growth Report (1972)



"Running the same system harder or faster will not change the pattern as long as the *structure* is not revised"

(Hamant, 2023)

Human activity has disrupted Earth's natural systems

Anthropogenic environmental changes include:

- Biodiversity loss
- Changing biogeochemical flows
- Changing land use and land cover
- Global pollution
- Climate change
- Depletion of natural resources

The Nine Planetary Boundaries

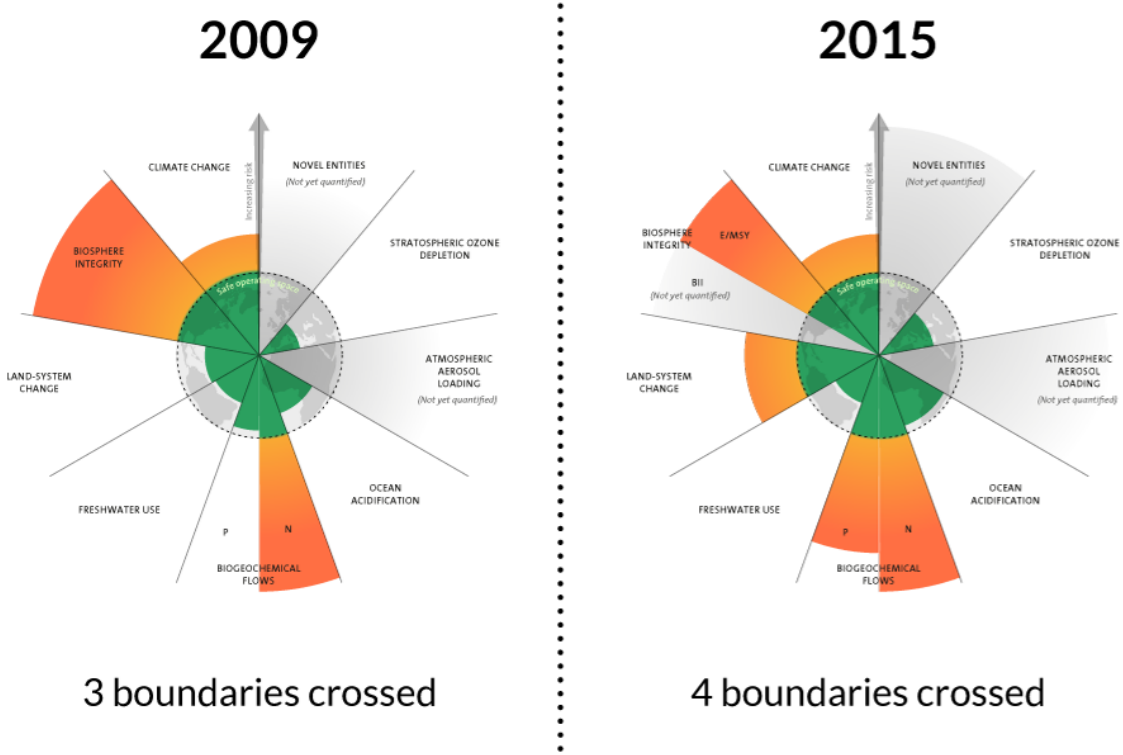
Biological and physical systems and processes required for the planet to support human life

These boundaries are the difference between a ‘safe operating space’ and dangerous conditions

The Planetary Boundaries and what they mean for the Future of Humanity
https://www.youtube.com/watch?v=SieN0IrZ5wg

(Steffen, 2015a)

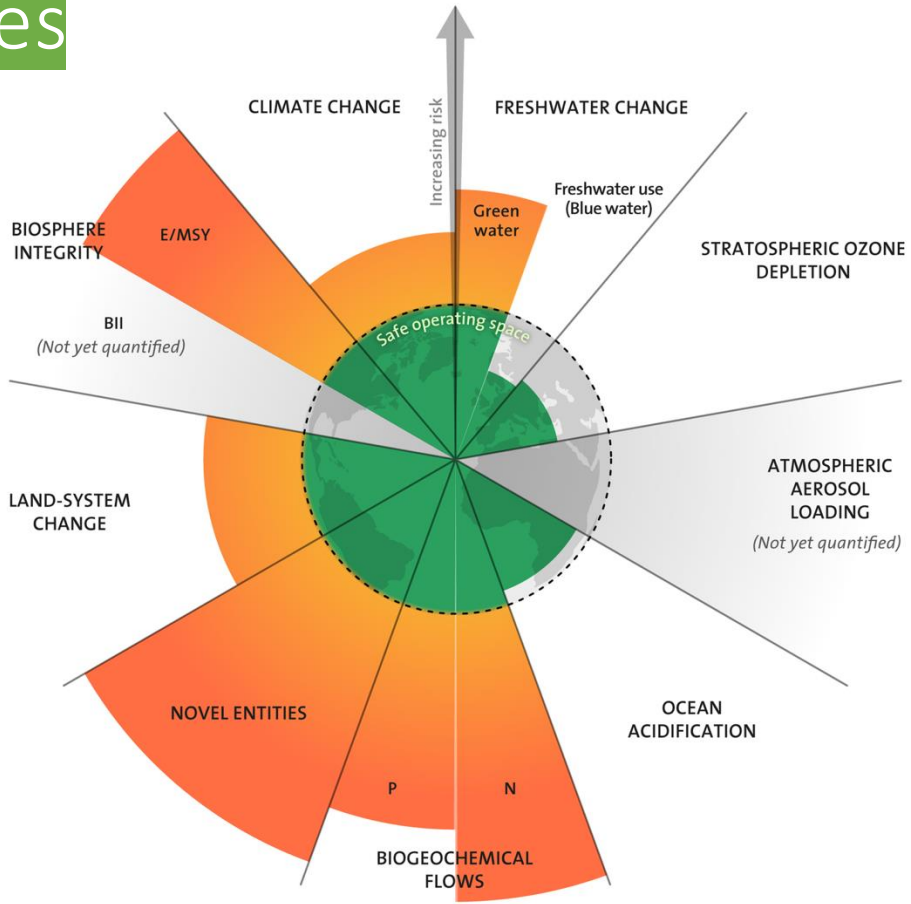
Planetary Boundaries



(Richardson et al, 2023)

Planetary Boundaries

In **2022: 6** of 9 planetary boundaries passed

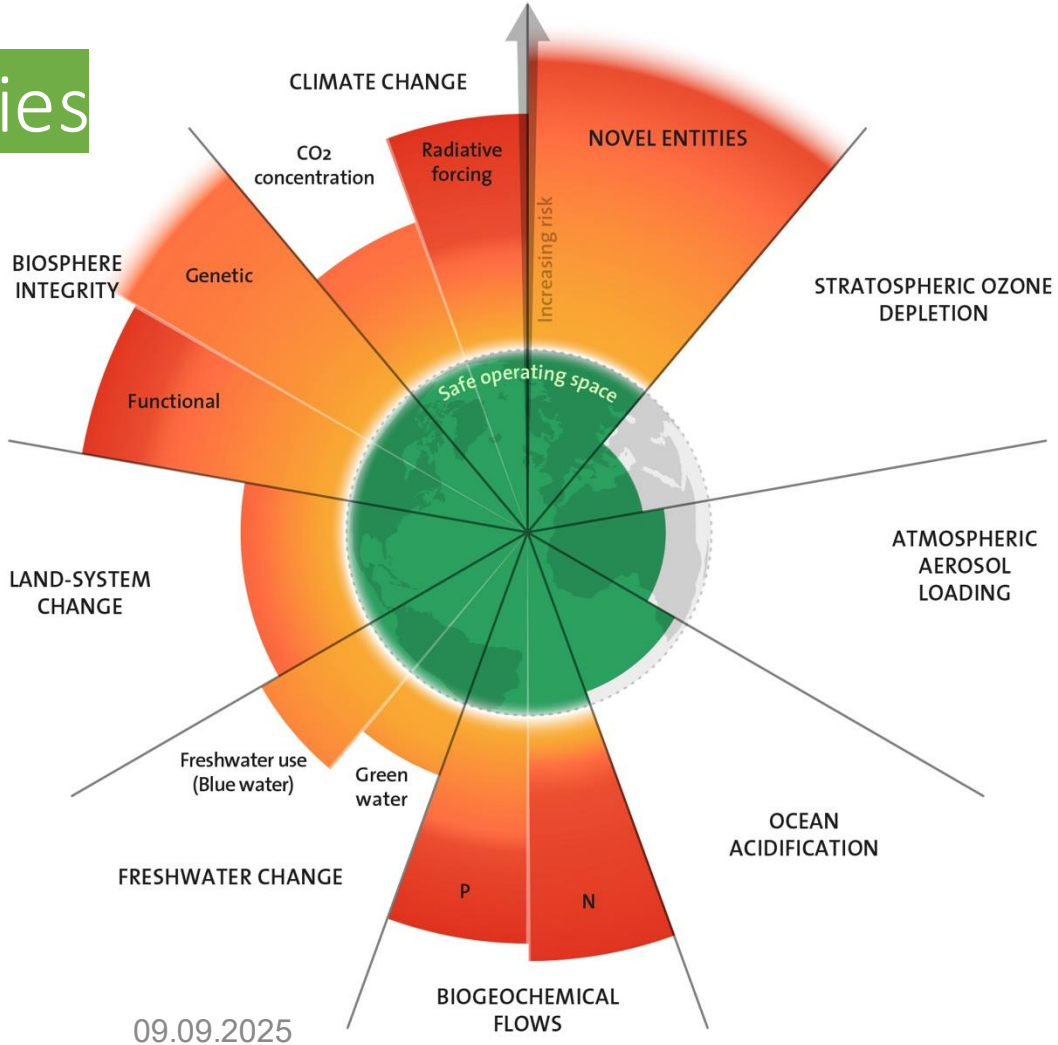


(Persson et al, 2022; Wang-Erlandsson et al, 2022)

