Engineering for a Sustainable Society

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Goal of the short course

Give You a

sustainable and multidisciplinary perspective and

Inspire You to cooperate for answering the societal challenges

Course plan

- Part 1
  - Definition
  - Green Deal
  - Gren house gas emissions
  - Sustainability Development Goals
- Part 2
  - Environmental Foot print
  - Planetary Boundaries
  - EU action
  - Circular economy
- Part 3
  - Environmental Impact of Healthcare

What does sustainability mean to you?

- Definition?
- Objectives?
- Actors?
- Color?
- Shape?

Sustainability – development of concept

The 1987 UN-commissioned study “Report of the World Commission on Environment and Development: Our Common Future” also known as the “ The Brundtland report”:

- *“Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.”*

1. Connecting human needs with its impact on the environment
2. Common global future (United the world around SDG)
3. Report became a “guiding star” for the environmental movement in the 90:ies.

Courtesy of Liisa Kiviloog

Definition from Wikipedia

- Sustainability is the **process** of maintaining change in a **balanced fashion**, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance **both current and future** potential to meet human needs and aspirations.

- For many in the field, sustainability is defined through the following interconnected domains or pillars: environment, economic and social.

Weak and Strong

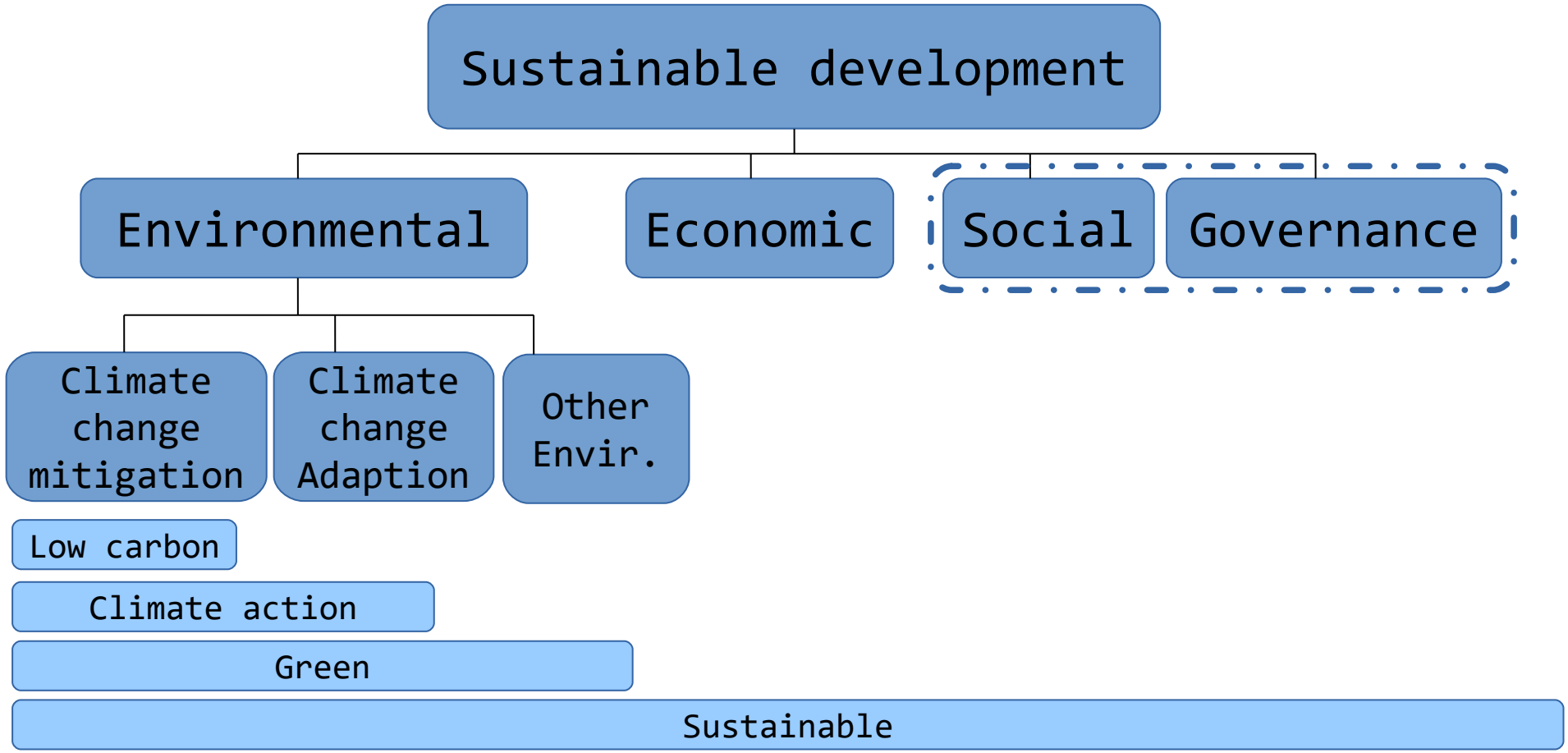
- Weak sustainability is an idea within environmental economics which states that 'human capital' can substitute 'natural capital.
  - natural resources may decline as long as human capital is increased
  - example of the benefit to human capital is financial profits
- Strong sustainability assumes that the economic and environmental capital is complementary, but not interchangeable.
  - Example The ozone layer is an ecosystem service that is crucial for human existence, i.e. forms part of natural capital that cannot be changed for something else.

