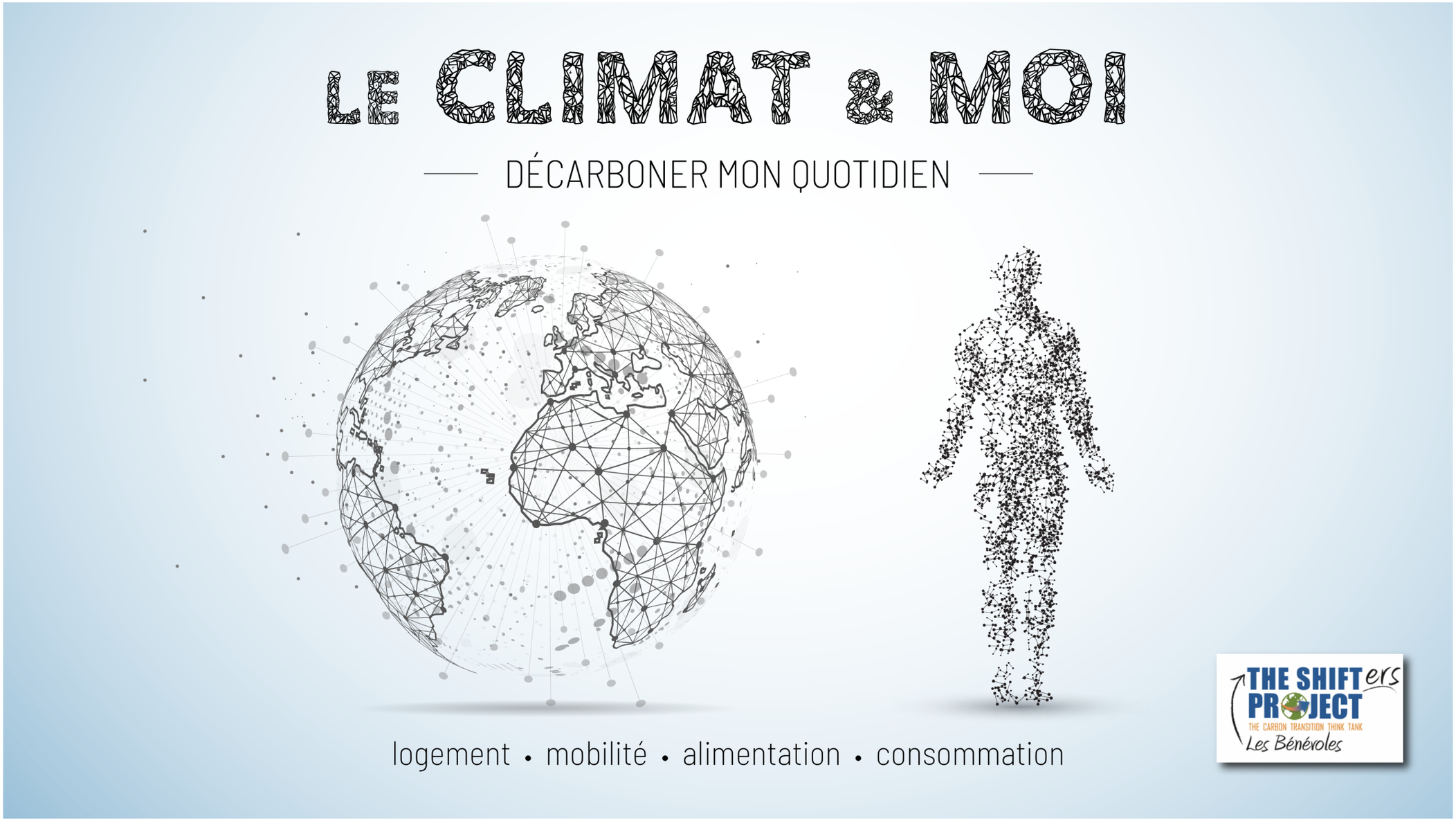
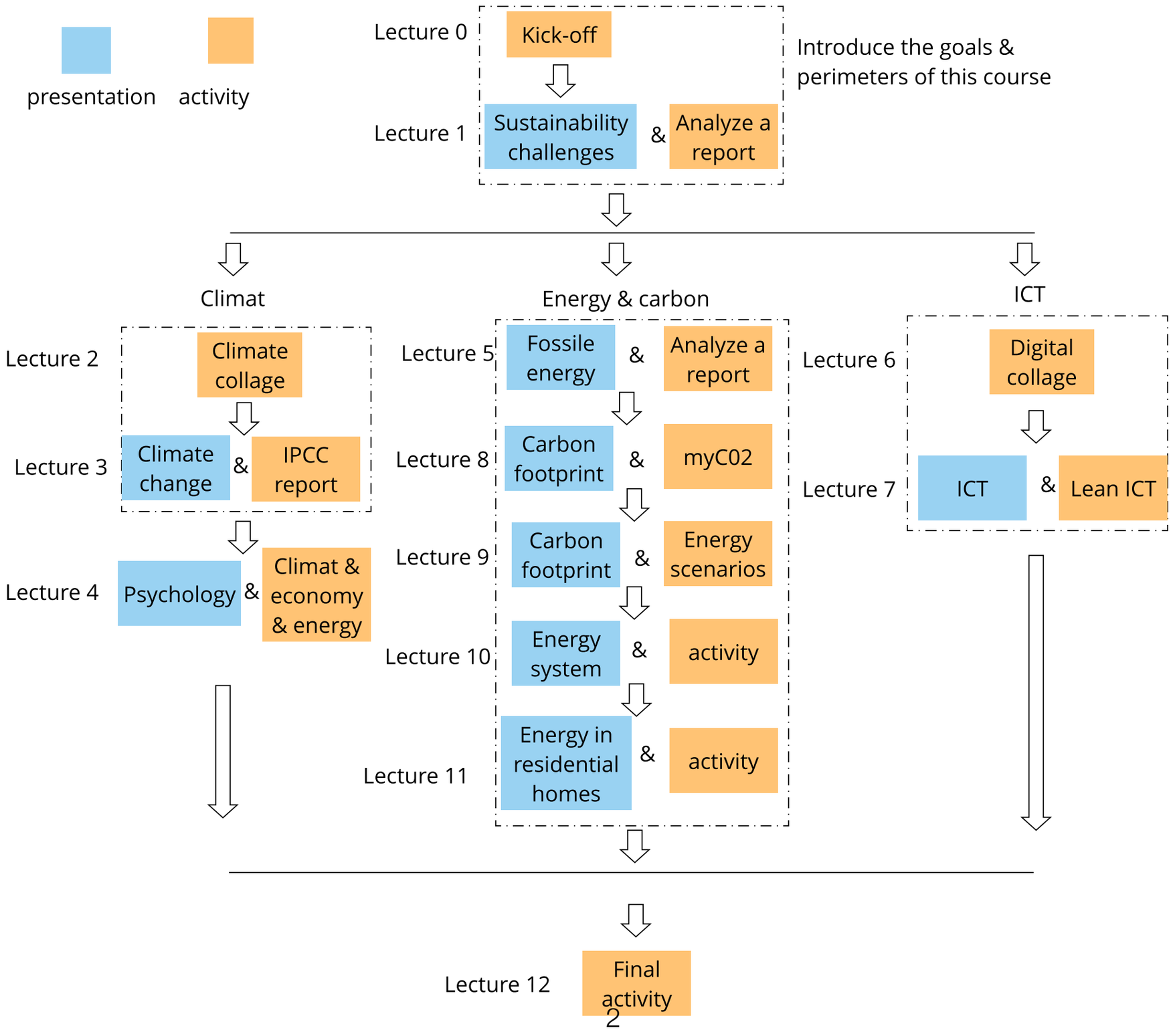
ENVT3065 Sustainability challenges
Lecture 1



Credits: https://theshiftproject.org/equipe/#benevoles

Lecture 1

Course map



Lecture 1

Credits

This lecture is mainly based on:

- Sustainable development & Transition given at the **Catholic University of Louvain** (UCL LEPL 1804). Professors: Bol David; Jeanmart Hervé; Luis Alconero Patricia; Marichal Xavier; Raskin Jean-Pierre;

- Sustainability development bachelor & lecture of Liège University. Professor: Aurore Degré.

- Jean-Marc Jancovici blog

Lecture 1

Goals

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges's perimeter

Energy

Rebound effect

Challenges

Lecture 1

Sustainable development

Quiz: What is sustainable development for you?

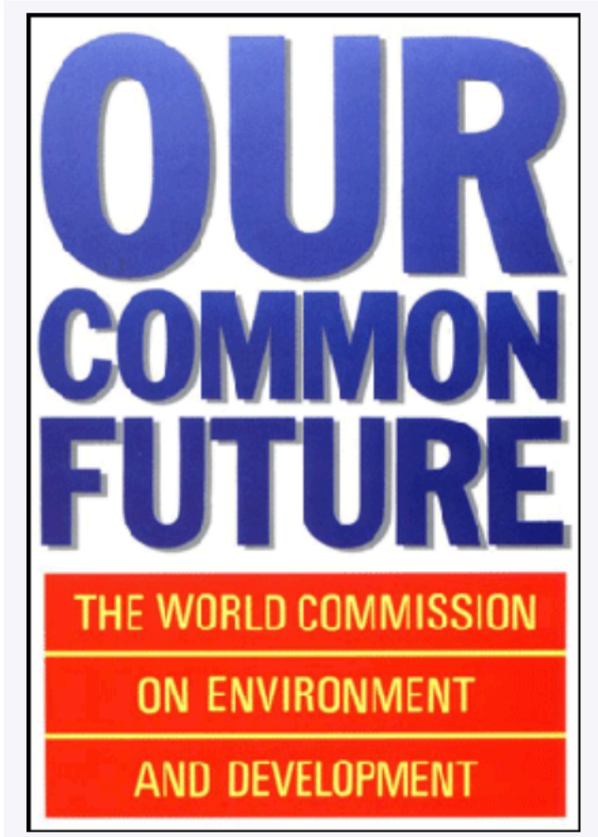
Lecture 1

Sustainable development

Our Common Future is also known as the Brundtland Report, was published in October 1987 by the United Nations through the Oxford University Press.

The report defined '**sustainable development**' as "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*".

Imperatives, Strategic. "Report of the World Commission on Environment and Development: Our common future." Accessed Feb 10 (1987): 1-300.



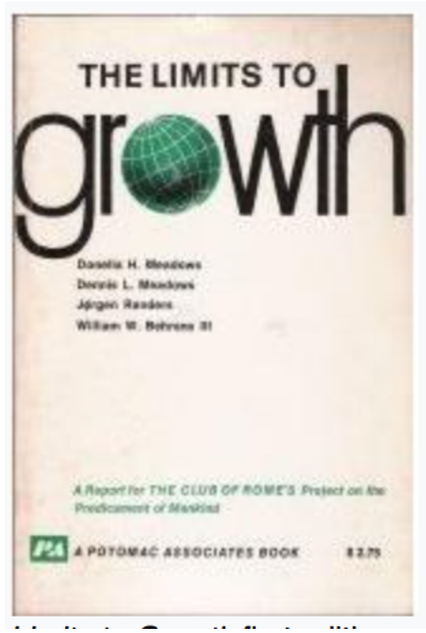
Lecture 1

Sustainable development

The limits to growth is a 1972 report on the exponential economic and population growth with a finite supply of resources, **studied by computer simulation**.

Commissioned by the Club of Rome, the study's findings were first presented at international gatherings in Moscow and Rio de Janeiro in the summer of 1971. The report's authors are *Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, representing a team of 17 researchers*.

Meadows, Dennis, and Jorgan Randers. The limits to growth: the 30-year update. Routledge, 2012.

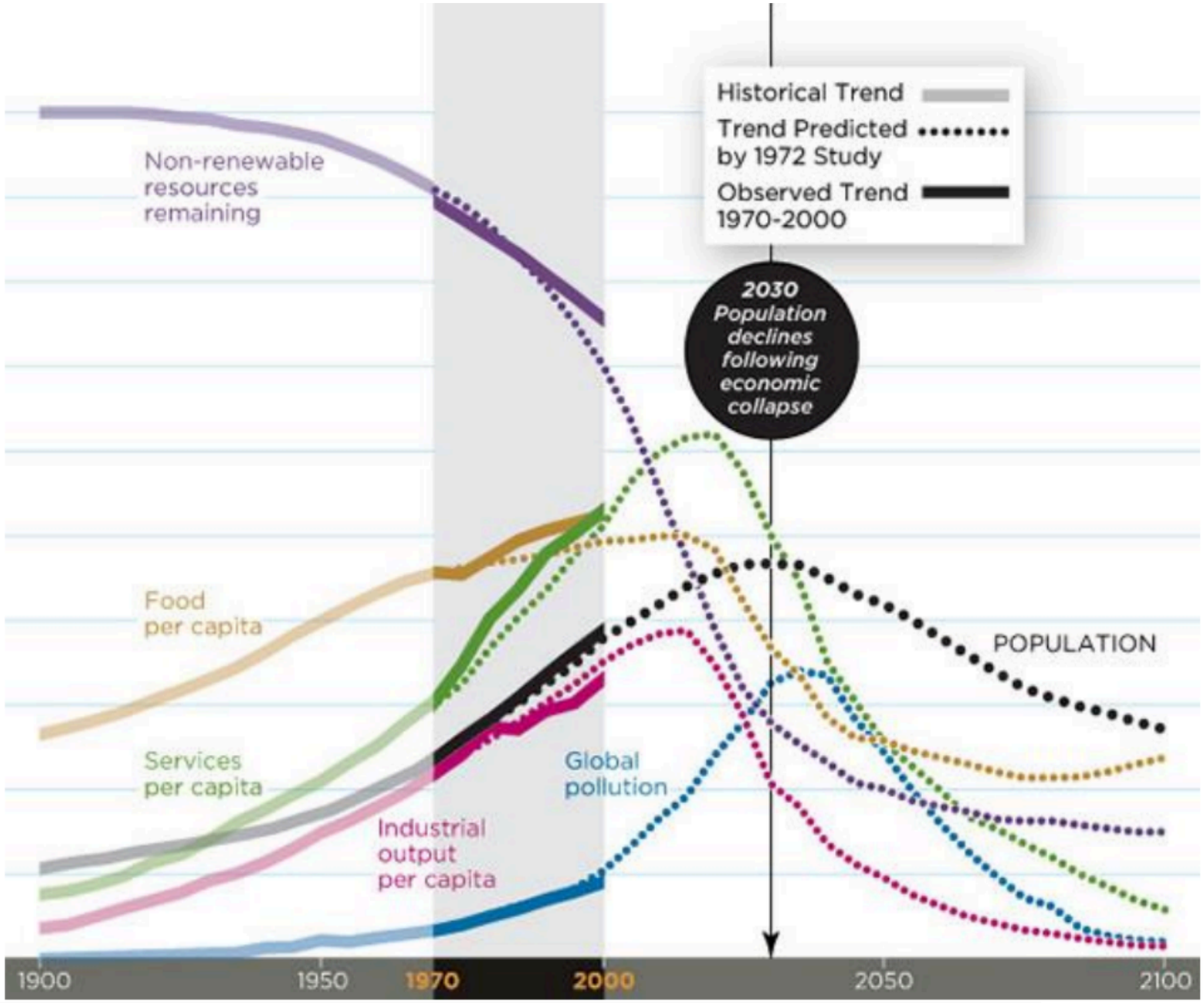


Lecture 1

Sustainable development

1970 - 2000: the data are in line with the model!

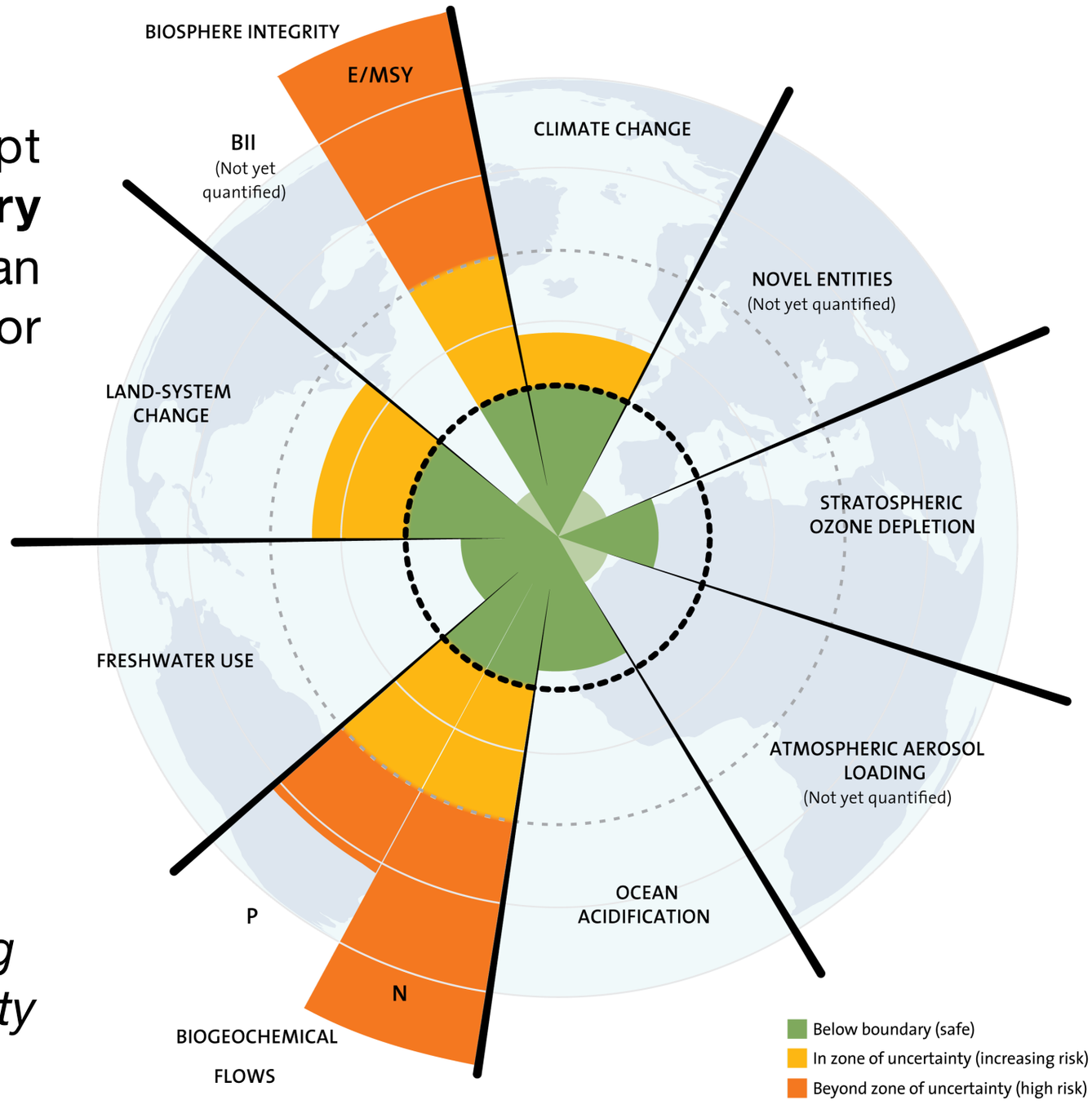
Major trends:
- depletion of non-renewable resources
- malnutrition
- increase in the quality of services
- rapid population growth
- accelerated industrialization
- deteriorated environment



Lecture 1
Sustainable development: planetary boundaries

The planetary boundaries concept presents a set of **nine planetary boundaries** within which humanity can continue to develop and thrive for generations to come.

https://www.stockholmresilience.org/research/planetary-boundaries.html



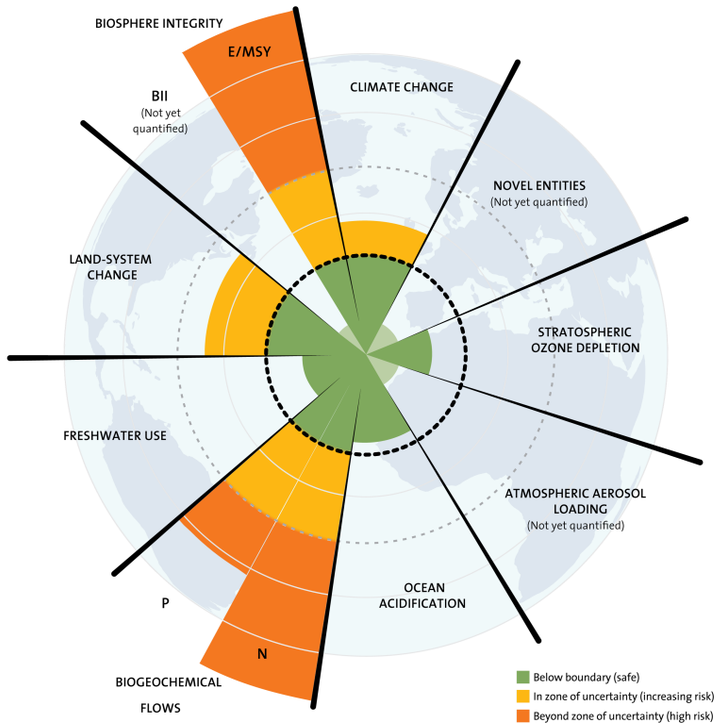
Rockström, Johan, et al. "Planetary boundaries: exploring the safe operating space for humanity." Ecology and society 14.2 (2009).

Credits: J. Lokrantz/Azote based on Steffen et al. 2015.

Lecture 1
Sustainable development: planetary boundaries

To go further:

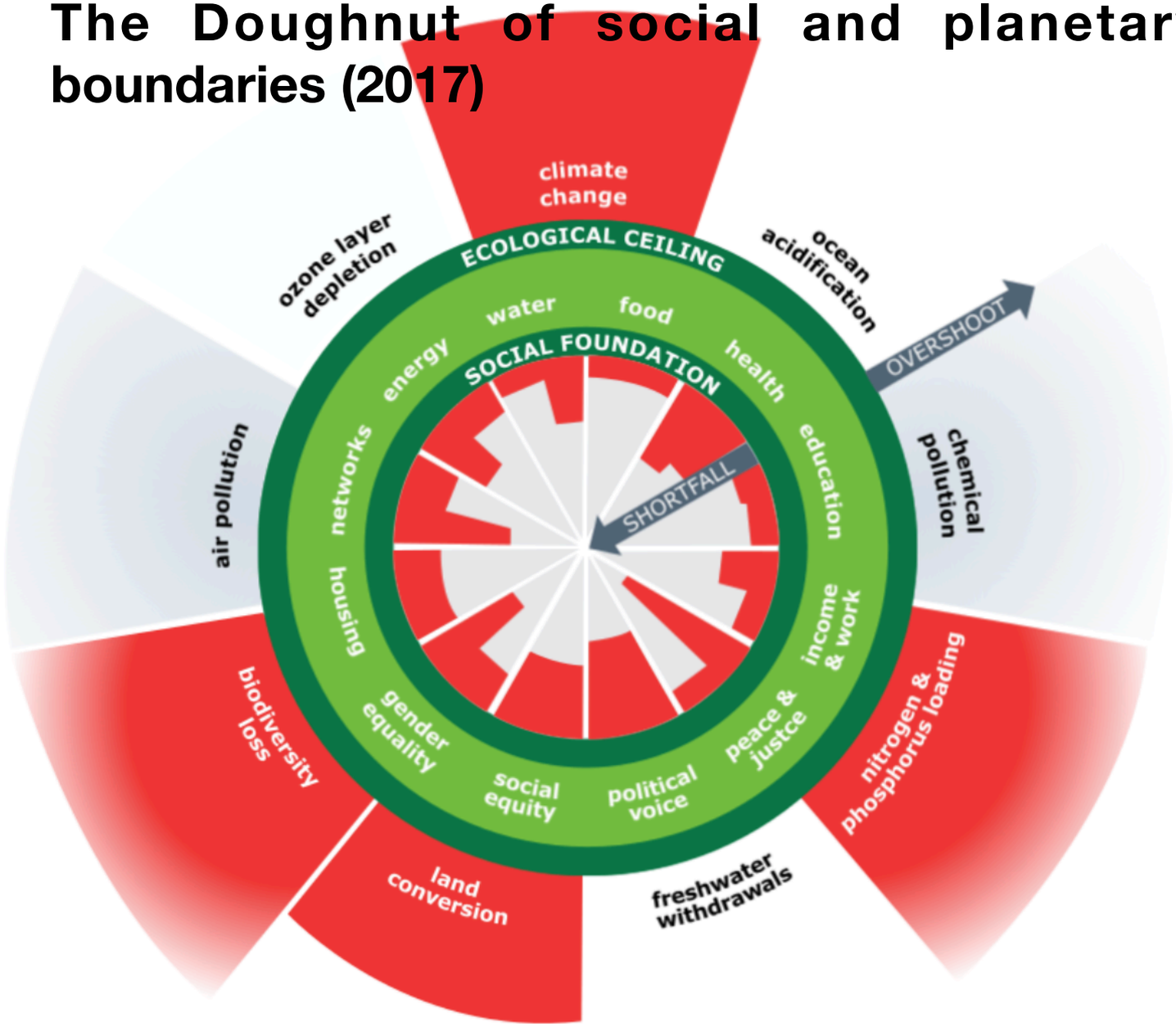
Johan Rockström introduces the Planetary Boundaries framework at TED Global 2010. https://youtu.be/RgqtrlixYR4



Steffen, Will, et al. "Planetary boundaries: Guiding human development on a changing planet." Science 347.6223 (2015). https://science.sciencemag.org/content/347/6223/1259855

Lecture 1
Sustainable development: DONUT !

