Doutoramento em Alterações Climáticas e Políticas de Desenvolvimento Sustentável

SEMINAR ENERGY & CLIMATE CHANGE

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NOVA SCHOOL OF SCIENCE & TECHNOLOGY

CENSE center for environmental and sustainability research

SEMINAR ENERGY & CLIMATE CHANGE

AGENDA

1. ENERGY & CLIMATE CHANGE: A COMPLEX, PERENNIAL AND INTERDISCIPLINAR RELATION
2. II. Scope and purpose of the course. Syllabus. Practicalities.

WORLD ECONOMIC FORUM

FIGURE C

Global risks ranked by severity over the short and long term

"Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period."

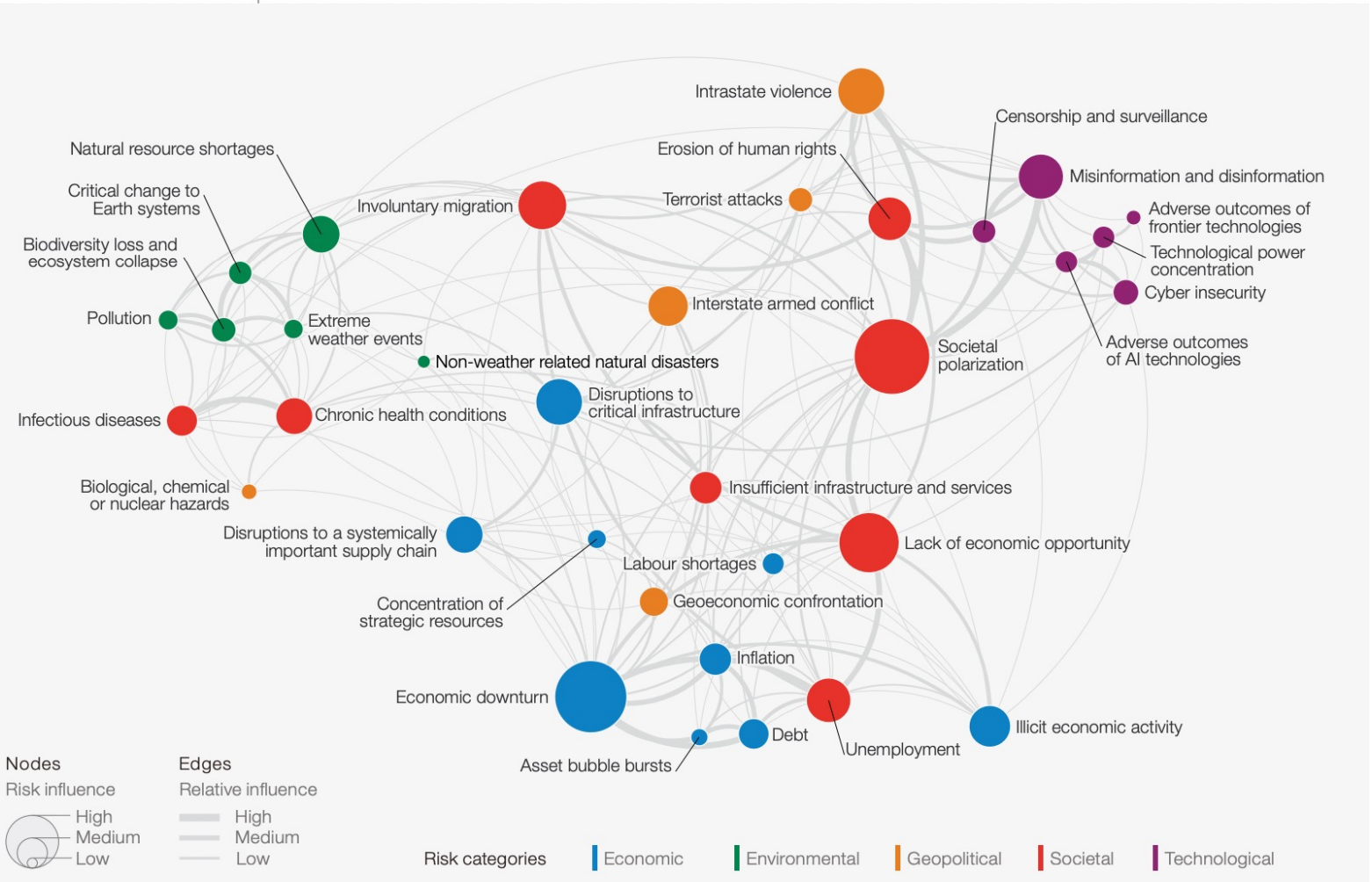
Source

World Economic Forum Global Risks Perception Survey 2023-2024.

[The Global Risks Report 2024](#)
19th Edition

WORLD ECONOMIC FORUM

FIGURE D | **Global risks landscape: an interconnections map**



Source

World Economic Forum Global Risks Perception Survey 2023-2024.