Weak sustainability is not enough
Relation between of Biodiversity and Economy according to Swiss Re

- Swiss Re is a reinsurance company and they have introduced a bio-ecosystem (BES) index
- *Swiss Re Institute BES Index enables businesses and governments to factor in biodiversity and ecosystem issues into economic decision-making*
- 39 countries have ecosystems in a fragile state on more than a third of their land – Malta, Israel, Cyprus, Bahrain and Kazakhstan have the lowest Biodiversity and Ecosystems Services (BES) ranking
- Over half (55%) of global GDP, equal to USD 41.7 trillion, is dependent on high-functioning biodiversity and ecosystem services
- Major economies in Southeast Asia, Europe and the US exposed to BES decline

https://www.swissre.com/media/news-releases/nr-20200923-biodiversity-and-ecosystems-services.html

A graphical representation



Sustainability with perspective

Employment
Regulations
Labor laws
Stakeholders
Human rights
Anti-corruption

Water
Energy
Air

Emissions
Waste
Resources

Investments
Taxes
Procurement practices
Economic performance

Courtesy of Liisa Kiviloog

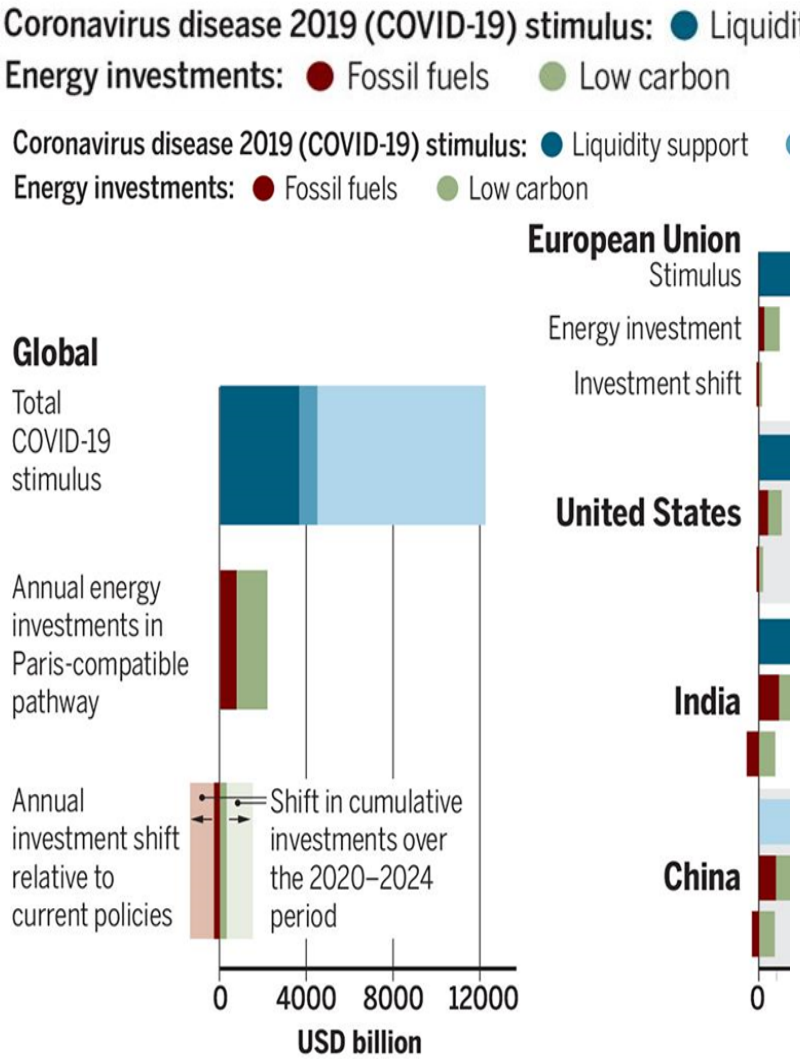
Green Deal

Why Green Deals?
Crisis recovery packages are unprecedented

- Recent paper in Science ”COVID-19 recovery funds dwarf clean energy investment needs”, DOI: 10.1126/science.abc9697
- Current economic recovery packages surpass USD 12 trillion
- 80% of which comes from countries in the Organization for Economic Cooperation and Development
- Total stimulus exceeds average annual low-carbon energy investment needs by a factor of 20 in the United States and by over 30 in the EU.
- Average annual low-carbon energy and end-use energy efficiency investment needs under a Paris-compatible pathway have been estimated at about USD 1.4 trillion per year globally over the near term between 2020 and 2024
- The article highlights that a climate-positive COVID-19 recovery relies as much on supporting green investments as it does on avoiding lock-in in polluting ones.

