Course: Global Energy Transitions and Climate Policy

lecture 2. Energy Transitions: Societal and Behavioral Aspects

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The Agenda Today

- Contemporary topics in energy and climate change

- Energy poverty and justice
- Societal and behavioural aspects of energy use
- Climate change and behaviour
- Digitalization and energy use

* *The slides and content of this lecture is in part borrowed from and inspired by what I learned from Prof. Peter Lund, Aalto University, Finland.*

Energy and Development (reminder)

- Energy use directly linked with human development index
- HDI is based on:
- life expectancy
- education
- income

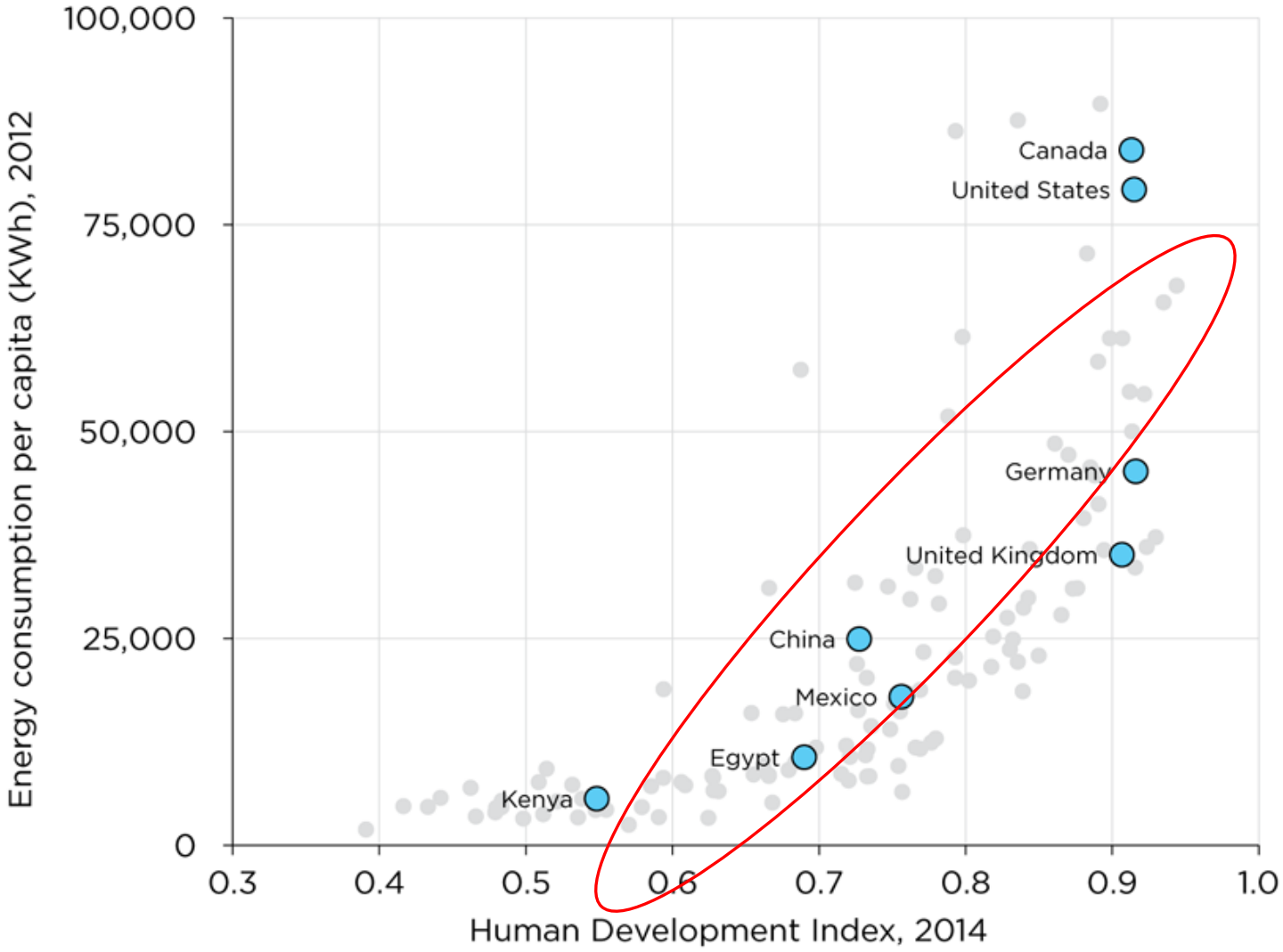
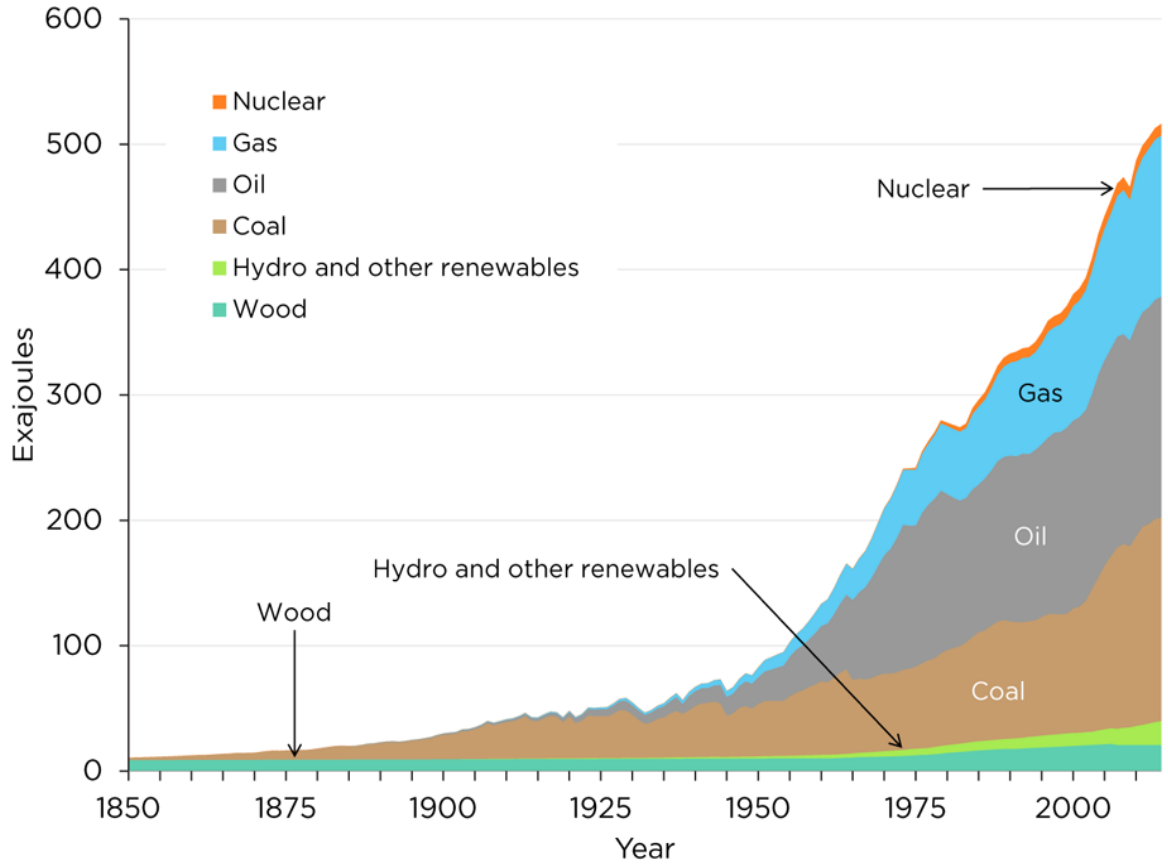