Planetary Boundaries

In **2023: 6** of 9 planetary boundaries passed

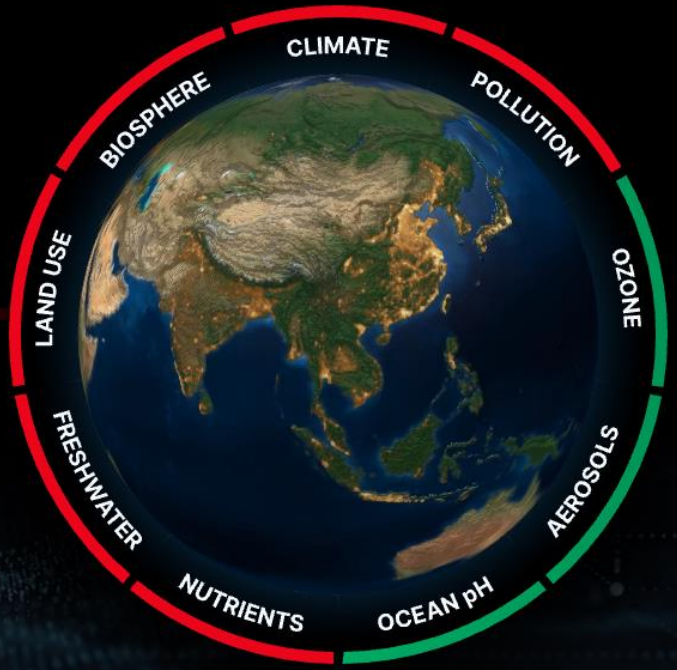
All 9 boundaries quantified



(Richardson et al, 2023)

Planetary Health Check

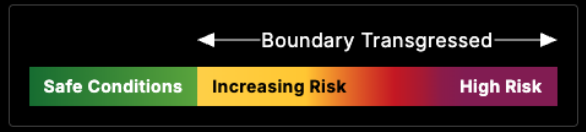
Our planet's vital signs are flashing red

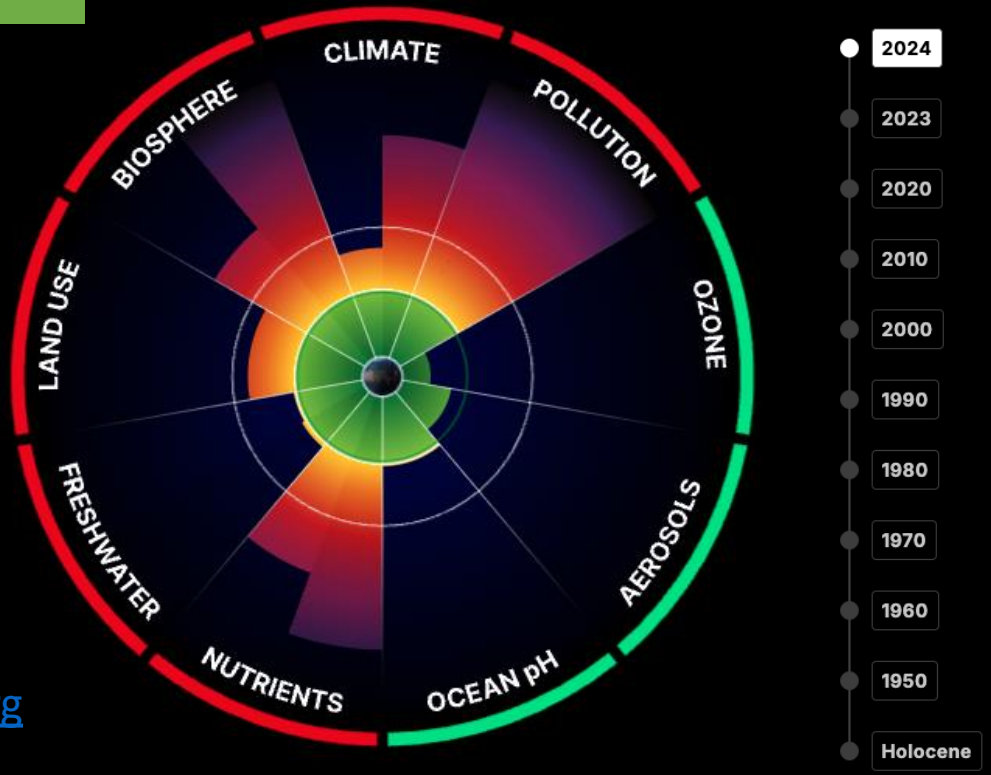


The Planetary Health Check is the most comprehensive, science-based global initiative dedicated to measuring and maintaining the Earth system.

https://www.planetaryhealthcheck.org

Planetary Health Check

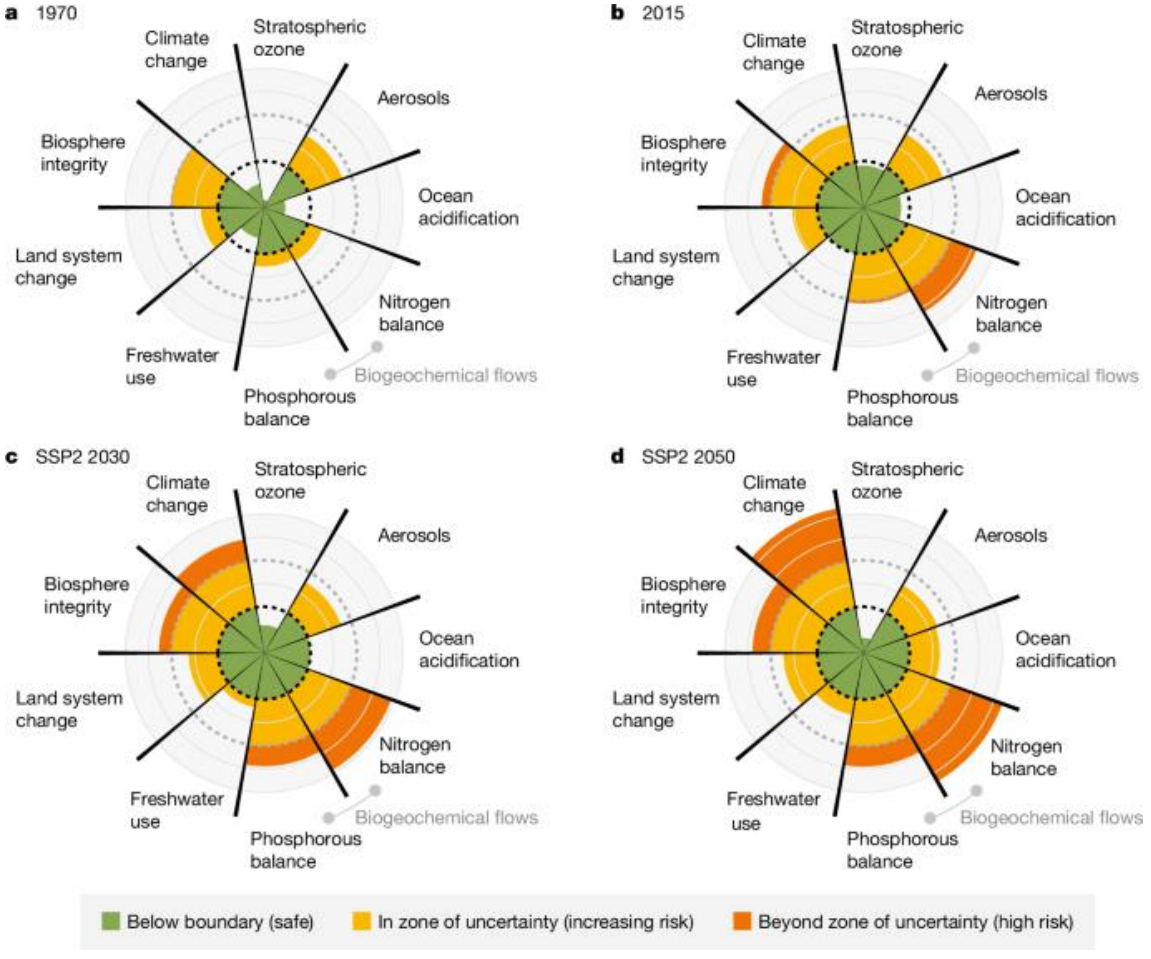




https://www.planetaryhealthcheck.org

Planetary Boundaries in the future

Business as usual



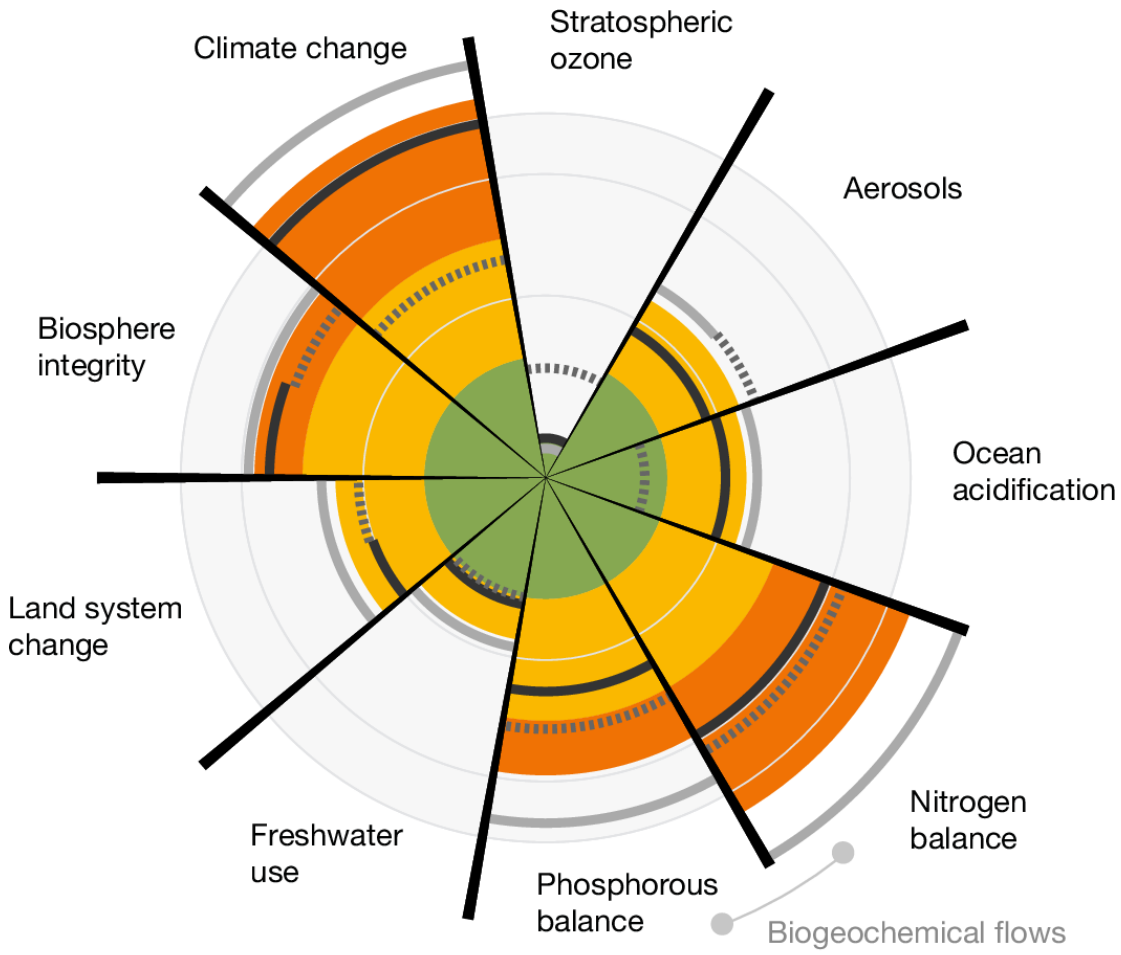
(van Vuuren et al., 2025)