Source: Andrijevic et al., 2020, DOI: 10.1126/science.abc9697

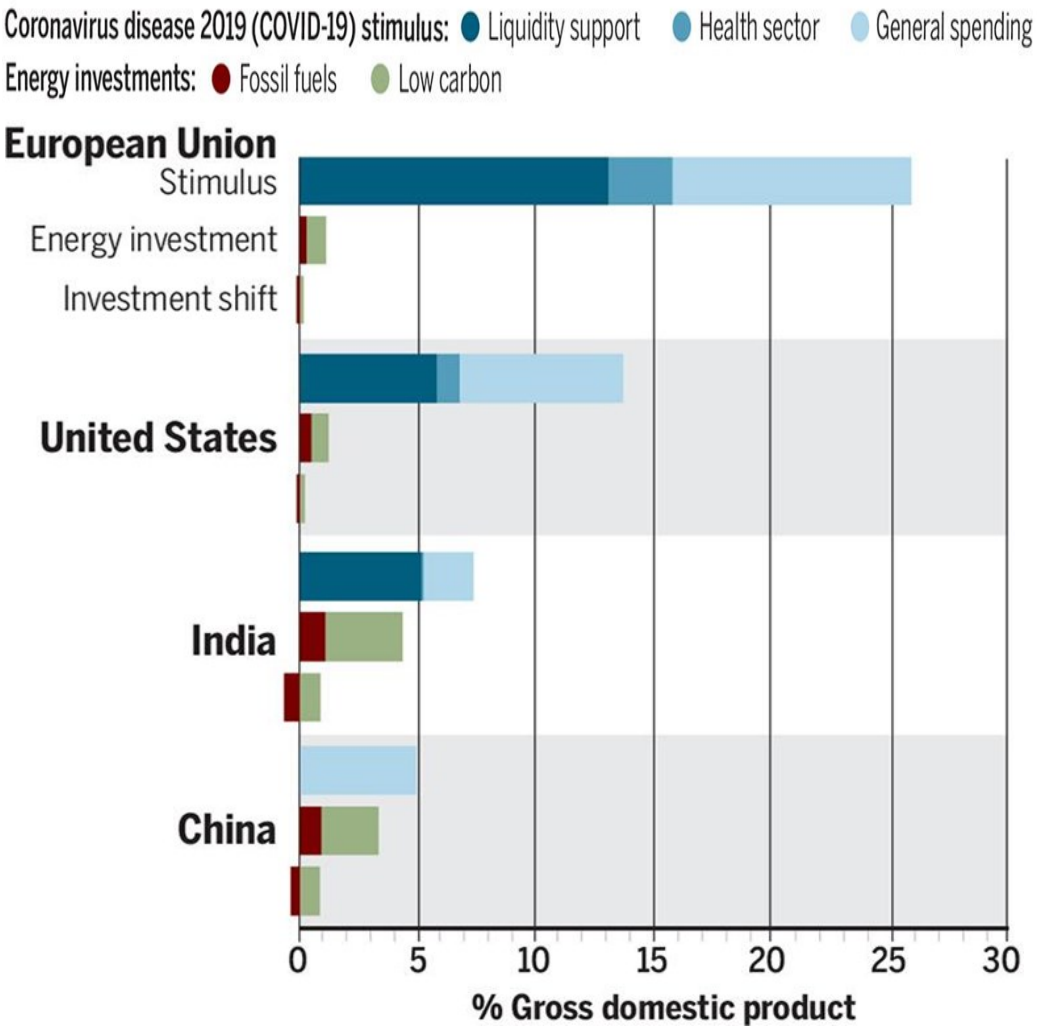
Good or bad?



- General spendings dominate
- Fossil energy is still supported
- Investments are higher in low carbon, but that was already a trend before
- Negative oil prices scare away investments
- Cheap wind technology is popular

Source: Andrijevic et al., 2020, DOI: 10.1126/science.abc9697

Geographical differences



EU is taking the lead

- Very unequal depending countries
- Green Deal is a part of it

Source: Andrijevic et al., 2020, DOI: 10.1126/science.abc9697

World UK Coronavirus **Climate crisis** Environment Science Global development Football Tech Business Obituaries

Fossil fuels

Fossil fuel industry gets subsidies of $11m a minute, IMF finds

Trillions of dollars a year are 'adding fuel to the fire' of the climate crisis, experts say

Damian Carrington
Environment editor
@dpcarrington
Wed 6 Oct 2021 07.00 BST

▲ A state-owned coal-fired power plant i in Huainan, Anhui province, China. Photograph: Kevin Frayer/Getty Images

The fossil fuel industry benefits from subsidies of $11m every minute, according to analysis by the International Monetary Fund.