Image: https://ourrenewablefuture.com

World's Energy Consumption and Emissions (reminder)

World energy consumption



World carbon emissions (Gt-CO2/yr)

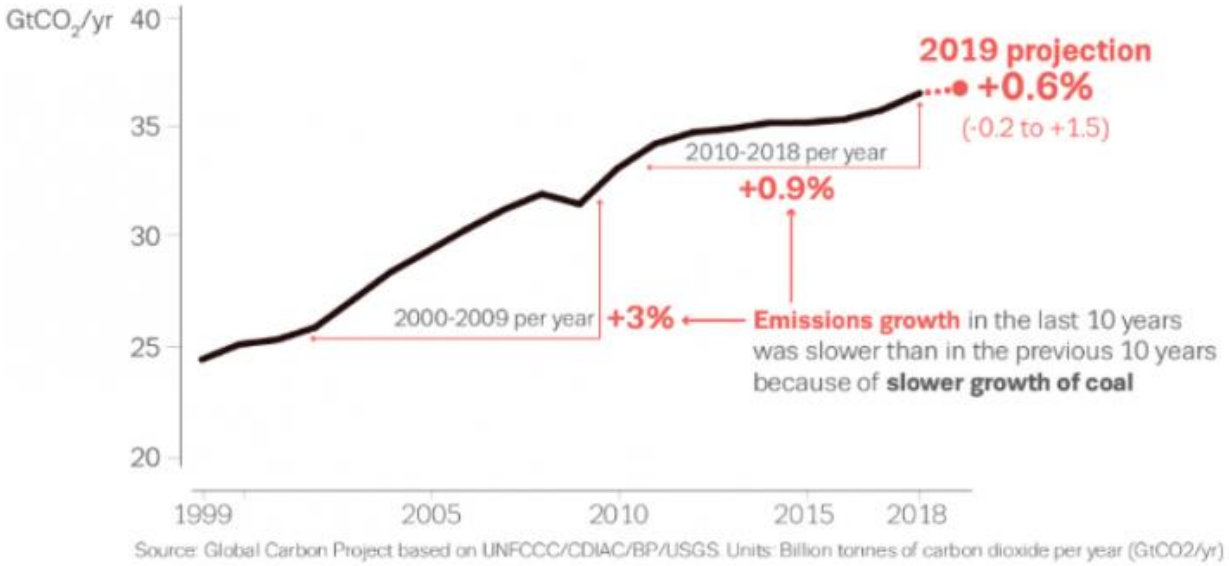


Image: http://ourrenewablefuture.org/

https://futurezone.at/

Energy Transition: structural changes in the energy system

- **Energy transition** is “usefully defined as a change in the state of an energy system as opposed to a change in an individual energy technology or fuel source”. Grübler, A. (1991)
- The term was used in 1973 (the first oil shock) and later further globally in 1980 (the second oil shock)
- Examples:
  - **Switching between fuels and technologies at large scale** (renewables instead of fossil fuel) and their economic, institutional, societal impacts (e.g., phase-in of nuclear in France, wind energy in Denmark, nuclear phase-out in Japan, uptake of electric vehicles)
  - Changing the **energy use pattern** (introduction of vehicles in 20th Century, digitalization, etc.)

Energy transition vs. transformation:

“Change to physical forms and systems can be denoted as transformations, and that changes to large socio-technical systems be denoted as transitions” (Child and Breyer, 2017).

“Energy transition refers to the **shift** from fossil fuels to renewable energy sources, while energy transformation refers to the broader implications of this **shift** in the economy, society, policy.” (IRENA, 2019)

Energy Transition: Characteristics

- Can happen at the country level, regional, and global.
- Linked with other changes (transitions) in the society, such as industrialization, human development, digitalization, etc.
- Happens over time, e.g., over 20-30 years.
- Different aspects: technological, societal, behavioural, institutional, political, economic, etc.
- Involves different actors/agents: consumer, producer, regulator, etc.
- Usually difficult: energy path dependency, investment needs, diffusion of new/unproven technologies, changing lifestyles/mindsets
- Phase-in vs. phase-out dilemma.
- Different goals/objectives for transitions: energy security, environmental goals, poverty eradication, climate change

Energy Transitions: Technological Perspective

- Condorcet paradox: a>b>c>a?

