Role of Nuclear in a Carbon-Free Future

CLIMATE WEEK NYC

19 SEPTEMBER 2022

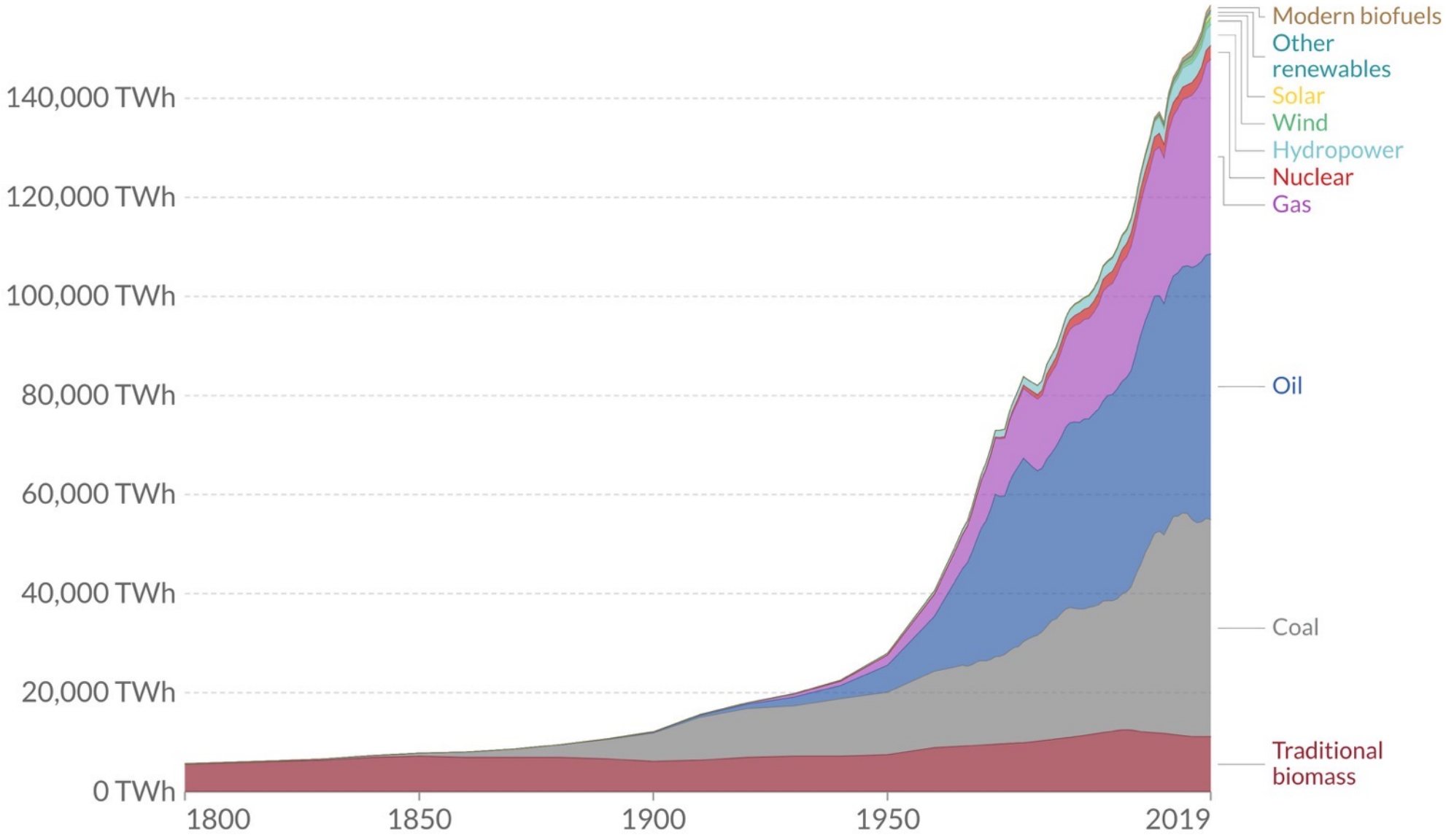
VIRTUAL EVENT

(RECORDING)

Nuclear New York

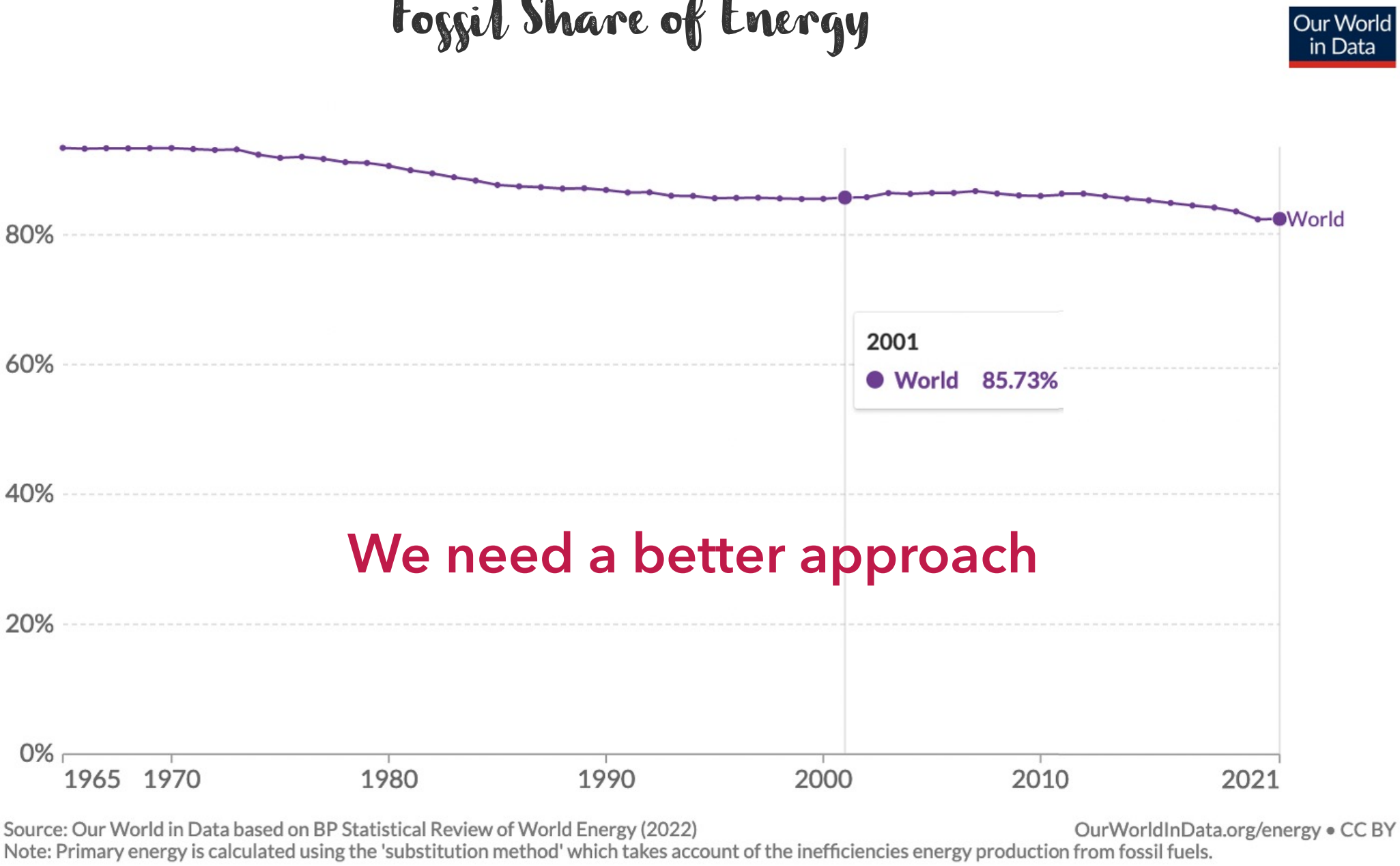
CLIMATE WEEK NYC
CLIMATE GROUP

Global Energy Consumption by Source



Source: Our World in Data (Vaclav Smil (2017) and BP Statistical Review of World Energy)