The Doughnut of social and planetary boundaries (2017)

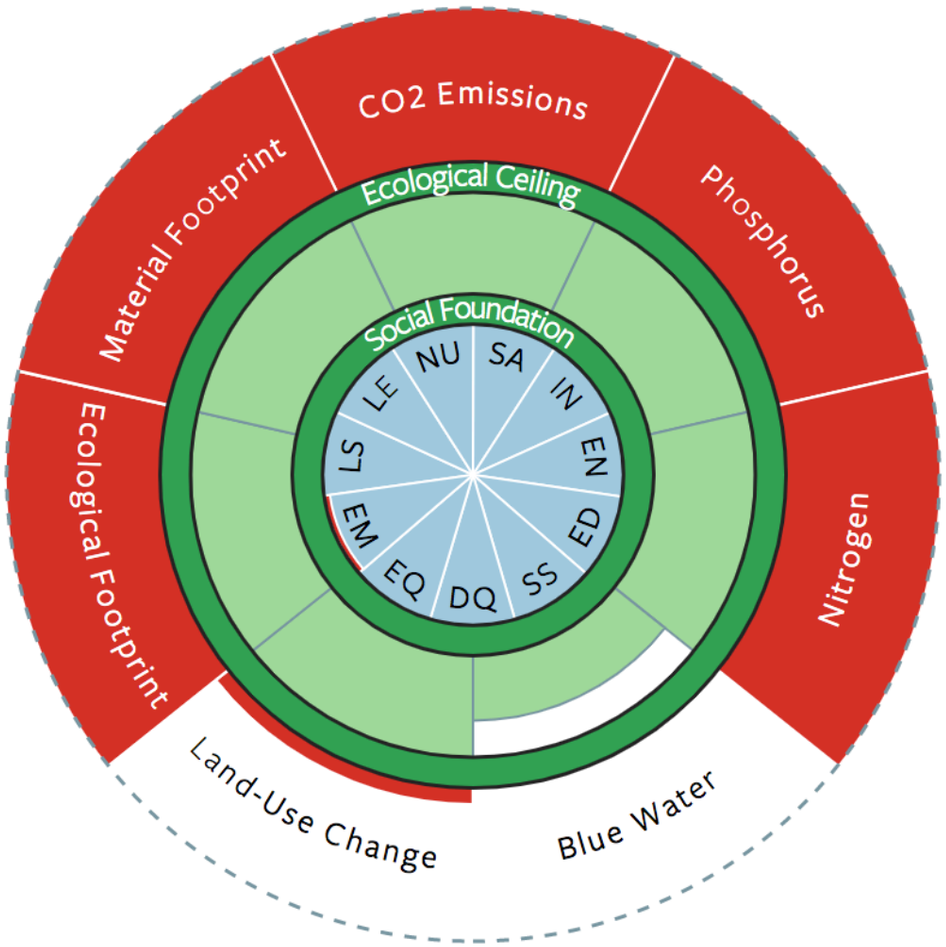


TED: A healthy economy should be designed to thrive, not grow

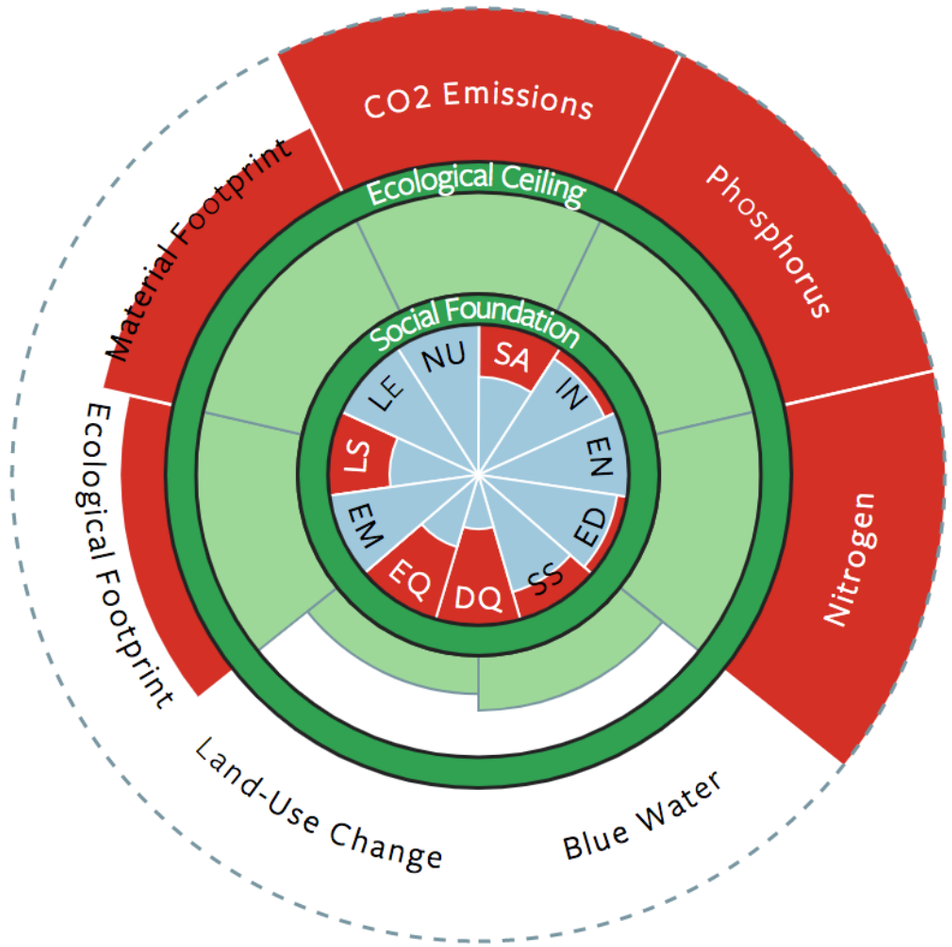
https://www.kateraworth.com/doughnut/

Lecture 1
Sustainable development: DONUT !

Belgium



China

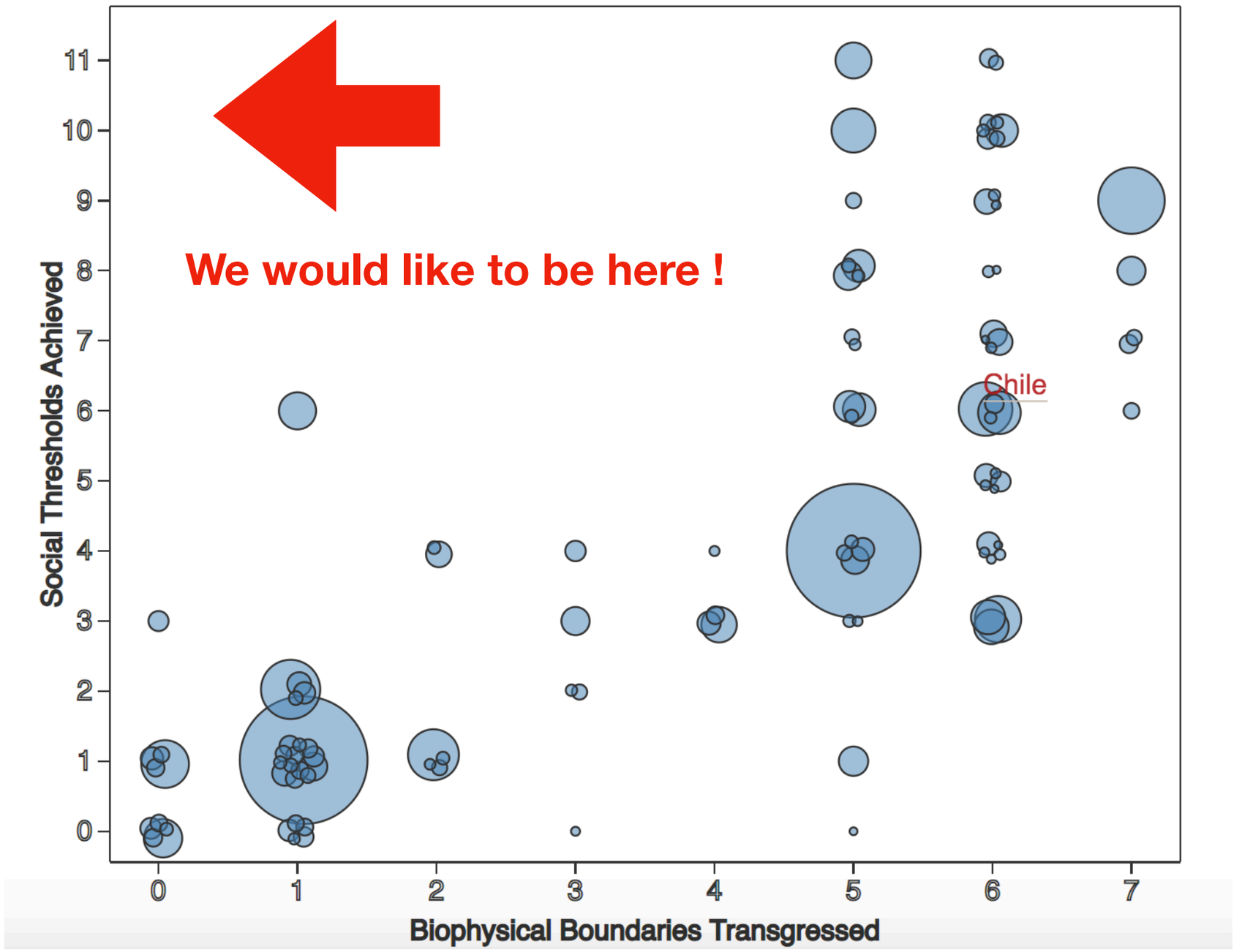


LS - Life Satisfaction	ED - Education
LE - Healthy Life Expect.	SS - Social Support
NU - Nutrition	DQ - Democratic Quality
SA - Sanitation	EQ - Equality
IN - Income	EM - Employment
EN - Access to Energy	

A Good Life For All Within Planetary Boundaries

https://goodlife.leeds.ac.uk/

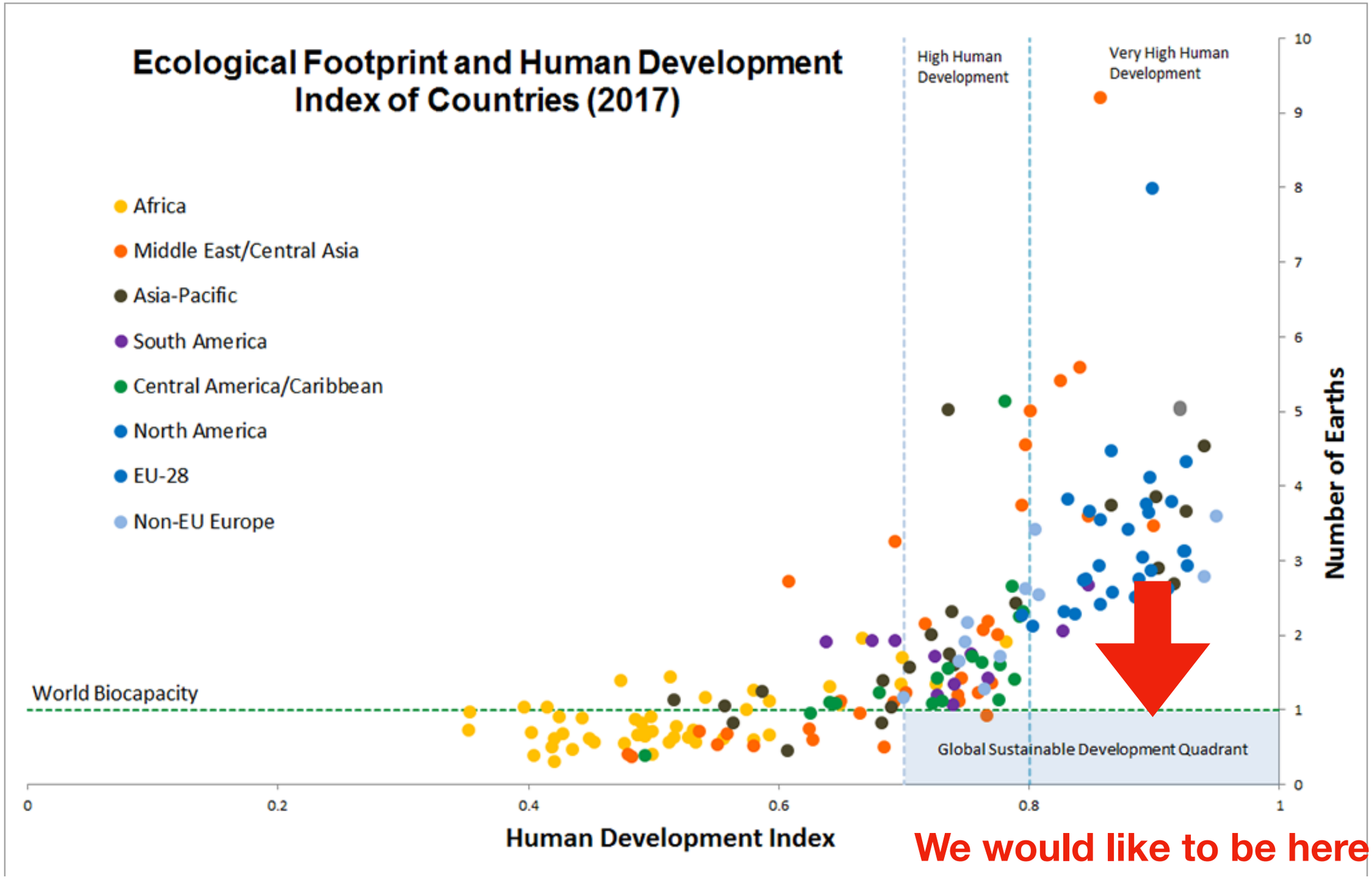
Lecture 1
Sustainable development: boundaries vs social thresholds



Biophysical Boundaries Transgressed versus Social Thresholds Achieved by Nation

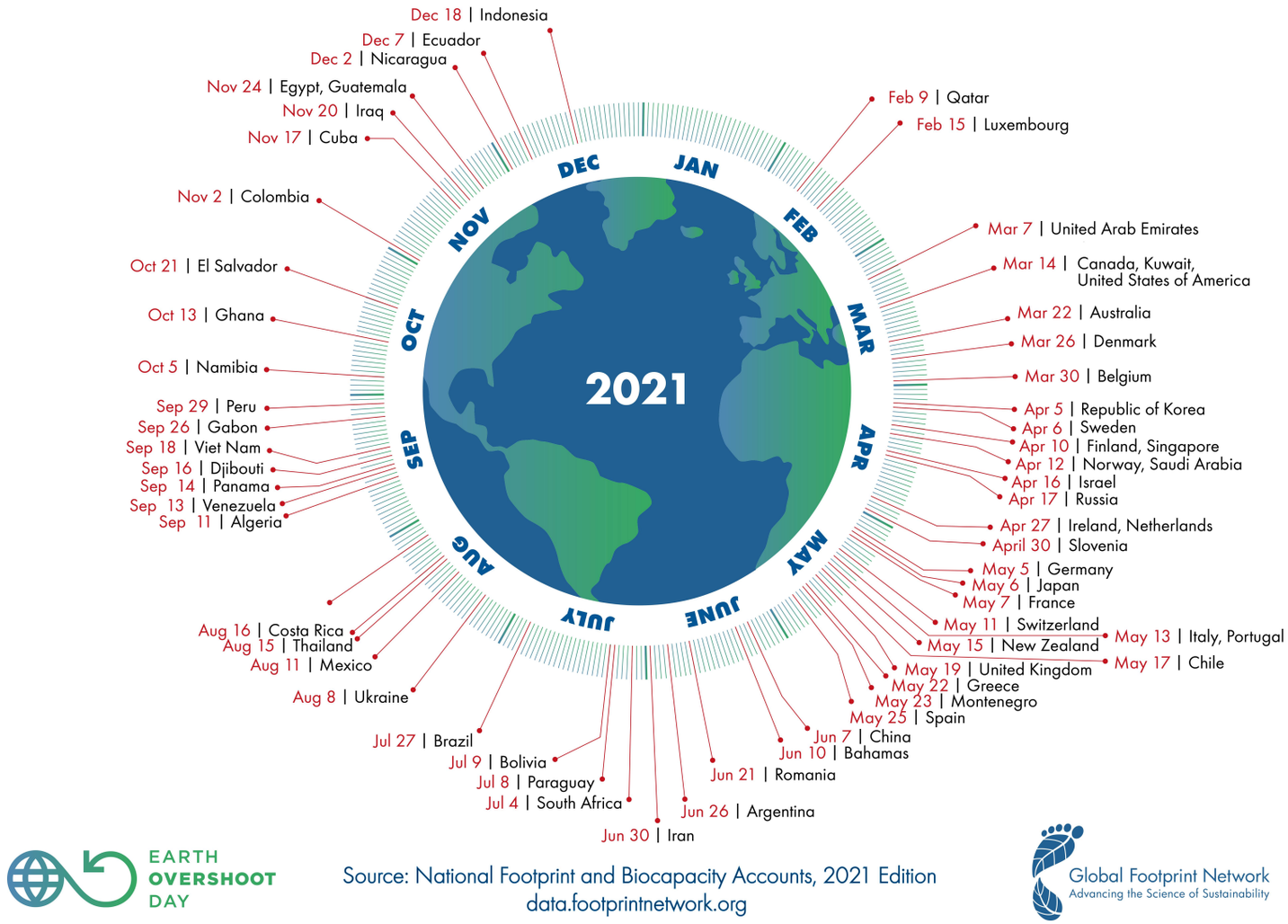
https://goodlife.leeds.ac.uk/

Lecture 1
Sustainable development: ecological footprint vs HDI



https://www.footprintnetwork.org/our-work/sustainable-development/

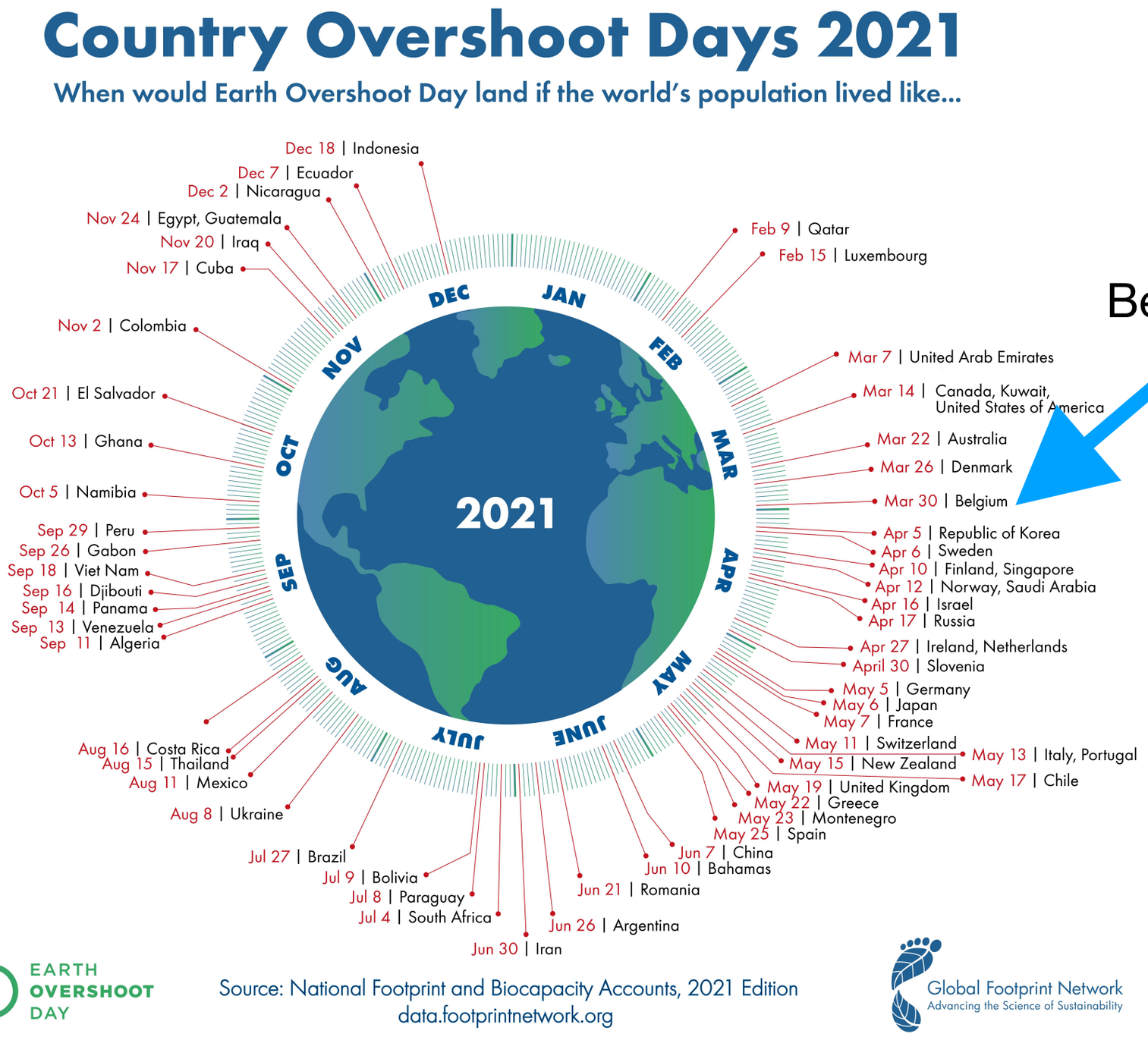
Lecture 1
Sustainable development: country overshoot day



A **country's overshoot day** is when Earth Overshoot Day would fall if all of humanity consumed like the people in this country.
https://www.overshootday.org/newsroom/country-overshoot-days/

Lecture 1
Sustainable development: country overshoot day

In 2021, Earth Overshoot Day lands on July 29.



Belgium

Lecture 1

Goals

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges's perimeter

Energy

Rebound effect

Challenges

Lecture 1
Sustainable Development Goals

UN Sustainable Development Goals SDGs

Quiz: Do you know the **15 SDGs** ?

https://youtu.be/0XTBYMfZyrM

Lecture 1
Sustainable Development Goals

https://www.un.org/sustainabledevelopment/news/communications-material/

Lecture 1

Goals

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges's perimeter

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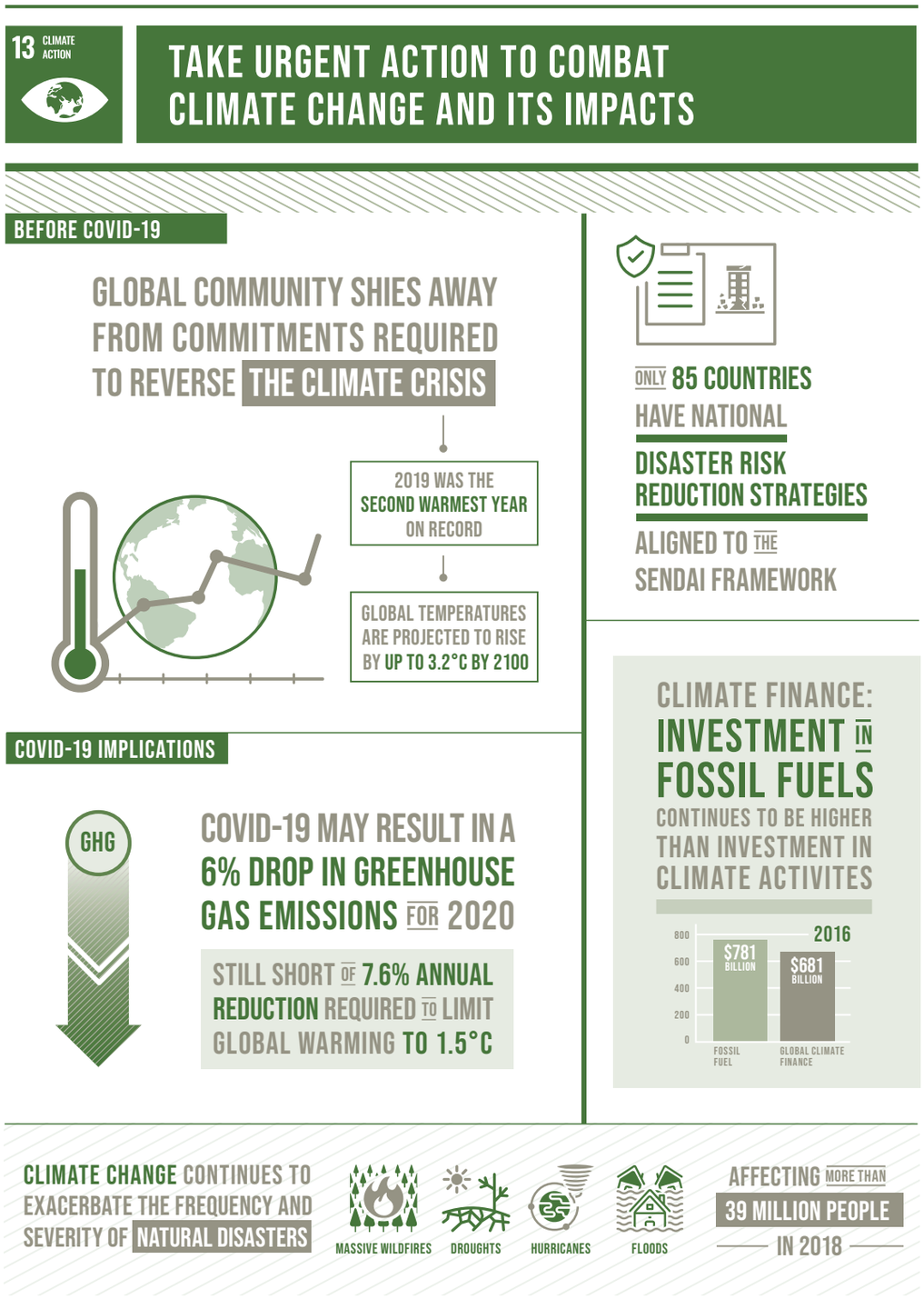
Lecture 1

Course perimeter

https://www.un.org/sustainabledevelopment/news/communications-material/

Lecture 1

Climat Change



13 CLIMATE ACTION

To limit global warming to 1.5C, as called for in the Paris Agreement, greenhouse gas emissions must begin falling by **7.6 % each year** starting in 2020

CLIMATE ACTION: WHY IT MATTERS

What's the goal here?