[The Global Risks Report 2024](#)
19th Edition

ENERGY & CLIMATE CHANGE:
A COMPLEX, PERENNIAL AND INTERDISCIPLINARY RELATION







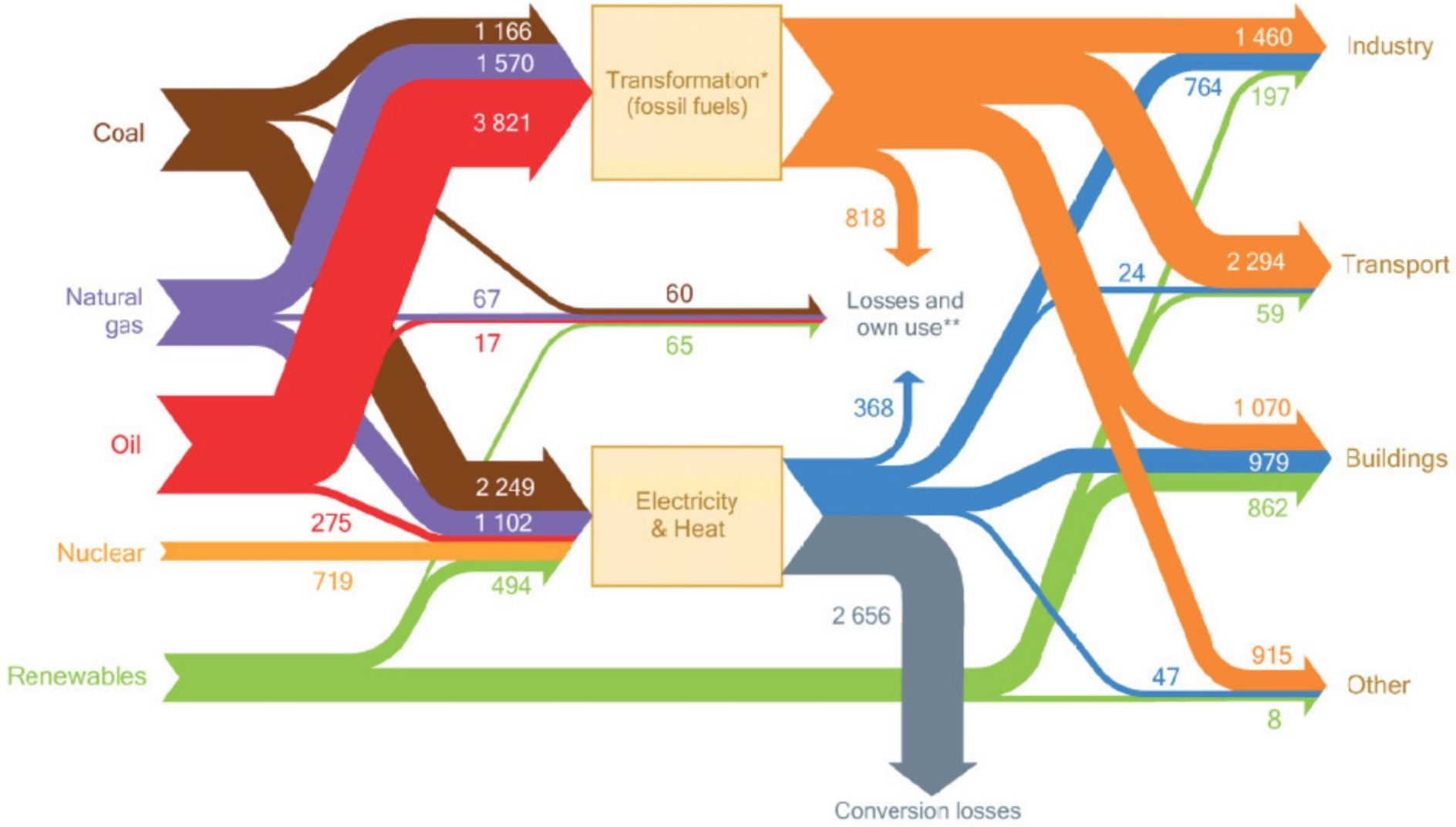


ENERGY & CLIMATE CHANGE: A COMPLEX, PERENNIAL AND INTERDISCIPLINARY RELATION

- Oil | coal
- Sun | water | wind
- Thermoelectric power plants
- Production of electricity from renewable sources
- Passengers mobility
- Heating / Cooling
- Biofuels
- Double windows
- Refrigerators & Freezers
- LED lamps
- Comfort | welfare

- 2016 warmer year
- Reduction of the icy area of Greenland
- Heat waves
- Snowstorms
- Forest fires
- Less efficient power plants in summer
- Rational energy use behaviors
- Access to electricity
- Energy cost - competitiveness
- Electrical Gadgets
- Urban habits

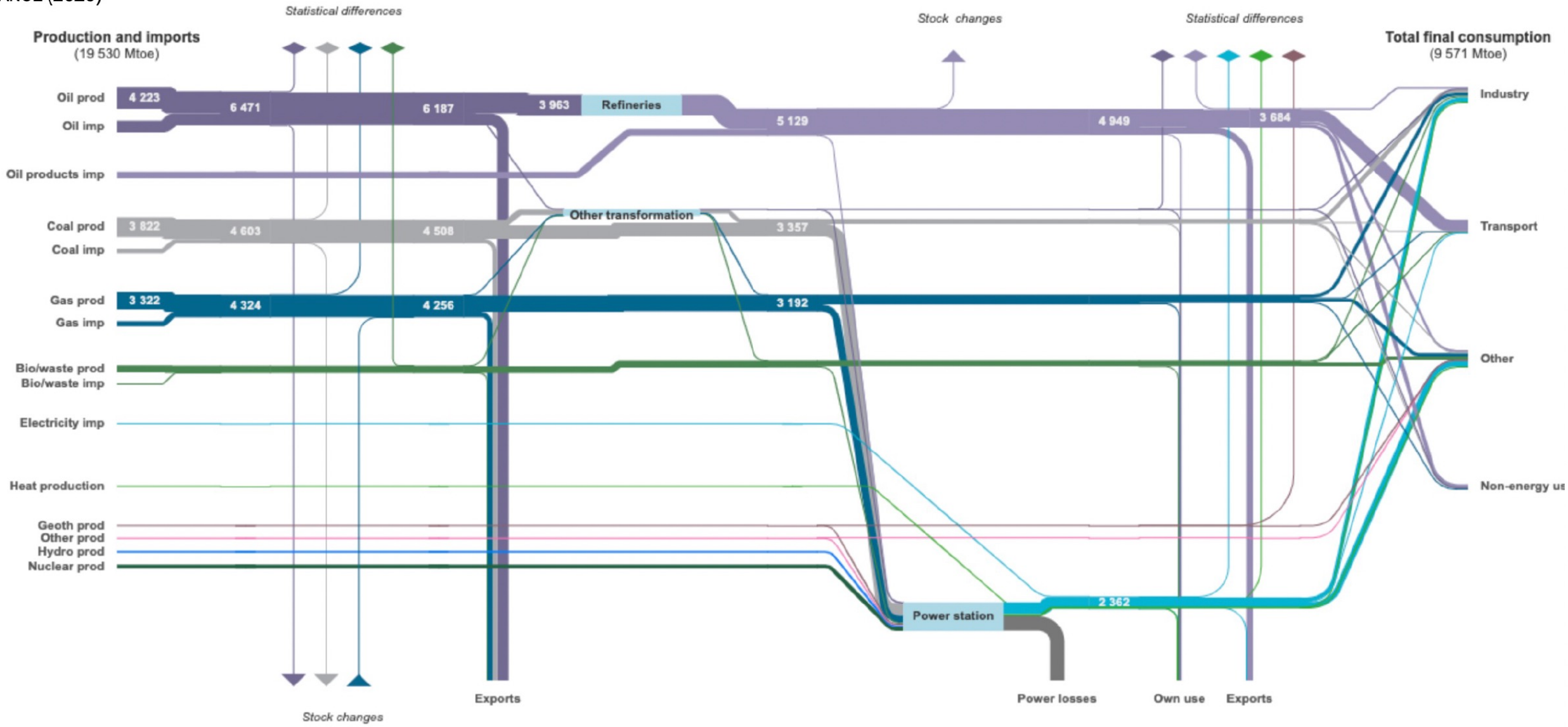
Figure 2.8 ▷ **The global energy system, 2010** (Mtoe)



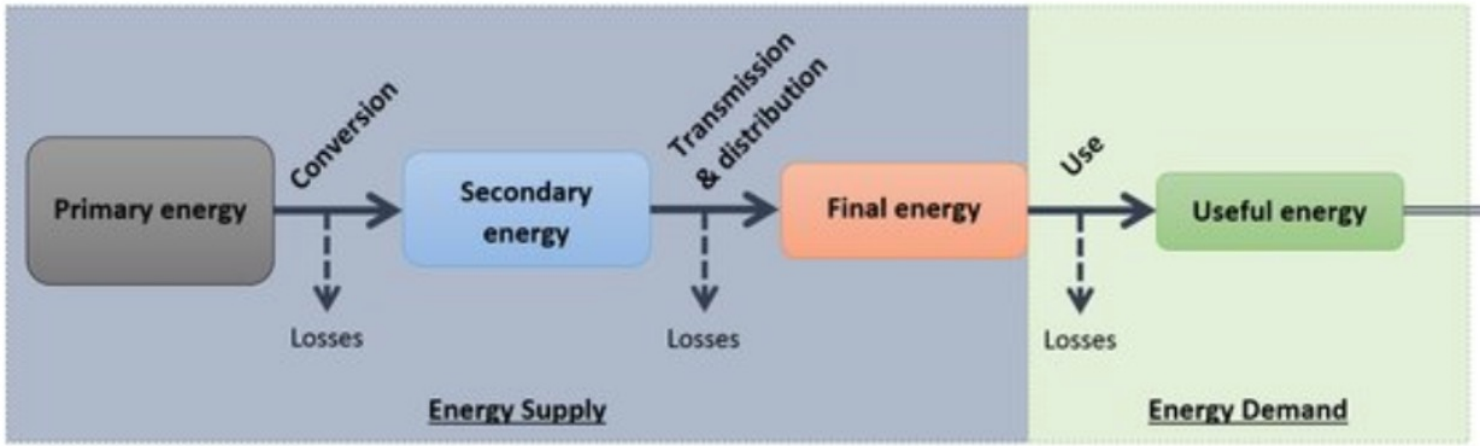
World

BALANCE (2020)