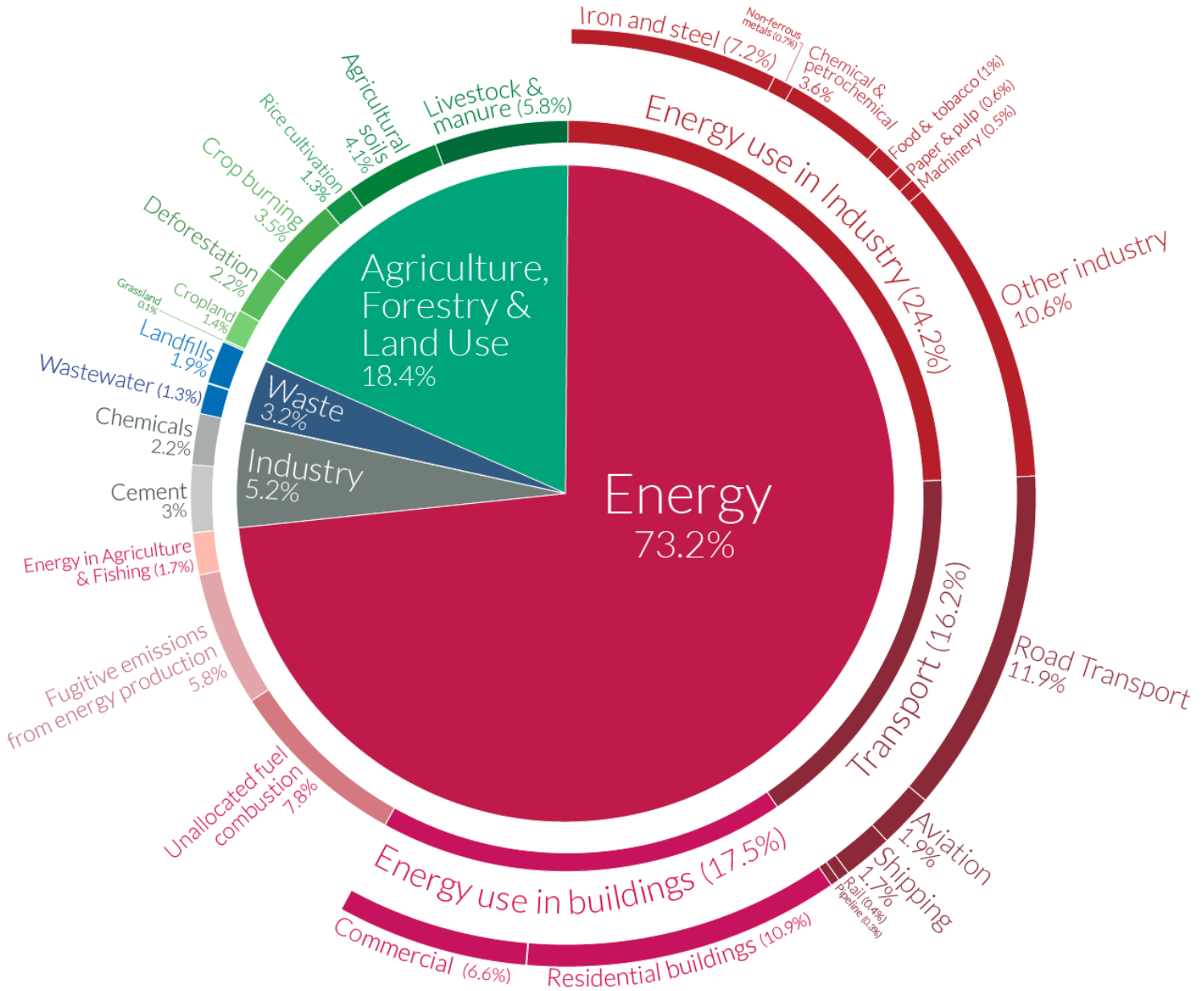
Fossil Share of Energy



Source: Our World in Data

Global Greenhouse Gas Emissions by Sector

Our World in Data



Source: Our World in Data

Global Greenhouse Gas Emissions by Sector

Our World in Data

Global Greenhouse Gas Emissions by Sector

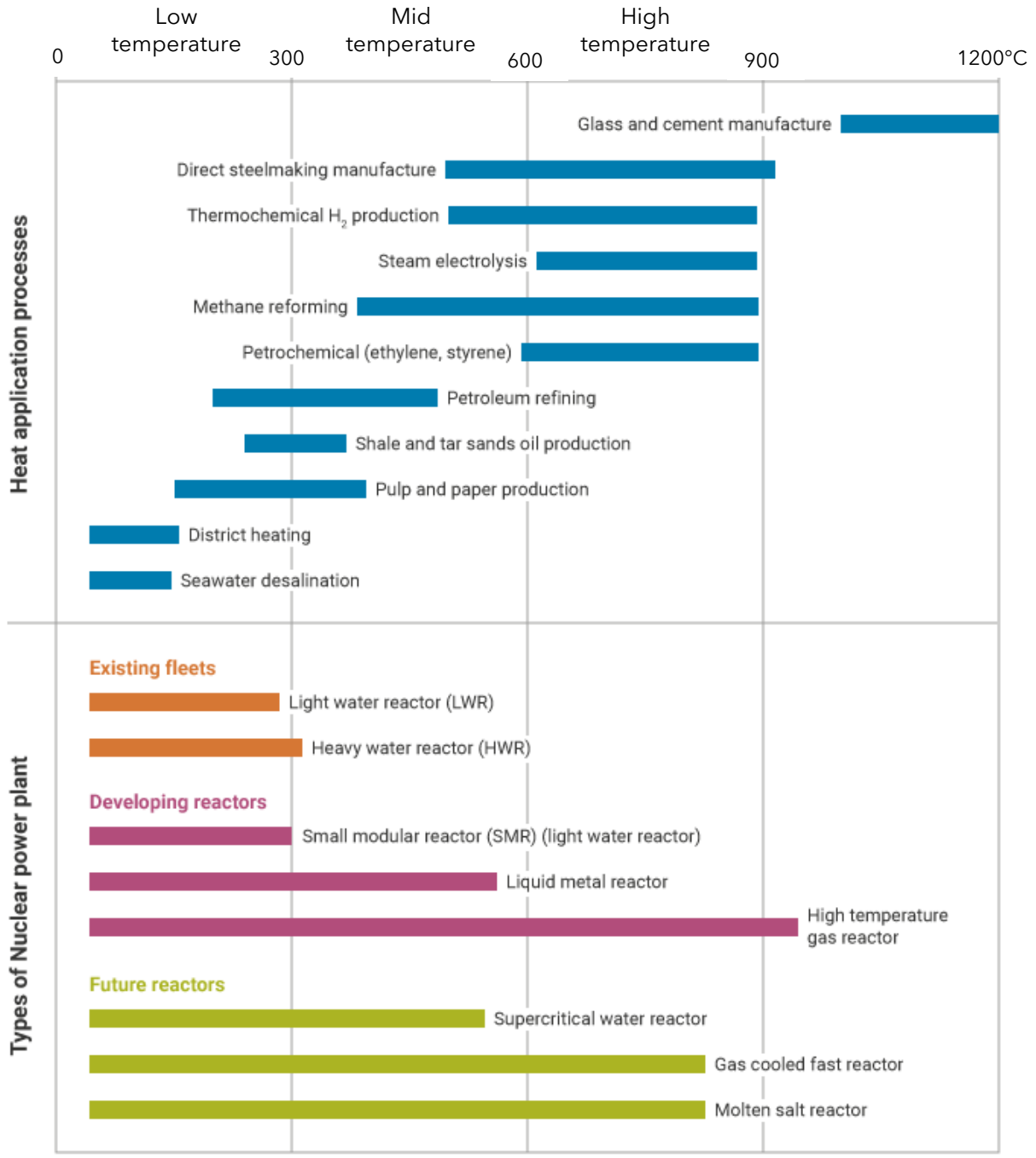
Our World in Data

Only ¼ emissions are from electricity

How to effectively decarbonize other sectors efficiently and sustainably?

Heat for Industrial Processes & Buildings

- Each phase change causes energy loss
- For most major industrial heat applications, nuclear energy is the *only credible* non-carbon option.
- ~80 reactors in use for desalination, district heating, or process heat.
- MIT/Stanford study: California's Diablo Canyon nuclear plant can provide desalinated water, and generate H_2 at ½ the cost of doing so with solar & wind.



Sources: World Nuclear, Stanford

"The Beautiful Relationship"

Intermittent vs. Baseload Power to Produce 1 Unit of Electricity

1kWh Intermittent

+

Storage

- Power-to-gas (hydrogen, biogas)
- STEP
- Batteries
- Flywheel
- etc.