Taking urgent action to tackle climate change and its impacts.

Why?

The climate crisis continues unabated as the global community shies away from the full commitment required for its reversal. 2010-2019 was warmest decade ever recorded, bringing with it massive wildfires, hurricanes, droughts, floods and other climate disasters across continents.

How are people being affected by climate change?

Climate change is affecting every country in the world. It is disrupting national economies and affecting lives and livelihoods, especially for the most vulnerable.

Weather patterns are changing, sea levels are rising, and weather events are becoming more extreme,

Lecture 1

Climat Change: IPCC

Quiz: do you know the IPCC?

The Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.

Understand how works the IPCC and its reports: https://youtu.be/C_UTITiVQ_0 (Le réveilleur)

AR6 Climate Change 2021: The Physical Science Basis
https://www.ipcc.ch/report/ar6/wg1/

« The Working Group I contribution to the Sixth Assessment Report addresses the **most up-to-date physical understanding of the climate system and climate change**, bringing together the latest advances in climate science, and combining multiple lines of evidence from paleoclimate, observations, process understanding, and global and regional climate simulations. »

Lecture 1

Climat Change: IPCC

« The Summary for Policymakers (SPM) provides **a high-level summary of the understanding of the current state of the climate**, including how it is changing and the role of human influence, and the state of knowledge about possible climate futures, climate information relevant to regions and sectors, and limiting human-induced climate change. (39 pages) »
https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

A.1 It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

{2.2, 2.3, Cross-Chapter Box 2.3, 3.3, 3.4, 3.5, 3.6, 3.8, 5.2, 5.3, 6.4, 7.3, 8.3, 9.2, 9.3, 9.5, 9.6, Cross-Chapter Box 9.1} **(Figure SPM.1, Figure SPM.2)**

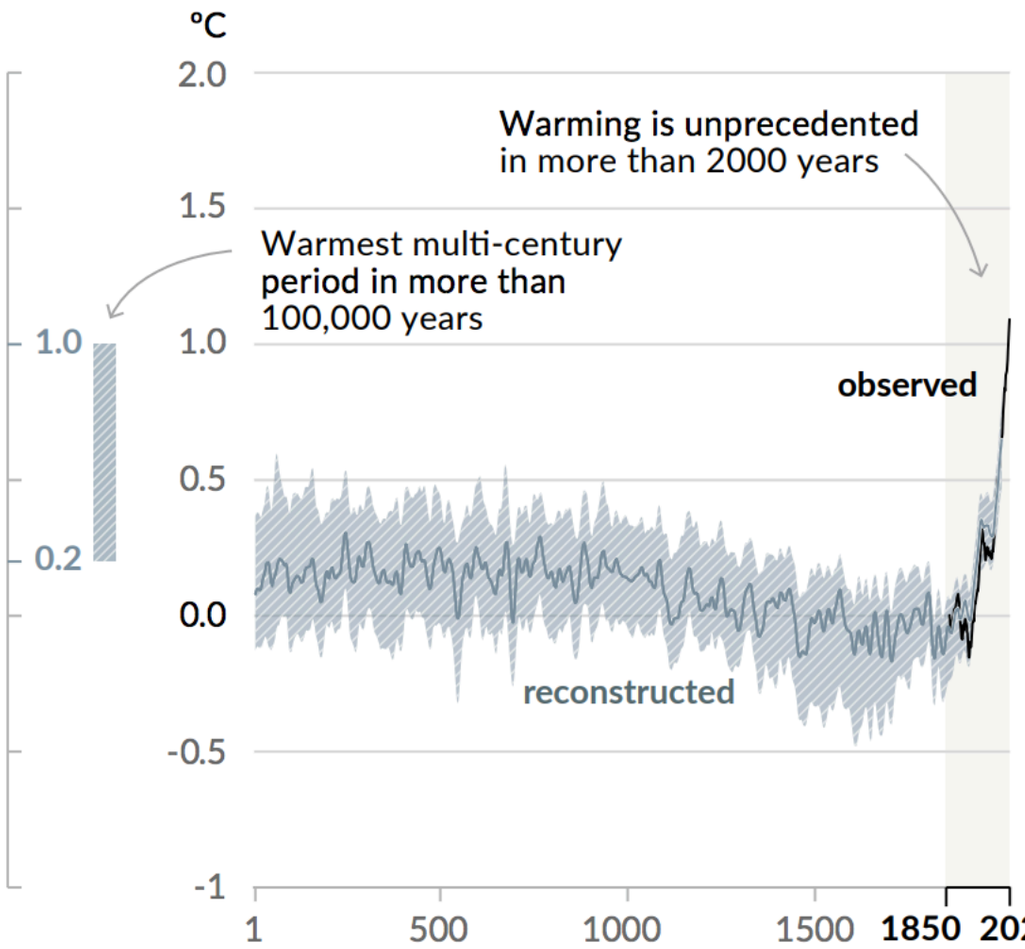
Lecture 1

Climat Change: IPCC

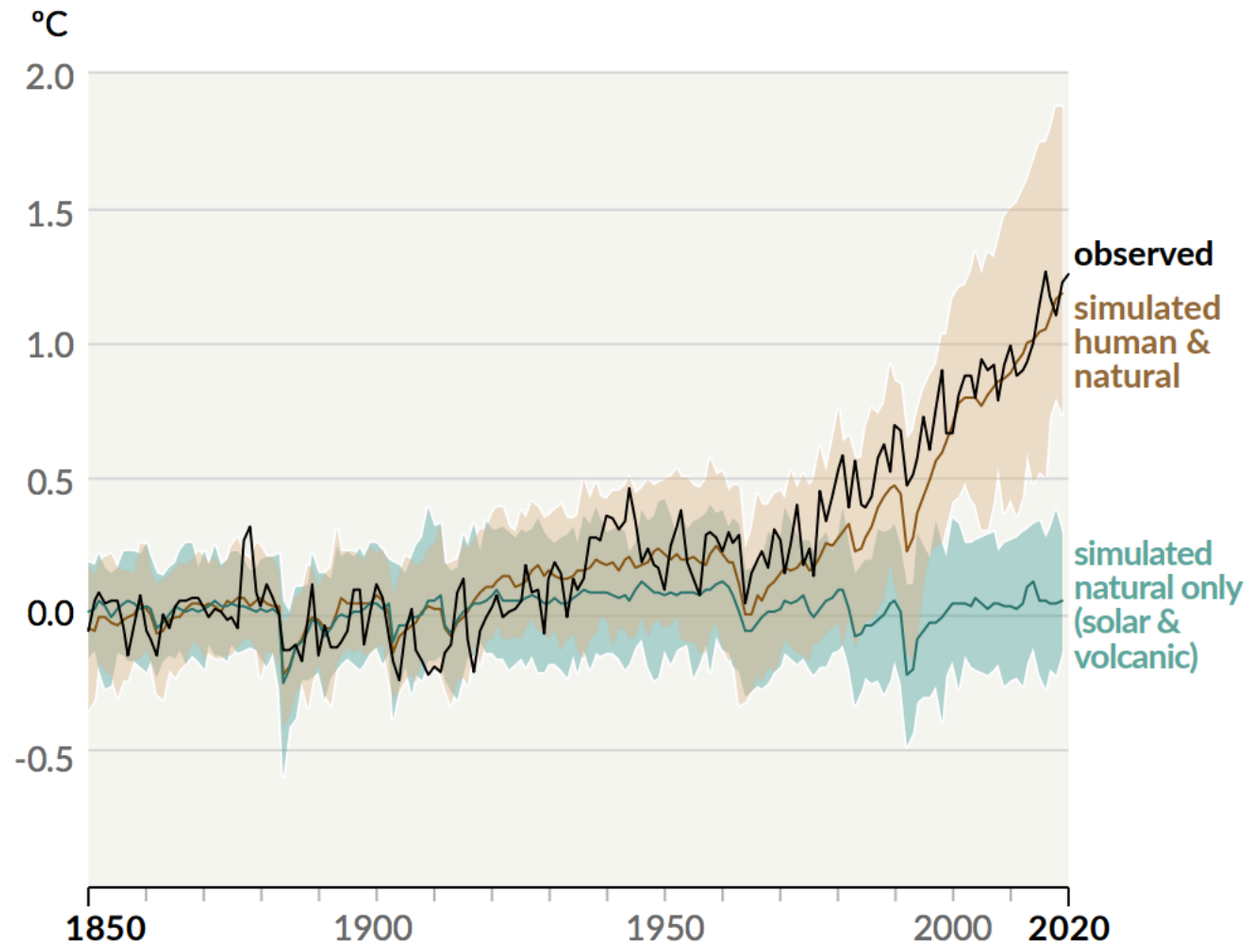
« Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years »

Changes in global surface temperature relative to 1850-1900

a) Change in global surface temperature (decadal average) as reconstructed (1-2000) and **observed** (1850-2020)



b) Change in global surface temperature (annual average) as **observed** and simulated using human & natural and only natural factors (both 1850-2020)

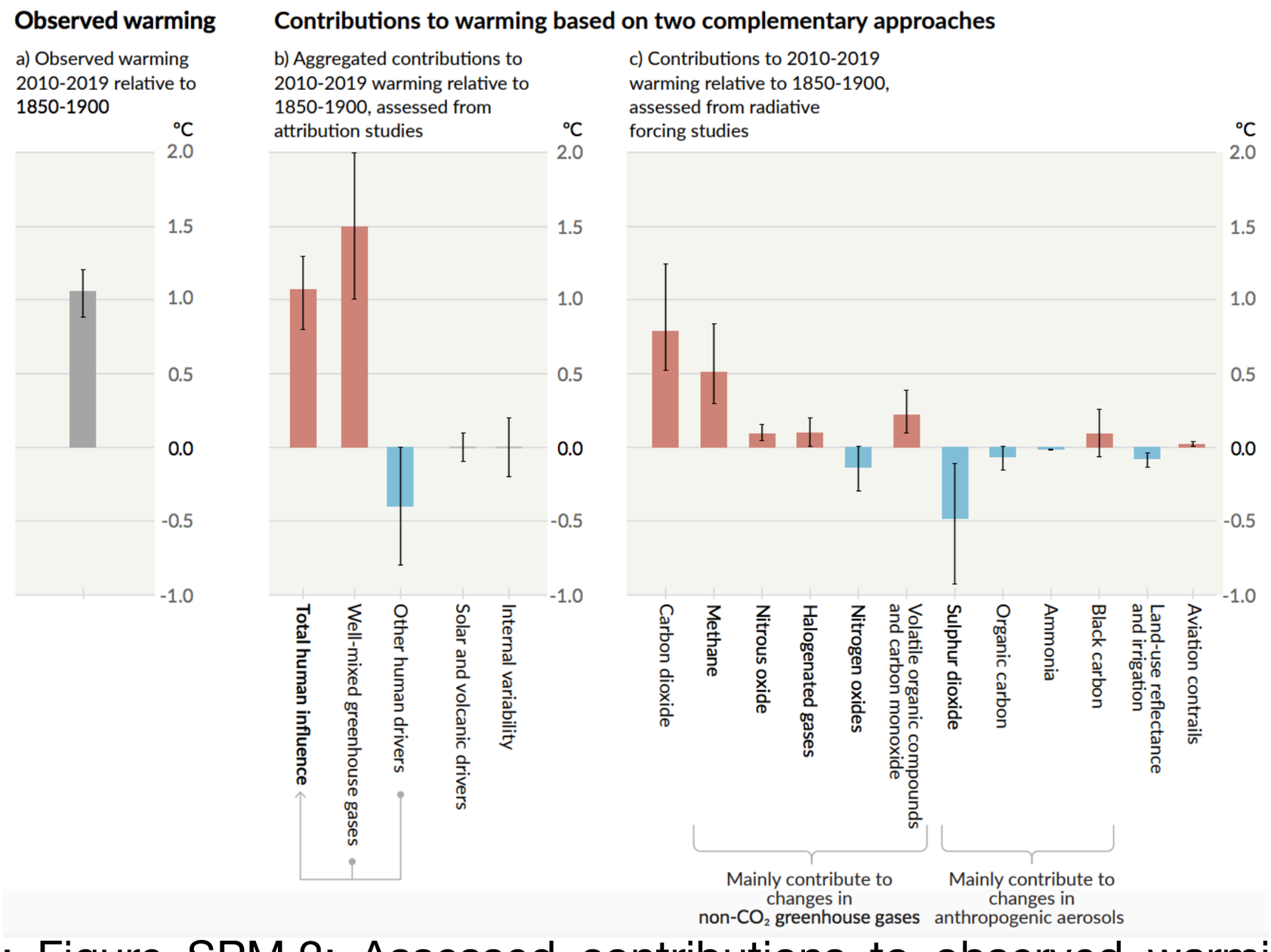


Credits: Figure SPM.1: History of global temperature change and causes of recent warming.

Lecture 1

Climat Change: IPCC

« Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling »

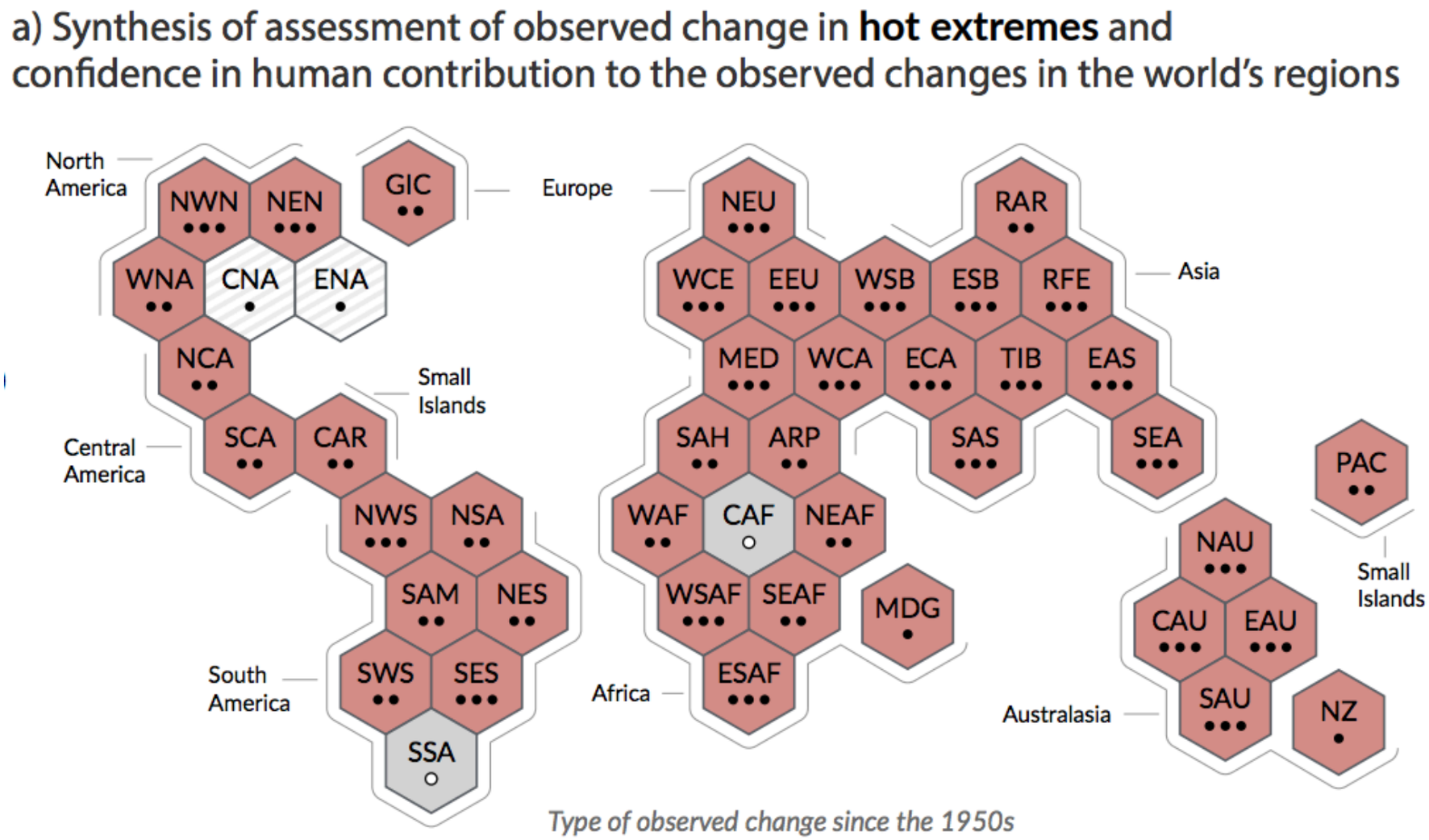


Credits: Figure SPM.2: Assessed contributions to observed warming in 2010–2019 relative to 1850–1900.

Lecture 1

Climat Change: IPCC

« Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes »

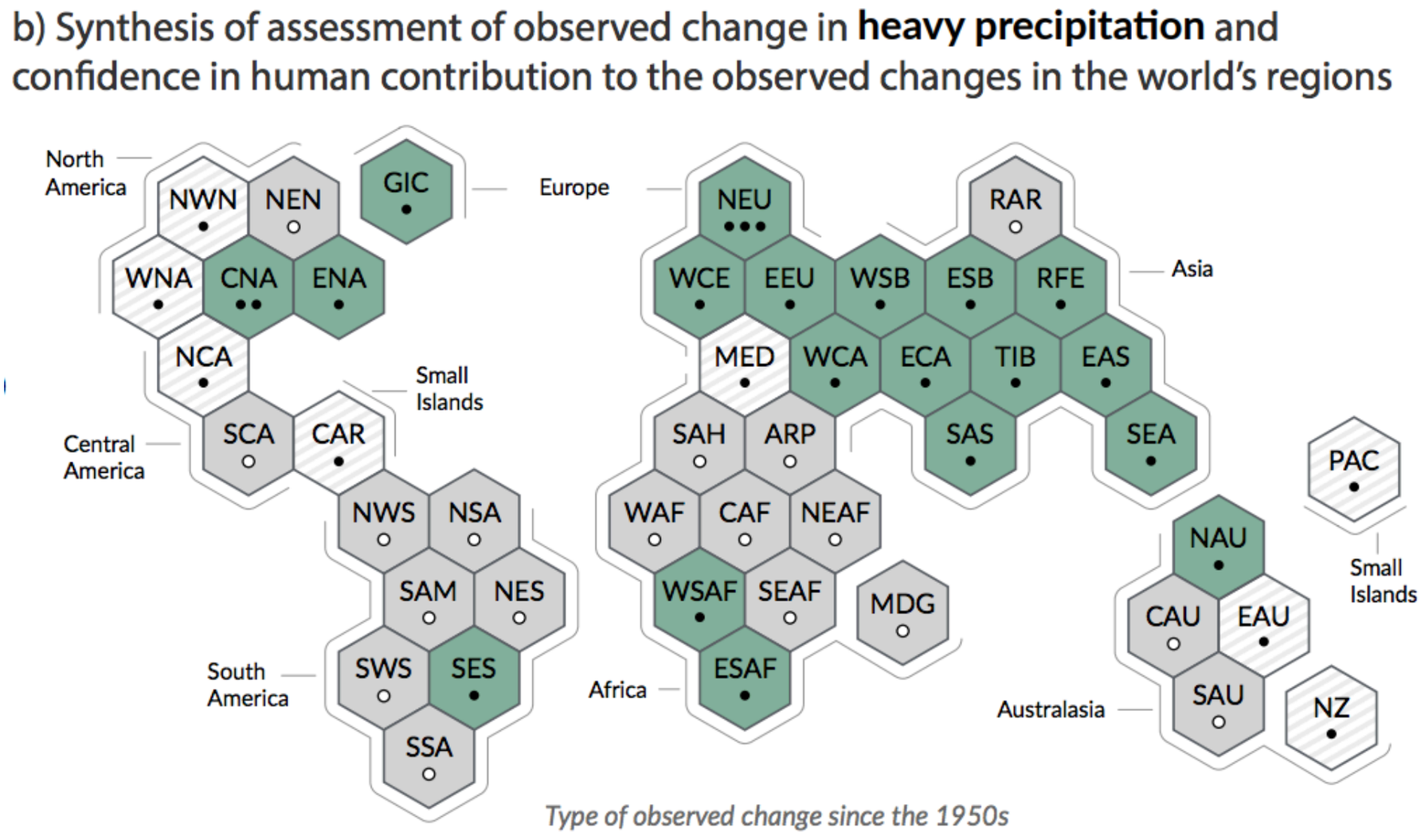


Credits: Figure SPM.3: (a) Synthesis of assessed observed and attributable regional changes.

Lecture 1

Climat Change: IPCC

« Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes »

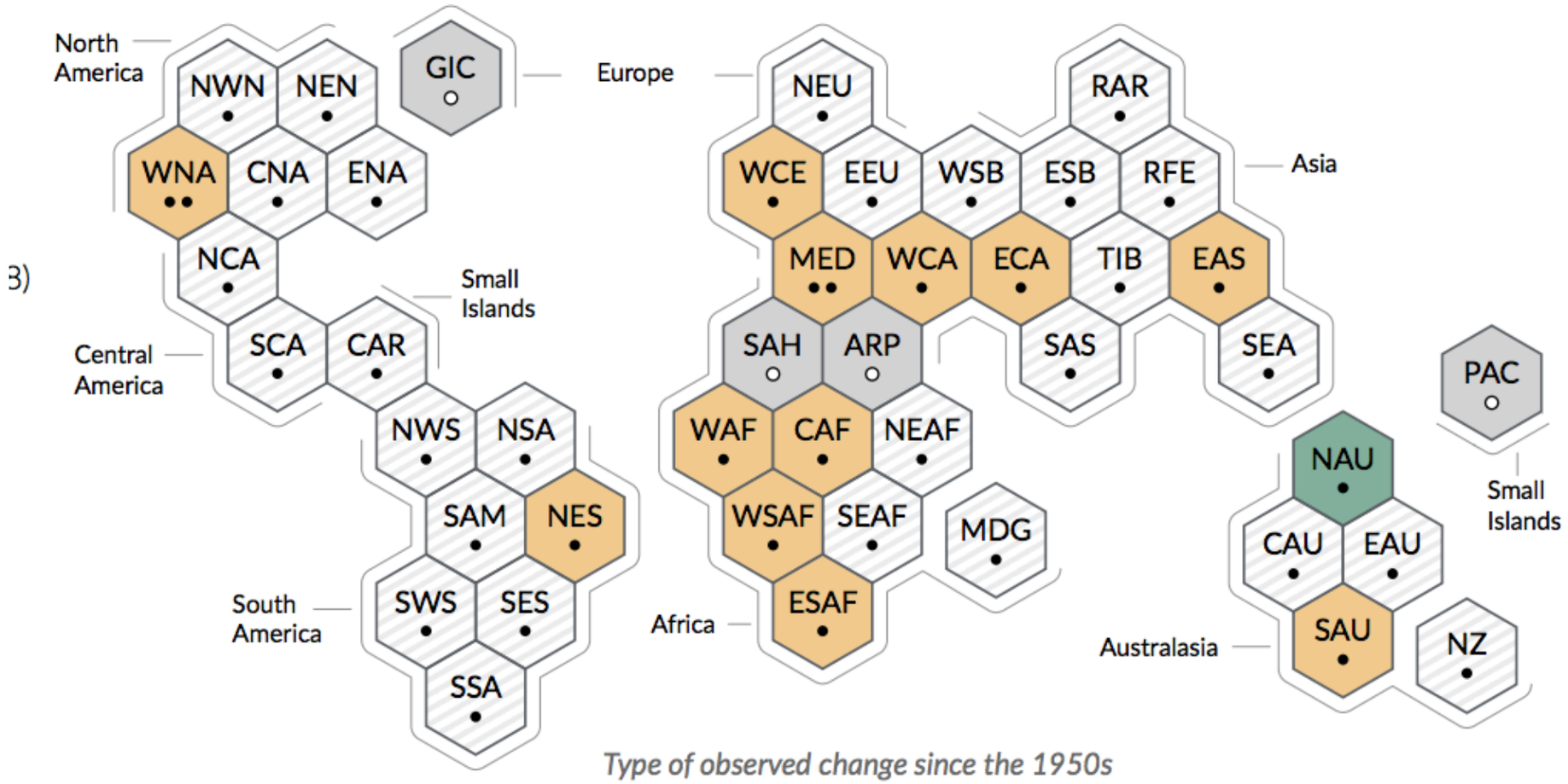


Credits: Figure SPM.3: (b) Synthesis of assessed observed and attributable regional changes.