Millions of tonnes of oil equivalent



THE ENERGY SYSTEM



COAL OIL SOLAR HYDRO	HEAT STEAM	ELETRICITY OIL PRODUCTS	LIGHT HEAT MOVEMENT	See next slide

Primary Energy $\xrightarrow{\eta}$ Final Energy $\xrightarrow{\eta}$ Useful Energy -> Energy services

For a better understanding on energy services, read this paper Hass et al (2008)

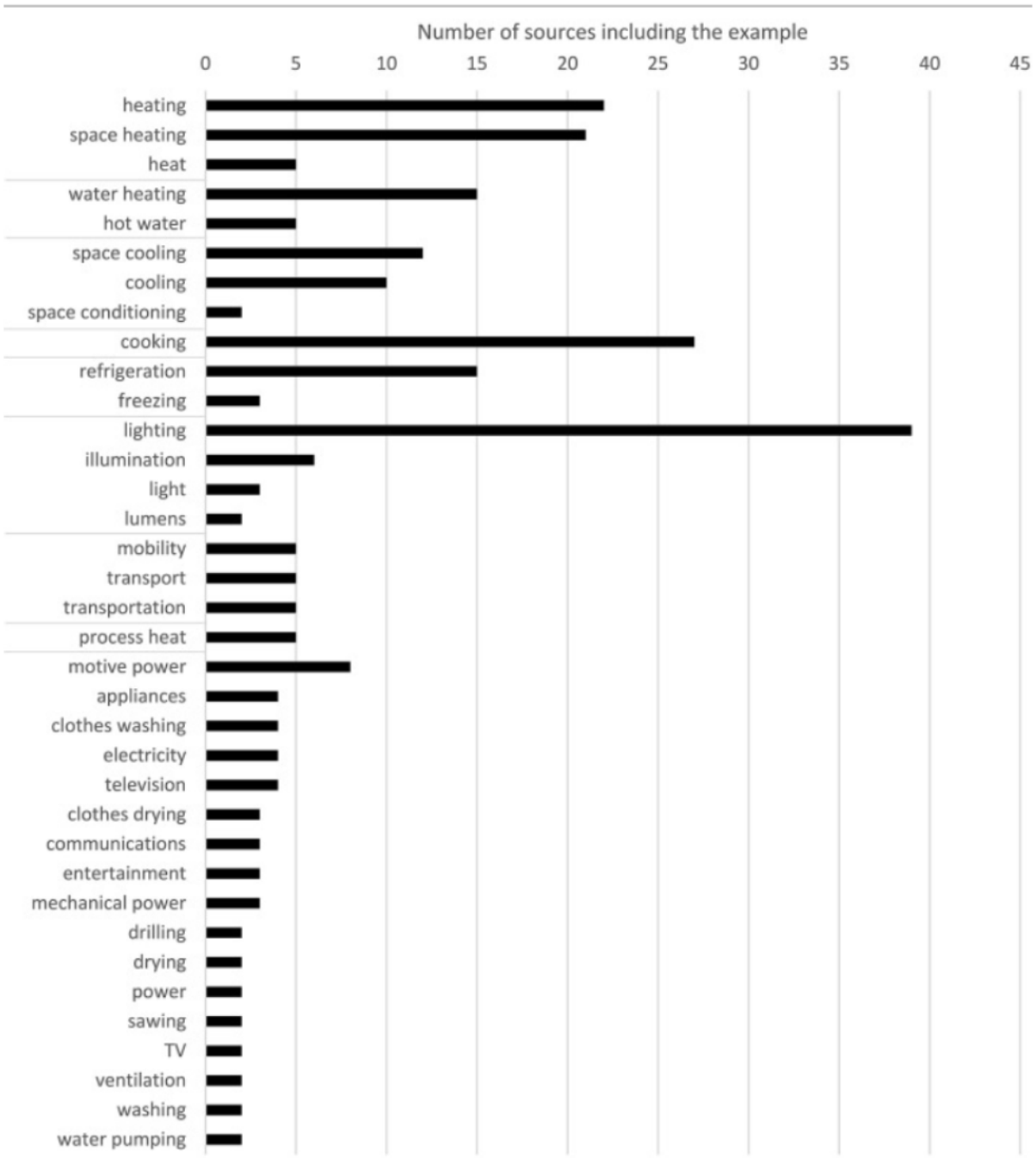


Fig. 2. Examples of energy services included in two or more sources. Source: (Fell, 2017)

Equipment at home: installed capacity

Características Específicas

Potência (W)	2100
Potência de Ligação (W)	2100
Capacidade Reservatório [ml]	300
Débito de Vapor [g/min]	30