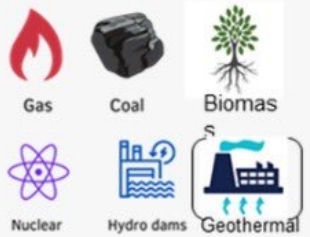
+/or

Interconnections

b/w
- producers,
- consumers,
- countries

+/or

Back-up baseload



High-carbon

Low-carbon

+/or

Demand management

- Smart grids (incl. Linky, V2G, …)
- Load follow from baseload producers
- Load shedding of industrial consumers

=

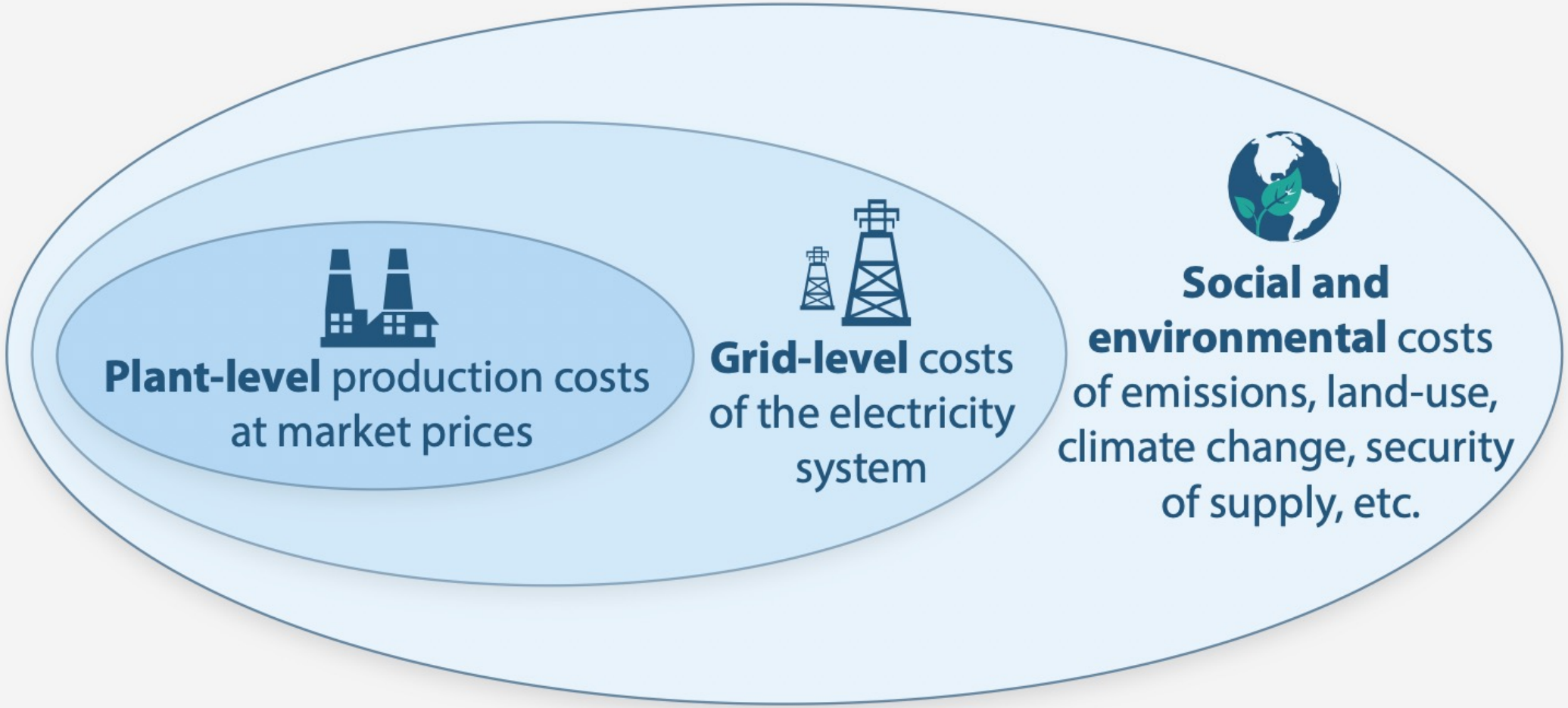
1kWh Baseload