Lecture 1

Climat Change: IPCC

« Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes »

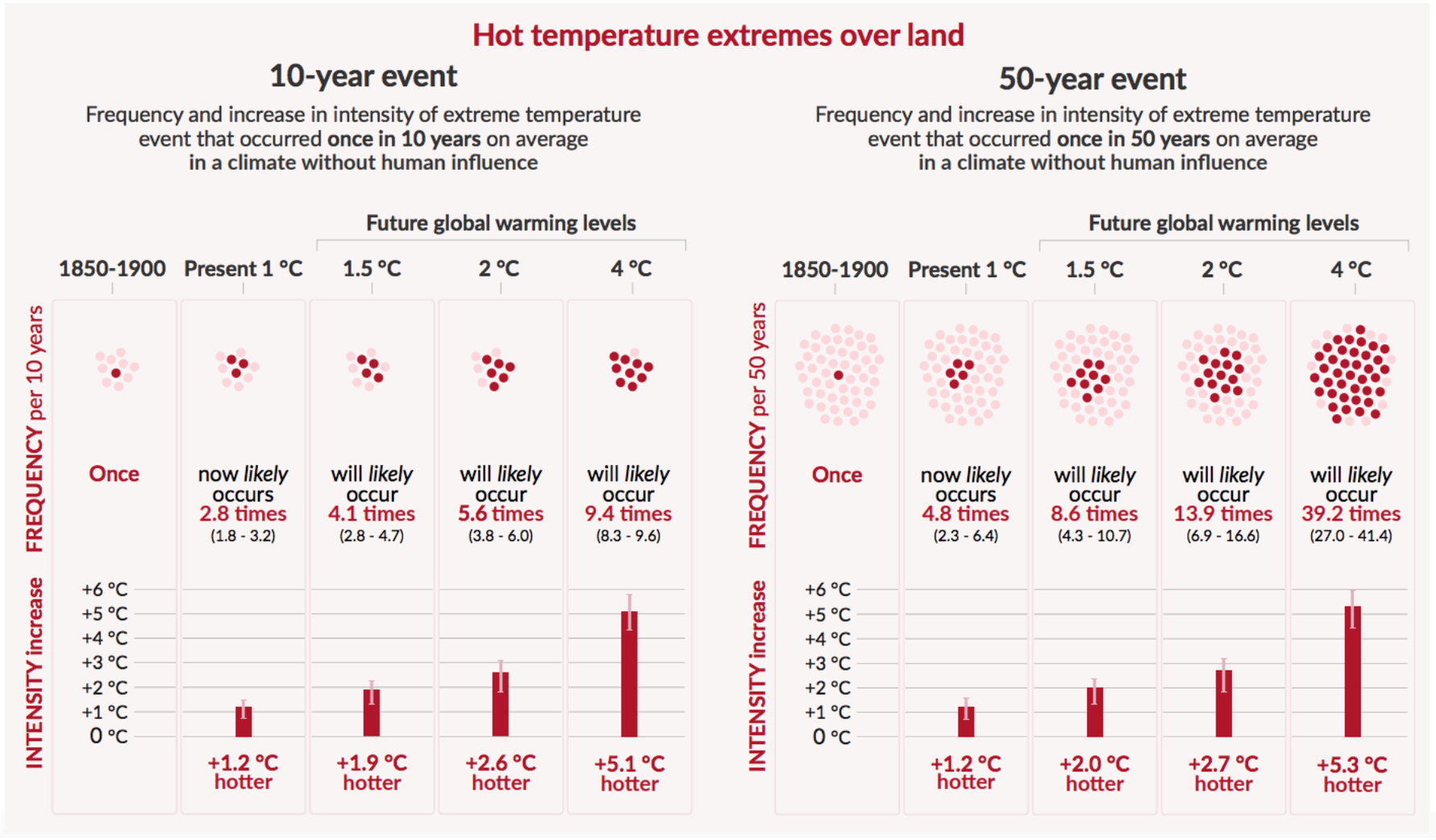


Credits: Figure SPM.3: (c) Synthesis of assessed observed and attributable regional changes.

Lecture 1

Climat Change: IPCC

« Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming »

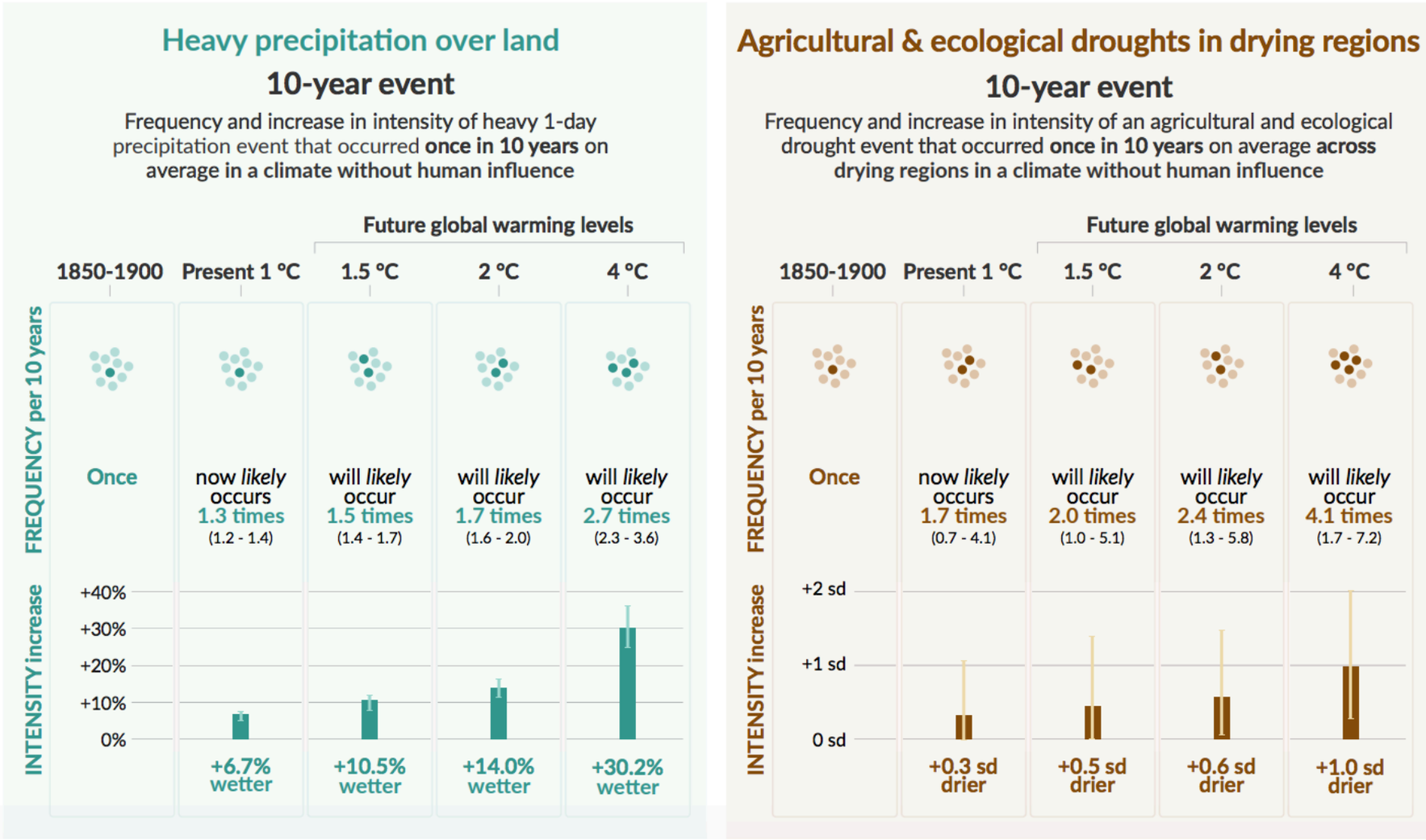


Credits: Figure SPM.6: Projected changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions.

Lecture 1

Climat Change: IPCC

« Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming »

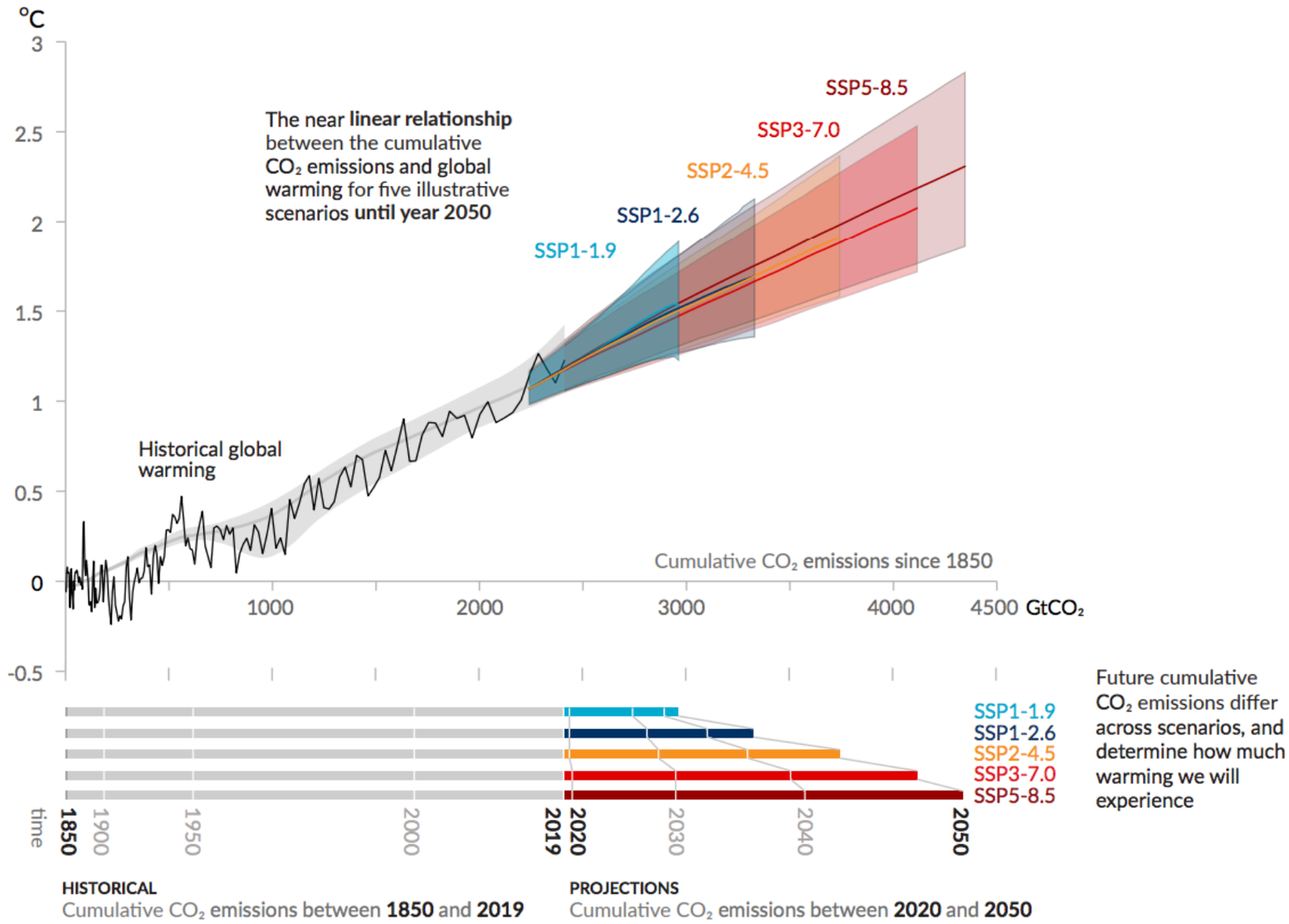


Credits: Figure SPM.6: Projected changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions.

Lecture 1

Climat Change: IPCC

« Every tonne of CO_2 emissions adds to global warming »



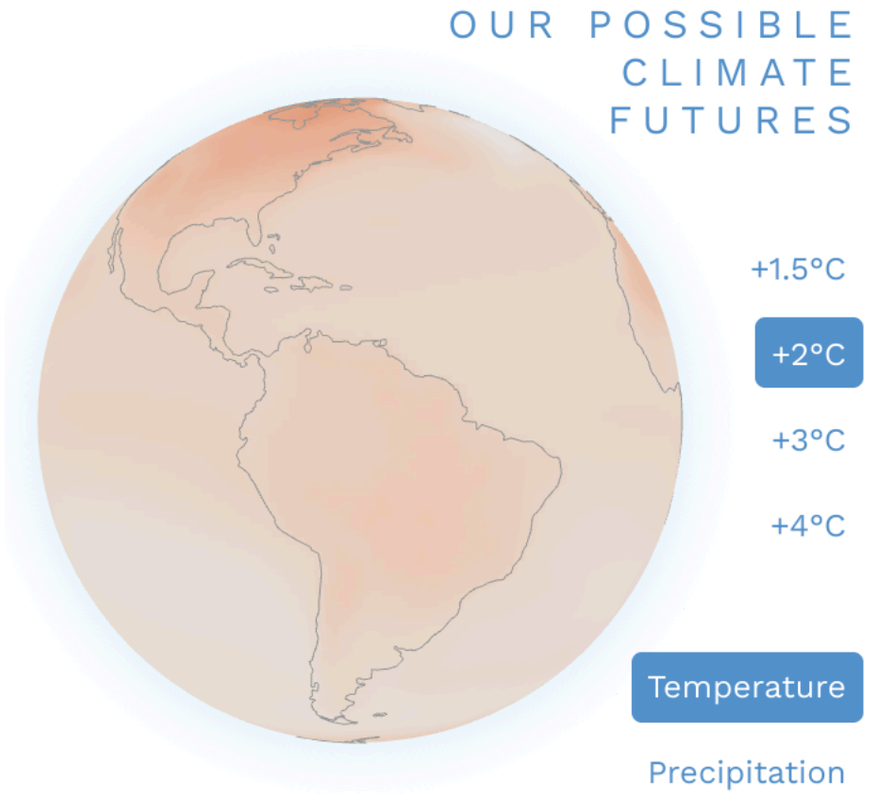
Credits: Figure SPM.10: Near-linear relationship between cumulative CO2 emissions and the increase in global surface temperature.

Lecture 1

Climat Change: IPCC

IPCC WGI Interactive Atlas

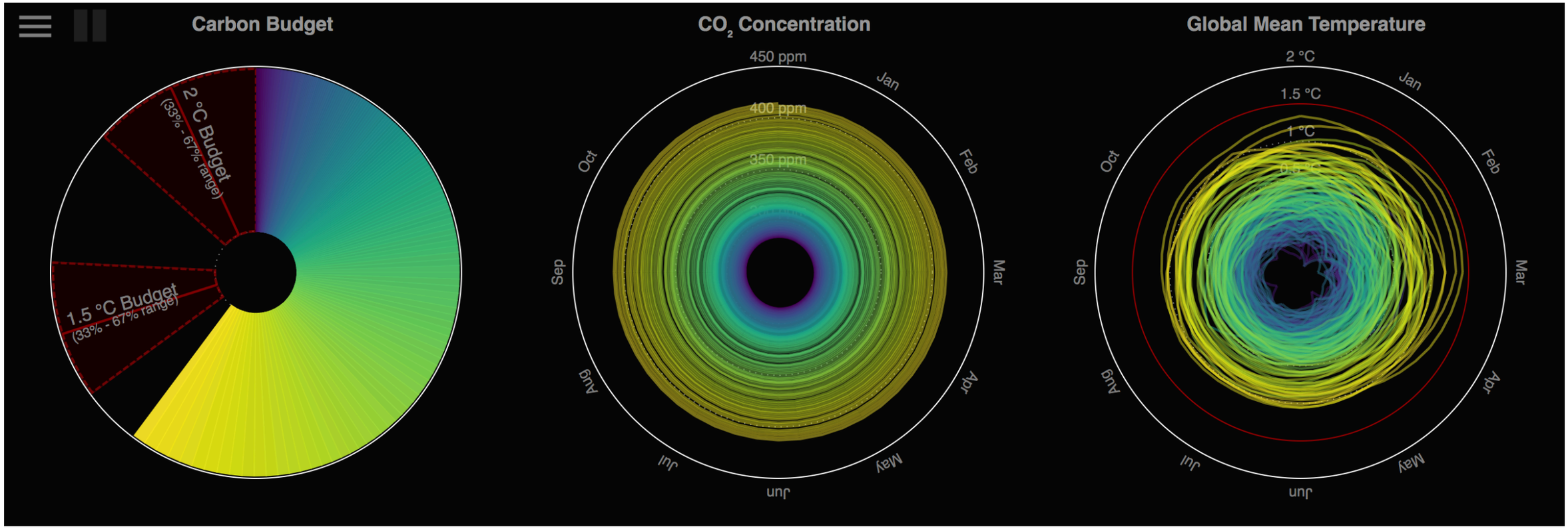
https://interactive-atlas.ipcc.ch/



Lecture 1

Climat Change

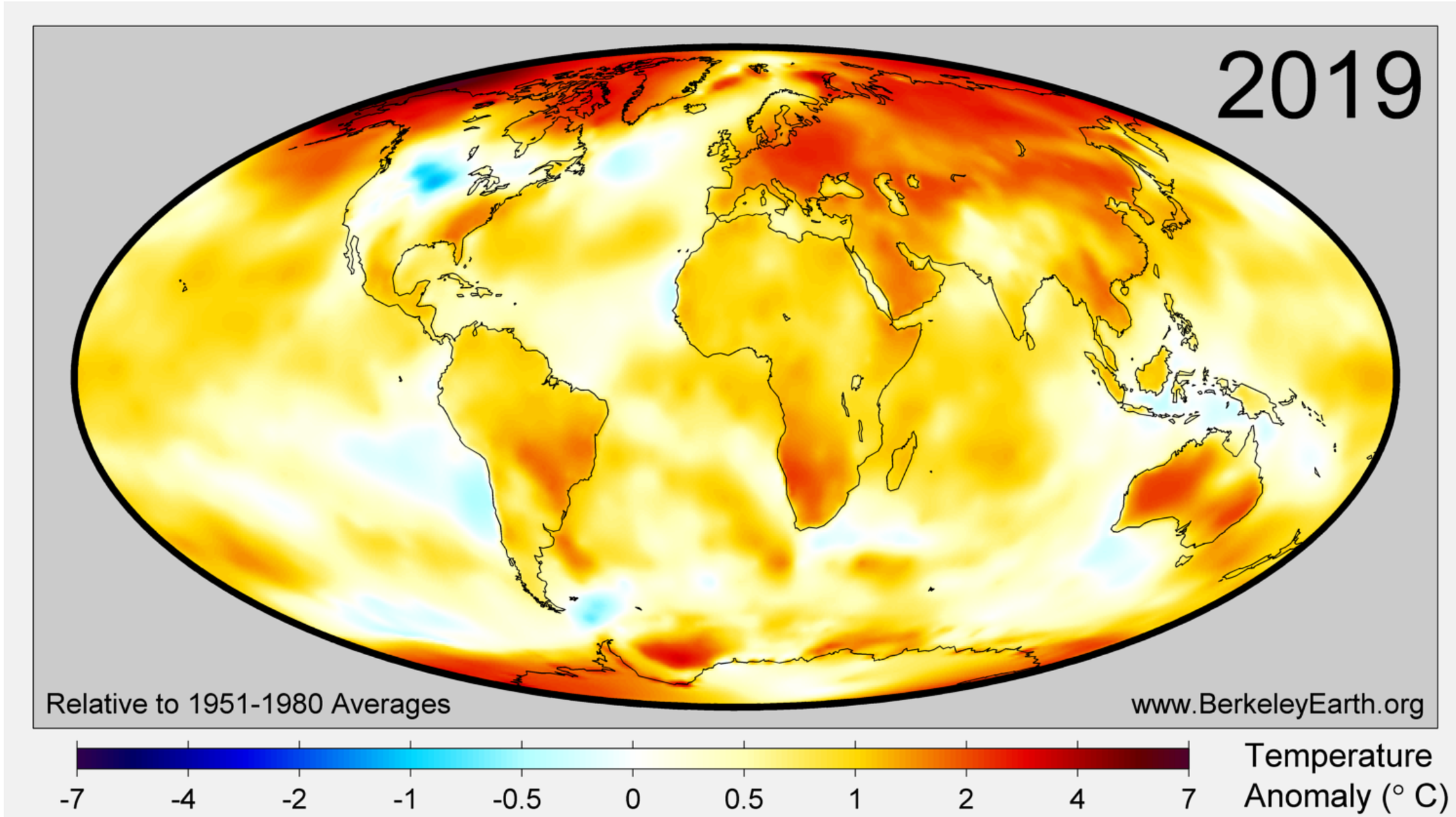
Combined animations for temperature, CO2 and carbon budgets



openclimatedata.net

Lecture 1

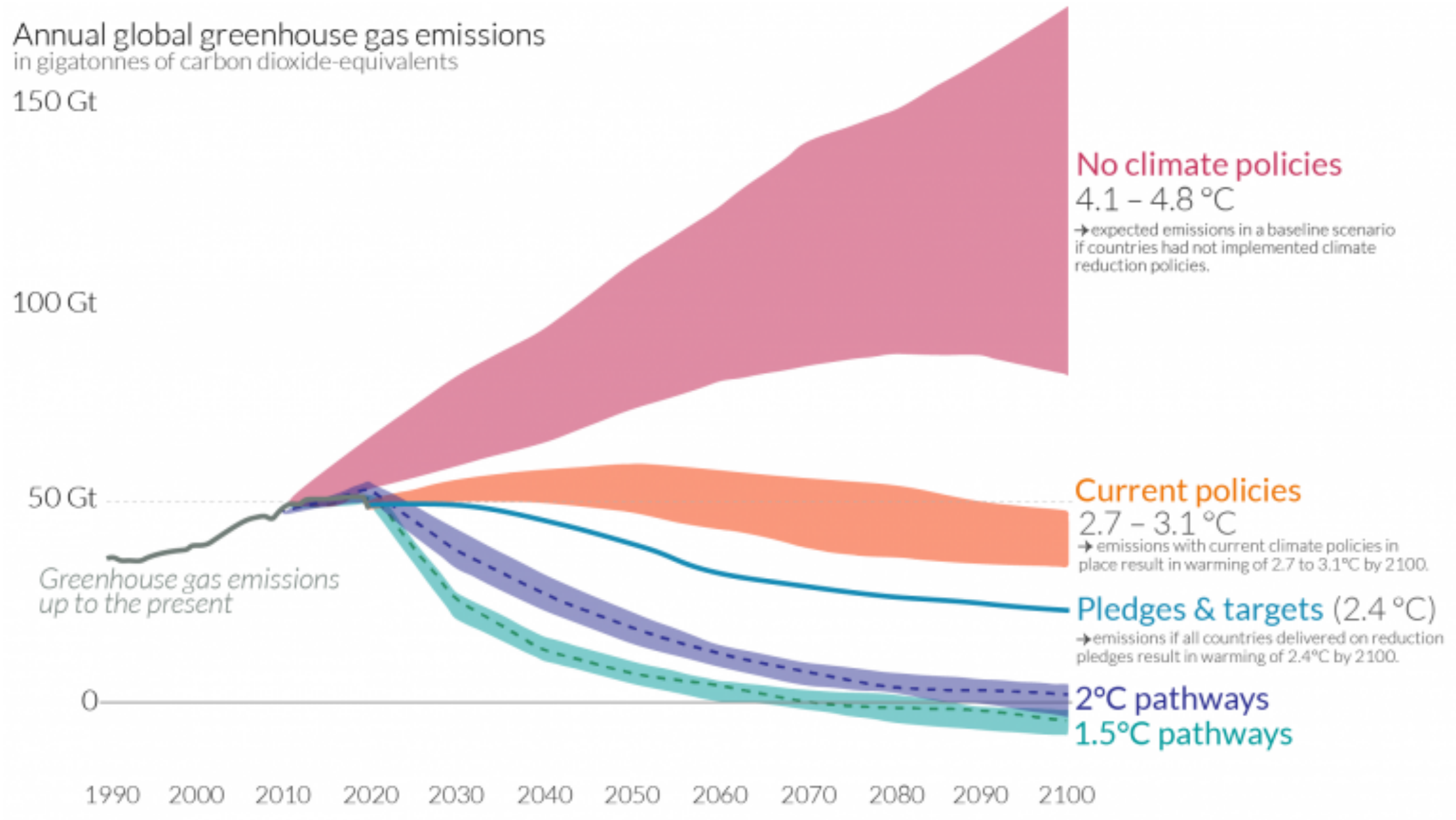
Climat Change



from the Berkeley Earth global temperature reports

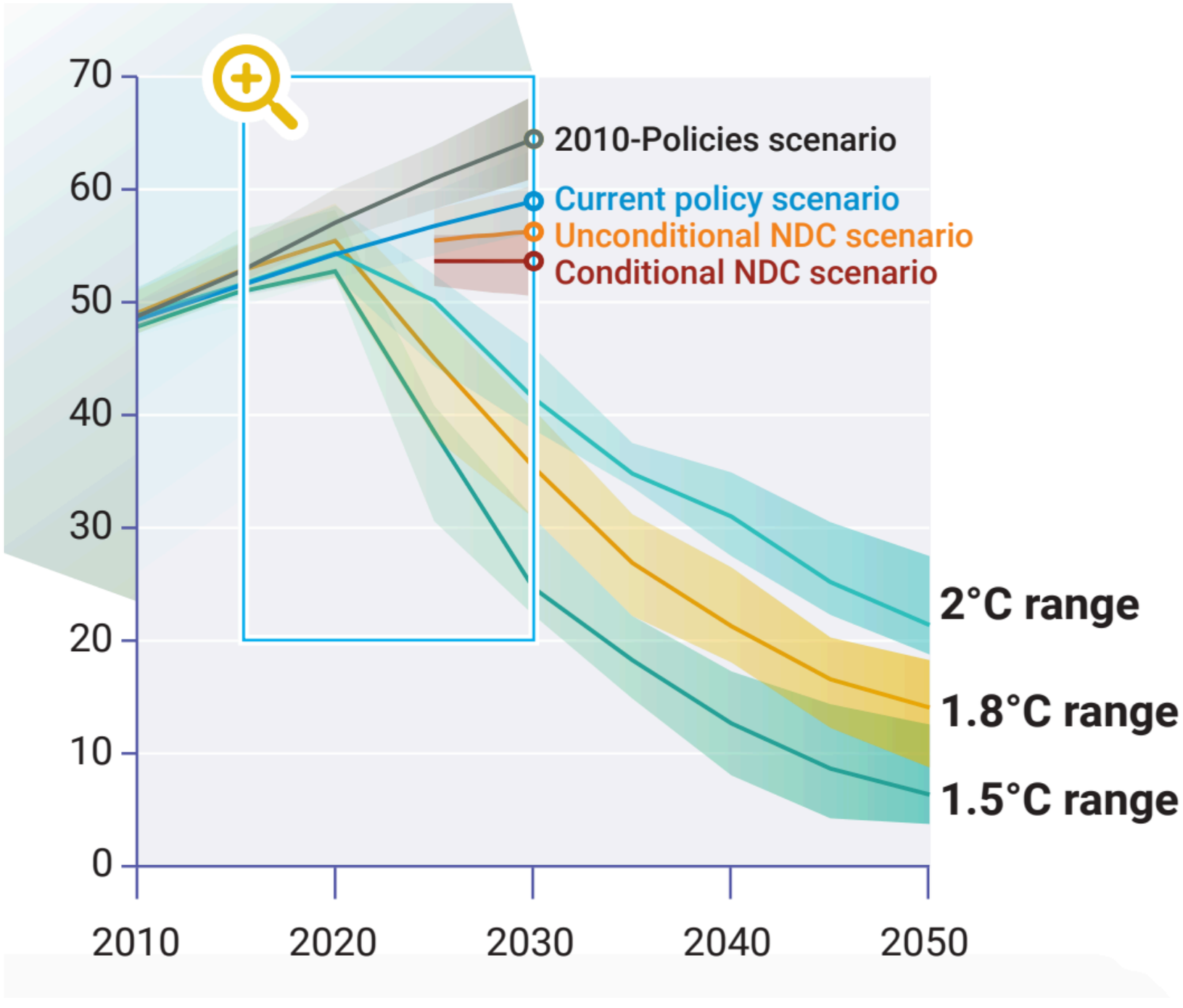
Quiz: what do you think of the current policies and the climate targets?