Renewables vs. nuclear

Nuclear vs. coal

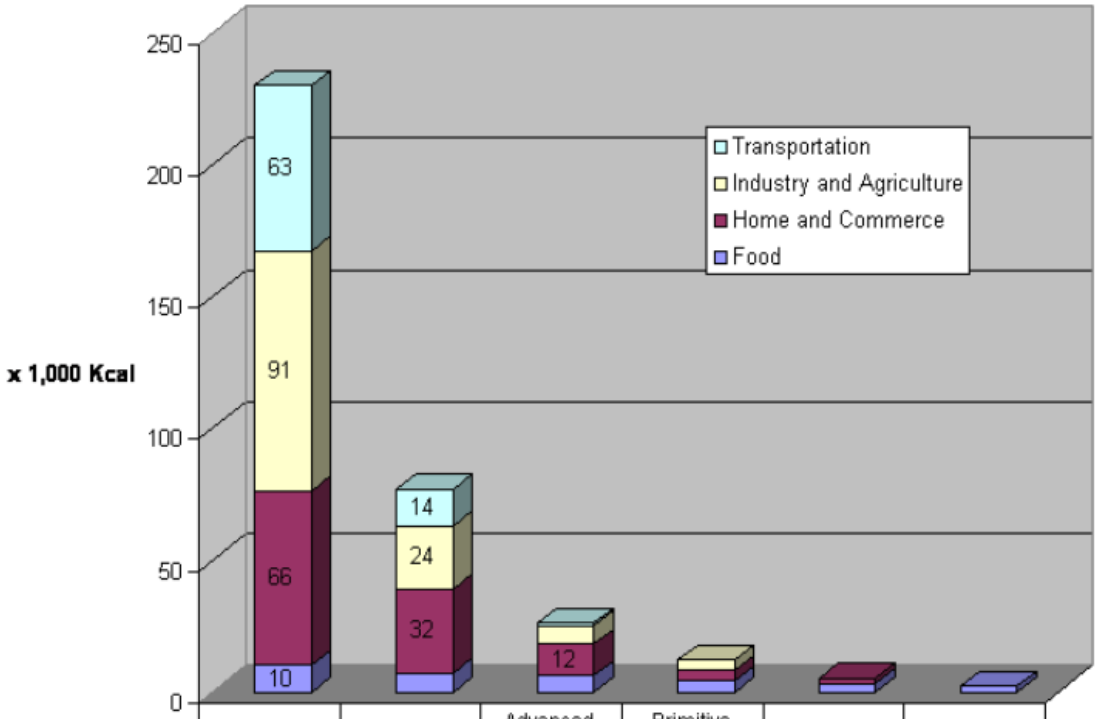
Coal vs. renewables

- Reliability, security of supply
- Economics, affordability
- Availability
- Self-sufficiency, independency

https://www.setis.europa.eu

Energy Transitions: Societal Perspective

Consumption of energy per capita



	Technological Man	Industrial Man	Advanced Agricultural Man	Primitive Agricultural Man	Hunting Man	Primitive Man
Transportation	63	14	1			
Industry and Agriculture	91	24	7	4		
Home and Commerce	66	32	12	4	2	
Food	10	7	6	4	3	2

- Technological man consumes 10 times more energy than advanced agricultural man

Estimated Daily Consumption of Energy per Capita at Different Historical Points
Adapted from: E. Cook, "The Flow of Energy in an Industrial Society" Scientific American, 1971 p. 135.

Energy Poverty

Energy poverty: lack of access to affordable, modern energy

https://www.weforum.org/

Cookstove Smoke, the biggest environmental threat:

- 3.5 million people die each year from indoor air pollution

from wood and biomass cookstoves (women and children)

- India 705 and China 612 million people lack clean fuel for cooking/heating
- 3.5 billion (40% of the world) do not have access to clean fuels for cooking

Energy Scarcity while there is plenty

- Energy-rich country like Nigeria has 82.4 million with no

Access to electricity and 117.8 million rely on wood and biomass

https://www.children.org/

Energy Access

- No access to electricity:

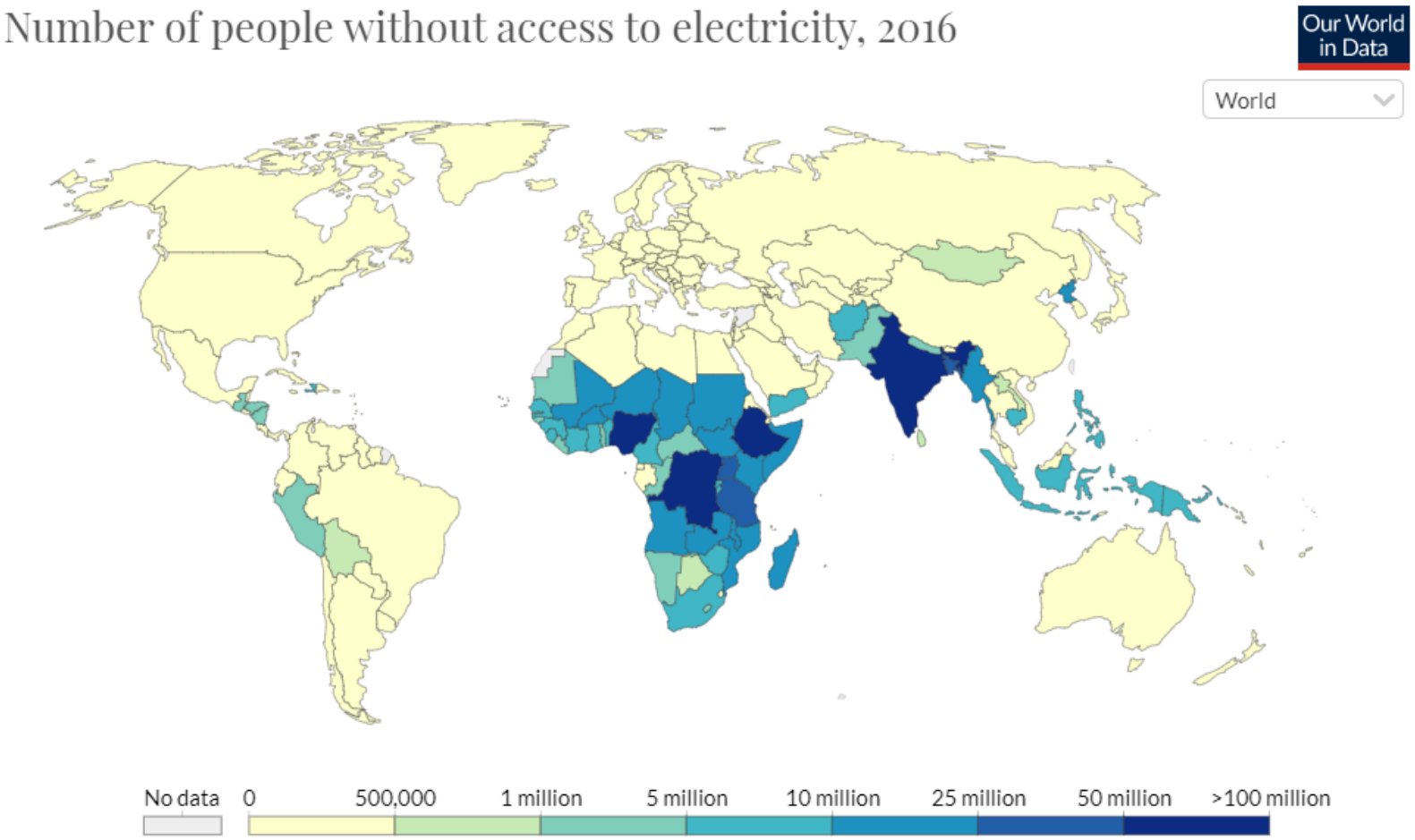
Almost 940 million people

- Not being able to pay the bill

(80 million people in Europe can't afford paying heating bills)