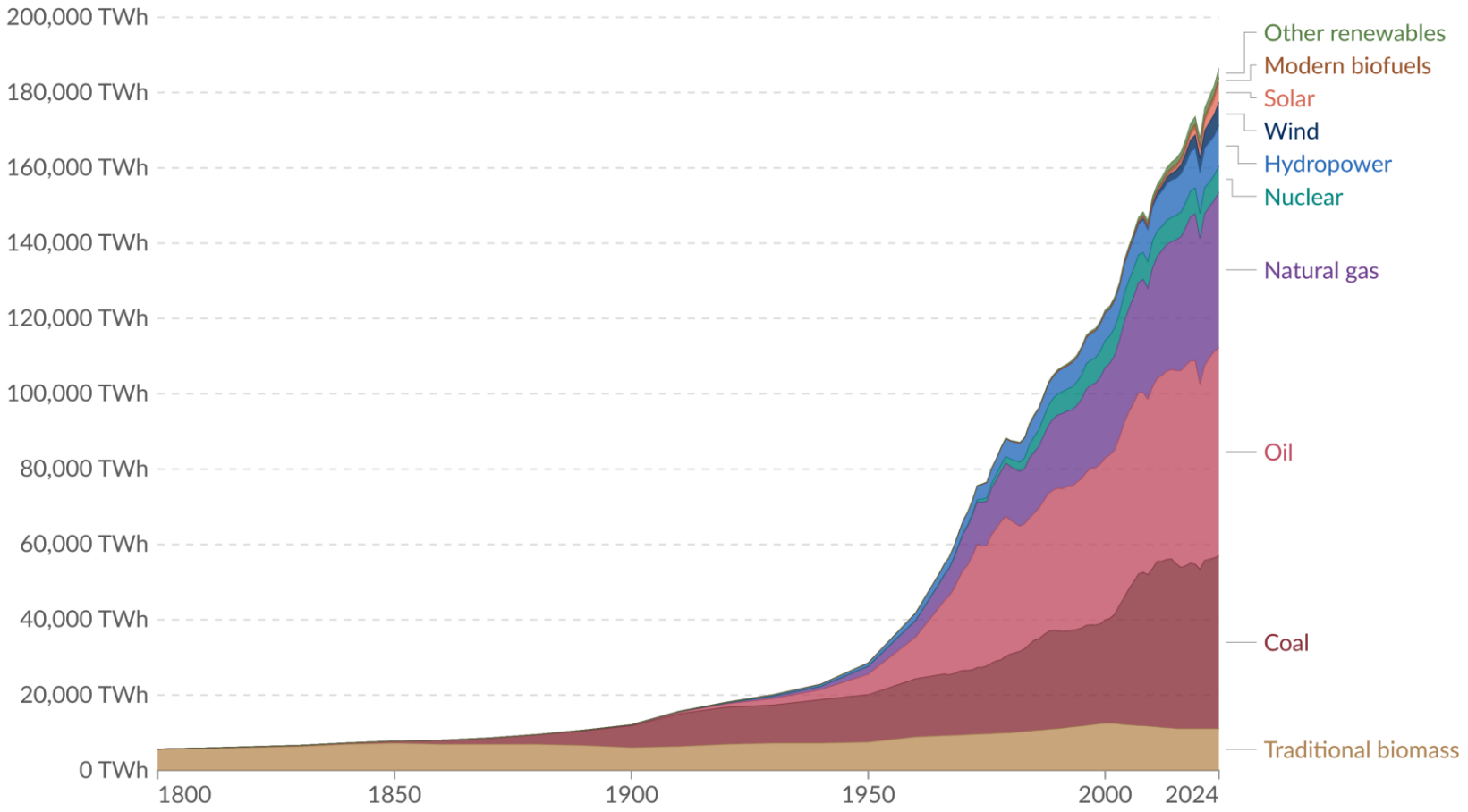
The IMF found the production and burning of coal, oil and gas was subsidised by $5.9tn in 2020, with not a single country pricing all its fuels sufficiently to reflect their full supply and environmental costs. Experts said the subsidies were "adding fuel to the fire" of the climate crisis, at a time when rapid reductions in carbon emissions were urgently needed.

Explicit subsidies that cut fuel prices accounted for 8% of the total and tax breaks another 6%. The biggest factors were failing to make polluters pay for the deaths and poor health caused by air pollution (43%) and for the

https://www.theguardian.com/environment/2021/oct/06/fossil-fuel-industry-subsidies-of-11m-dollars-a-minute-imf-finds

Global primary energy consumption by source

Primary energy[1] is based on the substitution method[2] and measured in terawatt-hours[3].



Data source: Energy Institute - Statistical Review of World Energy (2025); Smil (2017)