High-carbon

Low-carbon

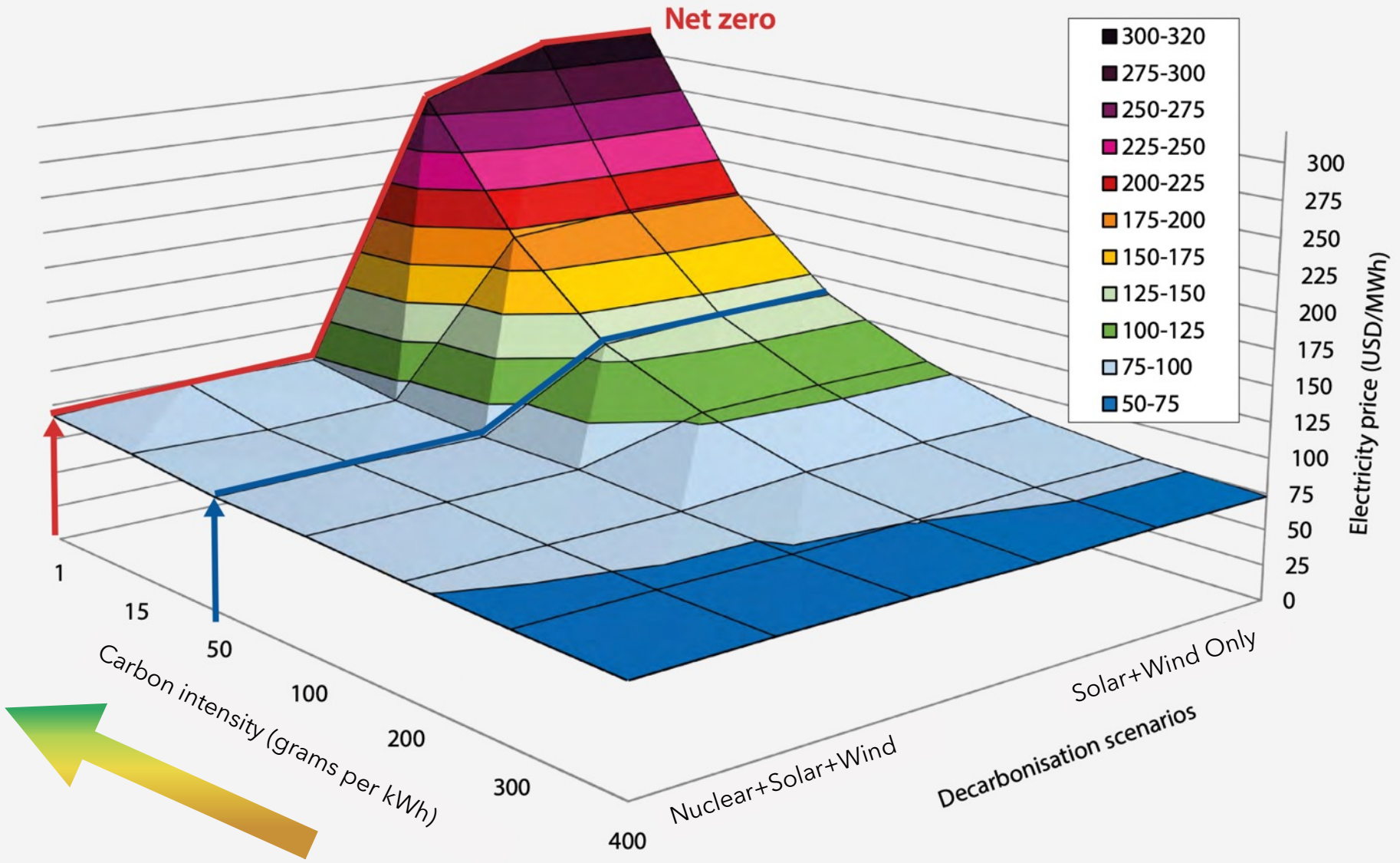
Source: Myrto Tripathi

Understanding System Costs of Electricity



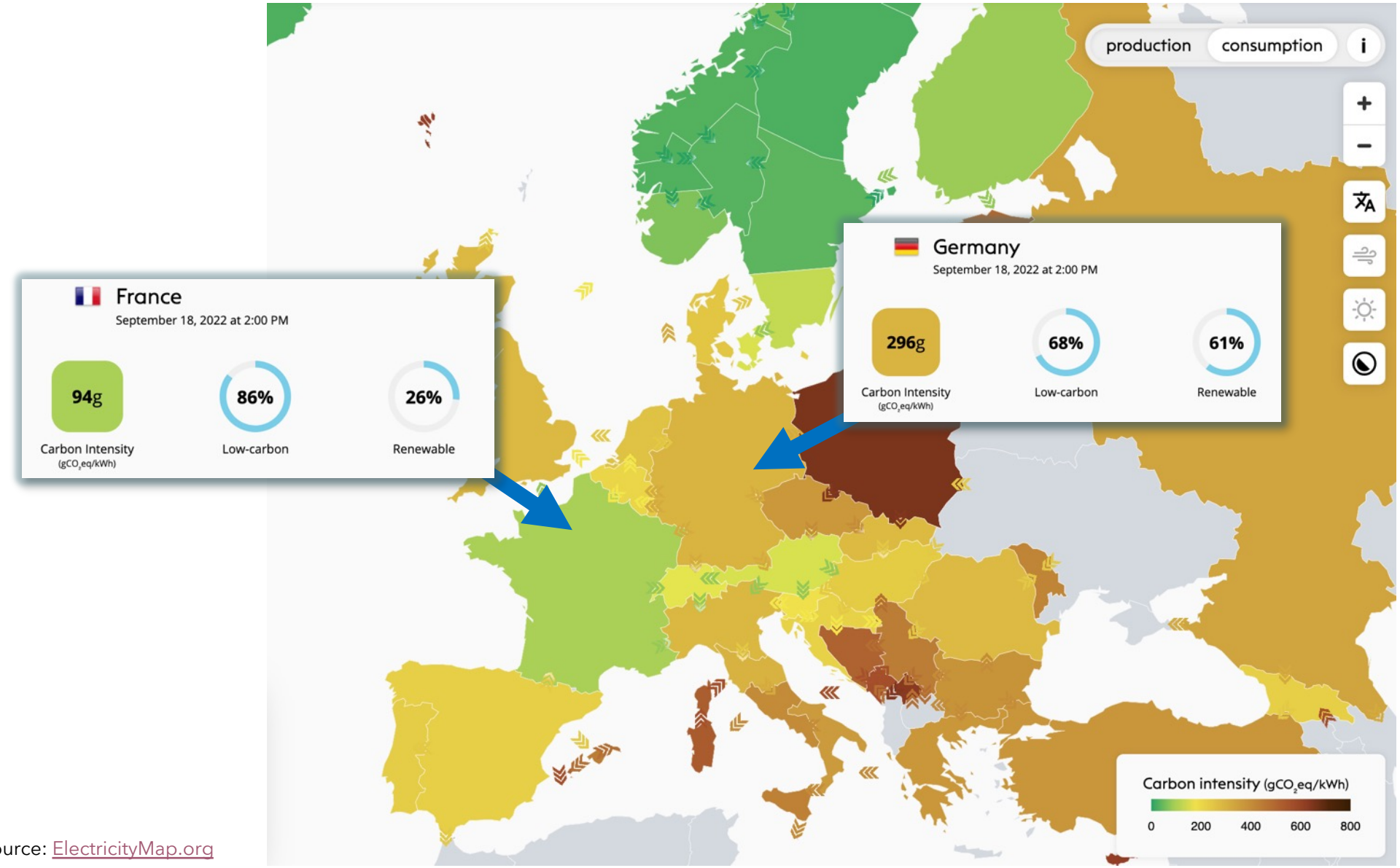
Source: OECD-NEA, adapted from NEA (2012)

Grid-Level Costs for Electricity Mixes



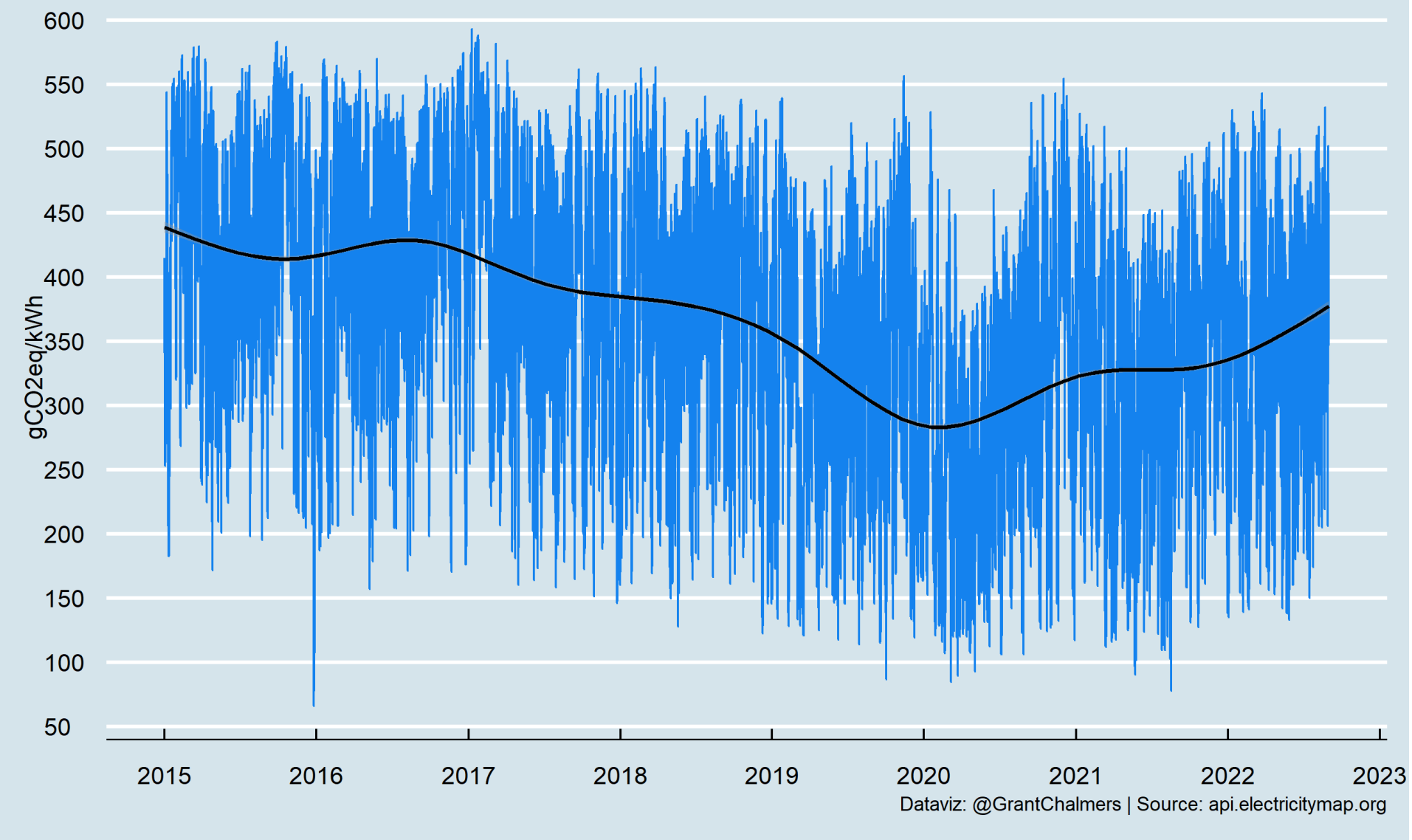
Source: OECD-NEA, based on Sepulveda (2016)