- The situation improving

in some regions yet a lot to do



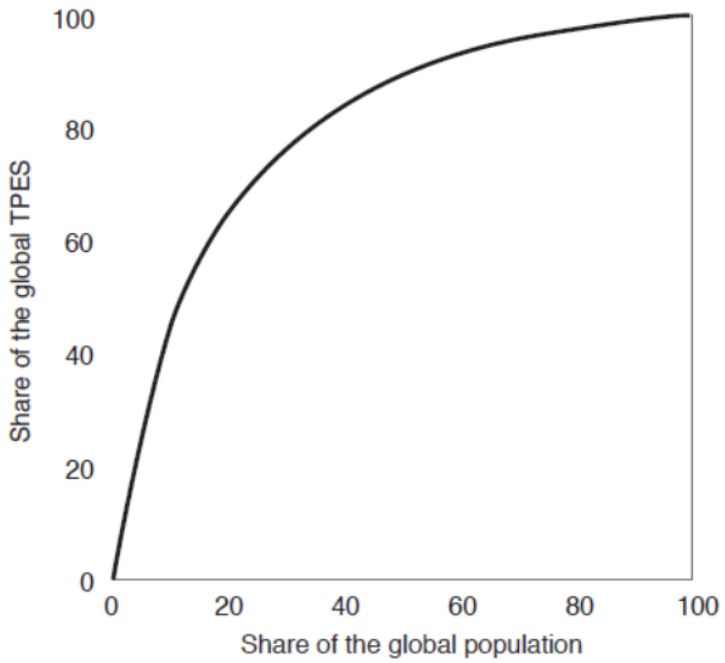
https://www.ourworldindata.org/

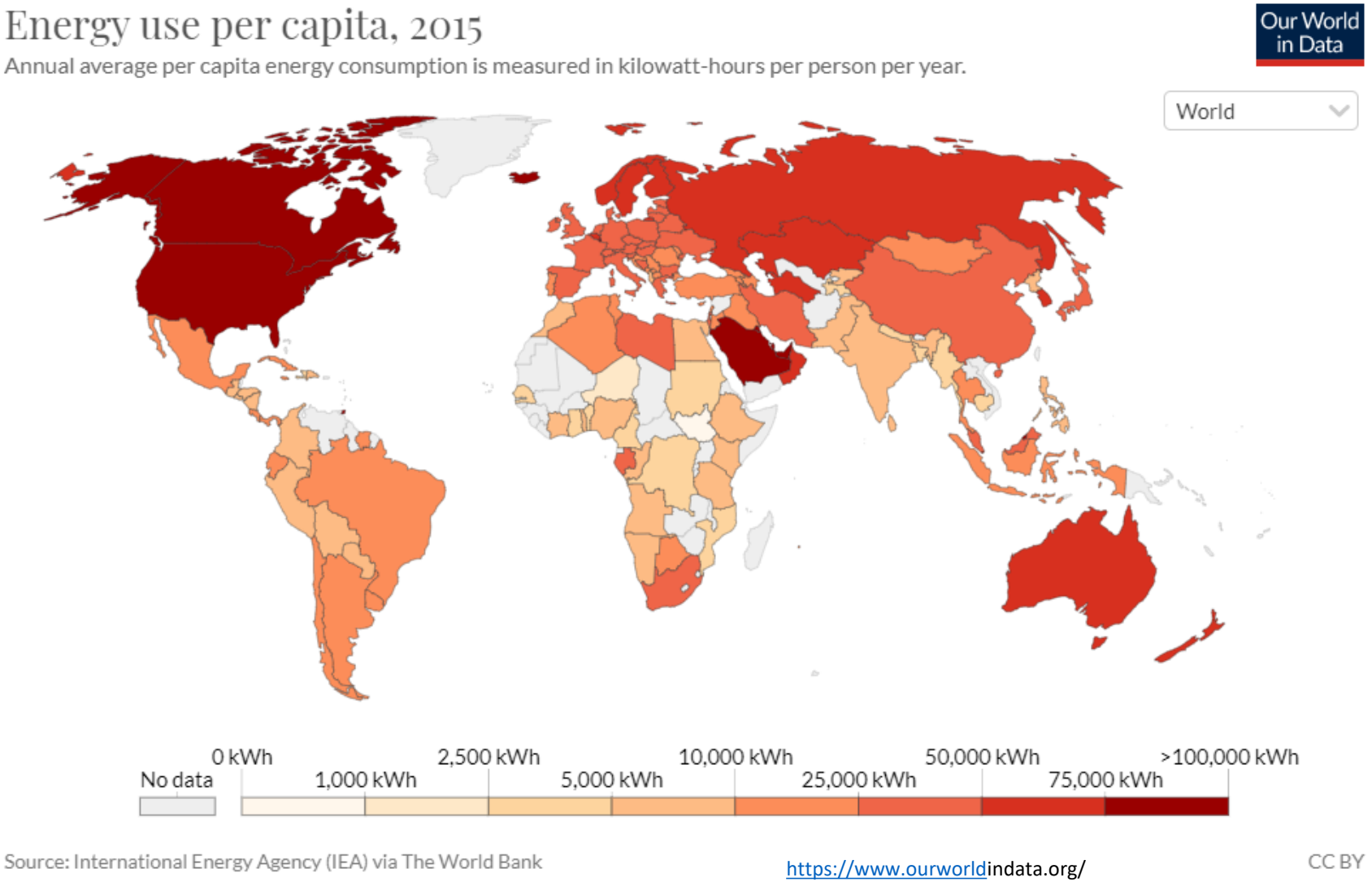
Energy Justice

20-80% Dilemma:

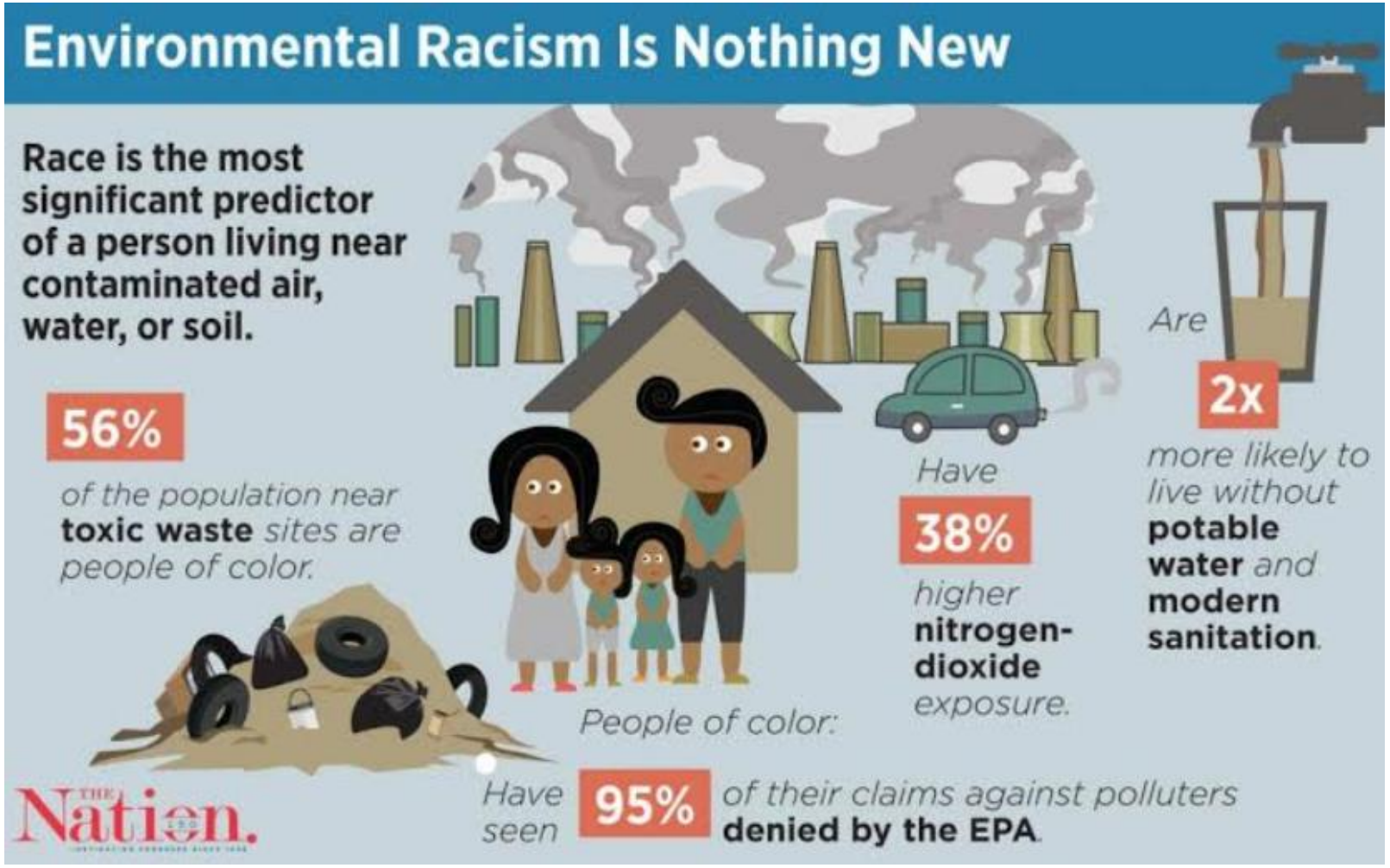
20% of world population uses

80% of energy resources





Energy and Environmental Racism



https://www.ncchurches.org/

https://www.iied.org/

Different views on energy transitions

Topic	Post-Industrialized world	Economies in transition
Access to energy	Basic need	Luxury
Cost of energy	Affordable/cheap	Expensive
Reliability of energy	Reliable (convenient)	Unreliable
Choice of energy	Possible based on different tariffs and environmental impact	No option
Energy security	Regional/international cooperation	National independence
Energy sustainability	Driven by environmental dimension	Driven by economic aspect
Energy policy makers	Providing options based on public interest (Green movements)	Preventing system collapse and social unrest
Energy and climate change	Public policy, driver for change	Sever impacts, caused by industrialized world
International climate agreements	The way to resolve the global problem	A new way of limiting national sovereignty and development

What is the solution?

"If there are to be problems, may they come during my life-time so that I can resolve them and give my children the chance of a good life."

Kenyan proverb

https://www.weforum.org/

Energy and Complexity

- Energy is NOT just about technologies or ‘kilowatthours’
- Energy systems are complex in relation to social, technological, economic and environmental aspects
- Energy systems consists of many actors and interacting networks.
- Key elements for energy systems:

Agents (we discussed in the class)

Networks

Dynamic

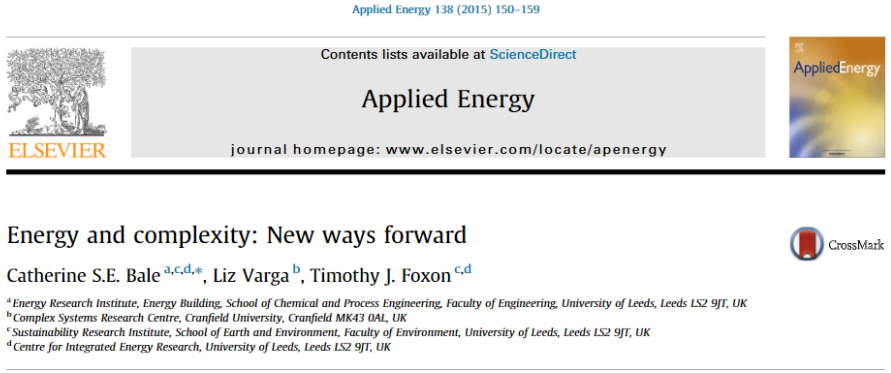
Self-organization

Path-dependency

Emergence

Co-evolution

Adaptation and learning



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Energy and complexity: New ways forward