OurWorldinData.org/energy | CC BY

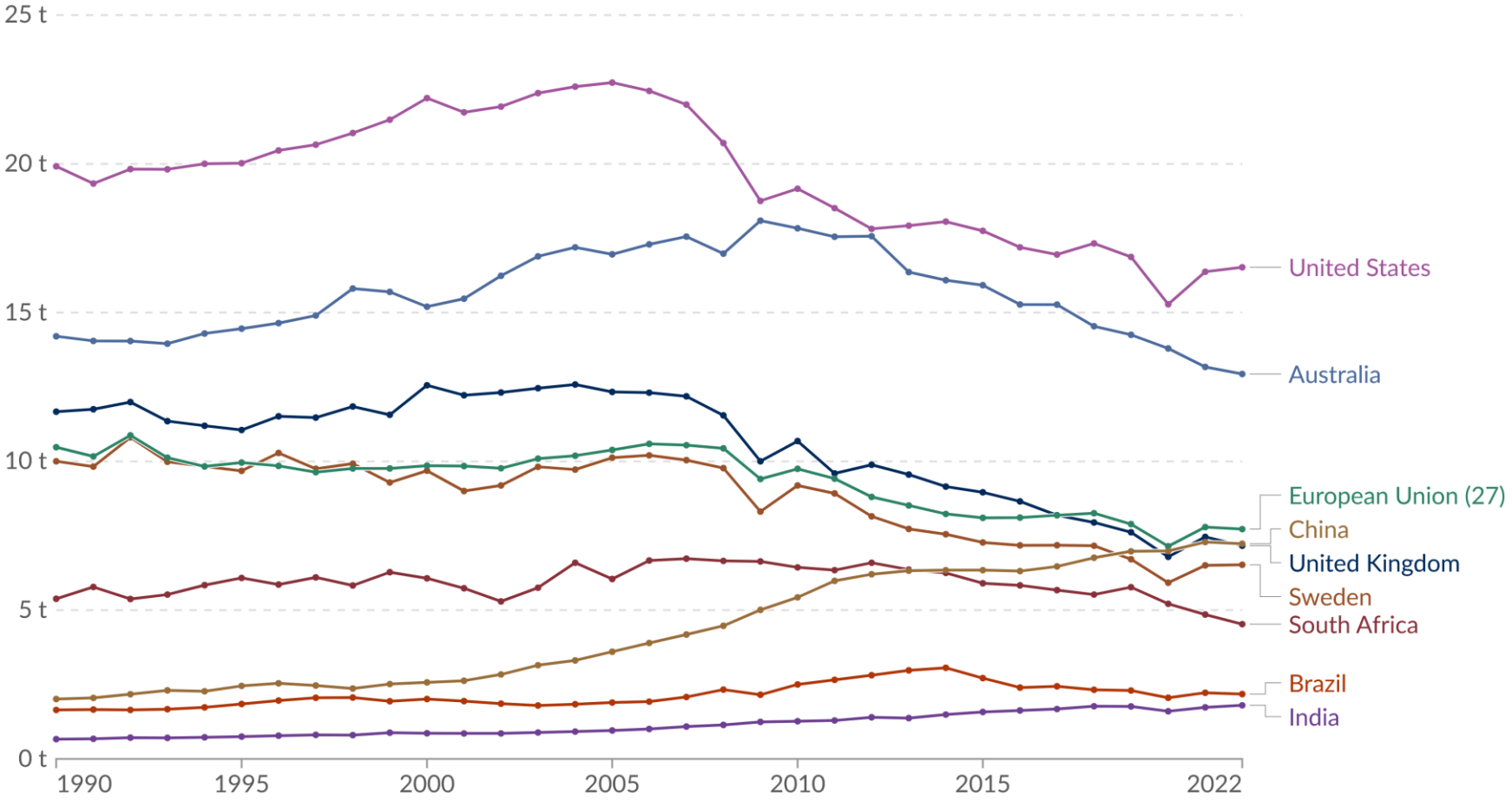
Note: In the absence of more recent data, traditional biomass is assumed constant since 2015.