The Tale of Two Neighbors: France vs. Germany



Source: ElectricityMap.org

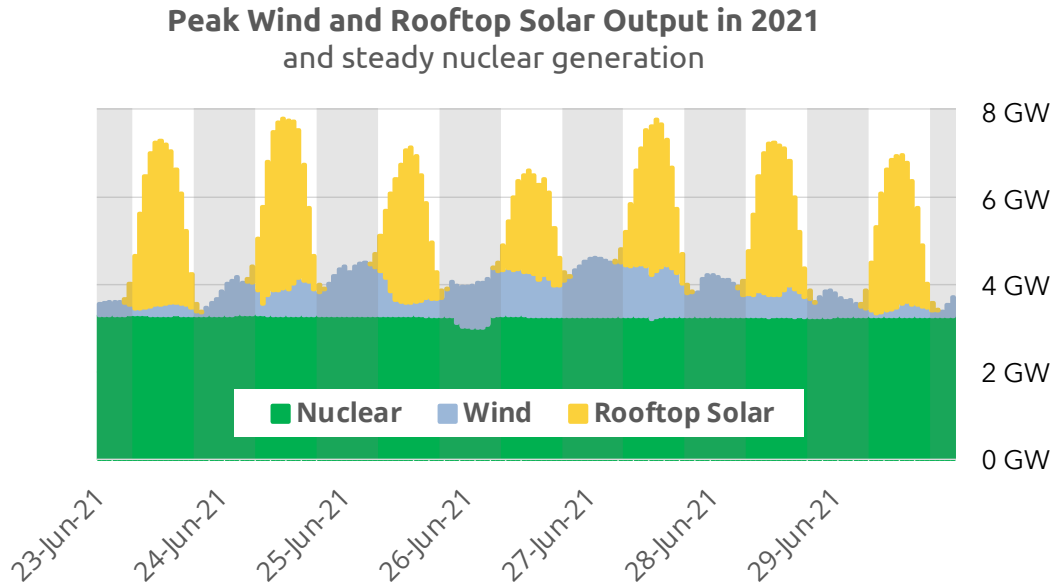
Carbon Intensity of German Electricity Consumption



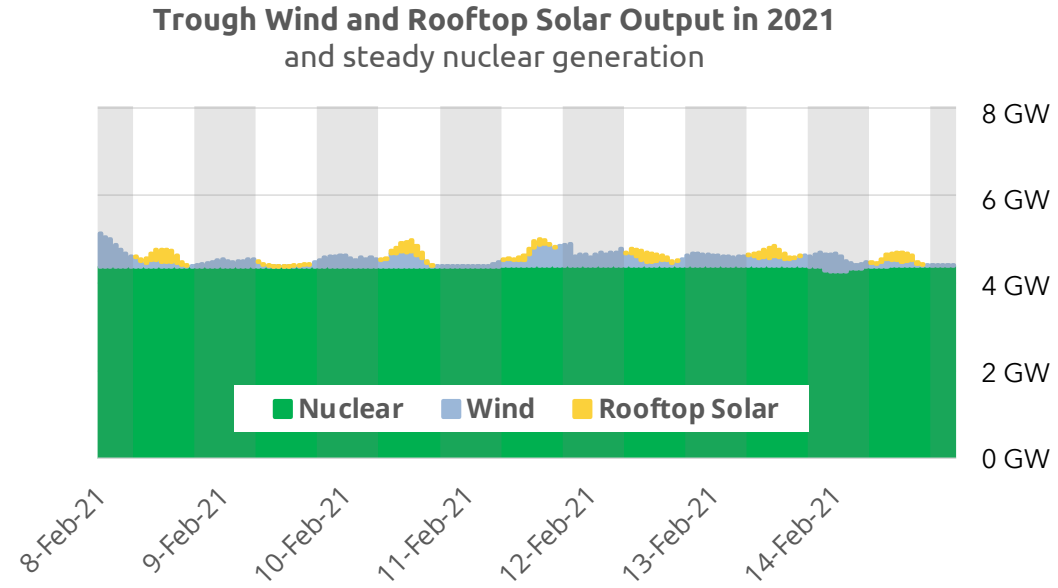
Source: ElectricityMap.org by way of Grant Chalmers

Challenges in Seasonal Variability: New York

- Electricity is generated and consumed near simultaneously
- If we electrify heating, transportation, and industry, shortages go from economically severe to life threatening
- Energy storage to bridge seasonal variation in a 100% intermittent renewable grid would be ruinous to both society and the environment.