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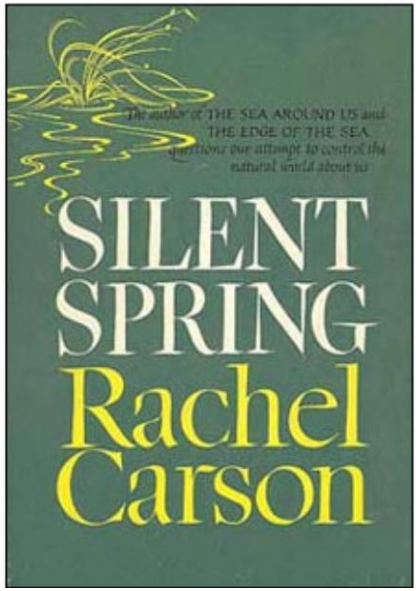


Energy and Sustainability: Framing

- First indication that coal increases CO2 already discovered in 1896 but became a political question not until 1988. Why so long?
- Carbon-intensive ideology of progress and development
- Framing the ‘problem’ shapes the discourses between climate change and energy-society transformation

- **Parameters affecting sustainability:**

– Energy

– Environment

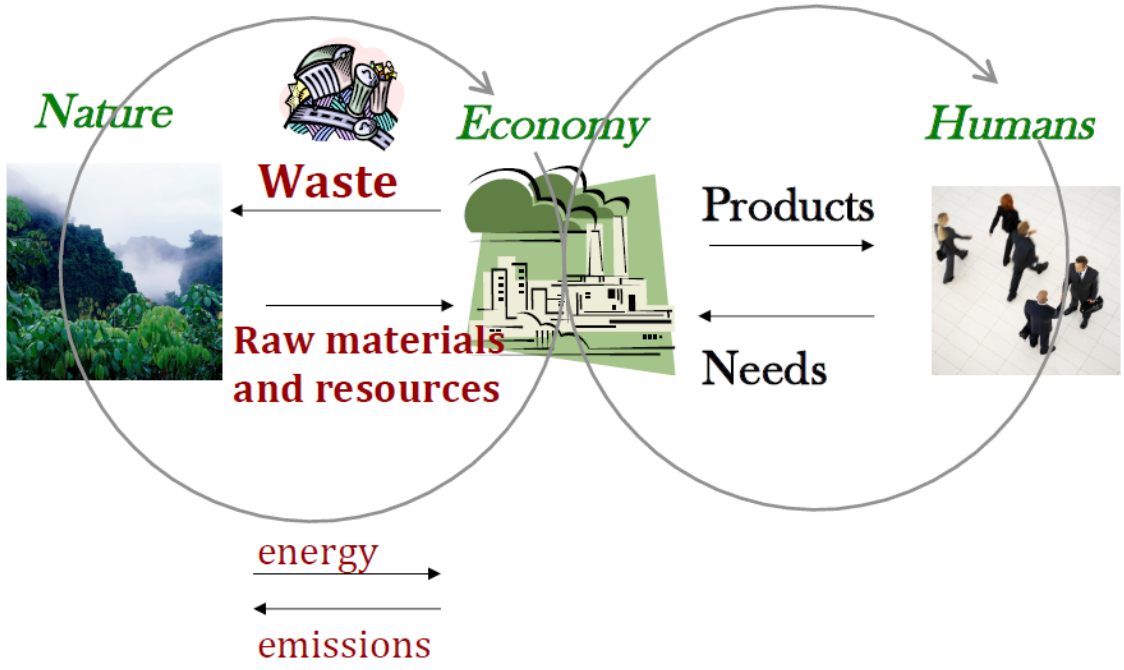
– Economics

– Climate & Justice

– Innovations

– New Industries

– Jobs Creation



Energy Transitions: Human Behaviour

➔ 3 principles of human decision making:

thinking automatically

thinking socially

thinking with mental models

Table O.1 People have two systems of thinking

Individuals have two systems of thinking—the automatic system and the deliberative system. The automatic system influences nearly all our judgments and decisions.

Automatic system	Deliberative system
Considers what automatically comes to mind (*narrow frame*)	Considers a broad set of relevant factors (*wide frame*)
Effortless	Effortful
Associative	Based on reasoning
Intuitive	Reflective

Sources: Kahneman 2003; Evans 2008.

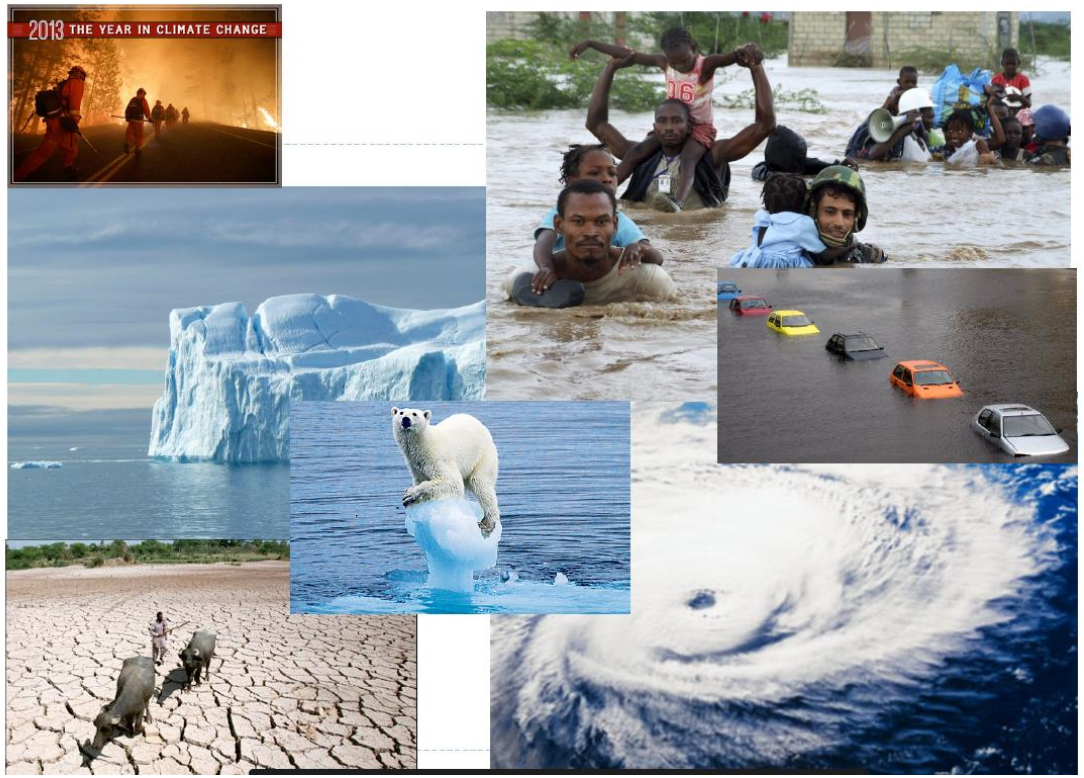
Human Behaviour: Why we do/not react?