1h of ironing: 2100 W *1h = 2100 Wh = 2,1 kWh

3h of ironing: 2100 W *3h= 6300 Wh= 6,3 kWh

Power

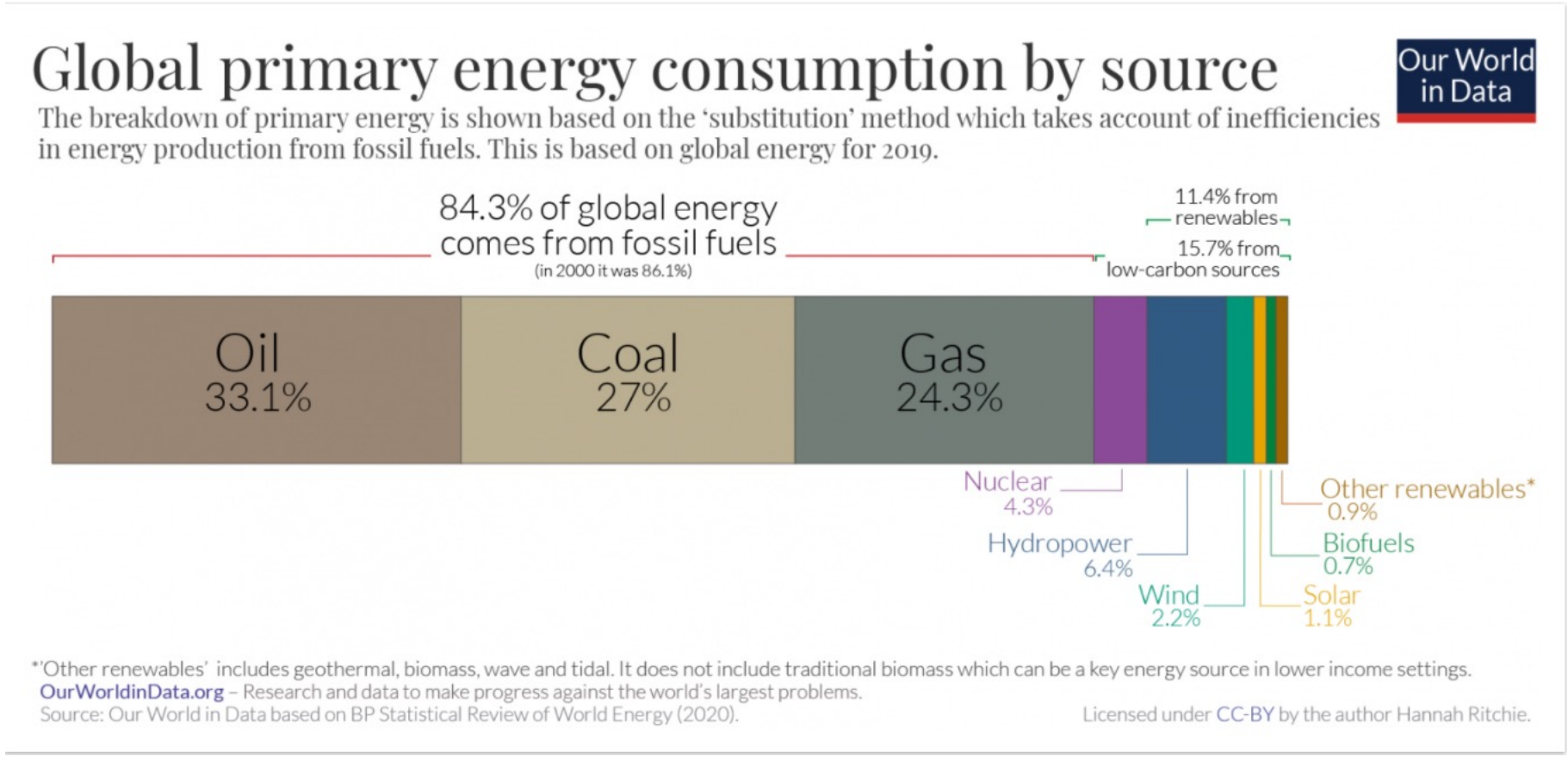
Energy consumed

How much is the renewables share in global primary energy consumption?:

a) 30%

b) 10%

c) 5%



The global energy sector contribution for world greenhouse gas emissions is approximately:

a) 70%

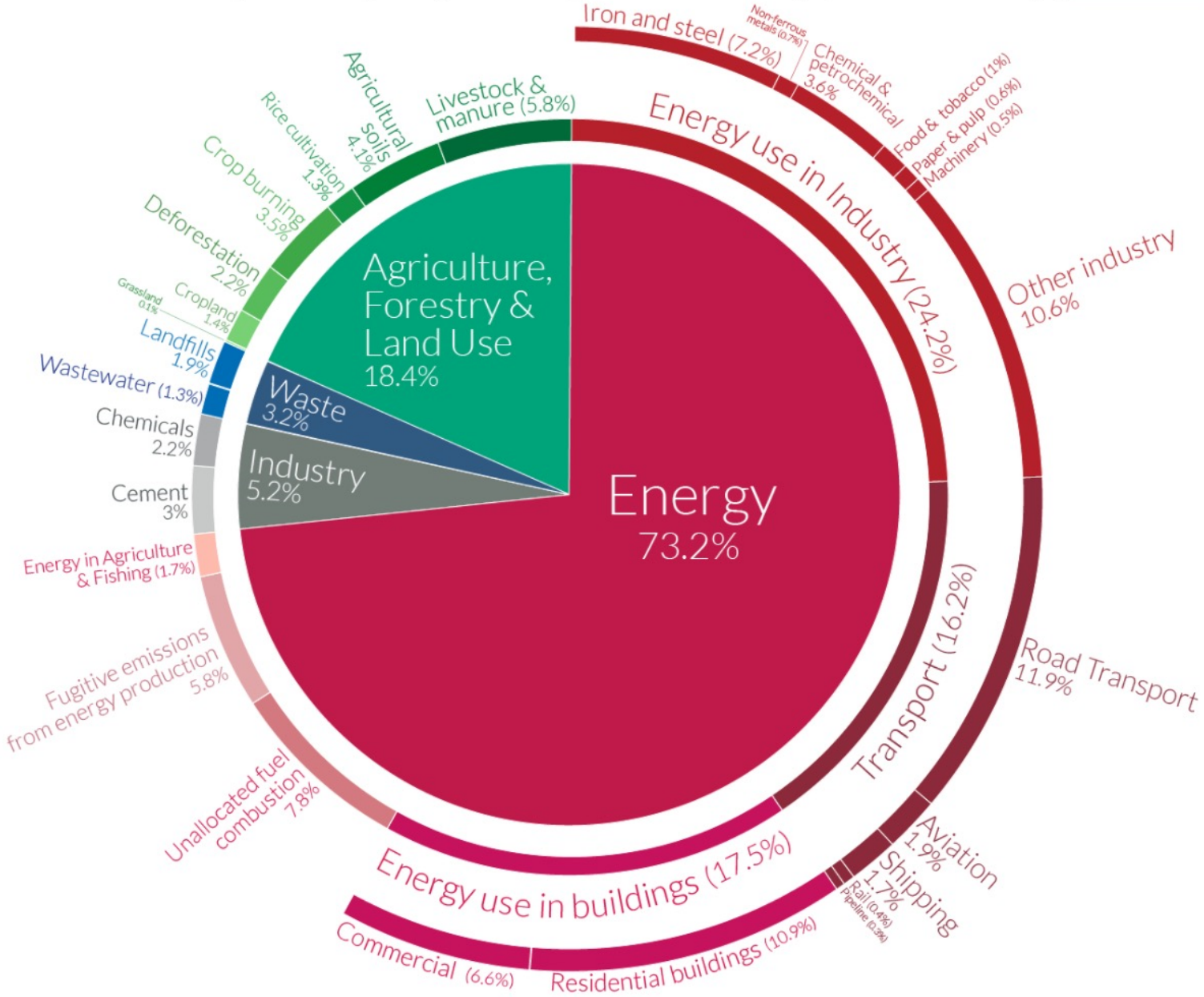
b) 90%

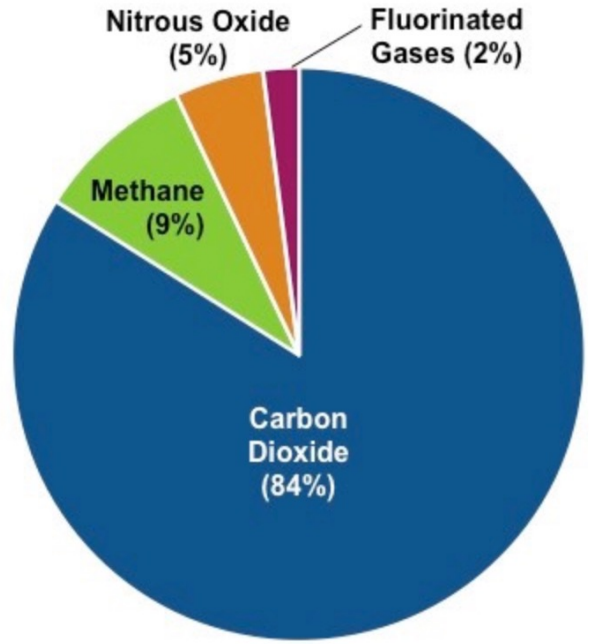
c) 40%

Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO_2eq.