Planetary Boundaries in the future

Comparison of different scenarios

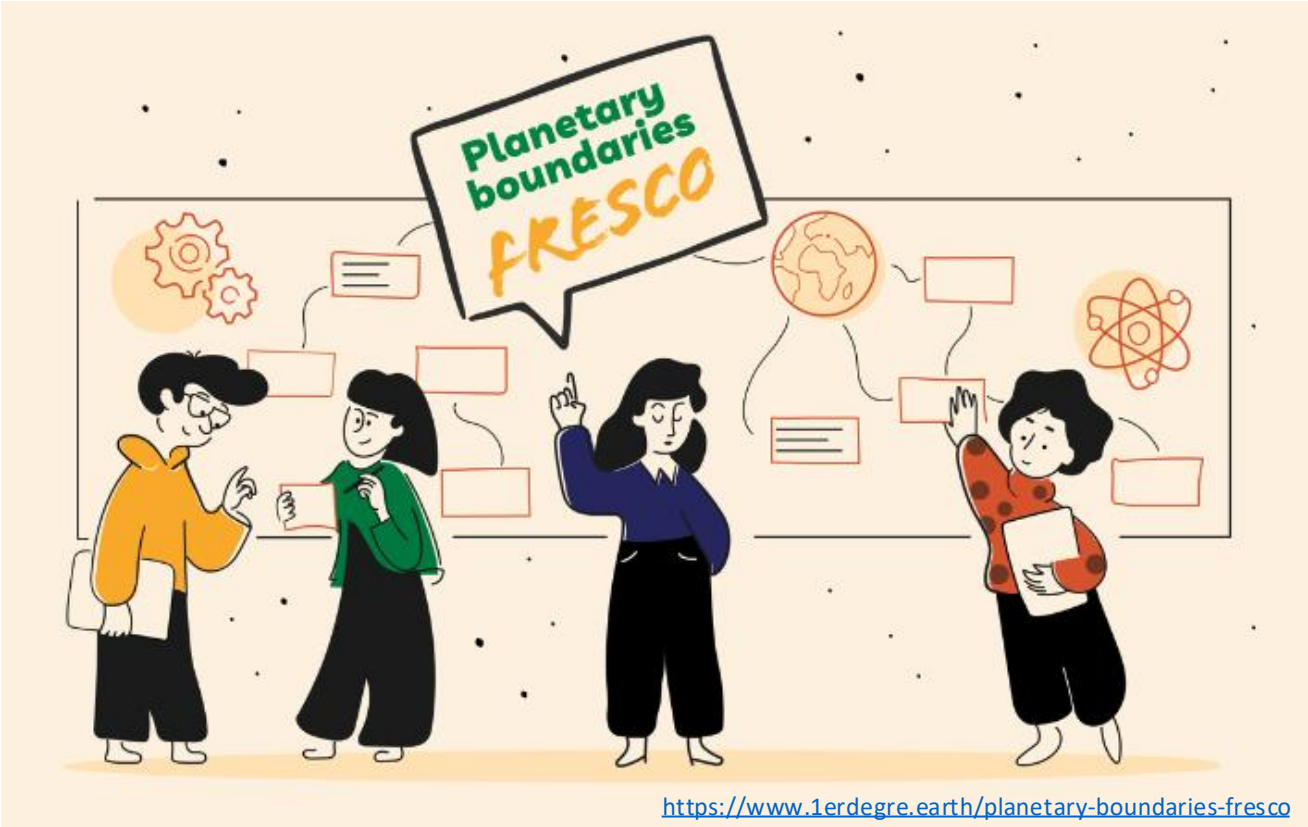
SSP2:
- Below boundary (safe)
- In zone of uncertainty (increasing risk)
- Beyond zone of uncertainty (high risk)

Comparison:
- SSP1
- SSP3
- 2015



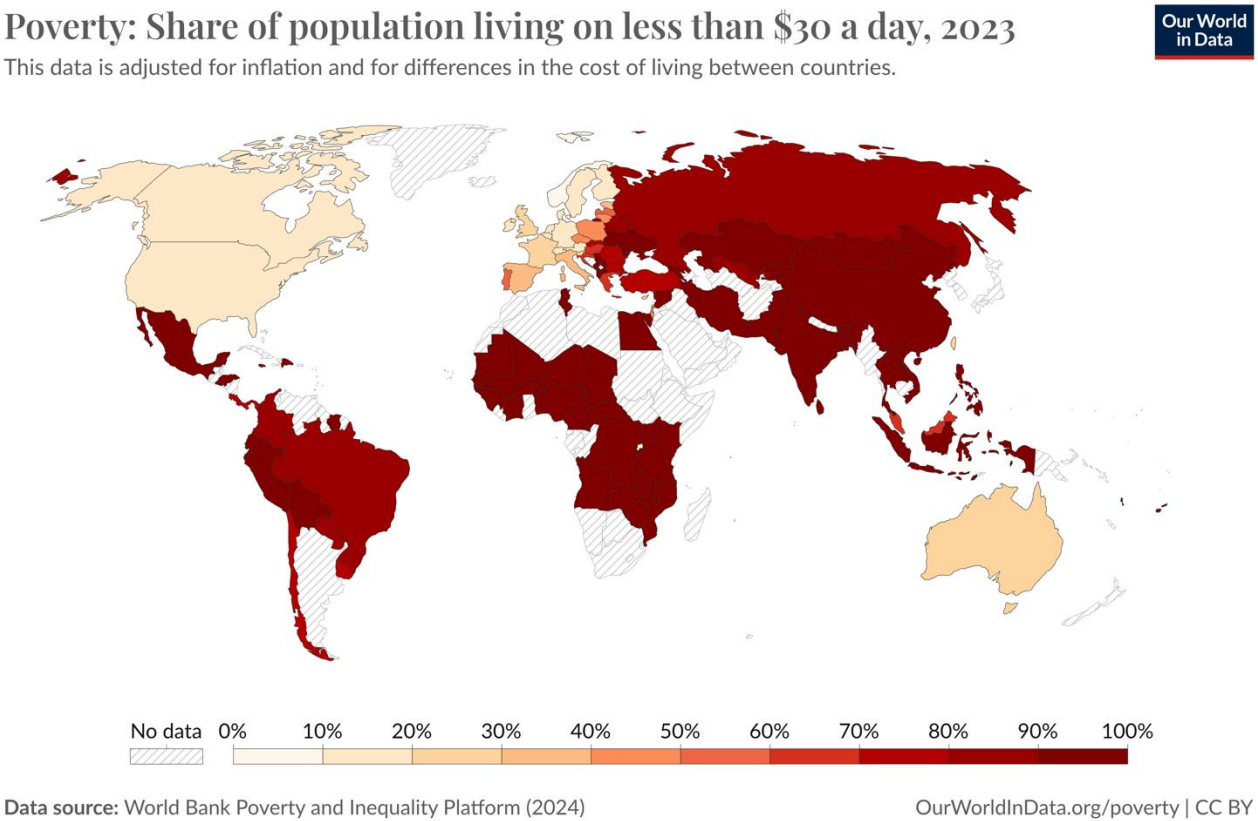
(van Vuuren et al., 2025)