Lecture 1
Climat Change & C02 & gaps



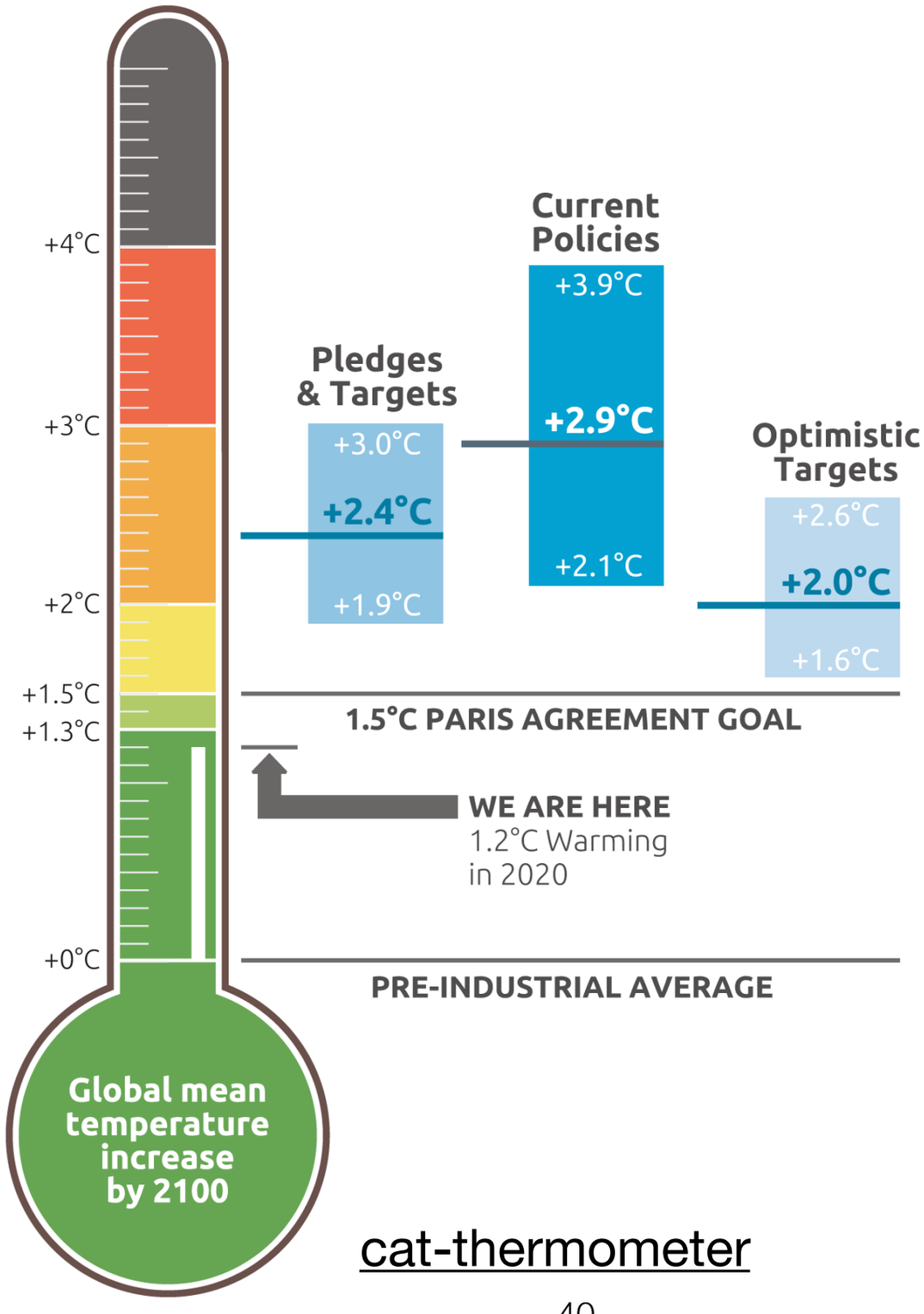
our world in data

Lecture 1
Climat Change & C02 & gaps



UN C02 gap

Lecture 1
Climat Change & C02 & gaps



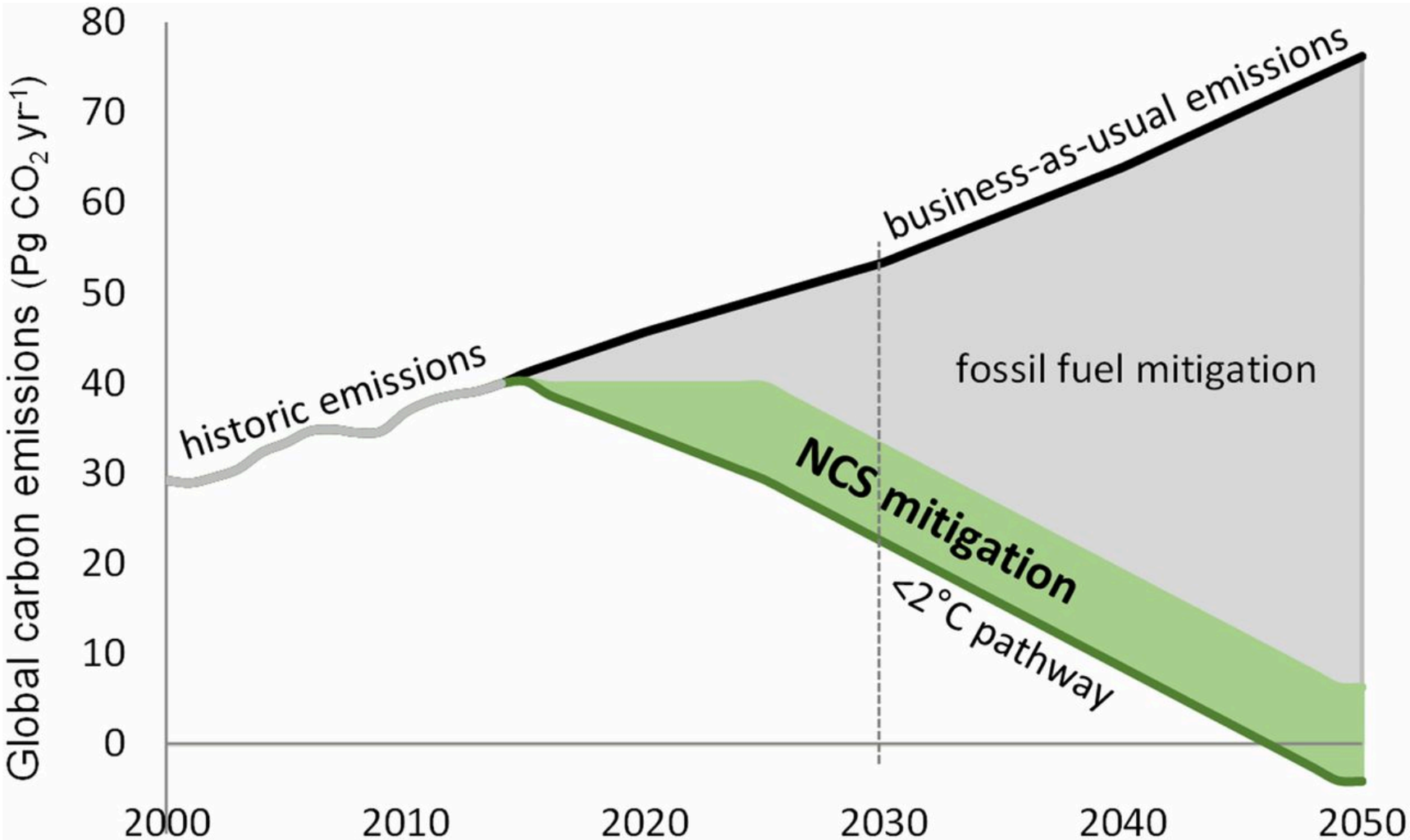
Climate Action Tracker

CAT warming projections
Global temperature increase by 2100

May 2021 Update

cat-thermometer

Lecture 1
Climat Change & C02 & Natural Climate Solutions (NCS)



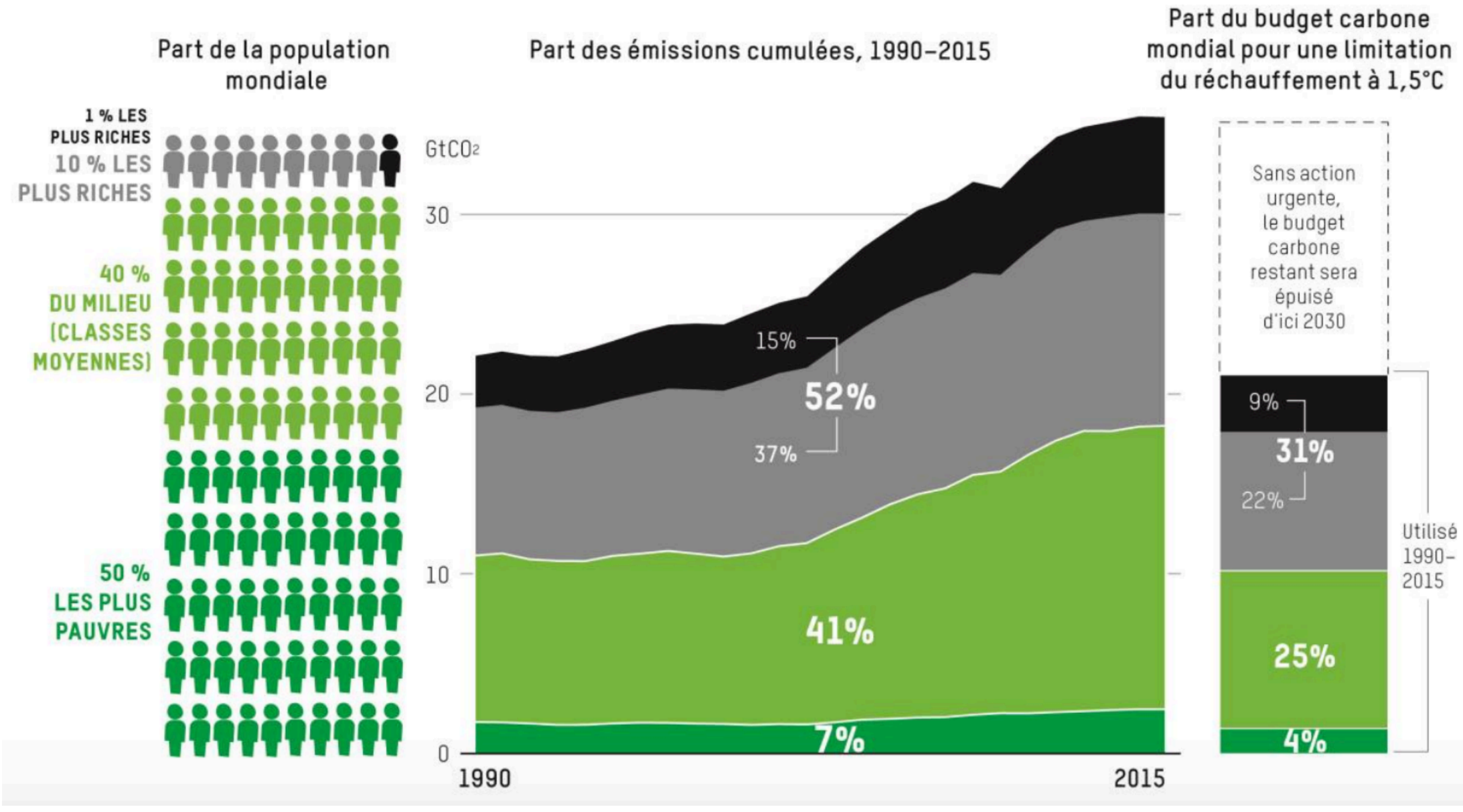
Reforestation is the main NCS.

NCS cannot do job alone !

Griscom, Bronson W., et al. "Natural climate solutions." Proceedings of the National Academy of Sciences 114.44 (2017): 11645-11650.

link to article

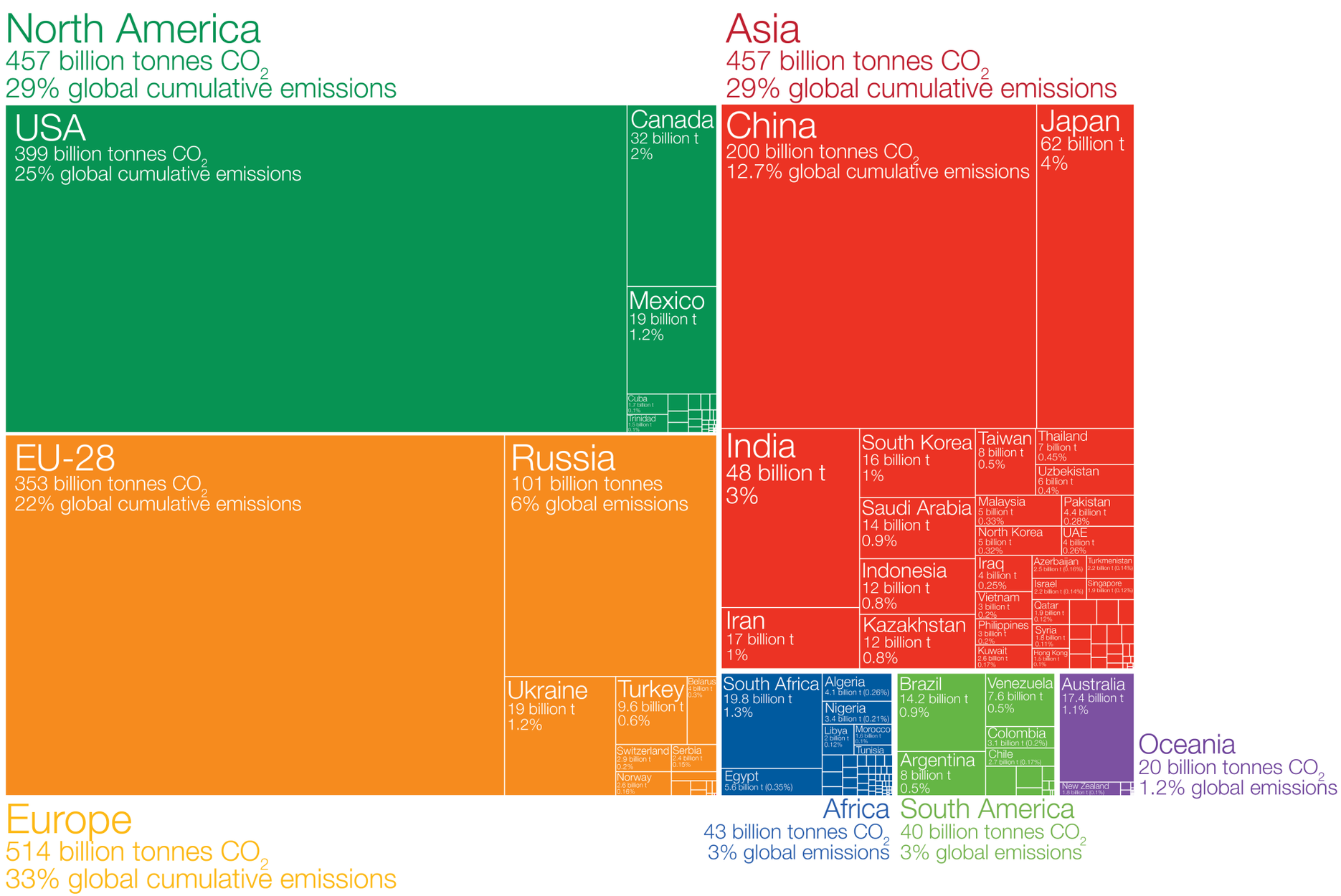
Lecture 1
Climat Change & C02 & inequalities



Oxfam

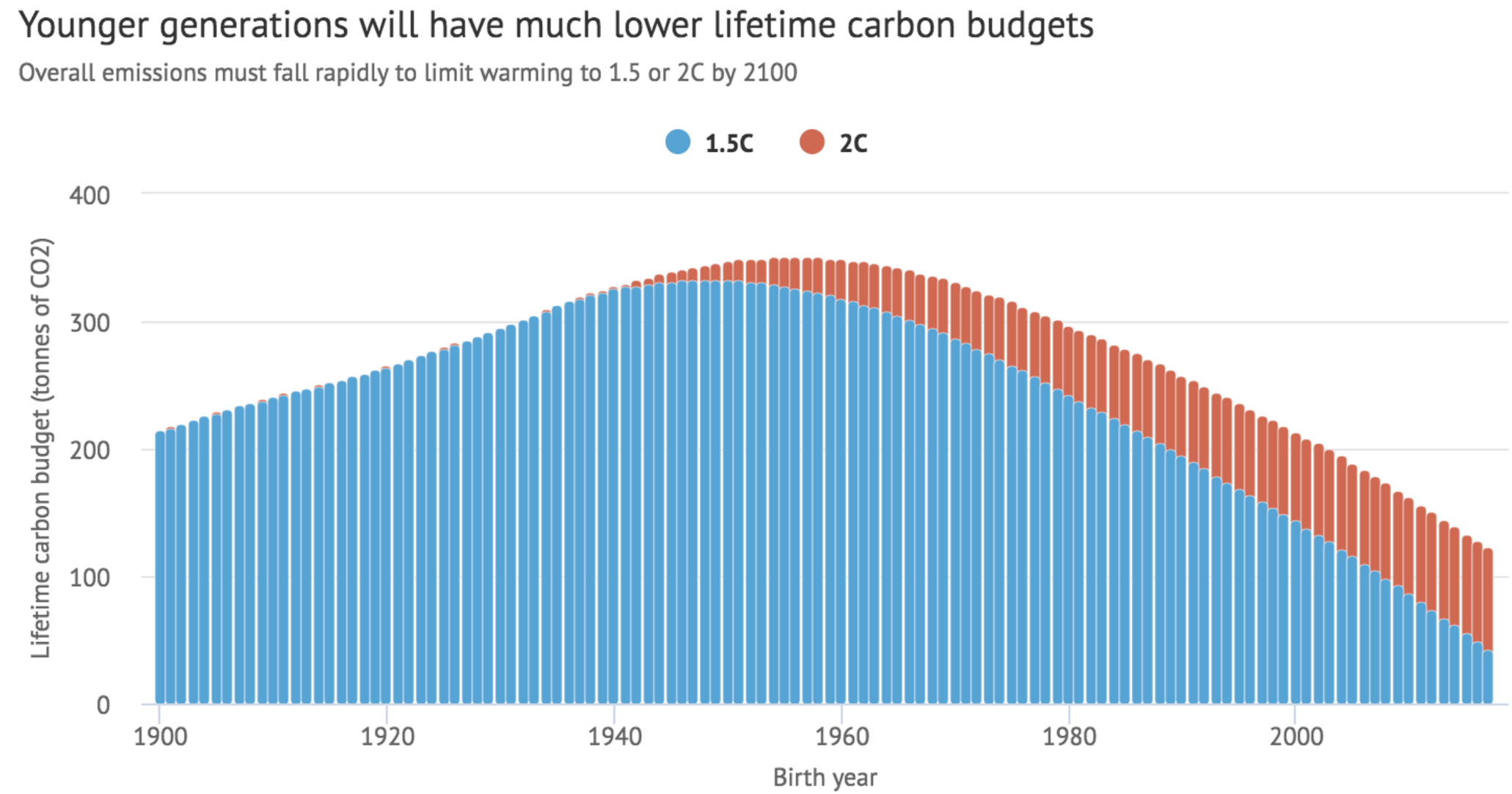
Quiz: what do you think of climate change and social inequalities?

Lecture 1
Climat Change & C02 & inequalities



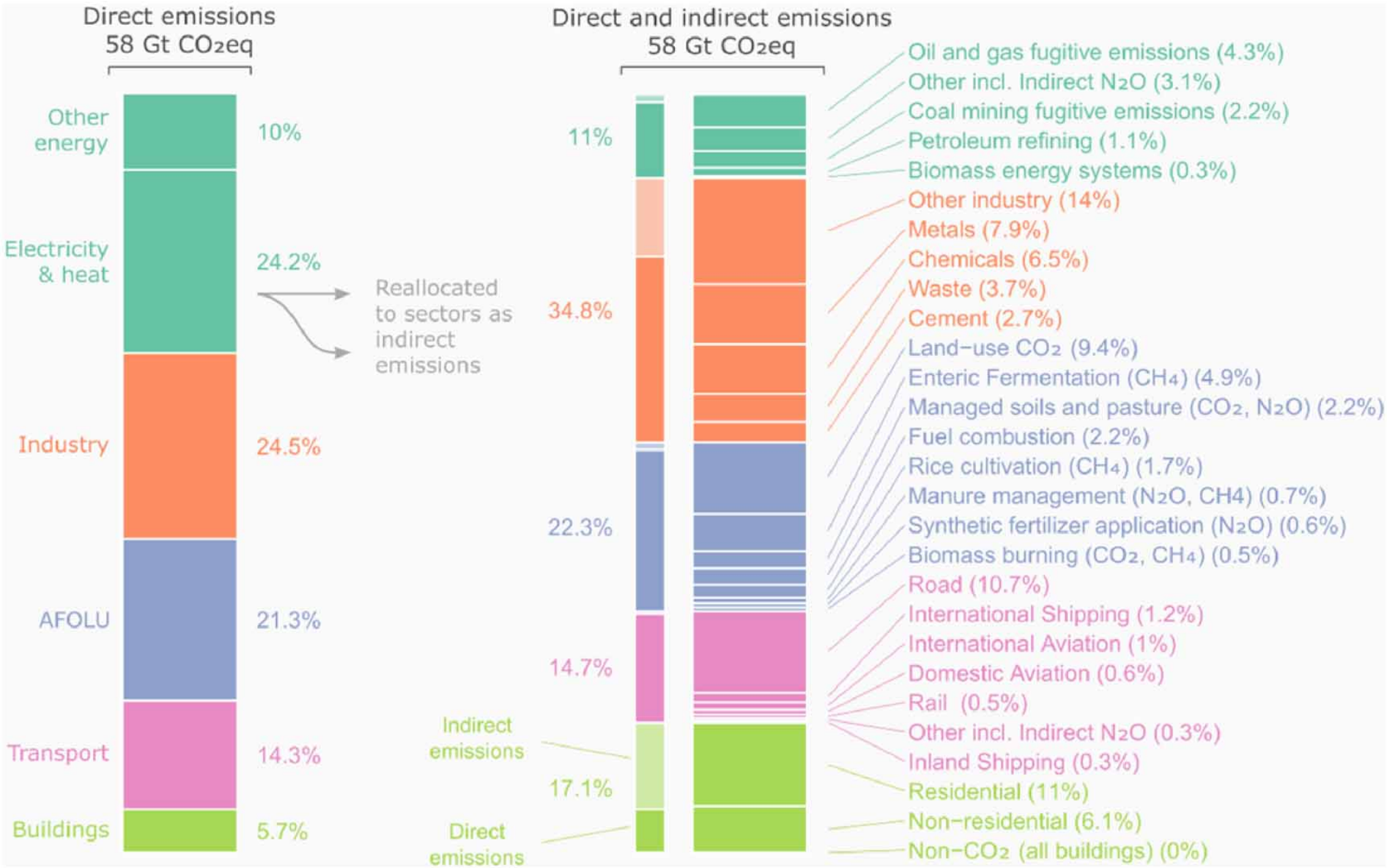
our world in data

Lecture 1
Climat Change & C02 & inequalities



carbonbrief

Lecture 1
Climat Change & C02 & sectors



Lamb, William F., et al. "A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018." *Environmental Research Letters* (2021).