https://ourworldindata.org/worlds-energy-problem

Per capita consumption-based CO_2 emissions

Our World in Data

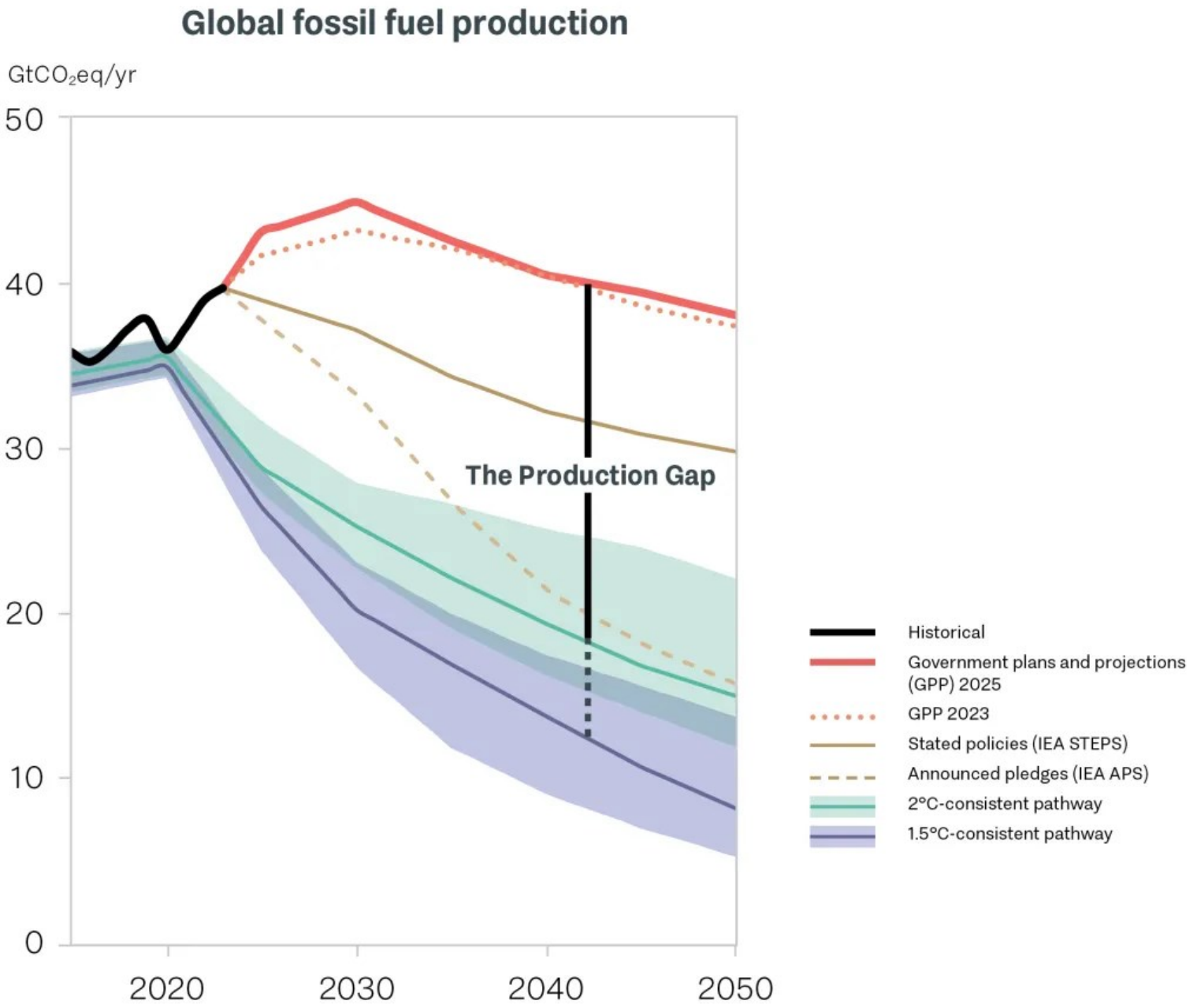
Consumption-based emissions[1] are national emissions that have been adjusted for trade. It's production-based emissions minus emissions embedded in exports, plus emissions embedded in imports.



Data source: Global Carbon Budget (2024); Population based on various sources (2024)

OurWorldinData.org/co2-and-greenhouse-gas-emissions | CC BY

https://ourworldindata.org/grapher/consumption-co2-per-capita



https://productiongap.org/2025report/

Take away

- Action is needed, knowledge based preferably
- The world is complex, sometime knowledge is missing
- The world is slow to change “No easy way out”
- The production gap remains
- Data is important – but only long term data
- Perspective is important
- It is easy to get depressed – best remedy is action and engagement

- Break

Putting Structure in the Problem

And

Recognizing that it is larger than just CO2 emissions

A good starting point:
http://www.un.org/sustainabledevelopment/sustainable-development-goals/

Click on Goal #9

INDUSTRY, INNOVATION AND INFRASTRUCTURE – WHY IT MATTERS (PDF)