For more information



https://www.1erdegre.earth/planetary-boundaries-fresco

Ongoing poverty crisis



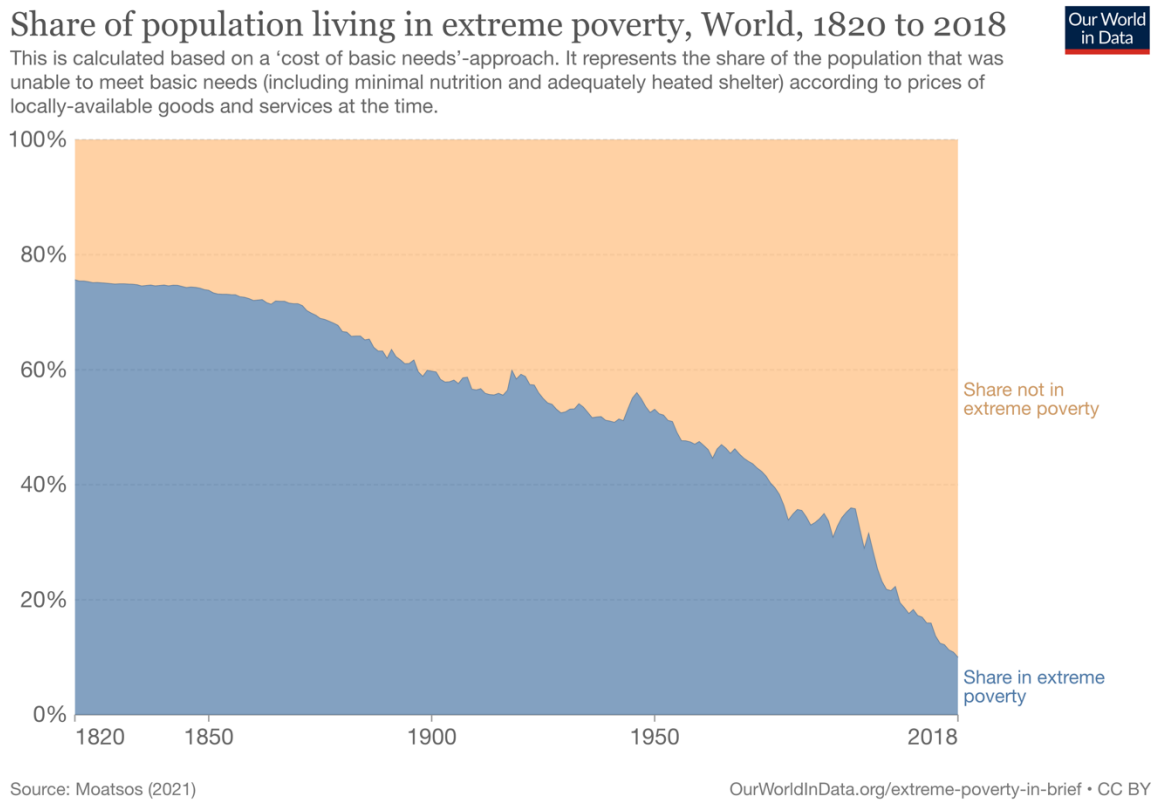
6.7 billion people

84% of the world population

90-100% of people living in Africa & majority of Asia

Between 1 in 10 and 1 in 5 people in high income countries

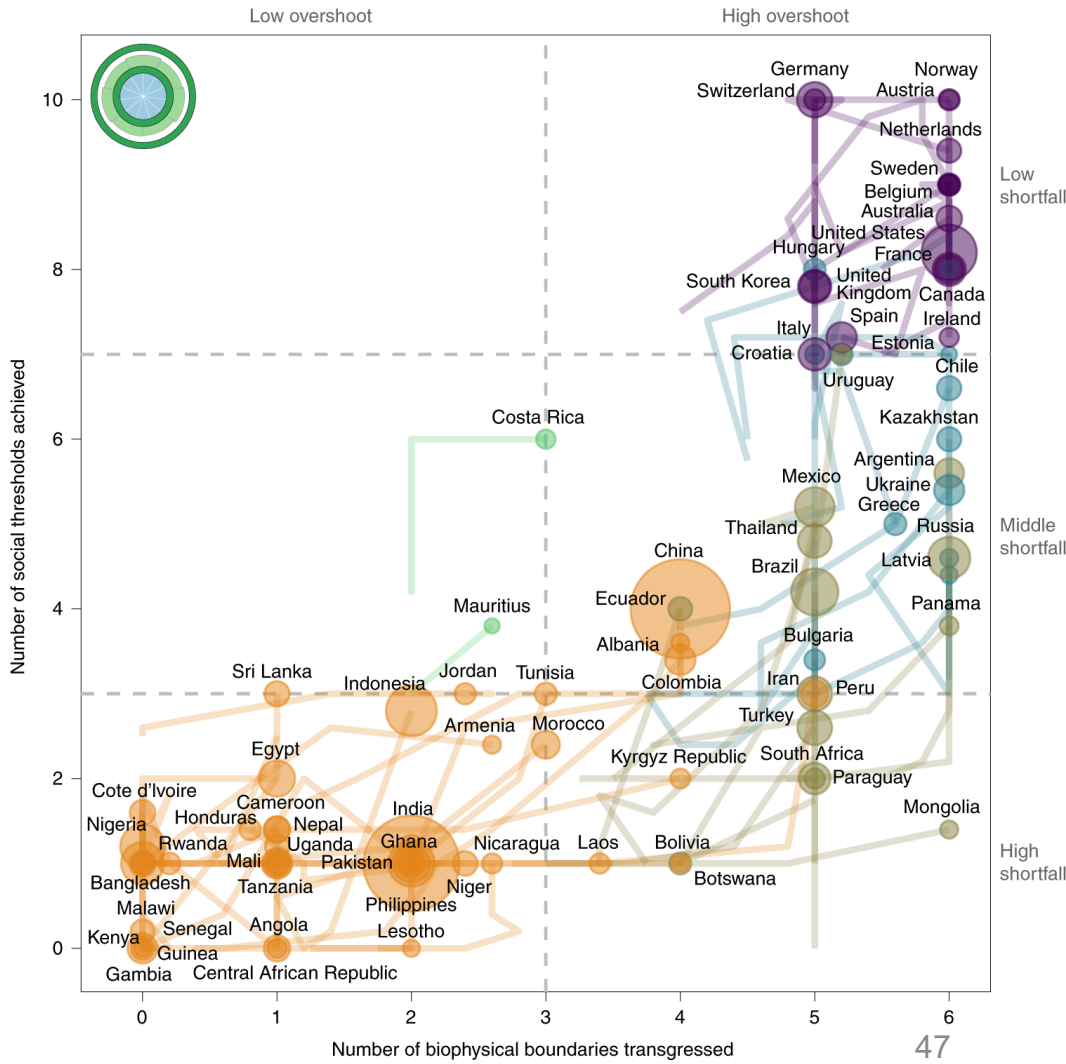
Some progress but inequalities persist



And many more struggling to meet basic needs (e.g. nutrition, education, health care, sanitation, safe shelter)

The social shortfall & ecological overshoot of nations

- 140 countries from 1992-2015
- No country currently meets the basic needs of its residents at a level of resource use that could be sustainably extended to all people in the world
- Wealthy countries (top right):
  - Increasingly crossed ecological boundaries with little social gains
  - Average of 3.5 x “fair share” of ecological limits



Changes in our environment severely impact our health and jeopardize decades of public health gains

Human health impacts include, but aren't limited to:

- Cardiovascular diseases
- Respiratory diseases, like asthma and Chronic obstructive pulmonary disease (COPD)
- Infectious zoonotic and diarrheal diseases
- Antimicrobial resistance
- Toxic and dioxin exposures
- Heat strokes
- Mental health effects
- Malnutrition
- Forced displacement and migration
- Civil strife and trauma

The people that are most vulnerable to impacts from global environmental change are those living in poverty

Key Concepts

Key concept: Human health

Human health

Definition according to the WHO:

“Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” (WHO, 2006)

Determinants of health

Factors that have a significant influence, whether positive or negative, on human health

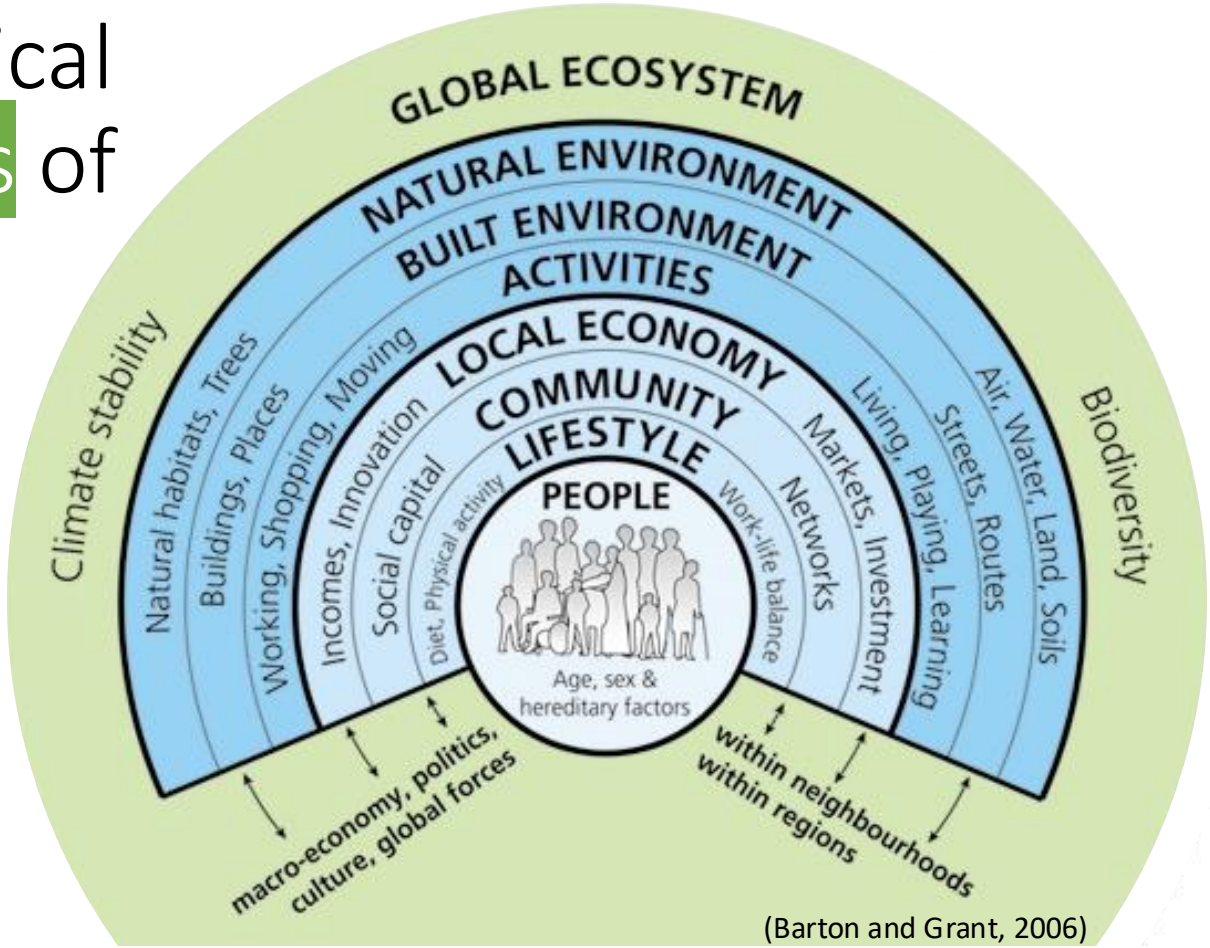
Social determinants - Social, cultural, political, economic and environmental conditions in which people are born, grow up, live, work and age, and their access to power, decision-making, money and resources that give rise to these conditions of daily life.