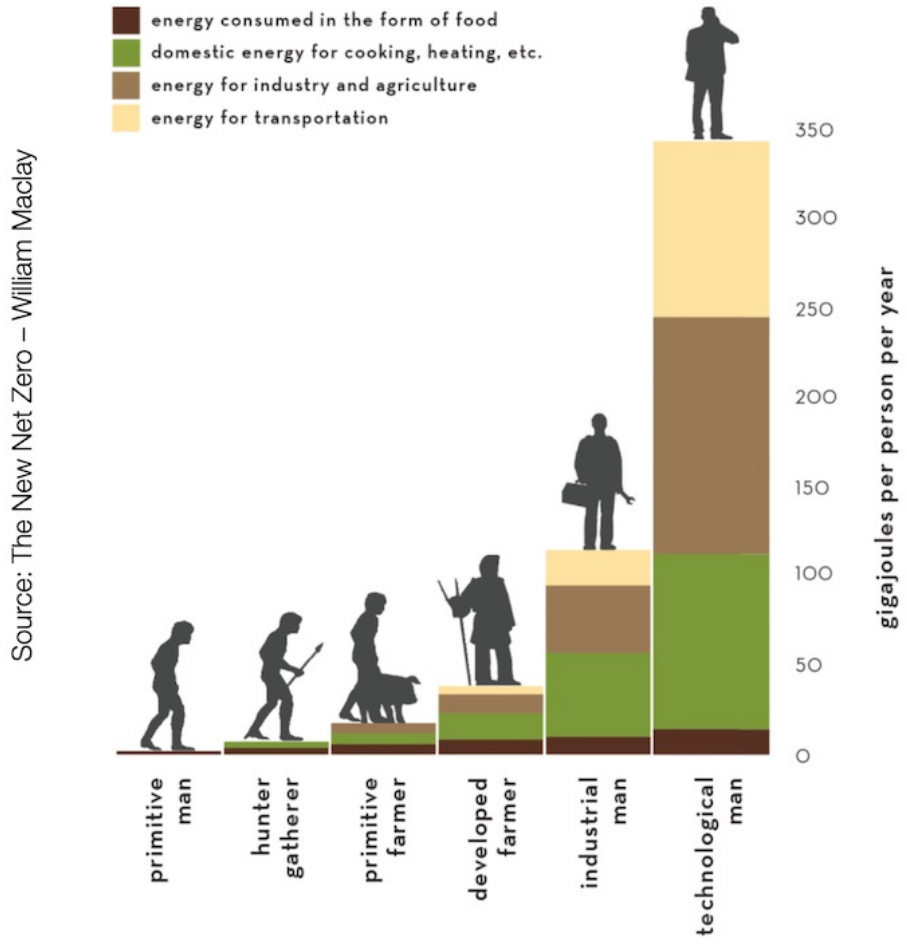
10x



Source: Bright Future, Nuclear New York

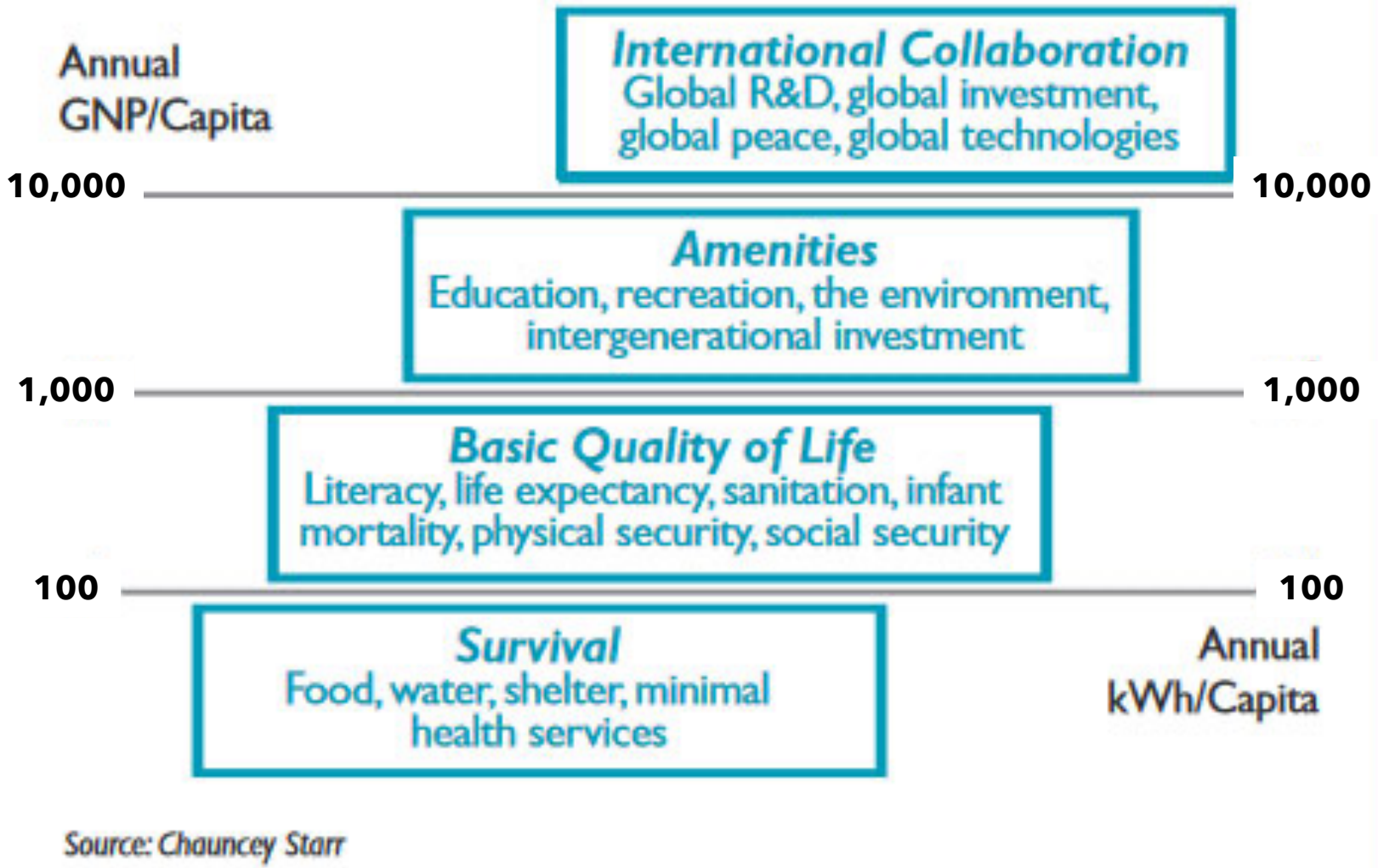
Energy Consumption per capita by Development Stage

(GJ per person per year)



Source: The New Net Zero - Maclay

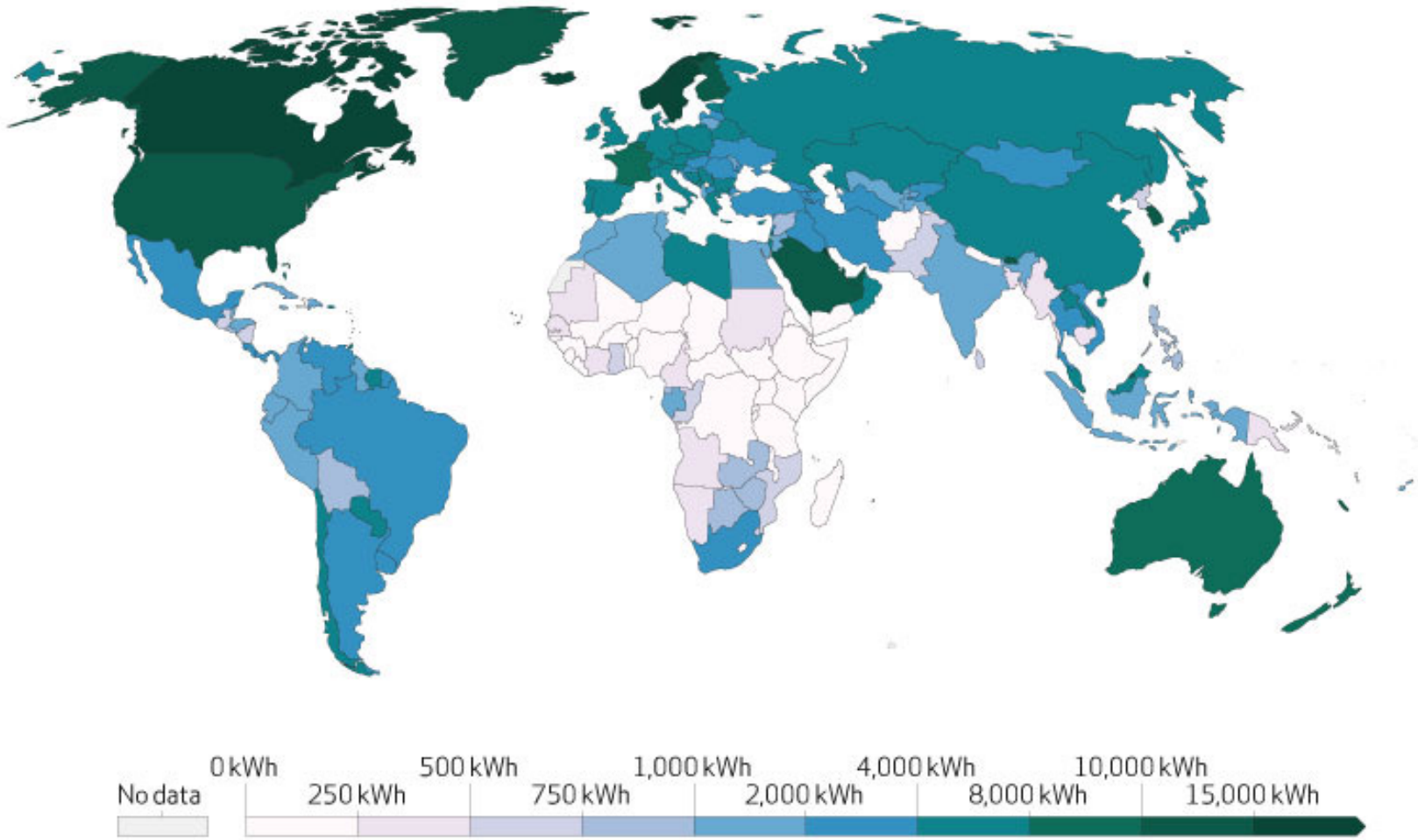
Electricity Consumption and Social Development



Source: Chauncey Starr

Per capita electricity generation, 2021

This is annual average electricity generation per person, measured in kilowatt-hours.



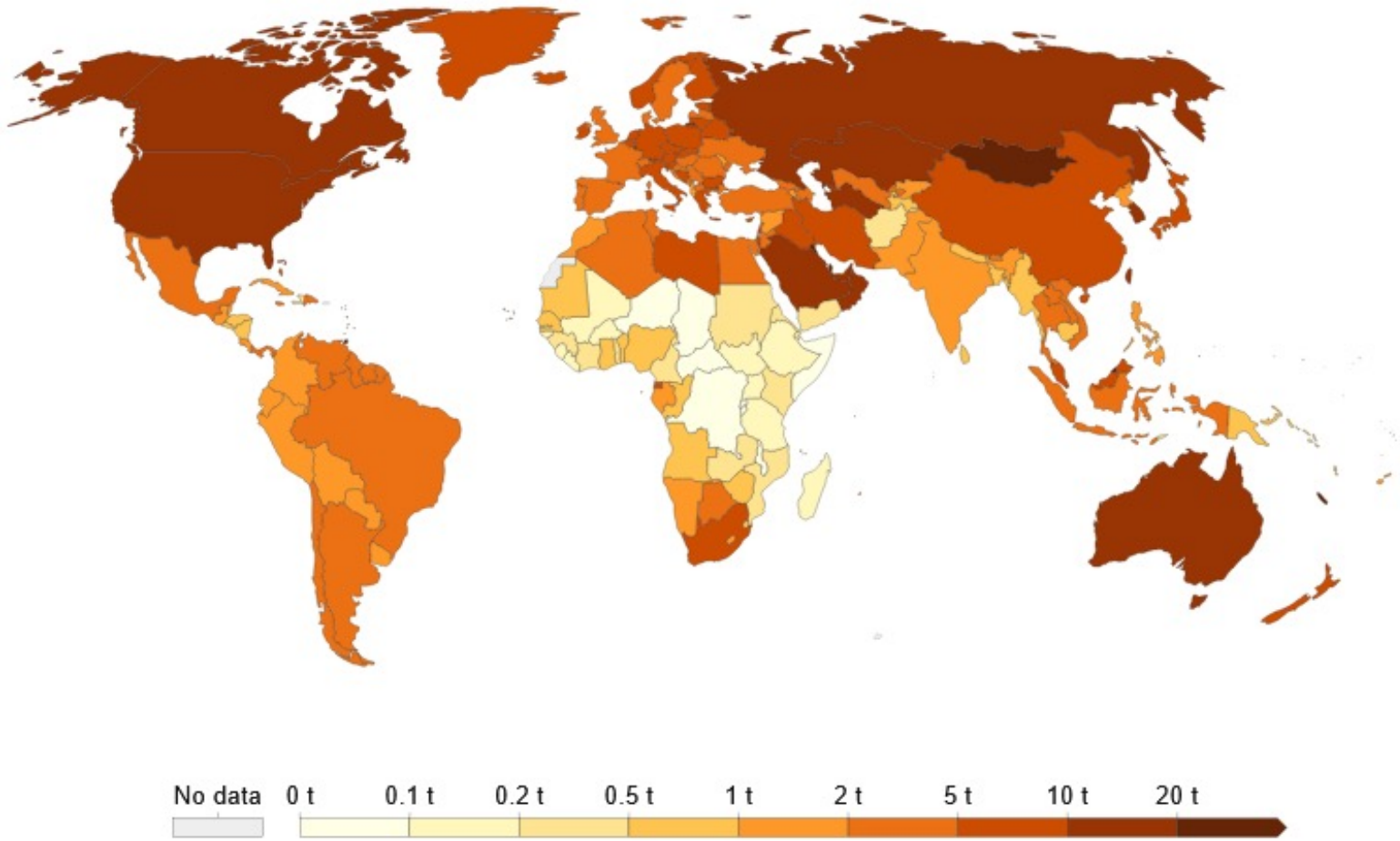
Source: Our World in Data based on BP Statistical Review of World Energy, Ember Global Electricity Review (2022) & Ember European Electricity Review (2022)
OurWorldInData.org/energy • CC BY