Facts and figures | Goal 9 targets | Links

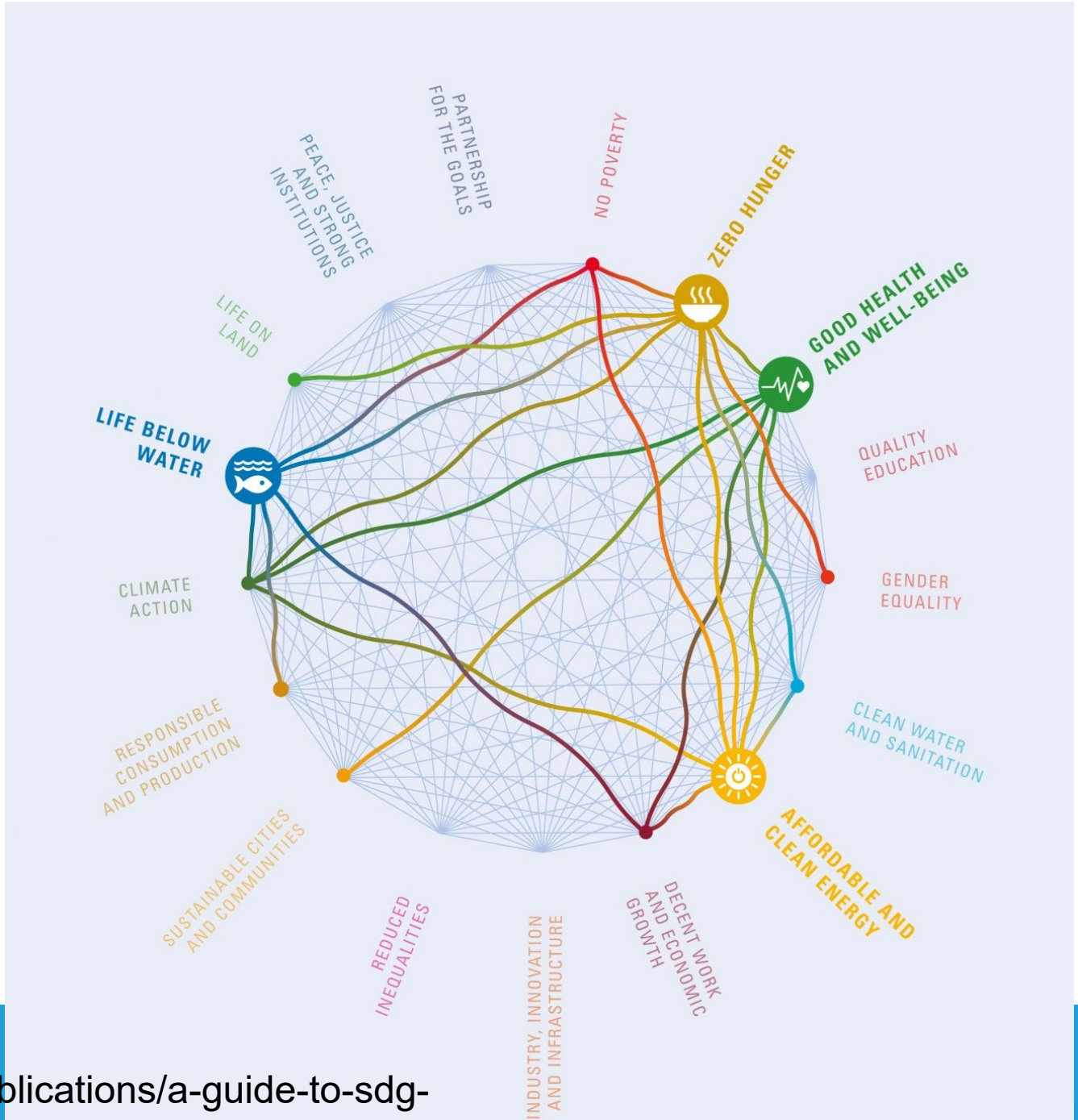
- Basic infrastructure like roads, information and communication technologies, sanitation, electrical power and water remains scarce in many developing countries
- About 2.6 billion people in the developing world are facing difficulties in accessing electricity full time
- 2.5 billion people worldwide lack access to basic sanitation and almost 800 million people lack access to water, many hundreds of millions of them in Sub Saharan Africa and South Asia
- 1-1.5 billion people do not have access to reliable phone services
- Quality infrastructure is positively related to the achievement of social, economic and political goals
- Inadequate infrastructure leads to a lack of access to markets, jobs, information and training, creating a major barrier to doing business
- Undeveloped infrastructures limits access to health care and education
- For many African countries, particularly the lower-income countries, the existent constraints regarding infrastructure affect firm productivity by around 40 per cent
- Manufacturing is an important employer, accounting for around 470 million jobs worldwide in 2009 – or around 16 per cent of the world's workforce of 2.9 billion. In 2013, it is estimated that there were more than half a billion jobs in manufacturing
- Industrialization's job multiplication effect has a positive impact on society. Every one job in manufacturing creates 2.2 jobs in other sectors
- Small and medium-sized enterprises that engage in industrial processing and manufacturing are the most critical for the early stages of industrialization and are typically the largest job creators. They make up over 90 per cent of business worldwide and account for between 50-60 per cent of employment
- In countries where data are available, the number of people employed in renewable energy sectors is presently around 2.3 million. Given the present gaps in information, this is no doubt a very conservative figure. Because of strong rising interest in energy alternatives, the possible total employment for renewables by 2030 is 20 million jobs
- Least developed countries have immense potential for industrialization in food and beverages (agro-industry), and textiles and garments, with good prospects for sustained employment generation and higher productivity
- Middle-income countries can benefit from entering the basic and fabricated metals industries, which offer a range of products facing rapidly growing international demand
- In developing countries, barely 30 per cent of agricultural production undergoes industrial processing. In high-income countries, 98 per cent is processed. This suggests that there are great opportunities for developing countries in agribusiness

INDUSTRY, INNOVATION AND INFRASTRUCTURE – WHY IT MATTERS (PDF)