Environmental determinants - The physical conditions in which people live and work that have an impact on health.

Ecological determinants - State of earth systems (such as the natural cycles of water, carbon and nitrogen) and the fundamental role they have in sustaining human life and the life of all other species.

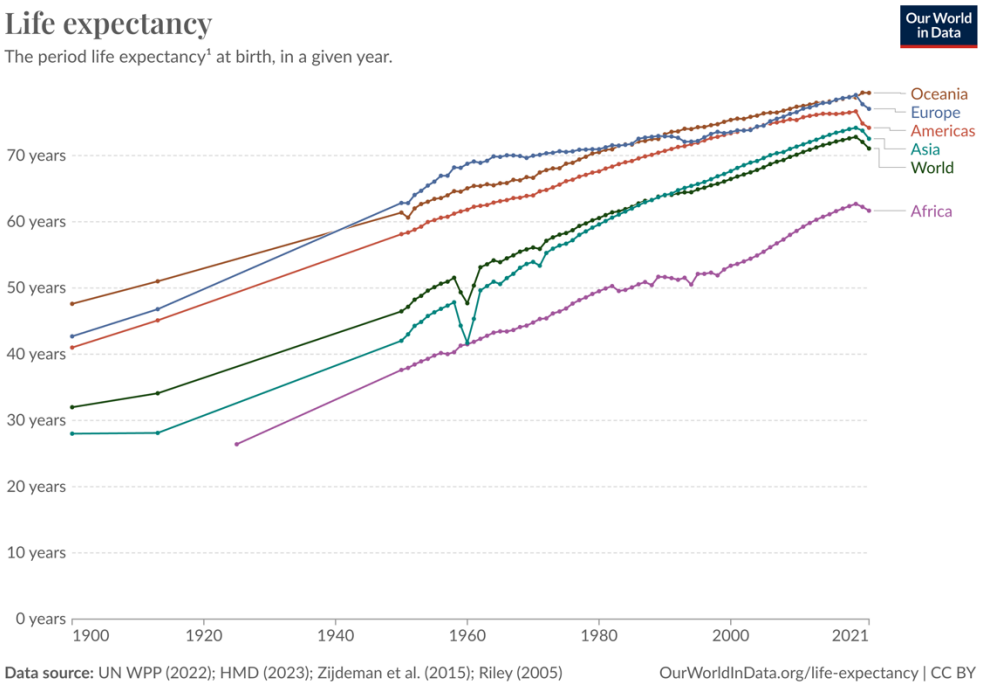
(WHO, 2021)

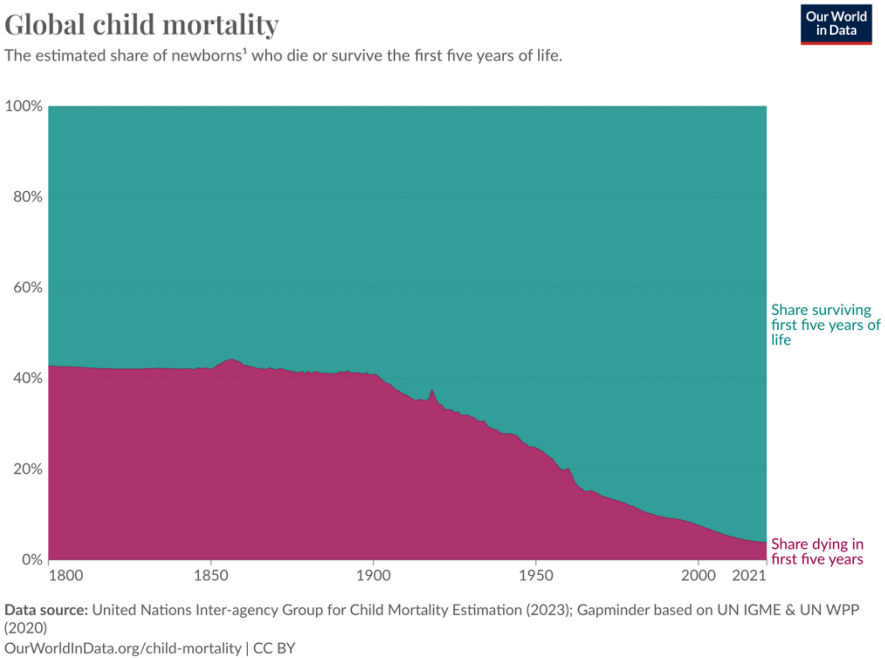
Socio-ecological determinants of health



(Barton and Grant, 2006)

Health gains since 1900





Key concept: Sustainability

Think – Pair – Share

How do you define sustainability?

Part 1 – Individually *(1 min)*

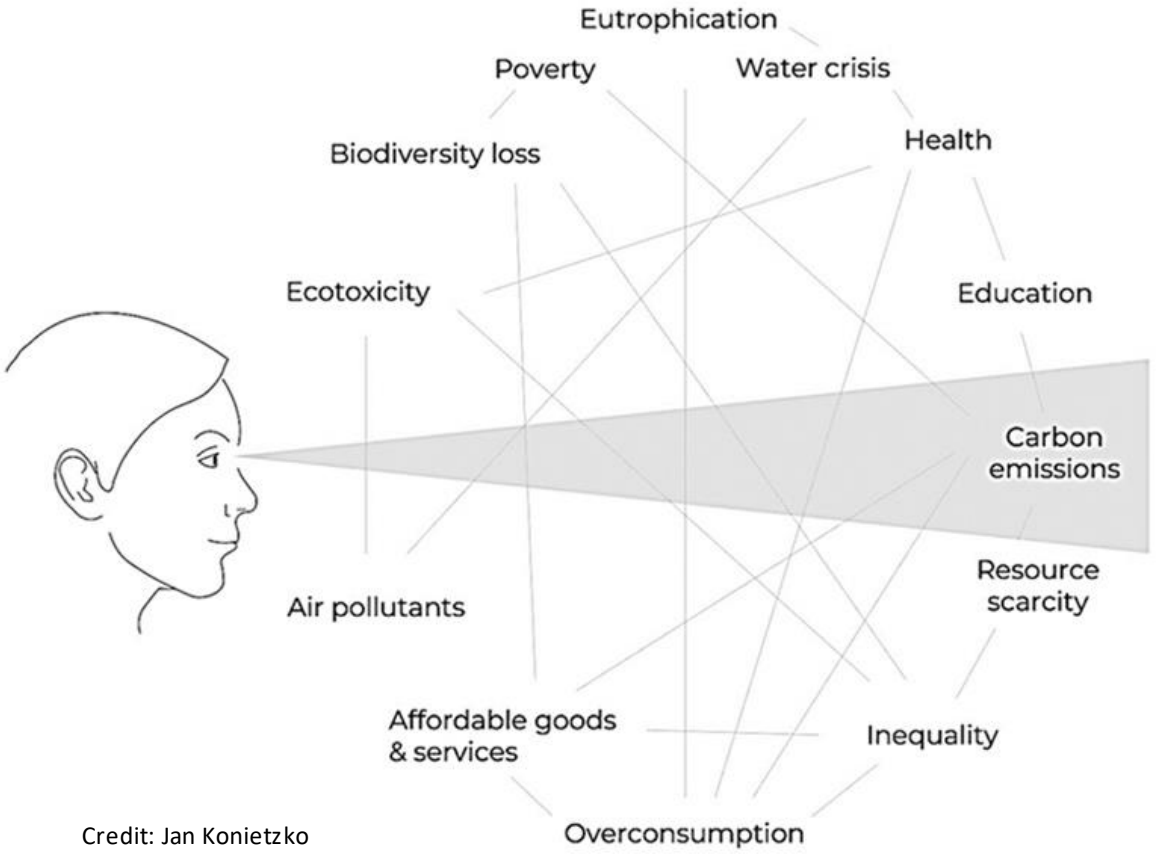
Write your response to this question on a piece of paper

Part 2 – Pair with a neighbor *(2 mins)*

Share your response with your neighbor and discuss the differences in your definitions