Our World in Data





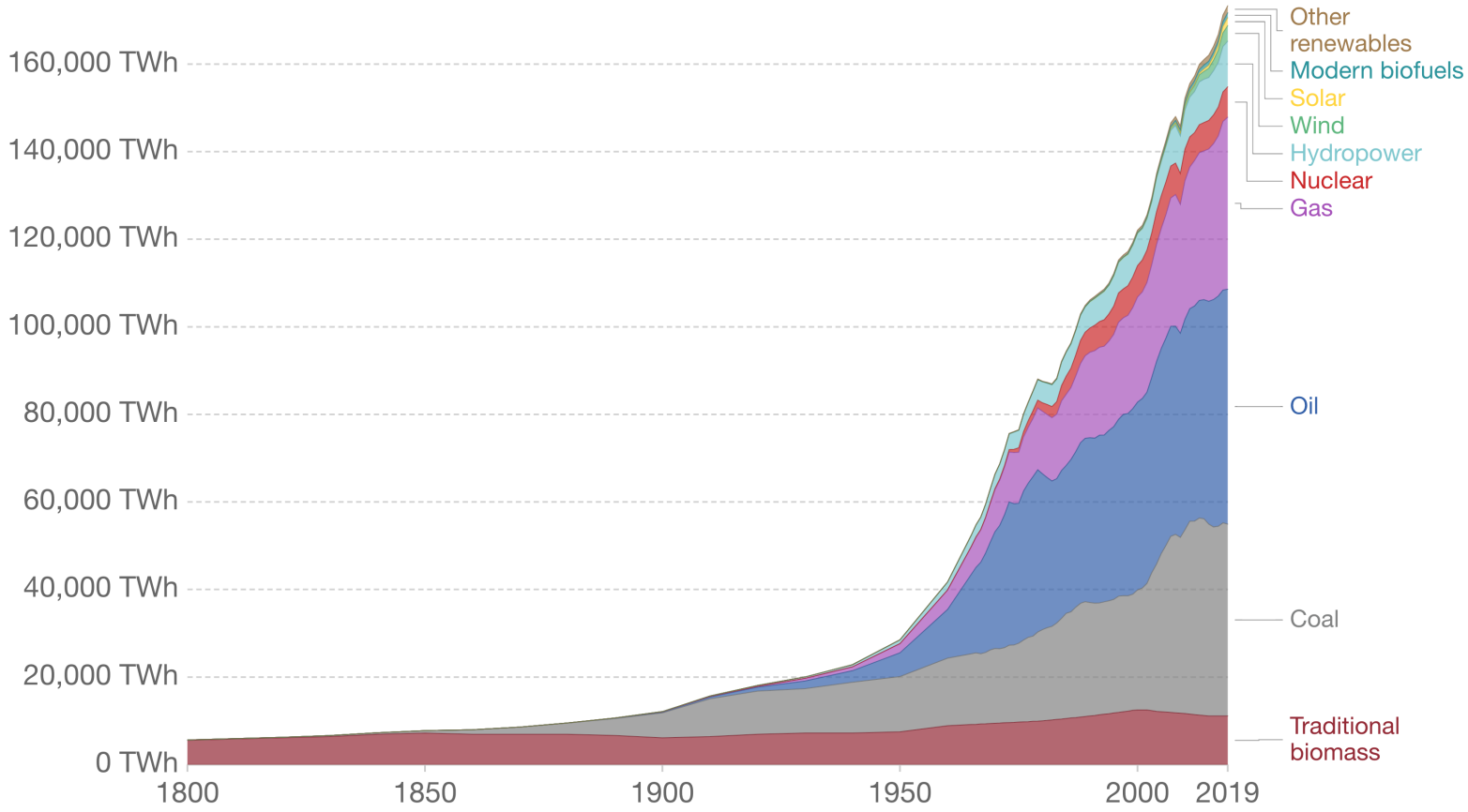
Anthropomorphic (Man-Made) Greenhouse Gases

ENERGY & CLIMATE CHANGE: A COMPLEX, PERENNIAL AND INTERDISCIPLINARY RELATION

Global primary energy consumption by source

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.