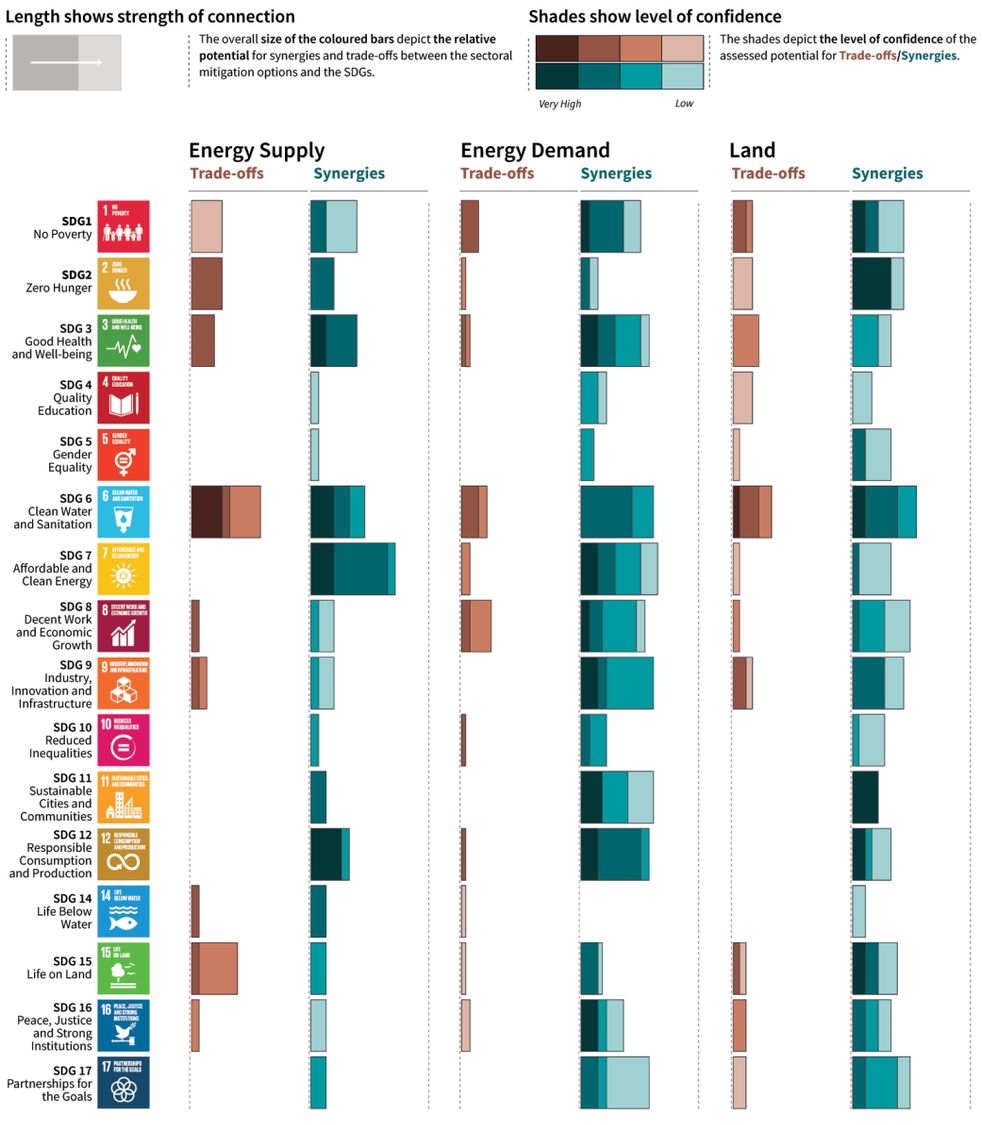
D.4. Mitigation options consistent with 1.5°C pathways are associated with multiple synergies and trade-offs across the Sustainable Development Goals (SDGs). While the total number of possible synergies exceeds the number of trade-offs, their net effect will depend on the pace and magnitude of changes, the composition of the mitigation portfolio and the management of the transition. *(high confidence)* (Figure SPM.4) {2.5, 4.5, 5.4}

Summary for Policymakers
https://www.ipcc.ch/sr15/chapter/spm/

Lecture 1
Climat Change & others SDGs

Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.



Course perimeter

WARNING!

We focus on climate change & energy but **it does not solve the other sustainability issues** (cf SDGs):

- Bio-diversity;
- Freshwater;
- Land, air, water pollution;
- Social and health inequalities;
- Etc

Sustainability is a whole, and all the issues must be addressed!

Lecture 1

Goals

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges’s perimeter

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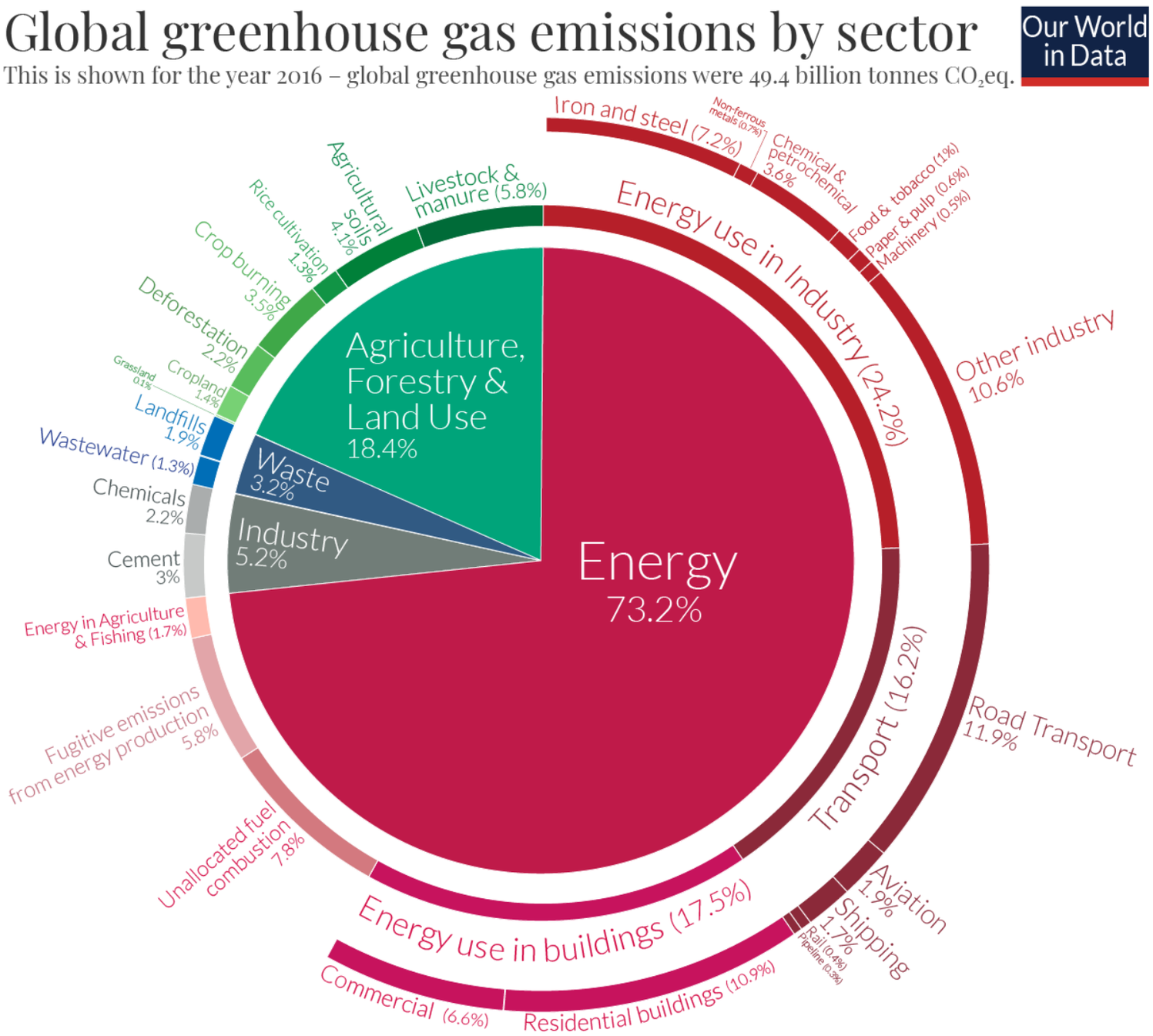
Quiz: What does imply the word energy for you?

Lecture 1

Energy & C02

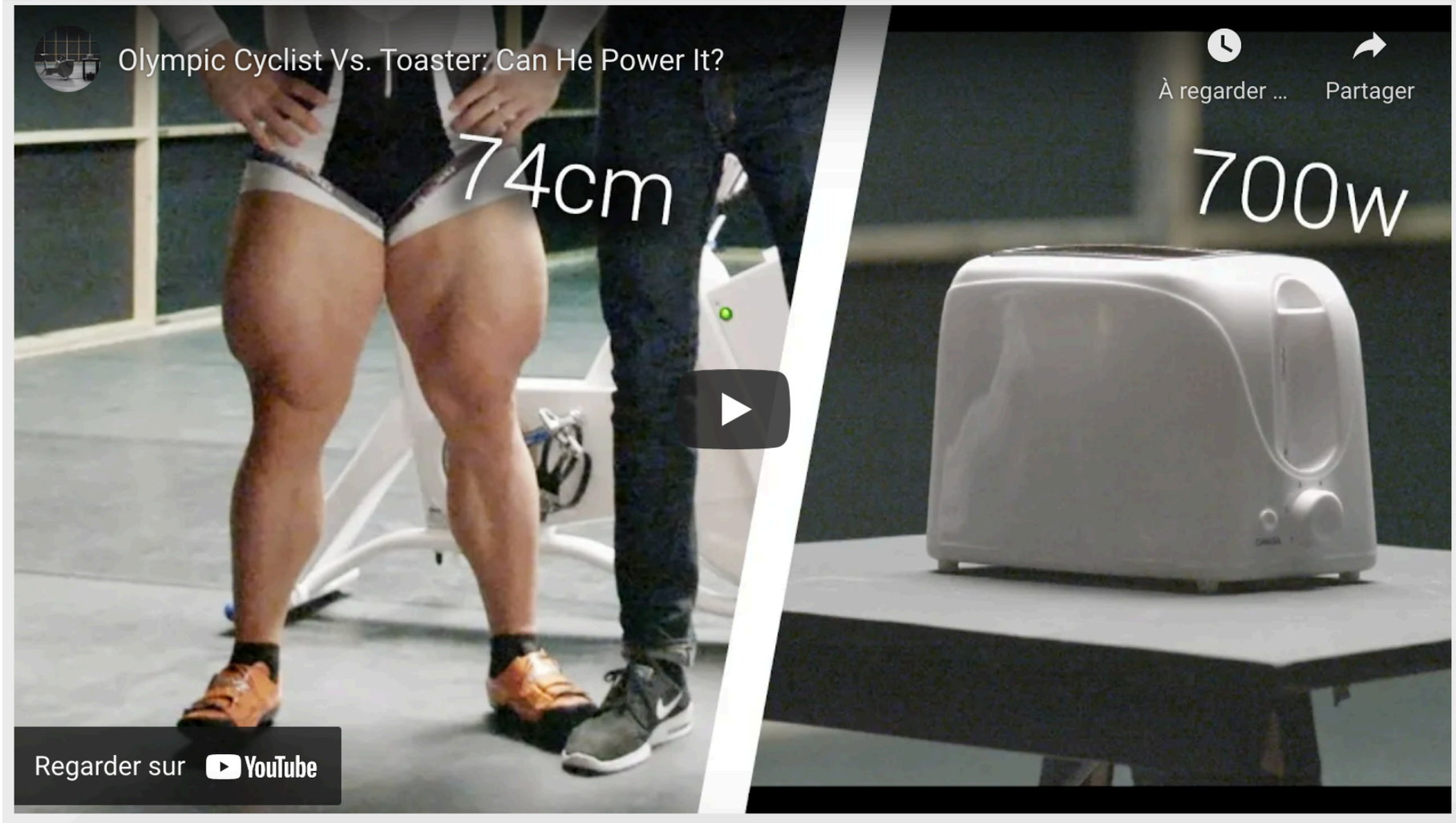


https://ourworldindata.org/emissions-by-sector

Quiz: Do you have any idea what is 1 kWh of energy?

Lecture 1

What is 1kWh?



https://youtu.be/S4O5voOCqAQ

https://jancovici.com/en/energy-transition/energy-and-us/how-much-of-a-slave-master-am-i/

Lecture 1

Energetic slaves

1 human being = 2 000 calories / day = **2,3 kWh / day**
-> 800 kWh / year

1 liter of oil = **10 kWh** of thermal energy

30 MWh / year = 400 energetic slaves
(by taking into account the efficiencies
see the assumptions in the article)

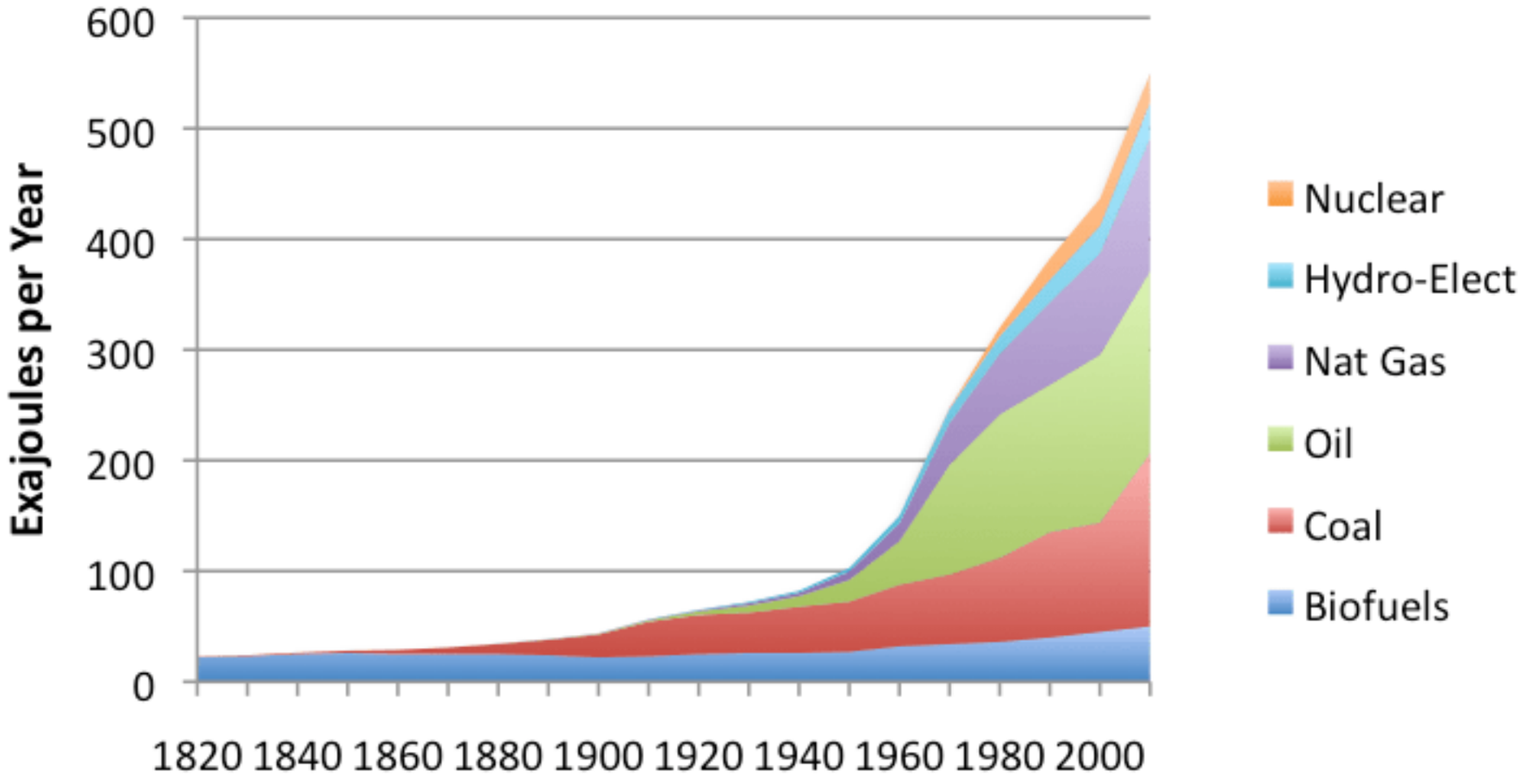
https://jancovici.com/en/energy-transition/energy-and-us/how-much-of-a-slave-master-am-i/

Lecture 1

Energy

Quiz: What do you think ?

Is there an energy transition ?

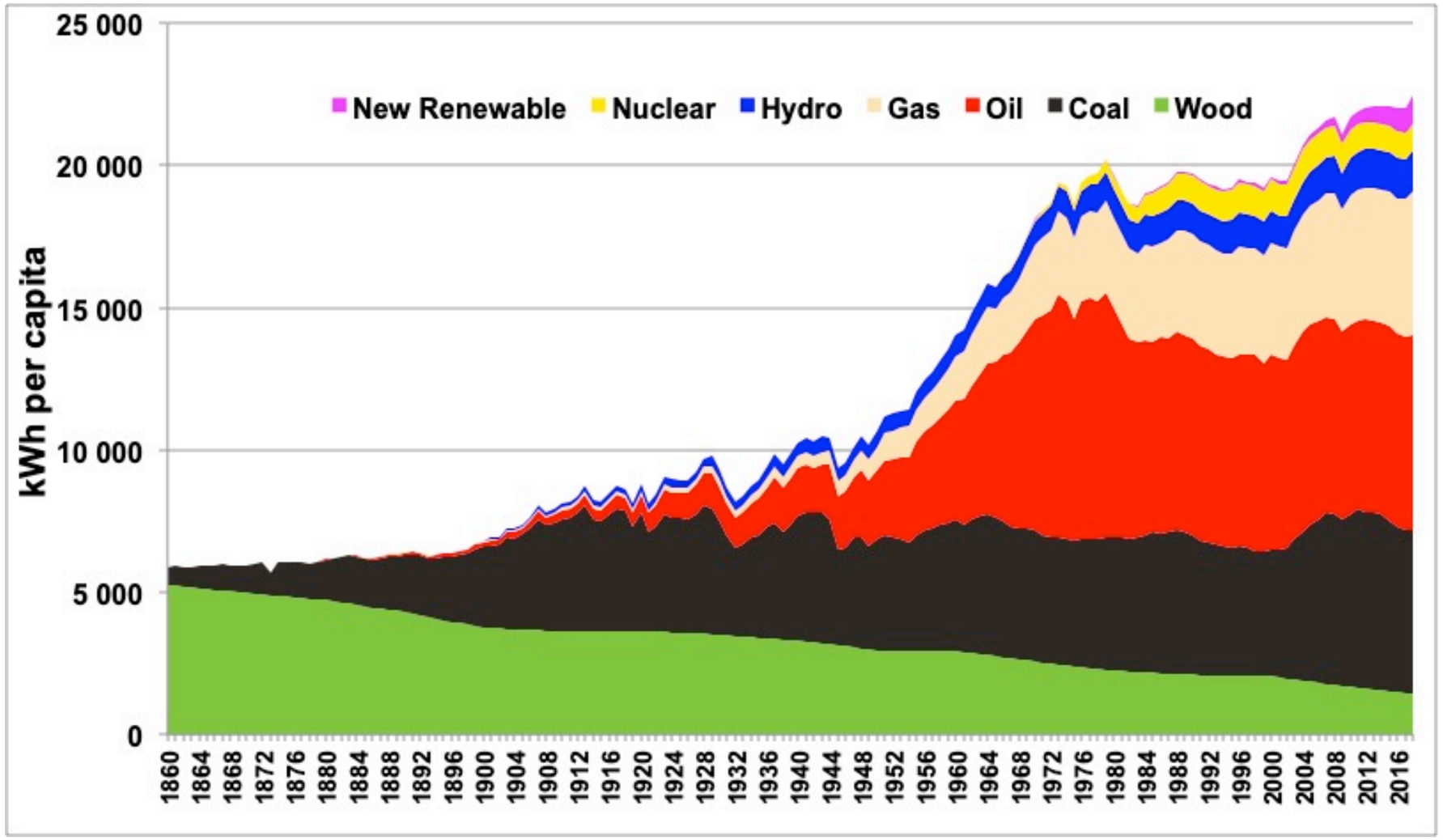


World Energy Consumption by Source, Based on Vaclav Smil estimates from Energy Transitions: History, Requirements and Prospects together with BP Statistical Data for 1965 and subsequent

Lecture 1

Energy

World per capita energy consumption

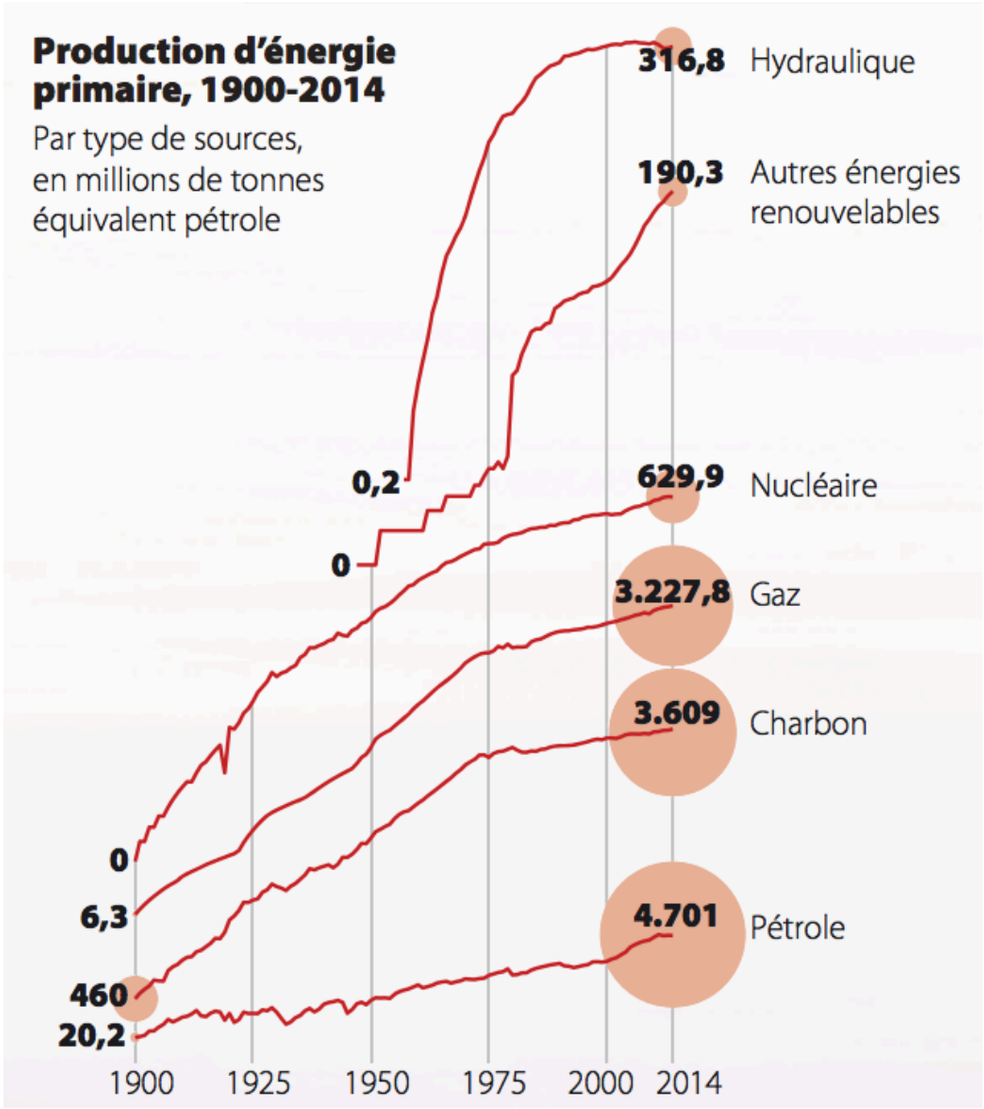


Author's compilation of the following primary sources: Shilling et al., BP statistical review, Energy Information Agency, United Nations.