Part 3 – Class discussion

Carbon Tunnel Vision

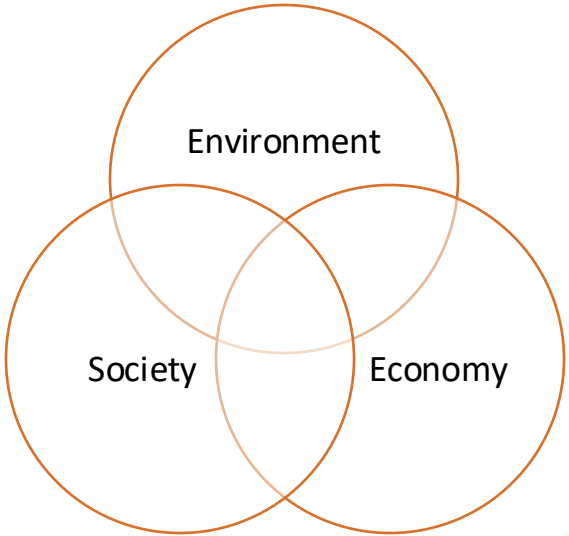


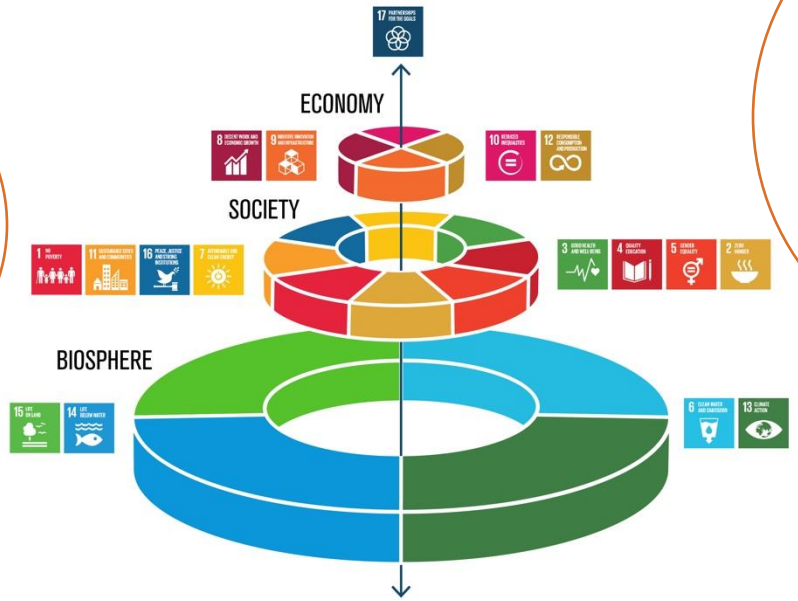
Credit: Jan Konietzko

Sustainability

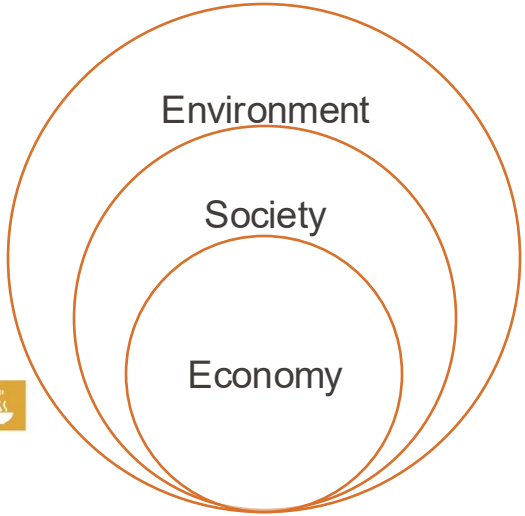
- Refers to the ‘end goal’ or ‘vision’ –
  - It is a moral ideal of the relationship between nature and society
    (Salas-Zapata & Ortiz-Muñoz, 2019; Meijboom & Brom, 2012)
- Normative concept –
  - Involves the social process of designating some actions/outcomes as good, desirable, or permissible, and others as bad, undesirable, or impermissible
- Pluralistic in conceptualisation
  (Bertrand et al., 2004 ; Lemenager et al., 2012 ; Mebratu, 1998 ; Norton, 2005; Ruggerio, 2021; Salas-Zapata & Ortiz-Muñoz, 2019)

Sustainability: multiple frameworks



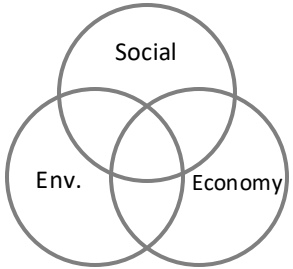


Rockström & Sukhdev © Azote Images for Stockolm Resilience Centre



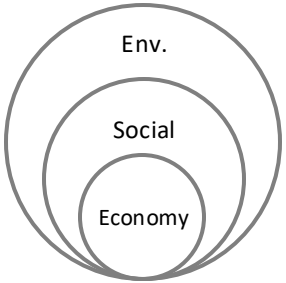
Sustainability paradigms

Sustainable Development



Priority: Balance of social, economic and environmental ‘pillars’

Strong Sustainability



Priority: Preservation of natural capital which is incommensurable with human or economic capital

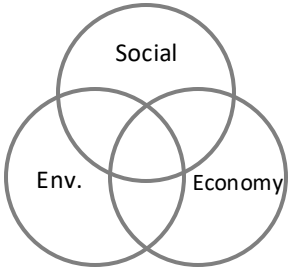
Deep Ecology

Priority: Ecology of interdependence focusing on quality of life and intrinsic value for all entities

(Développé sur la base de : Bertrand et al., 2004 ; Hess, 2013 Jacobs, 1999; Lejeune & Guimont, 2019; Lemenager et al., 2012 ; Mebratu, 1998 ; Norton, 2005; Ruggerio, 2021)

Sustainable Development

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"
(Our Common Future, Brundtland Commission, 1987, p.43)

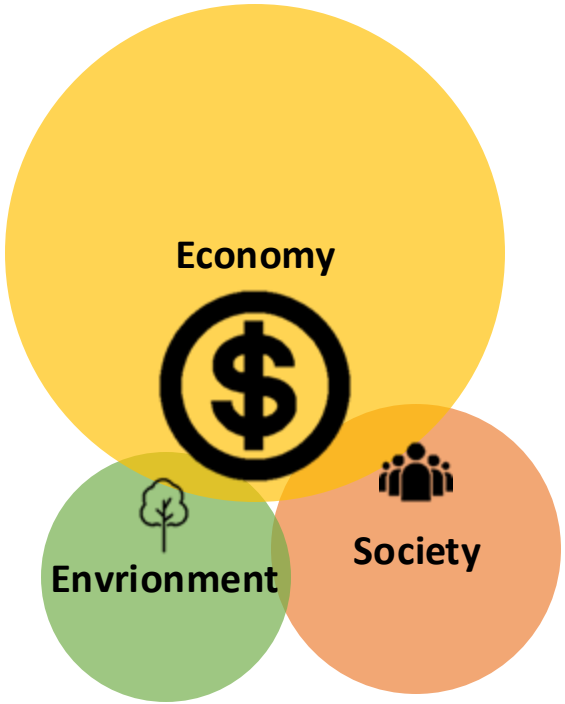


Priority: Balance of social, economic & environmental 'pillars'

Frame of reference – the SDGs

- Global blueprint for sustainable development
- 17 goals to be achieved between 2015-2030
- Apply to both the Global South and the Global North

A critique of sustainable development

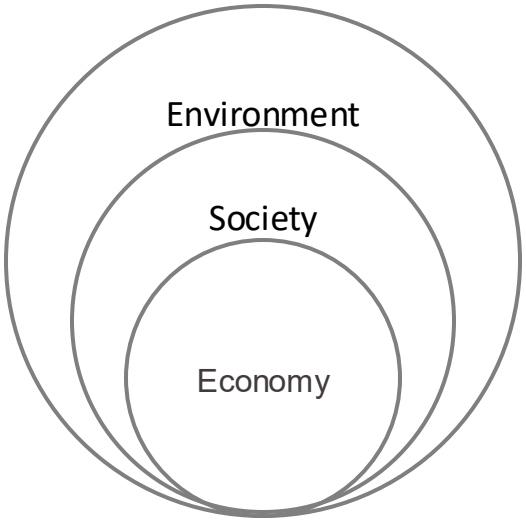


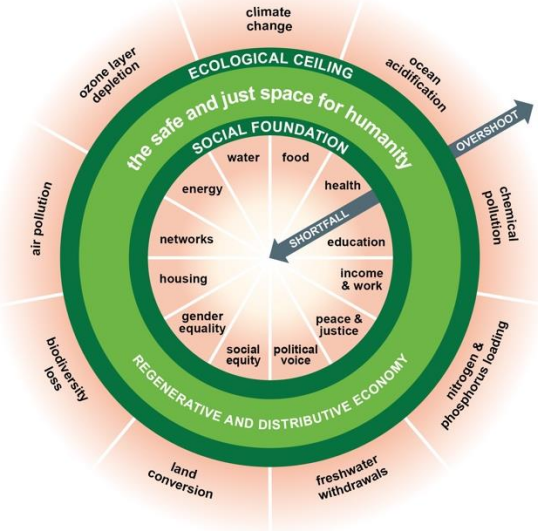
Often referred to as *weak sustainability* where environmental and human capital are interchangeable

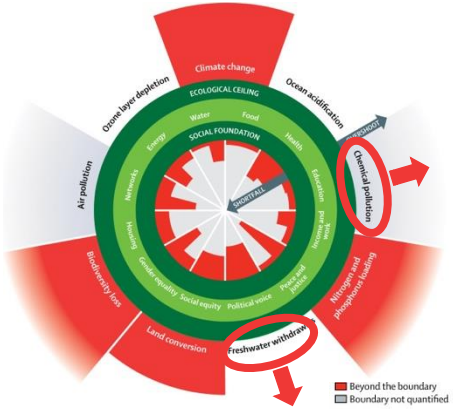
(Adapted from Messerli, 2019)

Strong Sustainability

Priority: Preservation of natural capital which is incommensurable with human or economic capital







Frames of reference:

- Club of Rome - *Limits to Growth*
- Planetary Boundaries
- Donut Economics

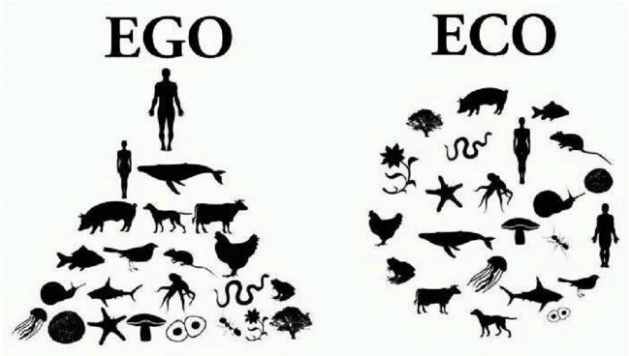
(Persson et al, 2022; Raworth, 2017; Wang-Erlandsson et al, 2022)

Deep Ecology

Priority: Ecology of interdependence focusing on quality of life and *intrinsique value for all entities*

Frames of reference:

- Humans as embedded in nature, as part of nature, and not as superior to nature
- Intrinsic value of nature and ecosystems
- Example: Deep ecology of Arne Naess



(Lehmann, 2019)

Integrated health-environment approaches


Planetary Health

Planetary health is a scientific field and global movement focused on **understanding and quantifying the growing human health impacts of anthropogenic global environmental change, and developing solutions** that will allow humanity and the natural systems we depend on to thrive now and in the future.