- Thinking with the existing biases is easy and comfortable (effortless)
- Problems like climate change seem **distant** (polar beer, people sinking!?)
- We don’t understand/see the problem

- CO2 is invisible

- Many complex reasons for the problem

- We don’t like to feel guilty, so we ignore/deny the problem
- We think there are people/companies/states stronger and guiltier than us that should react first



Example: Ozone Layer Depletion

- The problem was global (like climate change)
- The response was positive
- The problem is being solved
- People could understand **the cause**
- People could understand **the effect**
- People were worried of the effect (risk of skin cancer)

➔ Problem was close to us!

https://www.alami.com/

See the video:

https://www.youtube.com/watch?v=DkZ7BJQupVA&list=PLJ8cMiYb3G5fP5oq01TBp9fgh70vDDSMe&index=2&t=0s

Break

"History teaches us that men and nations behave wisely once they have exhausted all other alternatives"

Abba Eban

Energy and Digitalization

Data centers

- 18 million servers deployed in data centers globally
- Datacenters consume electricity to deliver the services
- Electricity use is dependent on the process (CPU) and storage of data
- Ancillary use of electricity for cooling the space
- The number of servers increasing fast
- Electricity must be 100% reliable all the year

To run the datacenter without the risk of failure

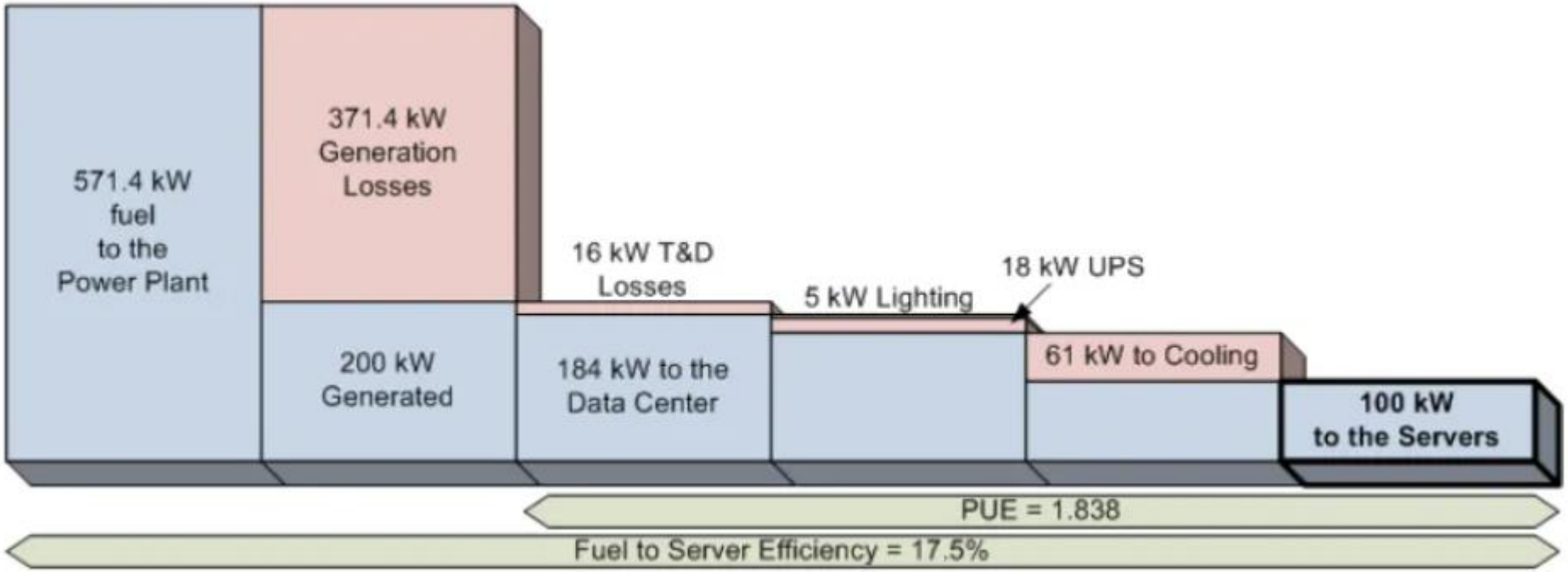
- Some datacenters have their own power plant

(image: Google datacenter in Hamina, Finland)