https://jancovici.com/en/energy-transition/energy-and-us/what-is-energy-actually/

Lecture 1

Energy

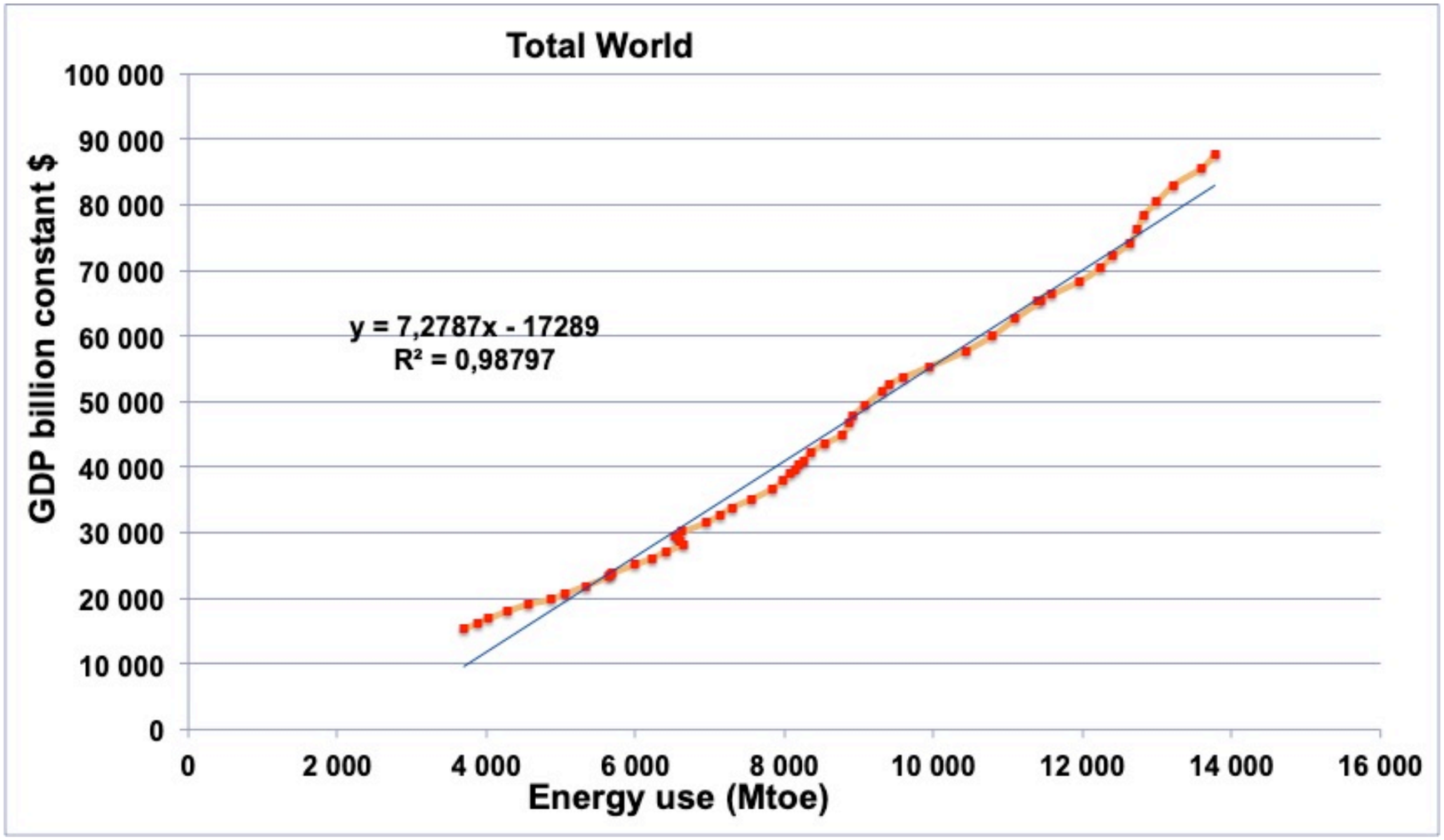


Credits: Source : The Shift Project Data Portal, d'après B. Etemad, J. Luciani (1900 - 1980) et US EIA Historical Statistics (1981-2014), www.tsp-data-portal.org

Lecture 1

Energy & GDP

World Gross Domestic Product GDP in constant dollars plotted against the world energy consumption in million tonnes oil equivalent, from 1965 to 2014.



Author's calculation on primary information coming from BP Statistical Review, 2015, and World Bank 2015 (GDP).

https://jancovici.com/en/energy-transition/energy-and-us/what-is-energy-actually/

Lecture 1

Energy & GDP

Warning: it is not simple as it looks!

-> Simultaneity Bias

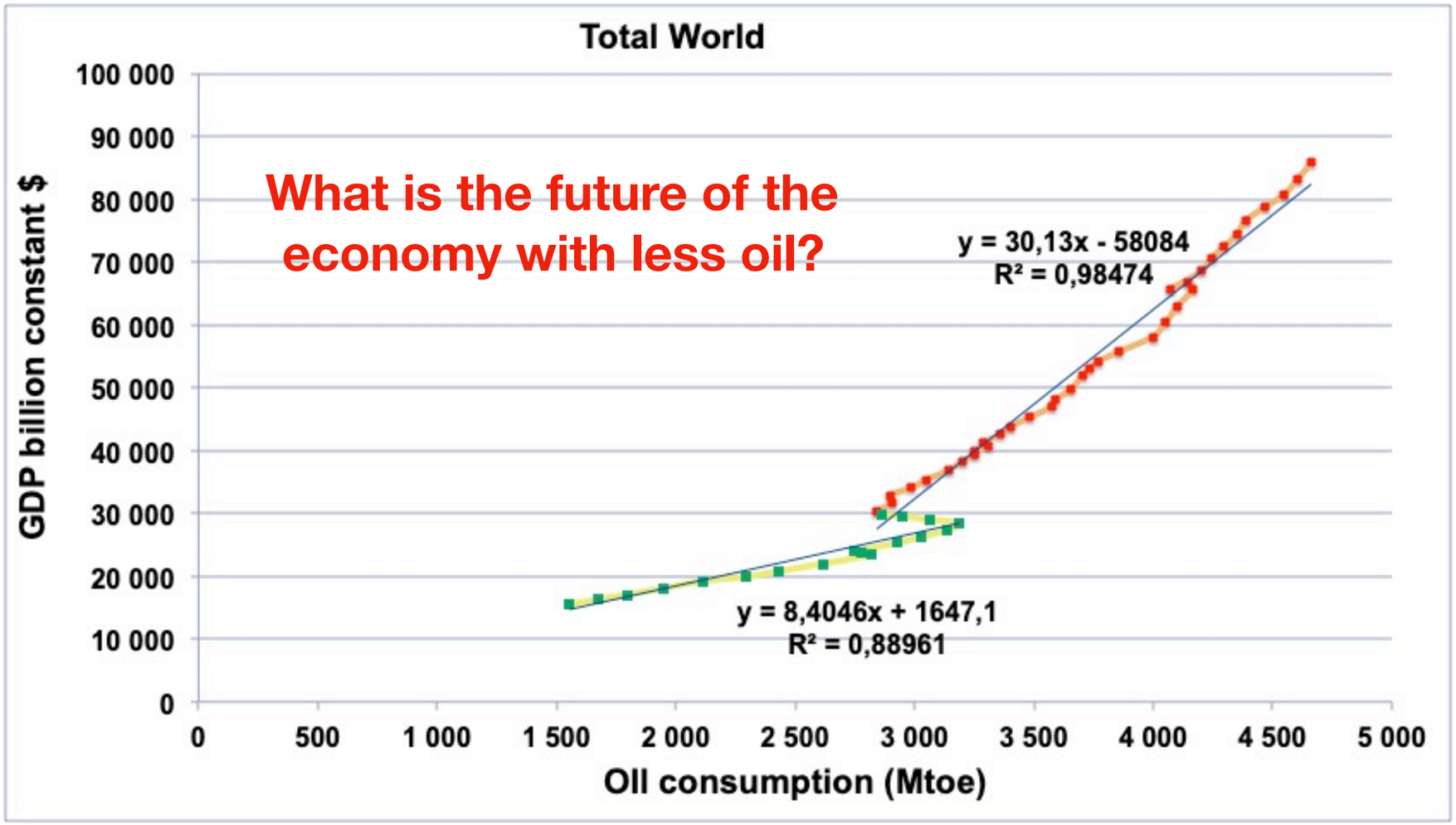
« **Causality can go both ways** between GDP and energy. In econometrics, this is called a simultaneity bias. Of course, when energy production contracts, this can constrain production. However, symmetrically, an economy in recession consumes less energy. Analogous reasoning can be constructed with a growing economy. An energy-economy correlation could be entirely explained by the effect of GDP on energy, energy on GDP, or a mixture of the two. «

https://www.fairementirleschiffres.com/post/le-meilleur-mod%C3%A8le-macro%C3%A9conomique-du-monde

Lecture 1

Energy & oil & GDP

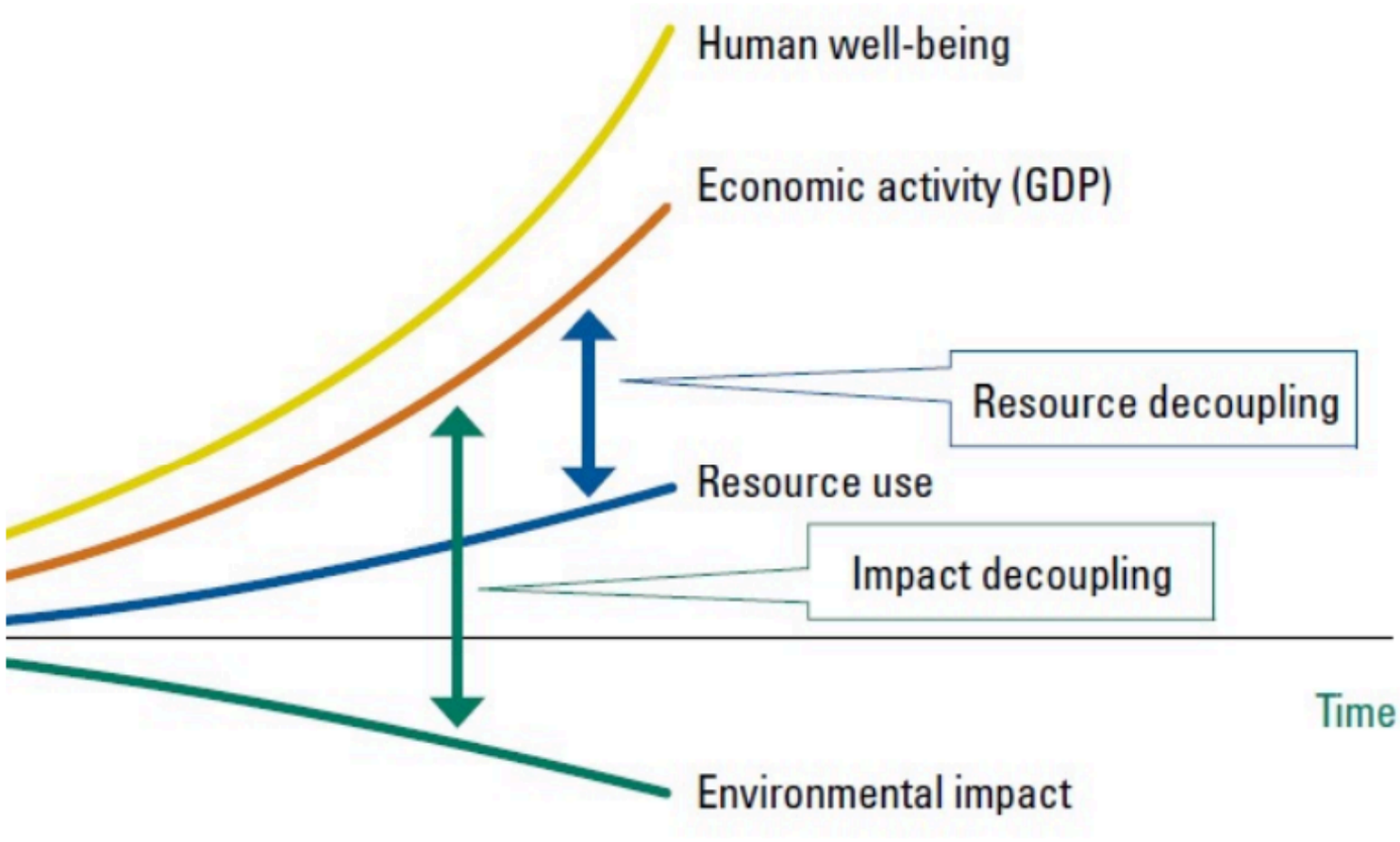
GDP per capita – world average – in constant 2012 dollars plotted against the world oil consumption in million tonnes oil equivalent, from 1965 to 2014.



Author's calculation on primary information coming from BP statistical review & Shilling et al. (energy) and World Bank (GDP).

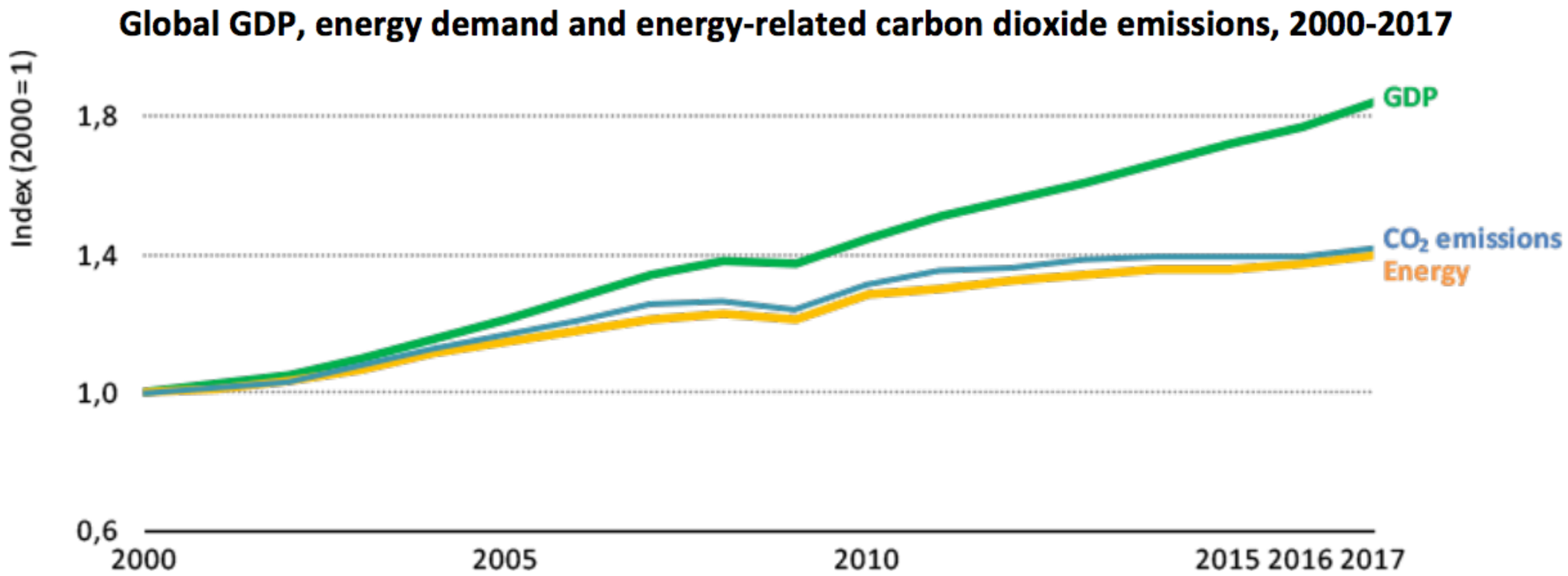
https://jancovici.com/en/energy-transition/energy-and-us/what-is-energy-actually/

Lecture 1
Energy & GDP & decoupling



We would like to decouple GDP - energy & resource use!

Lecture 1
Energy & GDP & decoupling



But the decoupling is still relative and not significant …

International Energy Agency, Global Energy & CO 2 Status Report 2017, March 2018 .

https://www.iea.org/reports/global-energy-co2-status-report-2017

Lecture 1

Goals

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges’s perimeter

Energy

Rebound effect

Challenges

Rebound effect

Quiz: Do you know what is the « rebound effect »?

Jevons paradox

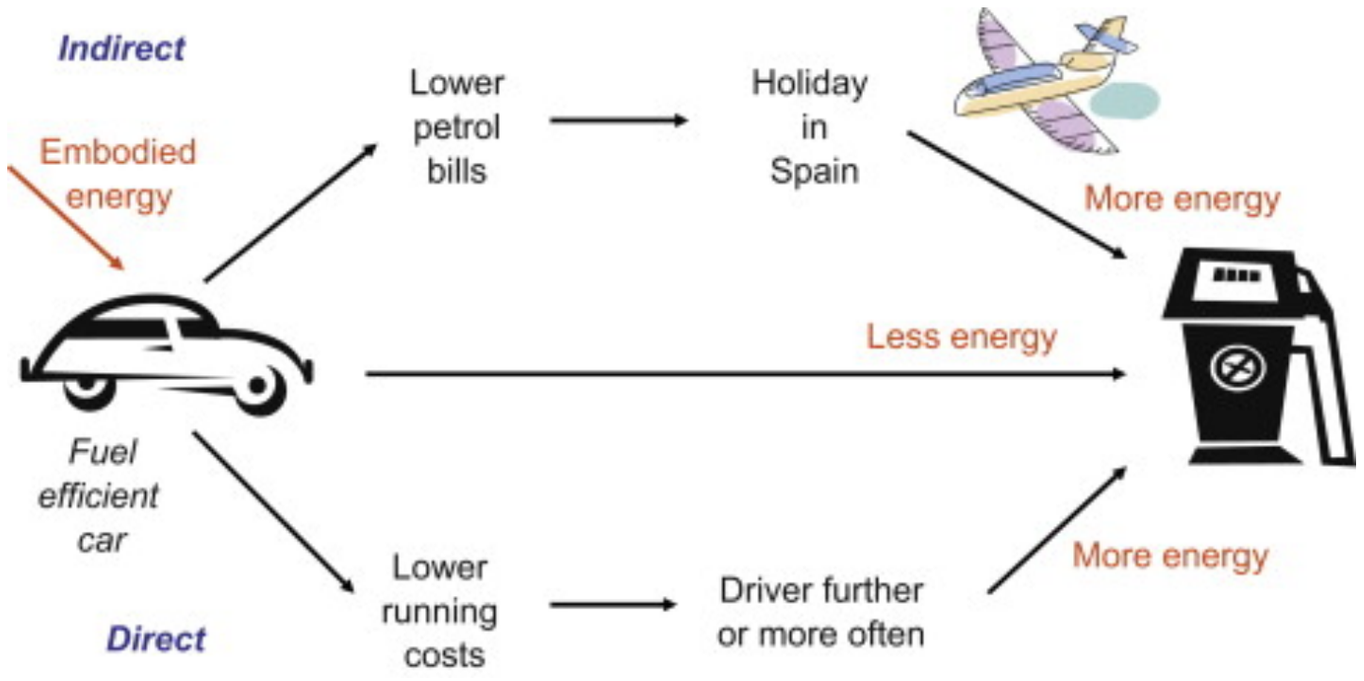
In economics, the Jevons paradox occurs when technological progress or government policy increases the efficiency with which a resource is used (reducing the amount necessary for anyone use). However, the rate of consumption of that resource rises due to increasing demand. The Jevons paradox is perhaps the most widely known in environmental economics.

However, governments and environmentalists generally assume that efficiency gains will lower resource consumption, ignoring the possibility of the paradox arising.

Lecture 1

Rebound effect

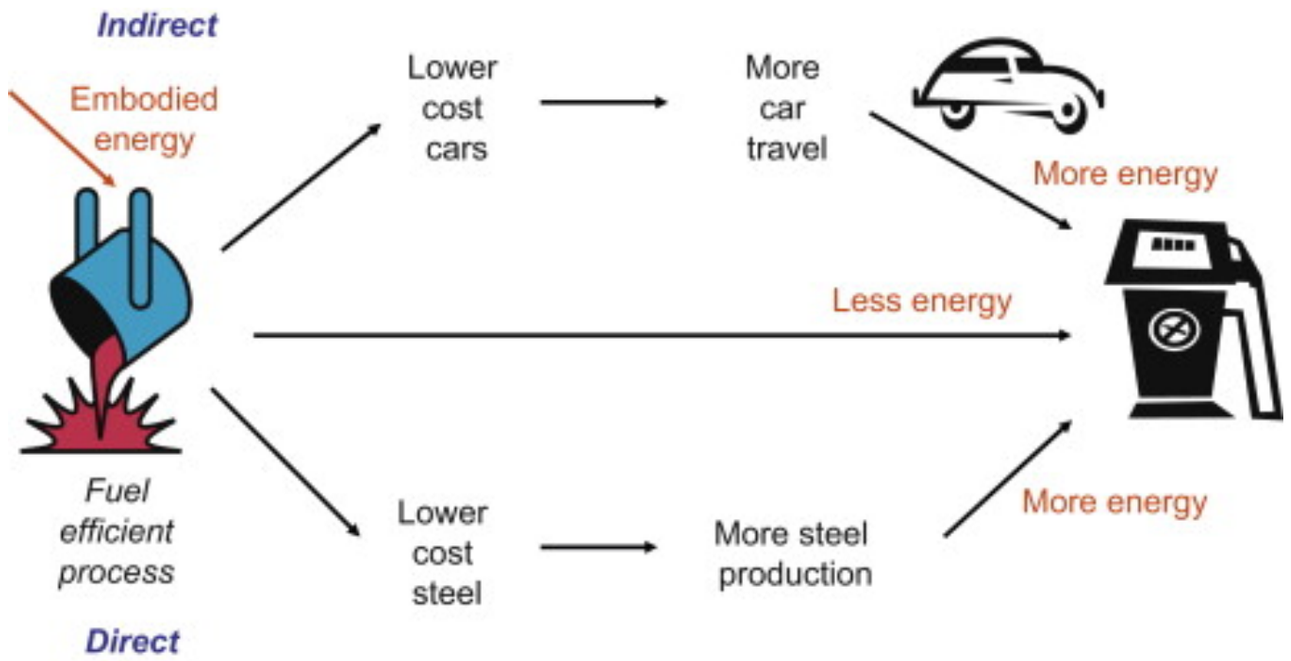
« While the evidence in favor of 'Jevons Paradox' is far from conclusive, it does suggest that ***economy-wide rebound effects are larger than is conventionally assumed*** *and that energy plays a more important role in driving productivity improvements and economic growth than is conventionally assumed. »*



Sorrell, Steve. "Jevons' Paradox revisited: The evidence for backfire from improved energy efficiency." Energy policy 37.4 (2009): 1456-1469.