Planetary Health (1)

"The achievement of the **highest attainable standard of health**, well-being and equity worldwide through judicious attention to the **human systems** – political, economic and social – that shape the future of humanity, and the Earth's natural systems that define **the safe environmental limits within which humanity can flourish**."
(WHO, 2021, p. 8)

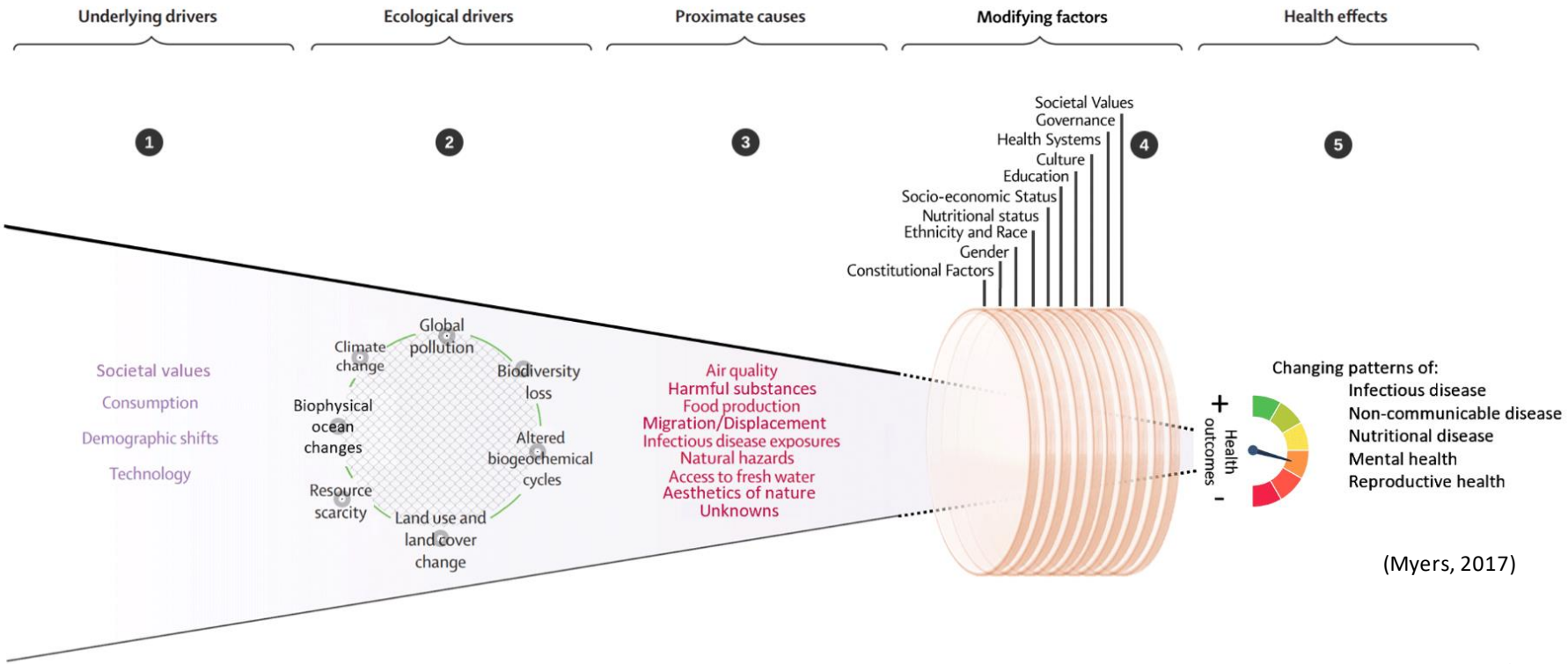
Planetary Health (2)

“Planetary health is the health of human civilisation and the state of the natural systems on which it depends."

(Whitmee et al, 2015)

Integration of two key concepts:
human health & environmental sustainability

Planetary Health Framework: impacts of anthropogenic change on human health



(Myers, 2017)

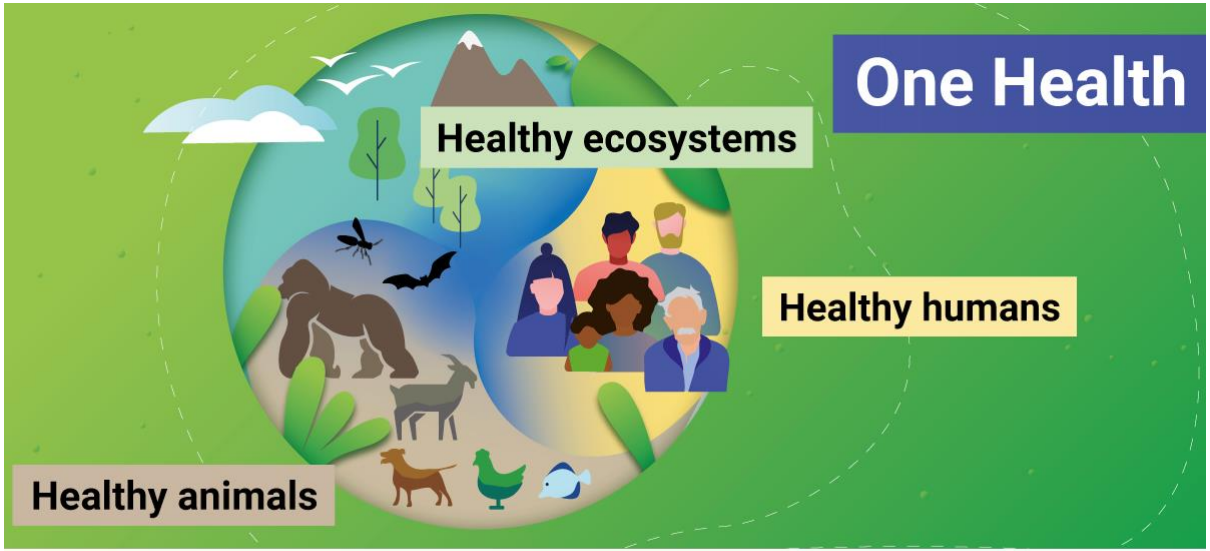
History and emergence of planetary health

- Focuses on: Linking climate change, biodiversity loss, and environmental degradation to human health (based on integrated socio-ecological systems approach)
- Emerged in western societies the 1970s–80s from environmental and holistic medicine movements
- Interdependence of human health and ecological systems recognised by numerous indigenous cultures well before this (e.g. Inuit cultures, Aboriginal cultures)
- Re-emergence in 2015 due to Rockefeller–Lancet Commission report positioned Planetary Health as a “new science”

One Health

One Health

“an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems.”



(WHO, 2021 & 2022)

One Health

- Based on the interdependence of health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems)
- Important to prevent, predict, detect, and respond to global health threats (e.g. COVID-19 pandemic)
- Intersectoral and interdisciplinary approach to address the full spectrum of disease control – from prevention to detection, preparedness, response and management

(WHO, 2021 & 2022)

Origins of One Health

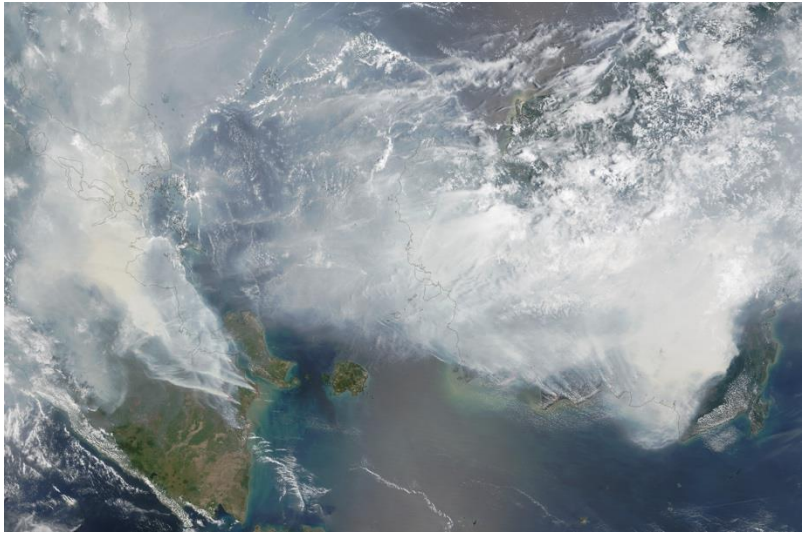
- Originating from veterinary medicine
- 1950s: Creation of a veterinary public health unit, which later became the US Centres for Disease Control and Prevention (CDC)
- Strong connection between One Health and Health Security (i.e. pandemic control and response)
- Remains dominated by animal health
- Main health-environment integrative approach mobilised by UN organisations (particularly WHO and FAO)

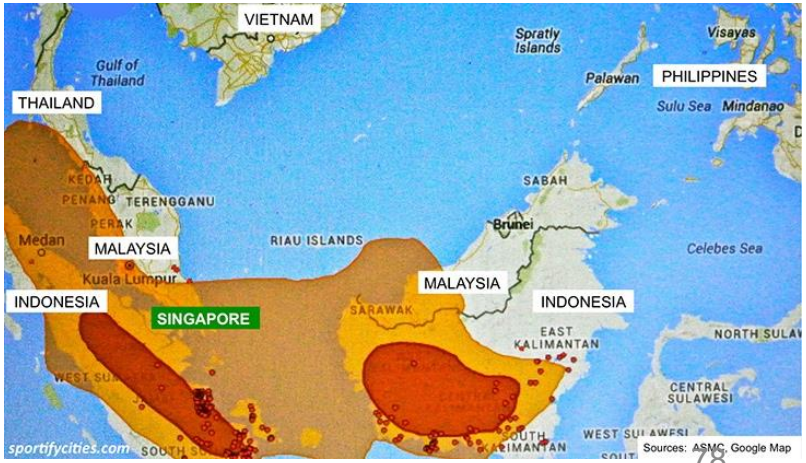
(van de Pas, 2019; Woods et al., 2018)

Some examples of integrated health-environment problems

Southeast Asian haze

- Haze: air pollution composed of suspended particles in dry air
- Fires in Indonesia regularly cause haze in Brunei, Malaysia, Singapore, Thailand, Vietnam, Cambodia, Philippines
- Major events in 2015 & 2019