Facts and figures | Goal 9 targets | Links

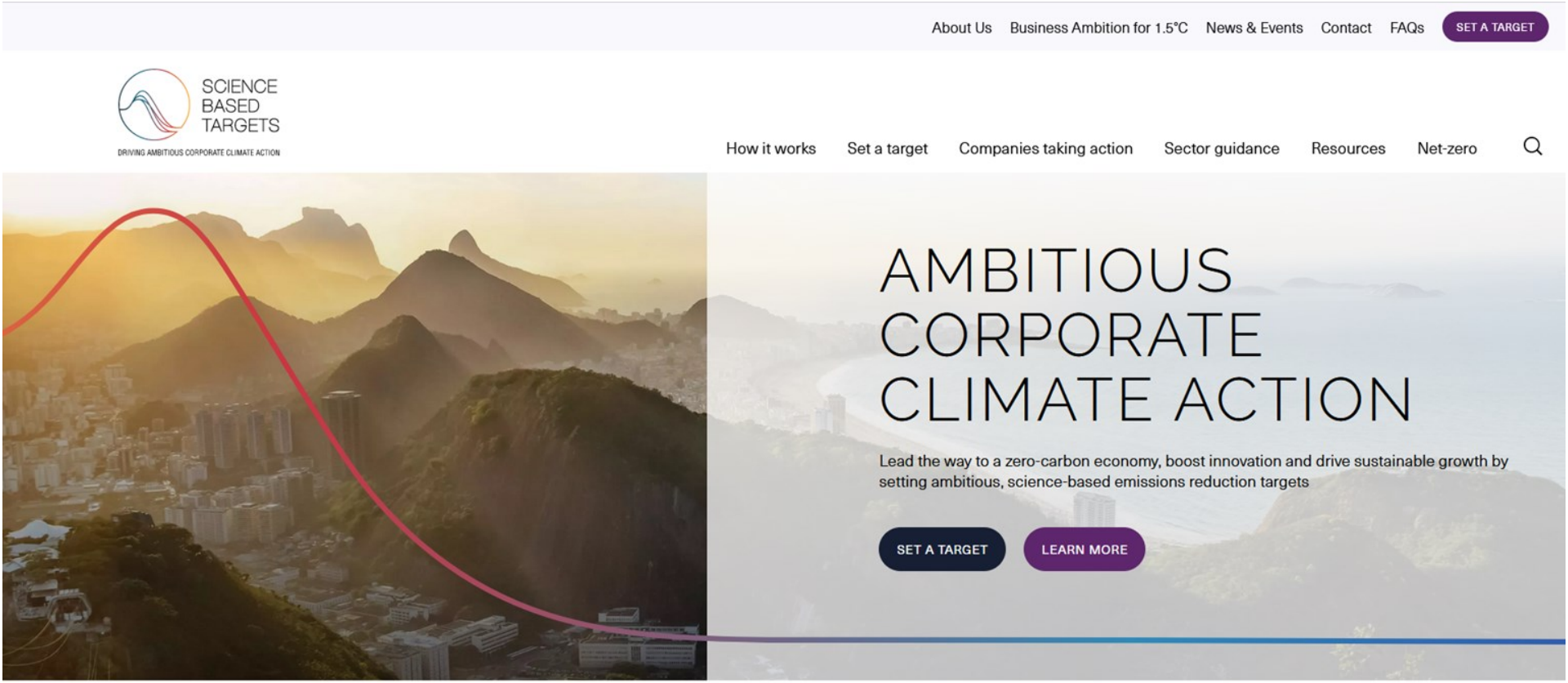
- Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all
- Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries
- Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets
- By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
- Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending
- Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States 18
- Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities
- Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020

Inter-connection of the goals



https://council.science/publications/a-guide-to-sdg-interactions-from-science-to-implementation/

Science Based Target Initiative



https://sciencebasedtargets.org/

Science Based Target Initiative, how to use the SDGs to guid corporate actions

- Motto ”Business Ambition for 1.5°C”
- Initiative for companies who want to be leading in climate action
- Partners
  - CDP a not-for-profit charity
  - United Nations Global Compact
  - World Resources Institute (WRI)
  - World Wide Fund for Nature (WWF)
- Objectives
  - Defines best practice in emissions reductions and net-zero targets
  - Provides technical assistance and expert to companies
  - Independent assessment and validation of targets.
  - Mobilizing companies to set net-zero science-based targets in line with a 1.5°C future.

https://sciencebasedtargets.org/

Recent Controversy

- April 2024
- Cause: Allow offsets
- Risk of Greenwashing

- It illustrates the difficult balance

Emissions trading

The age of extinction is supported by

the guardian .org

About this content

Patrick Greenfield *and* **Fiona Harvey**

Thu 11 Apr 2024 15.11 CEST

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Climate target organisation faces staff revolt over carbon-offsetting plan

Employees at SBTi have called for their CEO to resign over controversial plans which they fear will enable greenwashing

Luiz Fernando do Amaral, CEO of the Science Based Targets initiative (SBTi), which certifies whether a company is on track to help limit global heating to under 1.5C. Photograph: Valeriano Di Domenico/World Economic Forum

Staff at one of the world's leading climate-certification organisations have called for the CEO and board members to resign after they announced plans to allow companies to meet their climate targets with carbon offsets.

They fear that companies will use the offsets for greenwashing, while avoiding making the necessary cuts in greenhouse gas emissions - without which the world faces climate catastrophe.

The UN-backed Science Based Targets initiative (SBTi), which certifies whether a company is on track to help limit global heating to under 1.5C, has validated hundreds of net zero plans from companies including J Sainsbury plc, John Lewis and Maersk. Until now, the SBTi has ruled out the use of carbon offsets, instead emphasising the importance of deep greenhouse gas

https://www.theguardian.com/environment/2024/apr/11/climate-target-organisation-faces-staff-revolt-over-carbon-offsetting-plan-sbti

- Any question?
- Maybe one for you:

How can you develop sustainability aspects in your project?

Let’s take a break