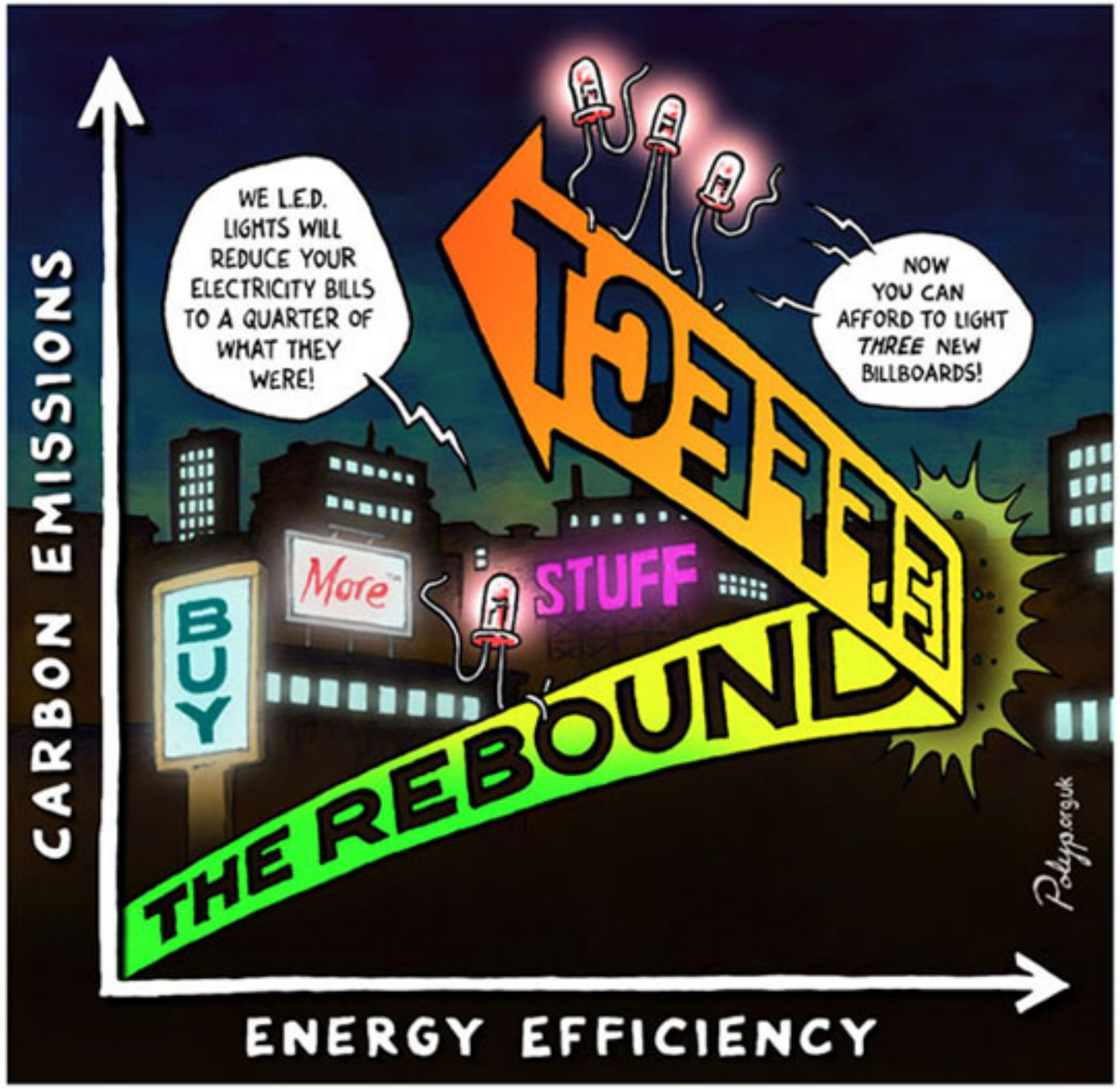
Lecture 1

Rebound effect



Lecture 1

Rebound effect

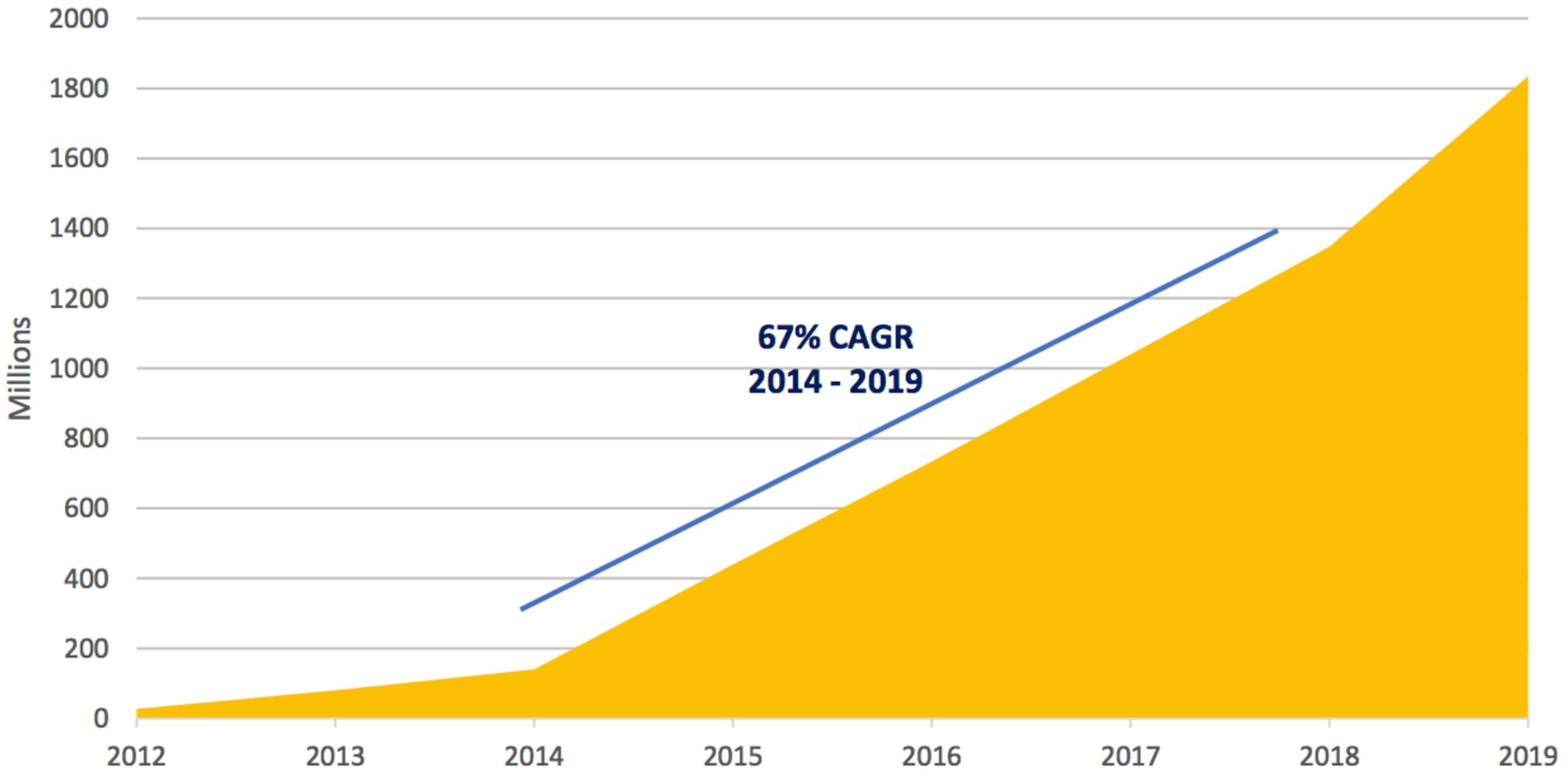


https://www.thegwpf.com/green-madness-energy-efficient-led-lighting-increases-energy-consumption-light-pollution/

Lecture 1

Rebound effect

The multiplication of peripherals of daily life (or "**connected living**")



« New peripherals are appearing (bracelets measuring physical activity, portable Bluetooth speakers, etc.) and existing equipment in all households is becoming capable of communicating (televisions, refrigerators, coffee machines, alarm and monitoring systems, thermostats, lighting, etc.). »

https://theshiftproject.org/en/article/lean-ict-our-new-report/

Quiz: How many digital devices do you have?

Lecture 1

Rebound effect

Digital devices in a household of 4 persons in an OECD country.

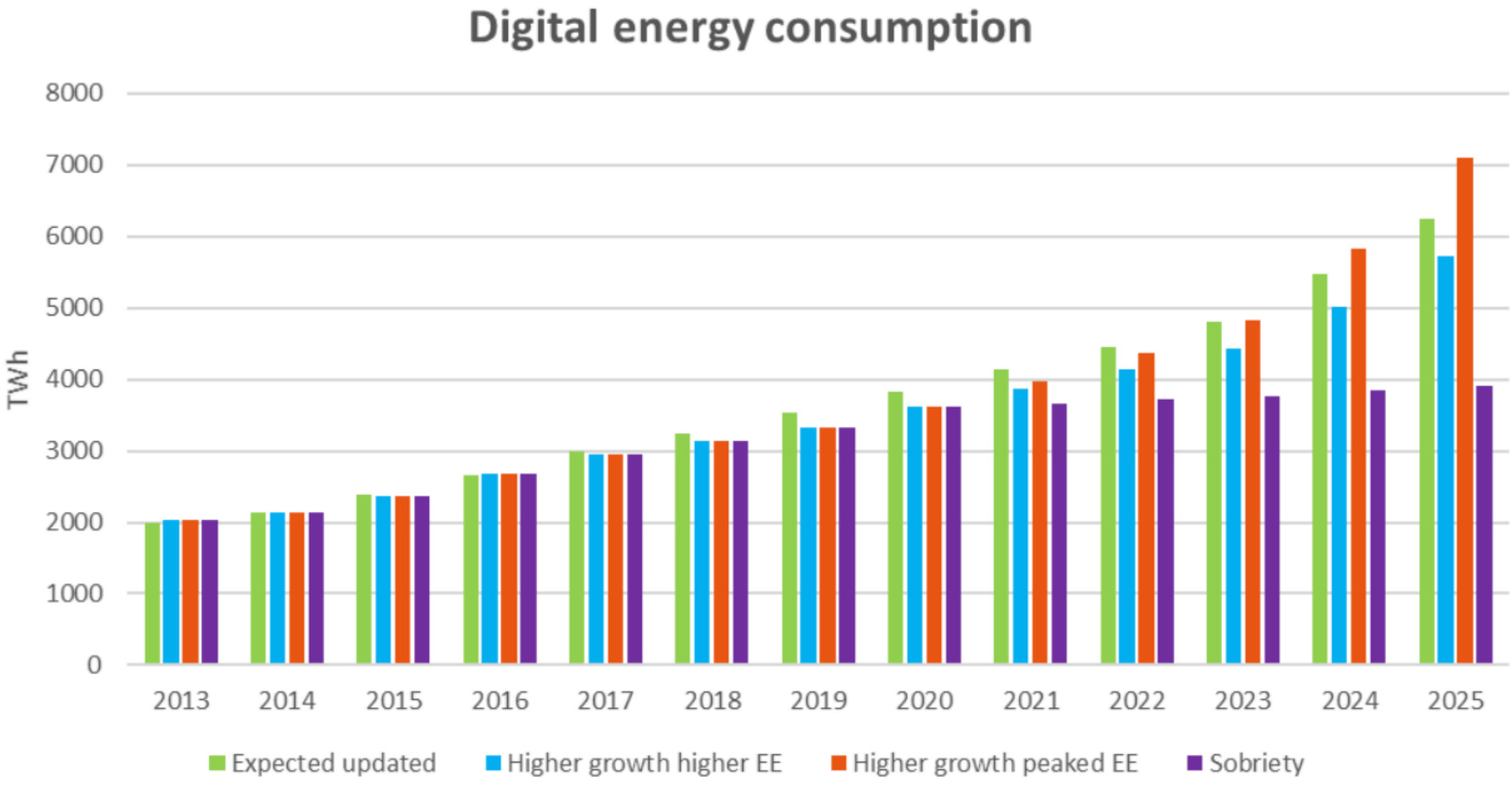
2012	2017	2022
2 smartphones	4 smartphones	4 smartphones
2 laptops/computers	2 laptops	2 laptops
1 tablet	2 tablets	2 tablets
1 DSL/Cable/Fibre/Wifi Modem	1 connected television	3 connected television
1 printer/scanner	2 connected set-top boxes	3 connected set-top boxes
1 game console	1 network attached storage	2 eReaders
	2 eReaders	1 printer/scanner
	1 printer/scanner	1 smart metre
	1 game console	3 connected stereo systems
	1 smart metre	1 digital camera
	2 connected stereo systems	1 energy consumption display
	1 energy consumption display	2 connected cars
	1 Internet connected car	7 smart light bulbs
	1 pair of connected sport shoes	3 connected sport devices
	1 pay as you drive device	5 internet connected power sock
	1 network attached storage	1 weight scale
		1 eHealth device
		2 pay as you drive devices
		1 intelligent thermostat
		1 network attached storage
		4 home automation sensors

https://theshiftproject.org/en/article/lean-ict-our-new-report/

Lecture 1

Rebound effect

The share of digital technology in final energy consumption (growing by 1.5% per year) will have increased by **almost 70%** between 2013 and 2020.



https://theshiftproject.org/en/article/lean-ict-our-new-report/

Lecture 1

Rebound effect

The gain of energy efficiency cannot compensate for the exponential increase in the number of digital devices.

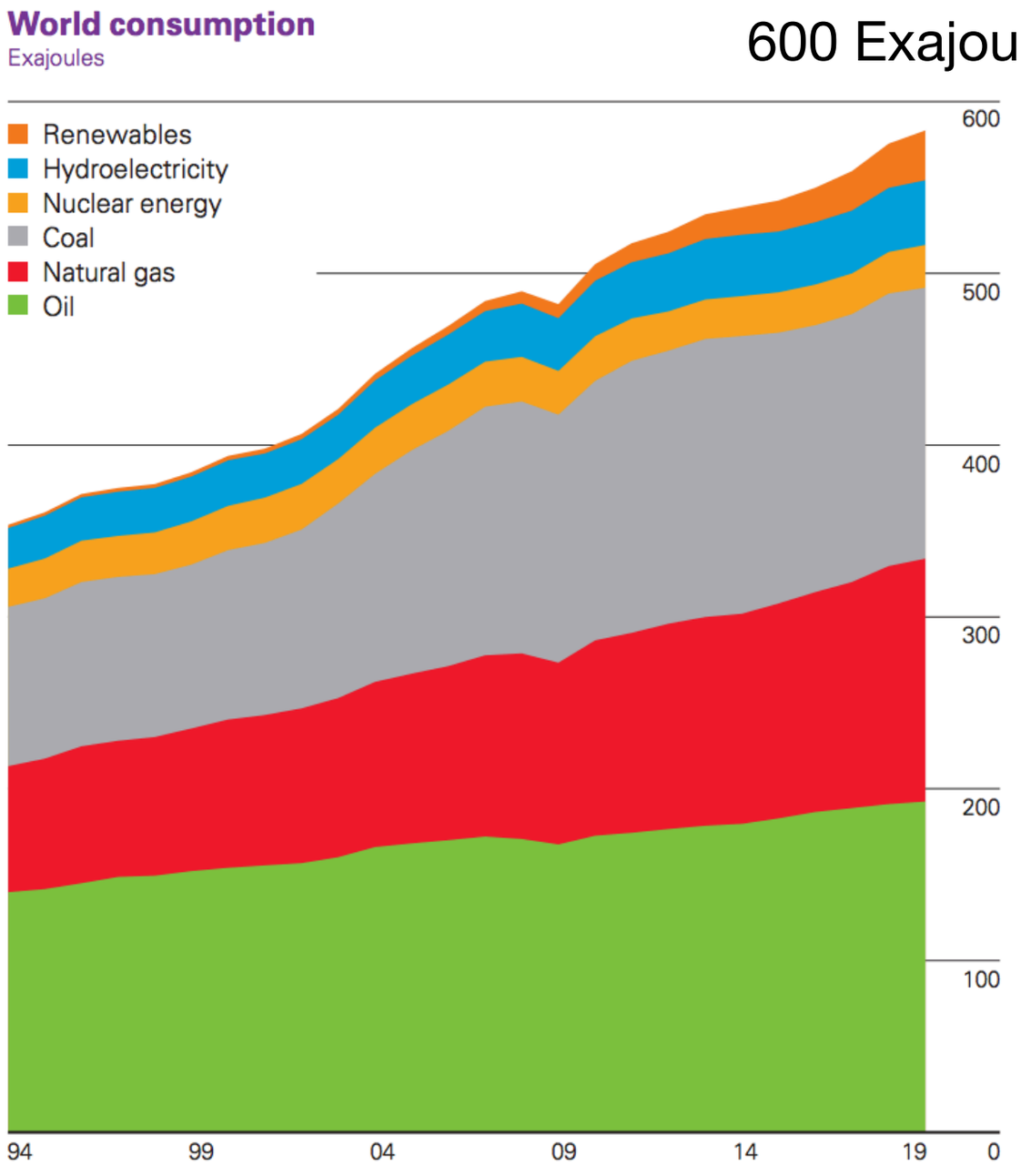
https://theshiftproject.org/en/article/lean-ict-our-new-report/

Same phenomenon for cars, etc.

Lecture 1
Rebound effect & energy

The energy consumption at the world scale keeps on increasing.

Furthermore, **fossil fuels are not decreasing**…



600 Exajoules = 166 667 TWh

Credits: bp Statistical Review of World Energy 2020

Lecture 1

Rebound effect & 5G

Quiz: What do you think of 5G ?

TSP 5G report

Lecture 1

Goals

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges’s perimeter

Energy

Rebound effect

Challenges

Lecture 1
Sustainability challenges

How to live x times better by using x times lesser resources?

How to get x times more meaning with x times fewer things?

Quiz: What do you think about these questions?

Credits: Sustainable development & Transition UCL LEPL 1804

Lecture 1
Sustainability challenges

Will **technology** save us ?

Can **technology** save us ?

Quiz: What do you think ?

Lecture 1
Sustainability challenges

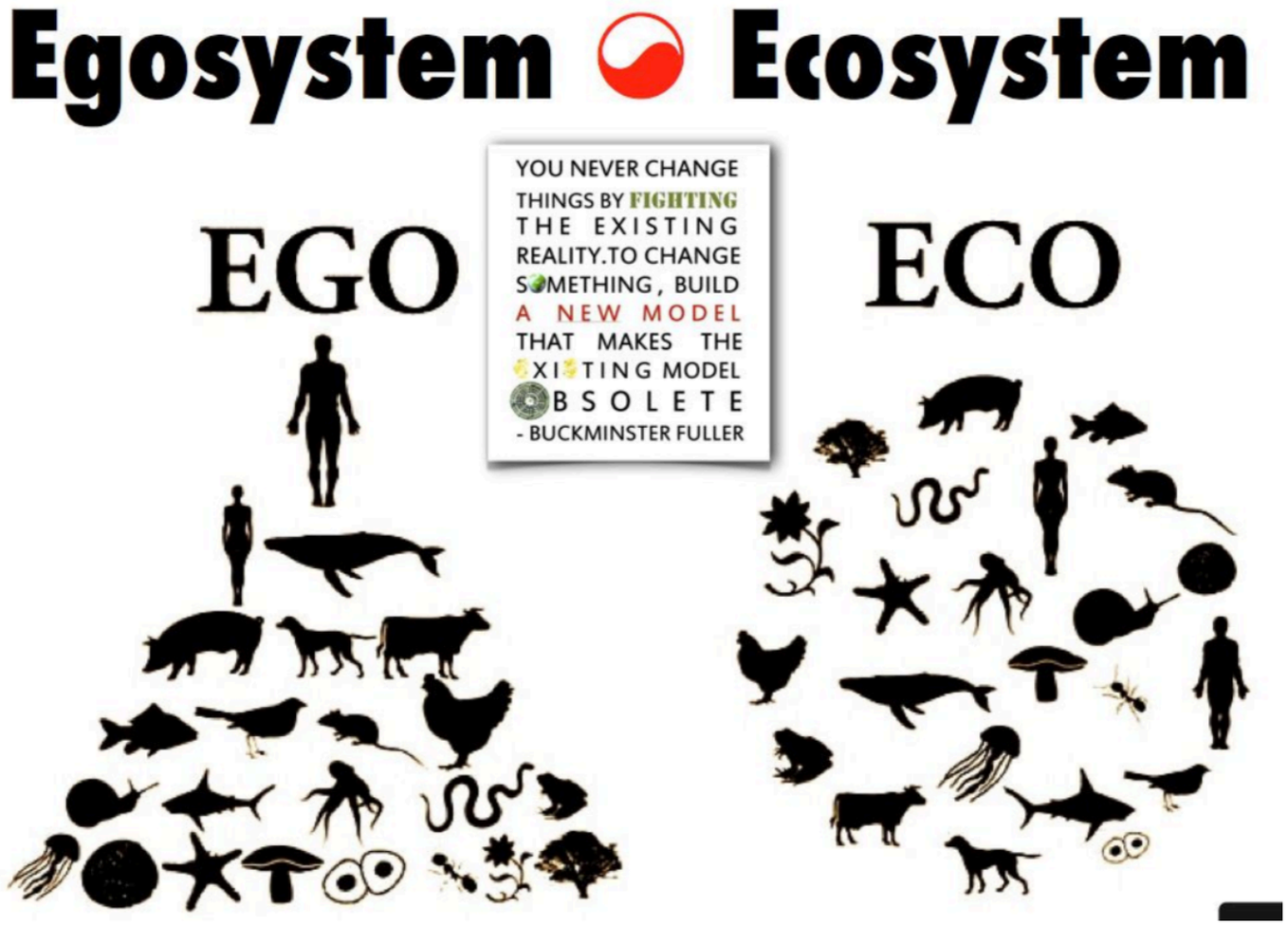
Let's question our imagination, our relationship to the world?

Anthropocentrism

Biocentrism

Credits: Sustainable development & Transition UCL LEPL 1804

Lecture 1
Sustainability challenges



Credits: Sustainable development & Transition UCL LEPL 1804

Lecture 1
Sustainability challenges

The need to re-invent ourselves?

- Global, holistic, systemic approach
- Thinking at the same time: technical, economic, responsibility, consequences (environmental, social),... Think with limits!
- Evaluate all the costs of innovation!
- Where are the winners, where are the losers?
- Importance of the collective, working together
- Collaboration vs. Competition
- New instruments, new units, new criteria of success, of excellence, of well-being
- Transition to appropriate technologies - responding to needs, responding to a shared vision of society - Human-centered innovations

Credits: Sustainable development & Transition UCL LEPL 1804

Lecture 1
Sustainability challenges

Transition to appropriate technologies

- Need for decision support tools - Life Cycle Assessment (LCA) Granta, GaBI, SimaPro, Umberto, OpenLCA,...
- Circular economy with recycling as a last resort
- Eco-design, modular design,... to repair, re-use,... (the 11 Rs)
- Fight against programmed obsolescence
- Anticipate the rebound effects (3-level environment impacts concept framework)
- The economy of functionality
- Legislation as a lever for change

Credits: Sustainable development & Transition UCL LEPL 1804

Lecture 1

Conclusions

Sustainable development

Sustainable development goals

ENVT 3065 Sustainability Challenges’s perimeter

Energy

Rebound effect

Challenges

Lecture 1

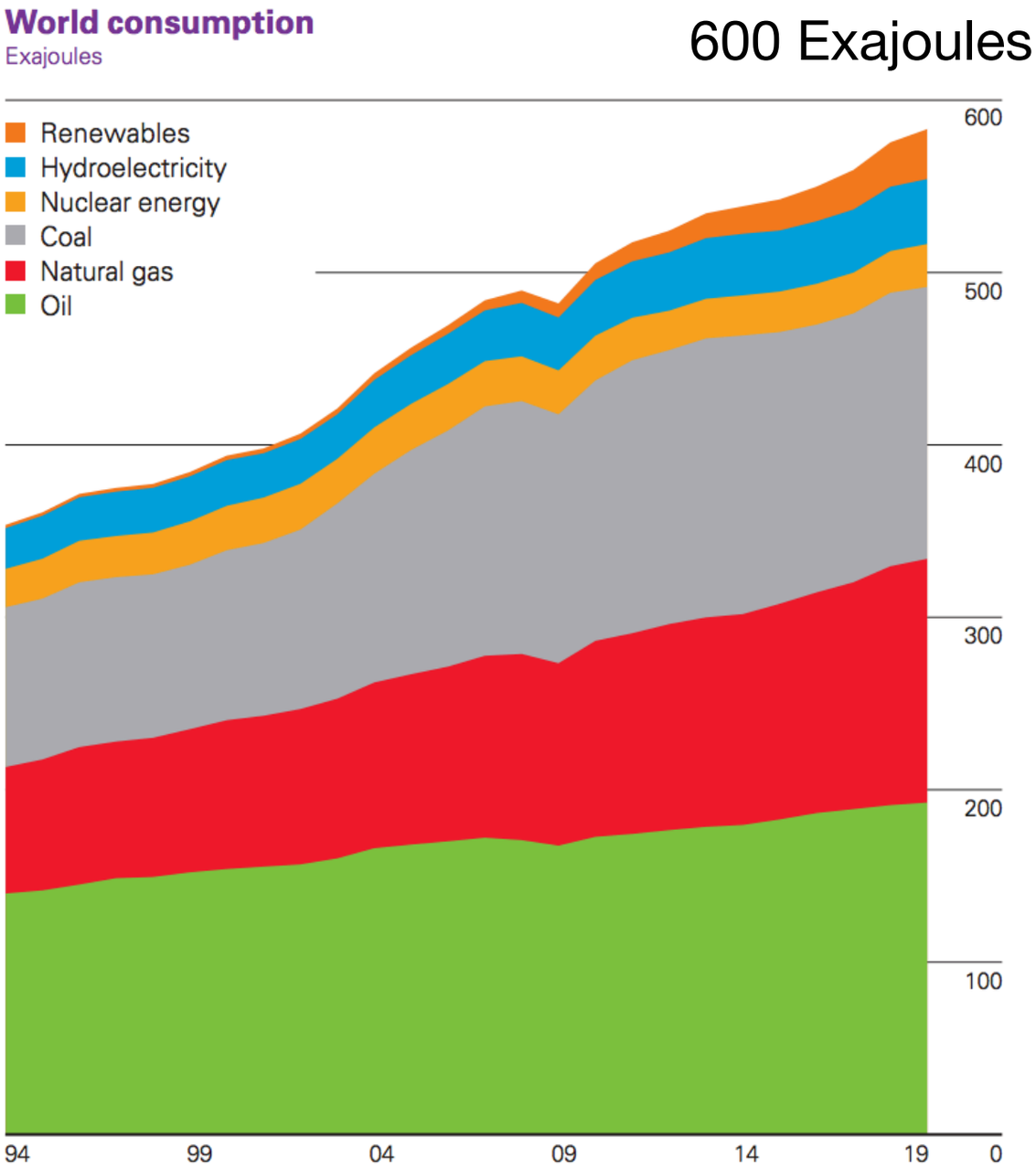
Course perimeter

https://www.un.org/sustainabledevelopment/news/communications-material/

Lecture 1
Rebound effect & energy

The energy consumption at the world scale keeps on increasing.

However, **fossil fuels are not decreasing** …



600 Exajoules = 166 667 TWh

Credits: bp Statistical Review of World Energy 2020

Lecture 1

Course map