Our World in Data

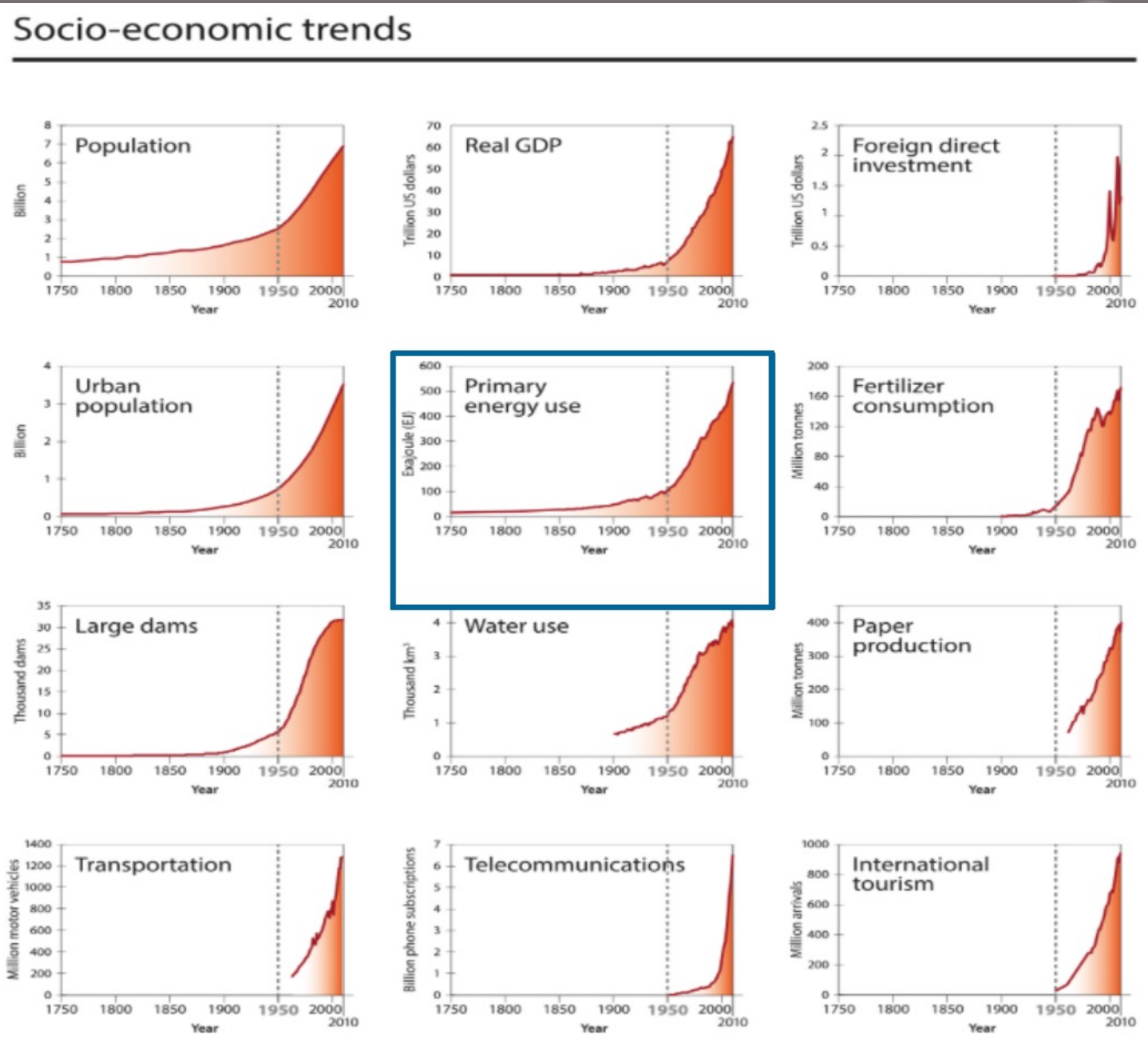


Source: Vaclav Smil (2017) & BP Statistical Review of World Energy

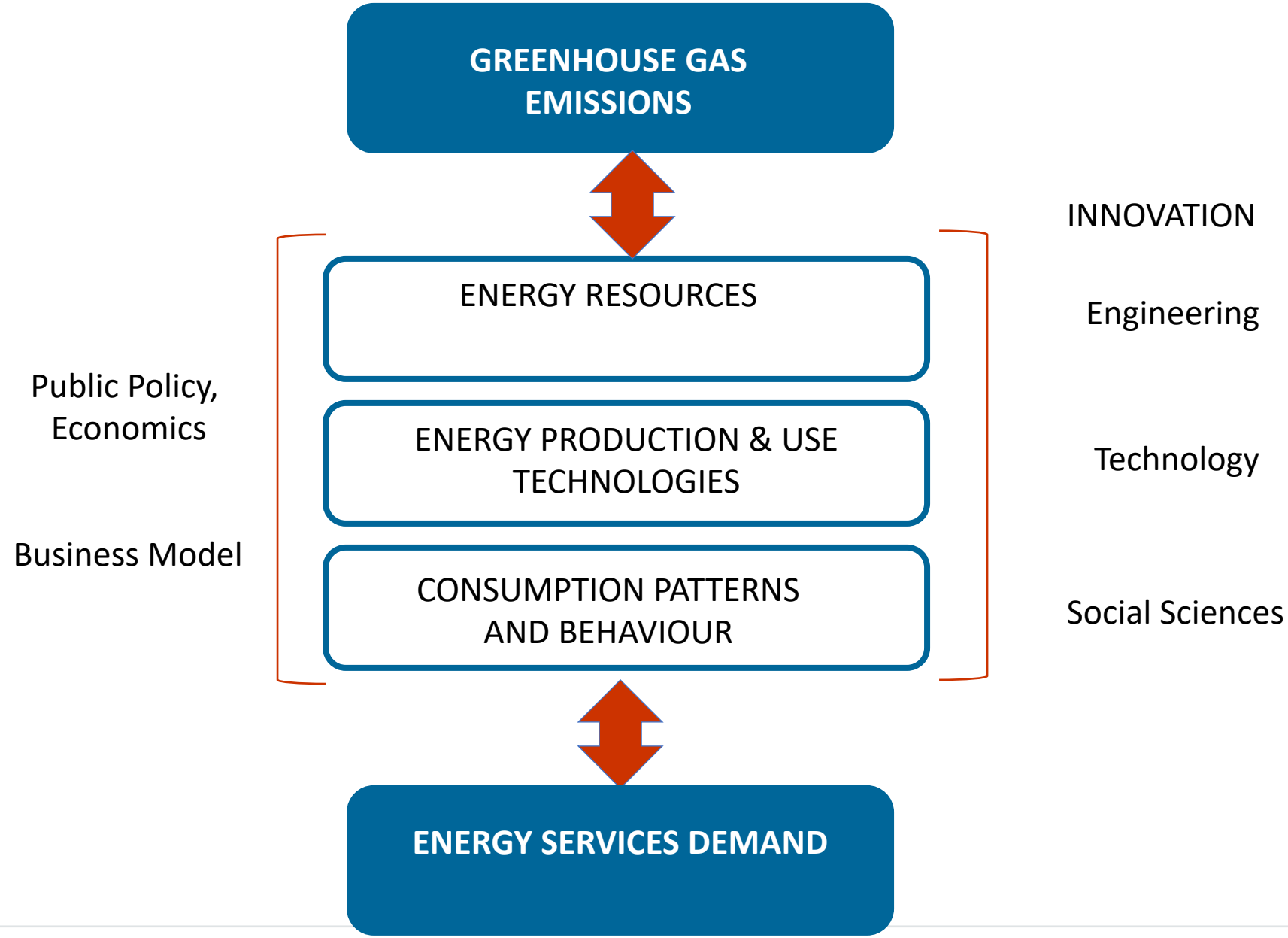
OurWorldInData.org/energy • CC BY

ENERGY & CLIMATE CHANGE:
A COMPLEX,
PERENNIAL AND
INTERDISCIPLINARY
RELATION

Explore more on the Great Acceleration here



ENERGY & CLIMATE CHANGE: A COMPLEX, PERENNIAL AND INTERDISCIPLINARY RELATION



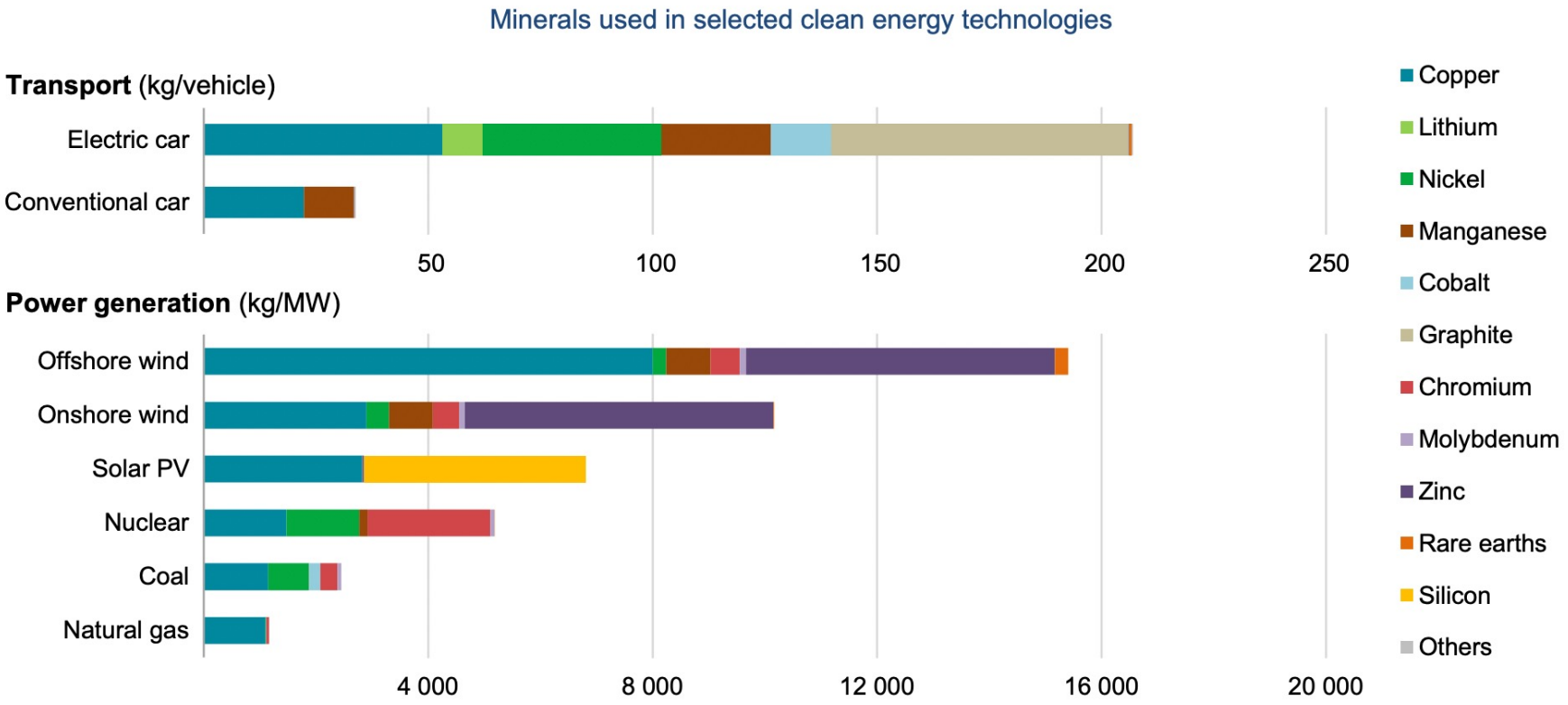
ENERGY & CLIMATE CHANGE:

SYSTEMIC APPROACH

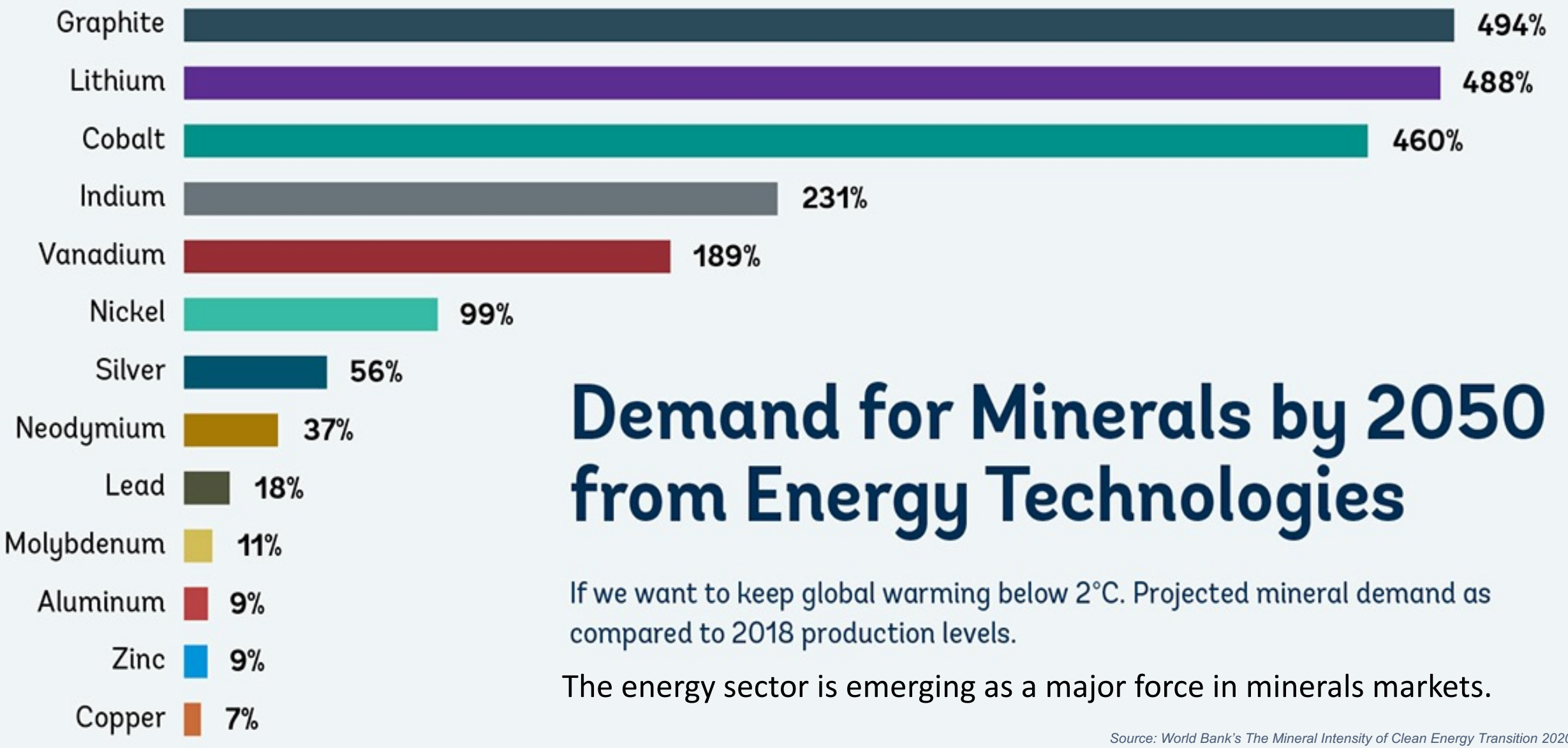
LONG-TERM ACCOUNTING

HOW MUCH SUSTAINABLE IS THE ENERGY TRANSITION?

The rapid deployment of clean energy technologies as part of energy transitions implies a significant increase in demand for minerals



An electric car requires six times more mineral resources than a conventional car, and an onshore wind farm requires nine times more mineral resources than a gas-fired power station.



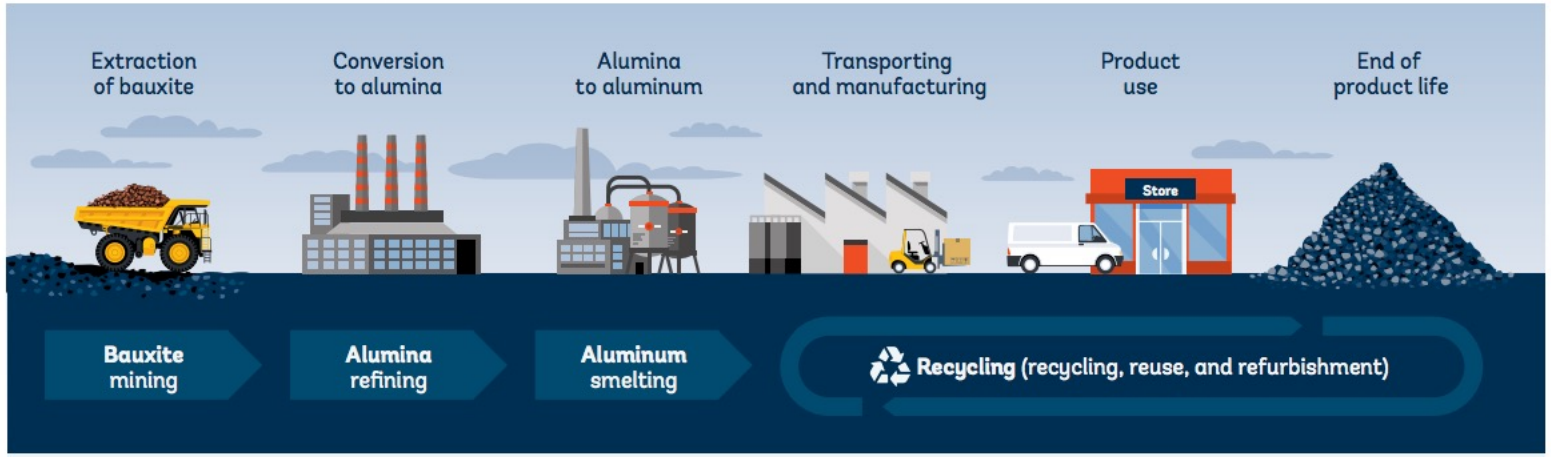
Demand for Minerals by 2050 from Energy Technologies

If we want to keep global warming below 2°C. Projected mineral demand as compared to 2018 production levels.

The energy sector is emerging as a major force in minerals markets.

Source: World Bank's The Mineral Intensity of Clean Energy Transition 2020

Materials and Mining



Minerals for Climate Action, World Bank (2020)

Extraction activities have impacts on:

- Energy consumption
- Water consumption
- Emissions
- Change in land use
- Ecosystem fragmentation
- Loss of biodiversity

A former rare earth mining site in Longnan county, Jiangxi province. MICHAEL STANDAERT/YALE E360

Materials and Mining

Salar de Atacama Basin:
rare rains and highest solar radiation on the planet => **high quality lithium at low cost**

By 2025, 45% of global demand for lithium will be fueled by water-intensive mining adjacent to fragile eco-hydrological systems in the Atacama.

Lithium-rich brines are pumped unsustainably from beneath salt flats. Fragile swamps and lagoons are drying out, protected Andean flamingo populations are dwindling, and the drinking water sources that have sustained local communities for millennia are dwindling.

Argentina, Bolivia and Chile hold the largest lithium reserves in the world

(unsustainable) Land use

Largest solar farm in the world: Bhadla Solar Park, Rajasthan, India: total installed capacity of 2,245 MW, distributed over a total area of 5,700 ha

PV systems require, on average, an area between 2 - 4 ha / MW.

Total area: all land delimited by the project, including land directly occupied by solar panels, access roads, substations, service buildings and other infrastructure.

Planet | 2030
820 GW solar PV 2030/2022 (IEA)
1,5 a 3 Million ha
(1,7 a 3 times the area of Portugal!)