Southeast Asian haze

- Caused by peat fires - an inexpensive way to clear land for agriculture (for palm oil, but also small holder farming) (Koplitz et al 2016)
- Peatland - wetland ecosystems created by decaying vegetation
- Stores carbon through sequestration by preventing release of CO_2 of the decaying vegetation into the atmosphere
- Cover 3% of the earth's surface but stores more carbon than all other terrestrial ecosystems combined
- Also important ecosystems for biodiversity
- **Release 10x CO_2 of forest fires**

(Duff et al 2020)

Southeast Asian haze

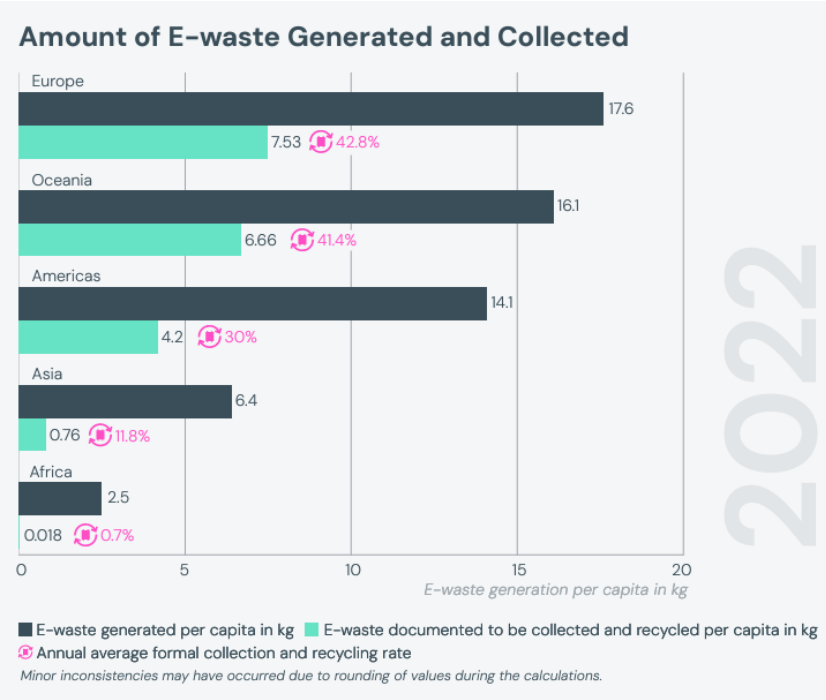
- In **2015 - 100,300 excess deaths** associated with haze
- Causes various respiratory symptoms & reduces lung function
- $PM_{2.5}$ absorbed into the bloodstream
- Health impacts depend on chemical composition of the haze (e.g. formaldehyde, carbon monoxide, ammonia) and its concentration

2019

2015

E-Waste

- Fastest growing solid waste in the world
- In 2022:
  - 62 billion kg produced (7.8 kg per person)
  - **only 22.3% formally** recycled
- Most of this waste is informally processed in lower and middle income countries
- Poor practices in informal recycling:
  - Dumping on land or in water bodies
  - Landfilling along with regular waste
  - burning or heating
  - Acid baths or acid leaching
  - Stripping and shredding plastic coatings
  - Manual disassembly of equipment.



E-Waste

- Components of modern electronics contain harmful substances (e.g. lead, cadmium, beryllium, mercury etc.)
- **Health impacts:**
  - Increased rates of stillbirth & premature birth
  - Neurological development
  - Reduced lung and respiratory function and increased asthma
- Also creates **environmental contamination**
- Linked to **child labor** and **poor working conditions**

E-Waste

Responses

- E-waste management infrastructure and legislation to encourage:
  - Reuse of valuable materials via formal recycling
  - Stop diverting e-waste to landfills
  - E.g. In 2020 Thailand implemented a ban on the import of e-waste

- *Not just a post-consumer problem*
  - Increasing repair and lifetime of electronic goods
  - Reduction of consumption of electronic goods

Thailand is new dumping ground for world's high-tech trash

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

Many other examples…

- Some others you will see in the course are linked to
  - Climate change
  - Biodiversity loss
  - Food systems
  - Etc…

Critical reflection

Integrated approaches

Critical Reflection

- Weak Sustainability
  - Often based on sustainable development model
  - High reliance on technology-based solutions

- Anthropocentric
  - Dominant focus on human health
  - Limited integration of ecosystem health in the concept
  - Views nature as an instrument for maintaining human health that needs to be balanced with social and economic gains

(Baquero et al, 2021; Farman & Rottenburg, 2019; Lerner & Berg, 2017)

Critical Reflection

- Conflict of interest in source of funding
  - Planetary Health supported by the Rockefeller Foundation
    - John D. Rockefeller - first world billionaire & owner of the Standard Oil Company
    - Philanthrocapitalism

- Colonialised view of health
  - Disregards alternative views of health, particularly of indiginous communities
  - Maintains current power systems & Western-dominated health models

(Baquero et al, 2021; Farman & Rottenburg, 2019; Lerner & Berg, 2017)

Critical Reflection

- Implementation
  - Gap between the discourse and what is actually implemented
  - Persistence of institutional silos and interdisciplinary challenges
  - Limited assessment of the real impacts of integrative initiatives

(Cheli et al., 2025)

Planetary Boundaries & Planetary Health

"We've now come to a point where **safeguarding the health of our planet** is fundamentally about the **health of people**, and we now have to integrate this at the **planetary level**."

Professor Johan Rockström
Potsdam Institute for Climate Impact Research, Germany
Founding Director of the Stockholm Resilience Centre, Sweden

https://www.youtube.com/watch?v=C9M5Y1mA_ZY

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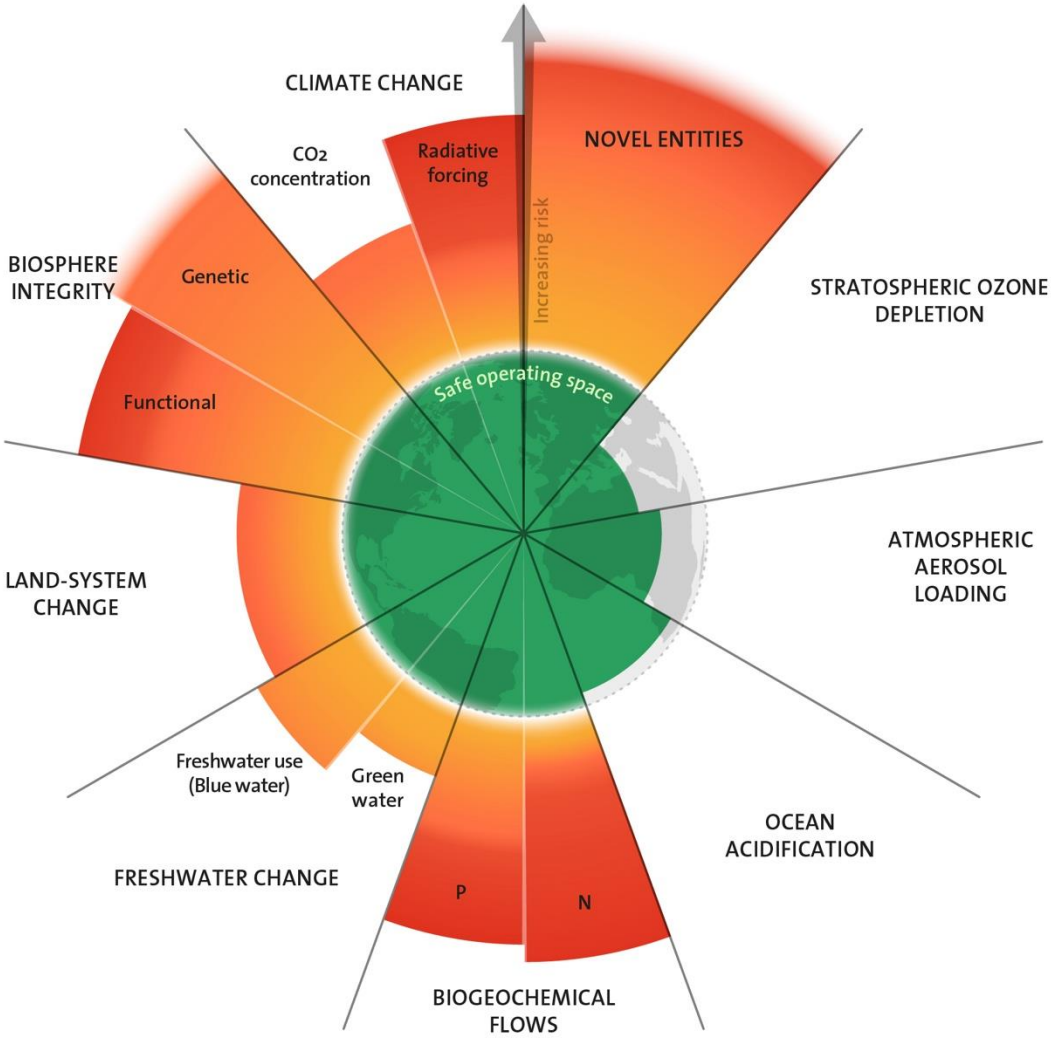
Exercise: Collective systems map of the Planetary Boundaries & Health



Collective mapping – PART 1

30 minutes

1. Form 9 groups
2. Read texts provided relating to the Planetary Boundary that your group is focusing on
3. Following the instructions and using the A3 paper provided **illustrate the connections or relationships that your Planetary Boundary has with:**
    1. Health
    2. Other Planetary Boundaries

    Refer to the example in the instructions for more details

Collective mapping – PART 2

5 minutes per group

Instructions:

1. Share your map with the class by drawing it on the blackboard
2. Make links with other planetary boundaries on the board
3. Briefly explain to the class the pathways you identified between the planetary boundary and health

Collective mapping – PART 3

Debrief

Collective mapping - Take aways

- Interactions between planetary boundaries, and with human health are highly complex
- Often such problems are classified as **'Wicked problems'** –
  - Poorly defined
  - Complex problem
  - In a state of constant evolution,
  - There is not one singular discreet solution
- It is crucial to take a systems thinking perspective
- Understanding and addressing such complex problems are better done through collective intelligence