Source: Our World in Data

Per capita CO_2 emissions, 2020

Carbon dioxide (CO_2) emissions from fossil fuels and industry. Land use change is not included.

Our World in Data

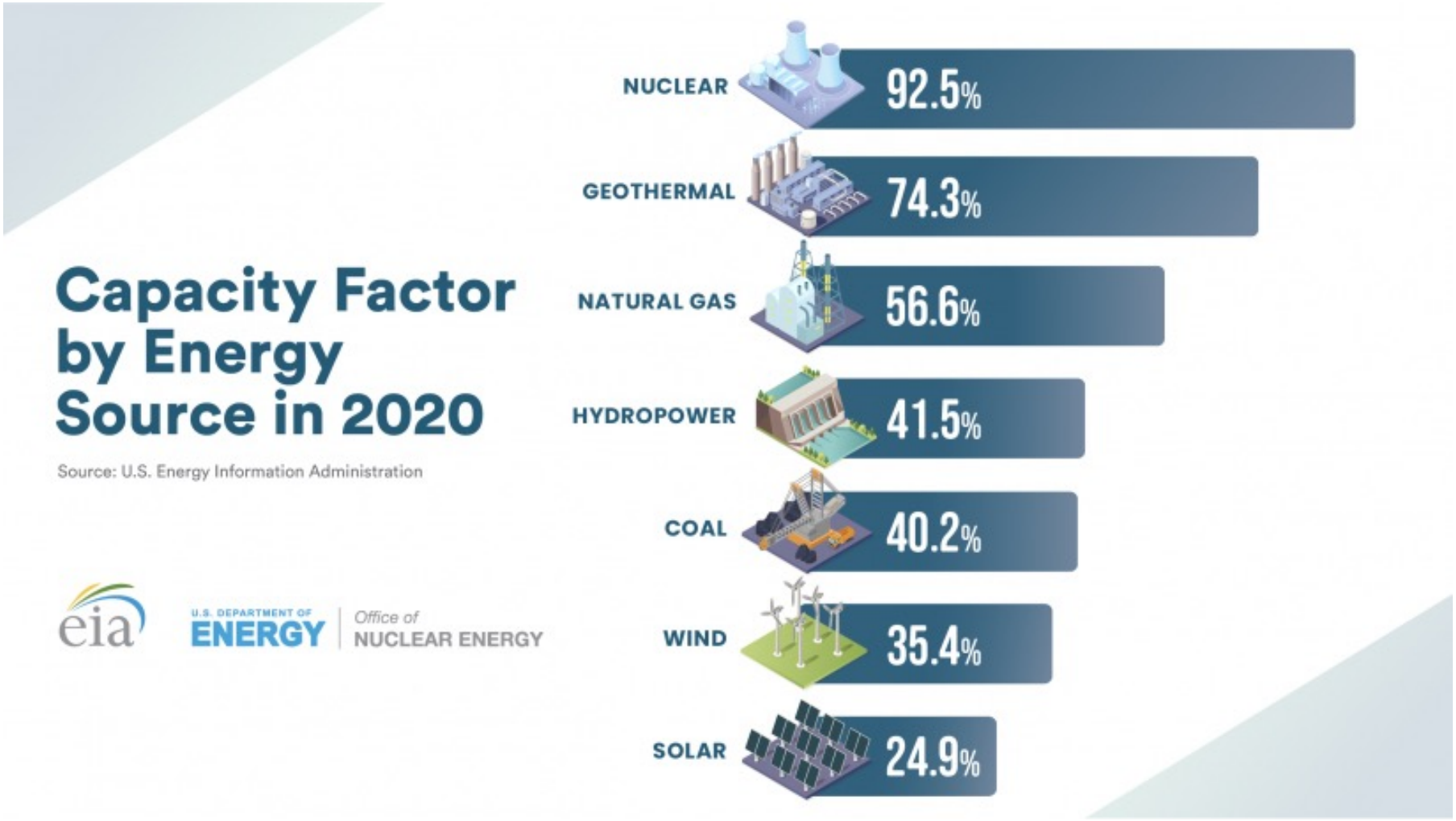


Source: Our World in Data based on the Global Carbon Project

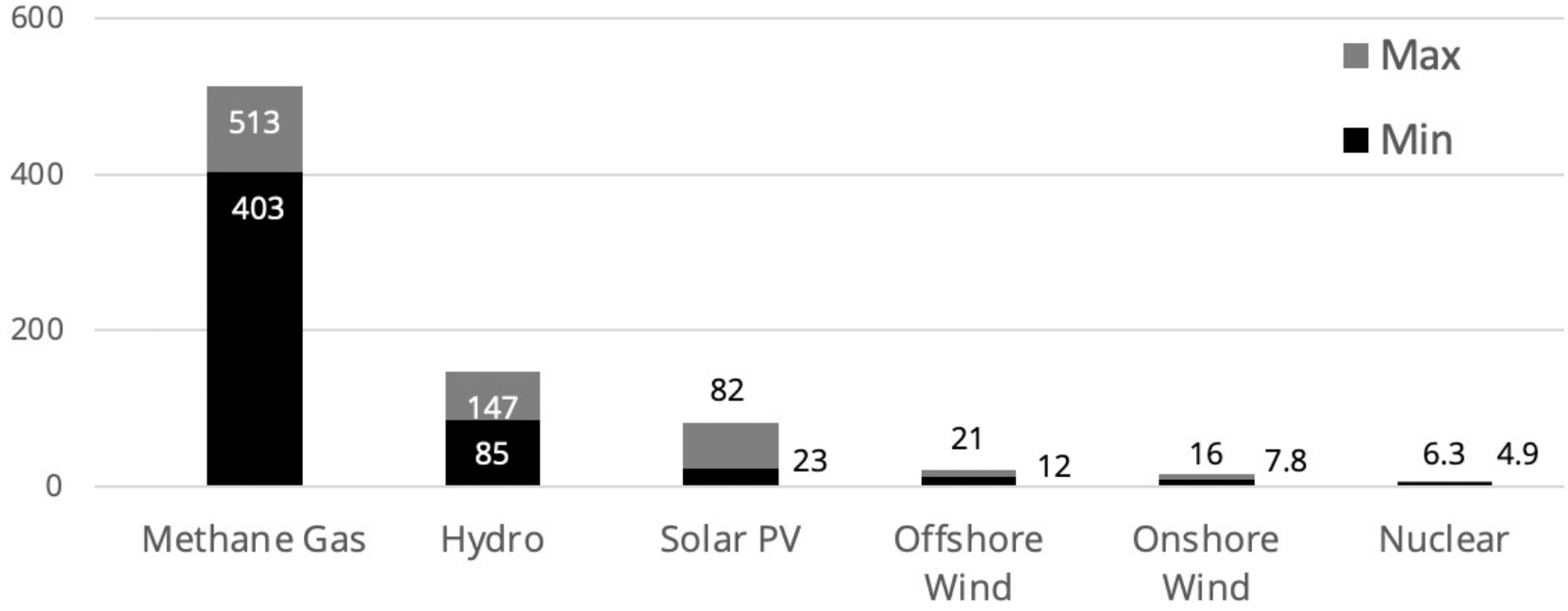
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