https://www.hothardware.com/

Data centers and Energy Use

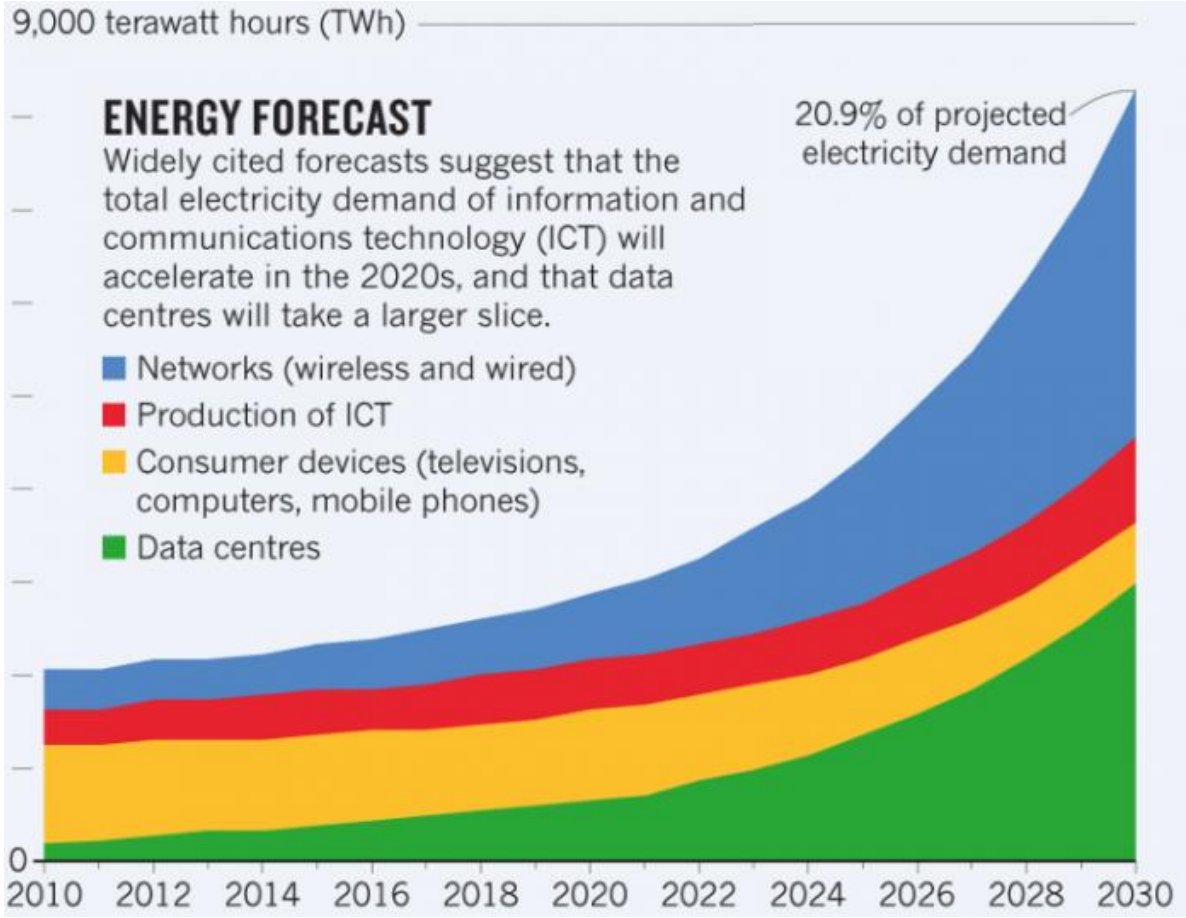
- PUE: power use efficiency (measure of efficiency of datacenters)
- PUE: electricity needed in the center for one unit of electricity used by servers
- From fuel to server **(not yet to service!)** ➔ 82% energy losses



https://www.davidmytton.blog

Datacenters and Energy Use (2)

- ICT will form 20% of the electricity demand globally in 2030



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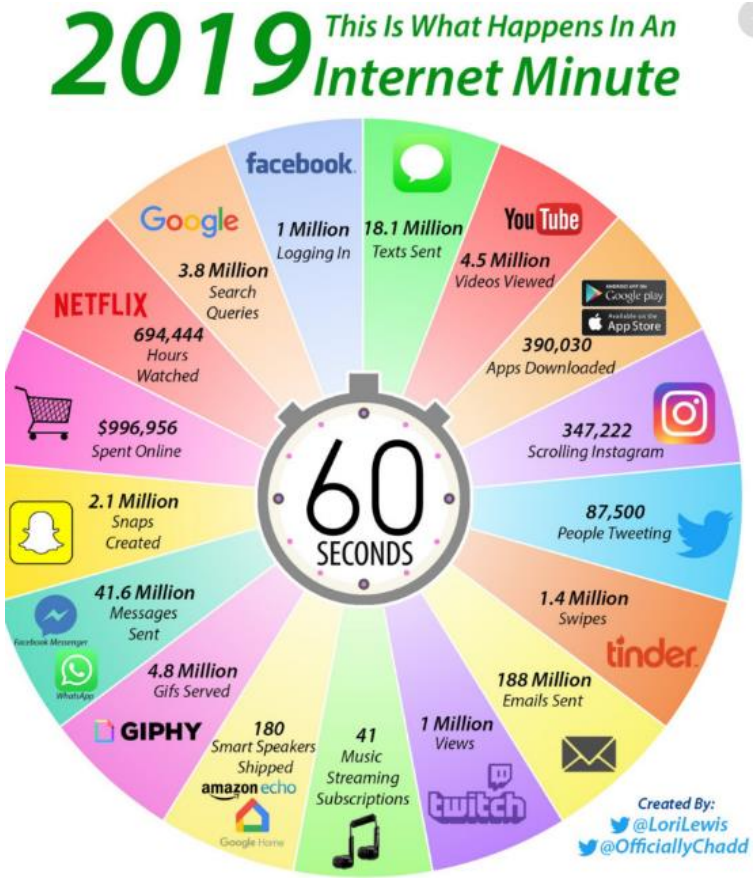

https://www.visualcapitalist.com

Question (5 min discussion in group)

- Which one of these activities does consume more electricity?

Note: only electricity use at the server side (datacenters), not at your side (not electricity use of your laptop)

1. **One search:** a search inquiry (e.g., searching something in Google)
2. **One file download:** Downloading a PDF file of 2 MB
3. **One minute video:** Watching a video online for 1 minute

Energy footprint of online activities

Comparing the results with the electricity use of a light bulb of 6W

1. **One search: 170 sec light**
2. **One file download:** 60 sec light
3. **One minute video:** 112 sec light

➔ *Every search matters!*

1. 0.0003 kWh on an average for one search query = 6 W bulb being on for 170 sec
2. File download (2 MB) = 6 W bulb being on for 60 sec
3. Video 0.0002 kWh video 1 min (4.2 Mb/s) = 6 W bulb being on for 112 sec

Further reading

- *Hafner, M. and Tagliapietra, S., 2020. The geopolitics of the global energy transition (p. 381). Springer Nature.*

https://library.oapen.org/handle/20.500.12657/39553

- *IRENA and UN DESA, 2019. A new world: The geopolitics of the energy transformation.*

https://www.irena.org/publications/2019/Jan/A-New-World-The-Geopolitics-of-the-Energy-Transformation

References

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- *Hölscher, K., Wittmayer, J.M. and Loorbach, D., 2018. Transition versus transformation: What's the difference?. Environmental innovation and societal transitions, 27, pp.1-3.*
- Child, M. and Breyer, C., 2017. Transition and transformation: A review of the concept of change in the progress towards future sustainable energy systems. Energy Policy, 107, pp.11-26.

- Thank you for your attention!

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