Portugal | 2030
14,9 GW solar PV 2030/2022 (PNEC)
30-60 thousand ha

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PURPOSE OF THE COURSE:

1. deepen the intrinsic relationship between climate change and energy, taking the perspective of greenhouse gas emissions mitigation.
2. focus on technological, economic, environmental and social aspects.
3. train the reasoning and practices on medium to long-term prospective exercises

At the end of the course, students will be able to perform a critical and robust analysis on:

a. the impact of energy options on the problem of climate change from the perspective of systems analysis and in the medium to long term;
b. the importance of clean energy production to economic competitiveness, in particular within the regulatory framework to promote low-carbon economy;
c. prospect and develop a plan for the success of an economic activity in a neutral carbon economy pathway - EVALUATION.

PROGRAM & RESOURCES @ SOFIA SIMÕES WILL PROVIDE THE ACCESS

Climate Change and Sustainable Development Policies

Programme of classes 2024

SEMINÁRIO ENERGIA E ALTERAÇÕES CLIMÁTICAS

Face to face classes in Room 3 of ICS

Doutoramento em Alterações Climáticas e Políticas de Desenvolvimento Sustentável

#	DATE		TOPIC	PROF.
1	02/mar Sat	9h-11h	**ENERGY & CLIMATE CHANGE:** A COMPLEX RELATION, PERENE AND INTERDISCIPLINARY. Framework and purpose of the course in the PDACPDS. Practicalities and seminar program. Basic concepts of the energy systems.	J. Seixas, FCT NOVA
2	02/mar Sat	9h-11h	**Energy Concepts & Global energy system:** primary/final energy; energy efficiency; sankey diagrams; energy services; energy carriers; final energy supply cost curves; energy production and consumption regions; energy access; energy and carbon intensity. How GHG (greenhouse gases emissions) are estimated.	S. Simões
3	16/mar Sat	9h-11h	**Global balance of CO_2 emissions** associated with energy and industrial processes. The greenhouse effect. GHG emissions from fossil energy per sources and countries. Estimates of the Global Carbon Budget (http://www.globalcarbonproject.org/) and its relationship to the global energy system and changes in land use. Future scenarios for GHG emissions: SSPs and RCPs. Global emissions based on consumption vs. production.	S. Simões
4	22/mar Friday	18h-20h	**GHG Emission Mitigation options:** Mitigation vs adaptation. Fuel switch, renewable energy, energy efficiency, green hydrogen, nuclear power, carbon capture & storage/utilisation, carbon removal. Behavioural mitigation options. Introduction to assignment.	S. Simões
5	05/apr Friday	14h-16h	**Drawdown** - Multisector Climate Solutions	J.P. Gouveia
6	12/apr Friday	14h-16h	**Renewables technologies:** Renewable energy technologies. Energy security of endogenous vs. imported resources. Learning curves of renewable energy technologies. Definition and usefulness of LCOE. System value of Renewables. Global renewables' market. Sustainability issues related with renewables. Land & water use, critical raw materials. Discussion: Where to place 7GW of solar PV in Portugal till 2030?	S. Simões
7	19/apr Friday	14h-16h	**Policy and economy of Climate Change:** Global framework to deal with climate change: UNFCCC, Paris Agreement. EU climate policy framework (FF55, REPowerEU, CBAM, etc.). Fundamentals of carbon and climate economics: risks and opportunities for organisations and businesses. State of the art on carbon pricing: emissions trading schemes, carbon taxes. Introduction to EN-Roads Simulation Game	S. Simões
8	03/may Friday	16h-18h	**30min Mini-quizz in class** (20% of final grade). **EN-Roads** simulation game: the transformation towards sustainability — interconnected challenges and solutions	students / S. Simões
9	10/may Friday	16h-18h	**Resources and datasets on energy and GHG emissions**: access to energy databases, Portuguese and European (PORDATA, DGEG, EUROSTAT). i) How to find and explore energy statistics and emissions of greenhouse gas (GHG) emissions for Europe and Portugal; ii) How to make energy conversions; iii) How to build indicators and charts with added value; iii) How to analyze economic sectors, and interpret their performance in terms of energy consumption and greenhouse gas emissions.	S. Simões
10	17/may Friday	16h-18h	**Energy systems modelling:** most well known models and exemplary applications at different scales & **Mentoring** with each students' group : discussion on the approach and methods adopted by the students, expected results to be obtained with the final work; assessing preliminary results, if any.	S. Simões
11	23/may Thursday	18h-20h	**Business strategy for climate change:** Climate change risks for companies. Mitigation, adaptation and risk management in companies. GHG emissions inventories. Carbon footprint of products. Rationale and examples of carbon voluntary markets.	S. Simões
12	24/may Friday	18h-20h	**Sustainable Cities and Buildings:** concept, components and implications for the energy systems. Energy poverty and the energy transitions.	J.P. Gouveia
13	07/jun Friday	18h-20h	**Evaluation**: assignment presentation by the students. Discussion in class (80% of final grade)	S. Simões / J. Seixas

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Challenge: Within the scope of your personal interests, select an economic activity: Fashion I Communication I Food and Beveragel Industry I Health services I Mobility I Other

Assuming your country will be in the midst of a pathway to achieve a carbon neutral economy by 2050 (as stated in the Paris Agreement) or earlier, how do you envisage the selected activity will picture by 2030?

Team work I Think out of the box I Innovate

What is the challenge for the activity? Who are the challenge owners?

What do you envisage the activity must/should deliver in the future?

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Suggestion of script for development:

- firstly, **formulate (and detail) the problem** as far as you are able;
- **characterize the activity at present** [for example, production / import technologiesl type of markets and consumers l competition from other markets? l energy consumption profile l indicators of carbon intensity]
- **envisage the activity up to 2030** [technological options l product change - greenl change of consumers l energy consumption profile l indicators of carbon intensity]
- **systematize opportunities for the mitigation** of the selected activities (identify needs of R & D, act on consumption preferences, the product value chain, among others)
- **identify and anticipate constraints and barriers** to the desired mitigation, and explain how to overcome them.

Tips: Start now; try to be objective and quantify what is possible; do not try to be exhaustive (you can not do it within just one course); explore examples that already exist in other countries; be creative.

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EVALUATION:
Criteria [points/100], the goal of the exercise is to promote:

1. Your ability to reason about the problem, in a structured and integrated way (for example, within the value chain of the activity, including the international dimension if applicable); [25]
2. Consistency and creativity in the scenario design in 2030 taking into account the expectations of a 450 ppm scenario (aggressive reduction of GHG emissions); [20]
3. Show knowledge about technological mitigation options, in particular regarding the energy component; [20]
4. Demonstrate robustness of analysis and arguments, focusing on aspects of cost effectiveness, carbon economics, competitiveness, among others. Demonstrate ability to synthesize information and data processing; [20]
5. Quality of presentation document & clear and concise oral presentation [15]

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How the work will be developed?

- Groups of 3 students (please send me an email with the group members until end of march)
- Coaching session to each group, on the work development (one class dedicated to this, end of may)
- Oral presentation: 30 min/group [15 min for oral presentation + 15 min Q&A]
- **Deliverable: at the day before the oral presentation at maximum, students will send to me the presentation by email.** Presentation in pdf format: maximum 10 slides + word document with 3 pages at maximum (only if needed for complementary information).

Oral presentation:
7 June 2024, friday, 14:00h, ICS (tbd)

In 2020, forest area represented 30.8% of the total land area; between 1990 and 2020, there was a net loss of 178 million hectares of forest areas (FAO, 2020).

THANK YOU

Júlia Seixas

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