Source: Our World in Data

Reliability



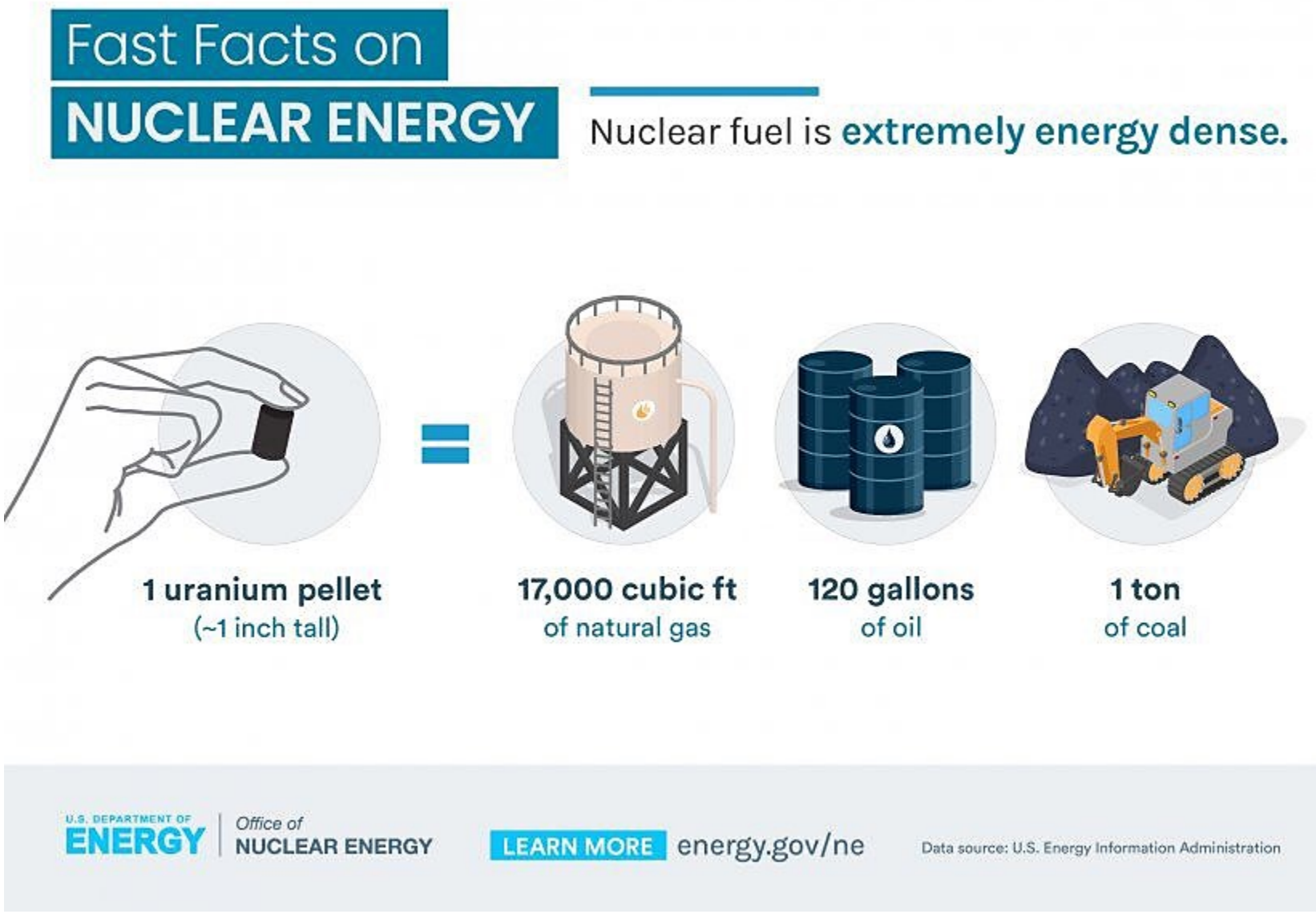
Lifecycle CO2 Emissions (CO_2e per kWh)



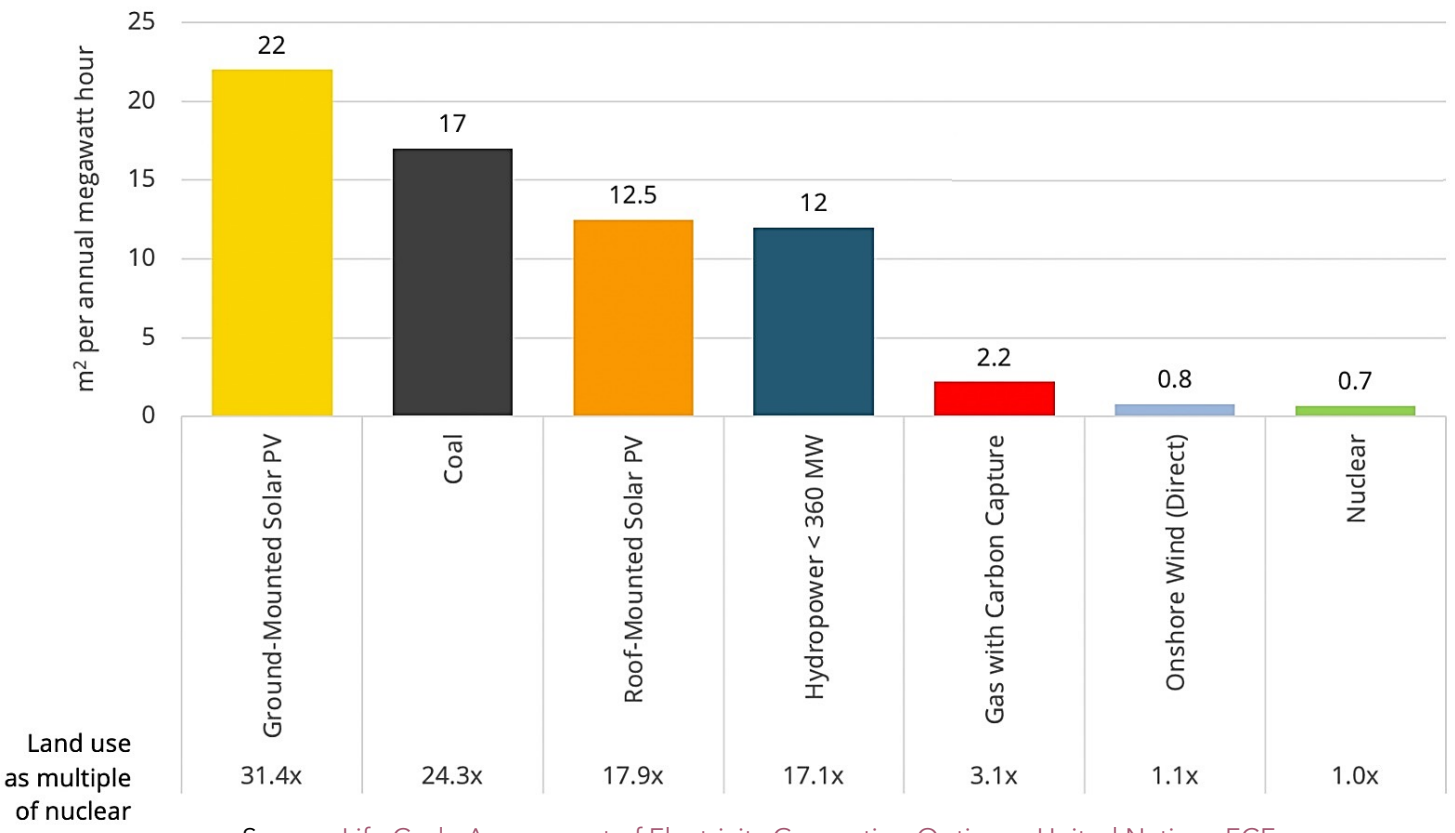
Source: Life Cycle Assessment of Electricity Generation Options - United Nations ECE

UNECE SUSTAINABLE DEVELOPMENT GOALS

Energy Density



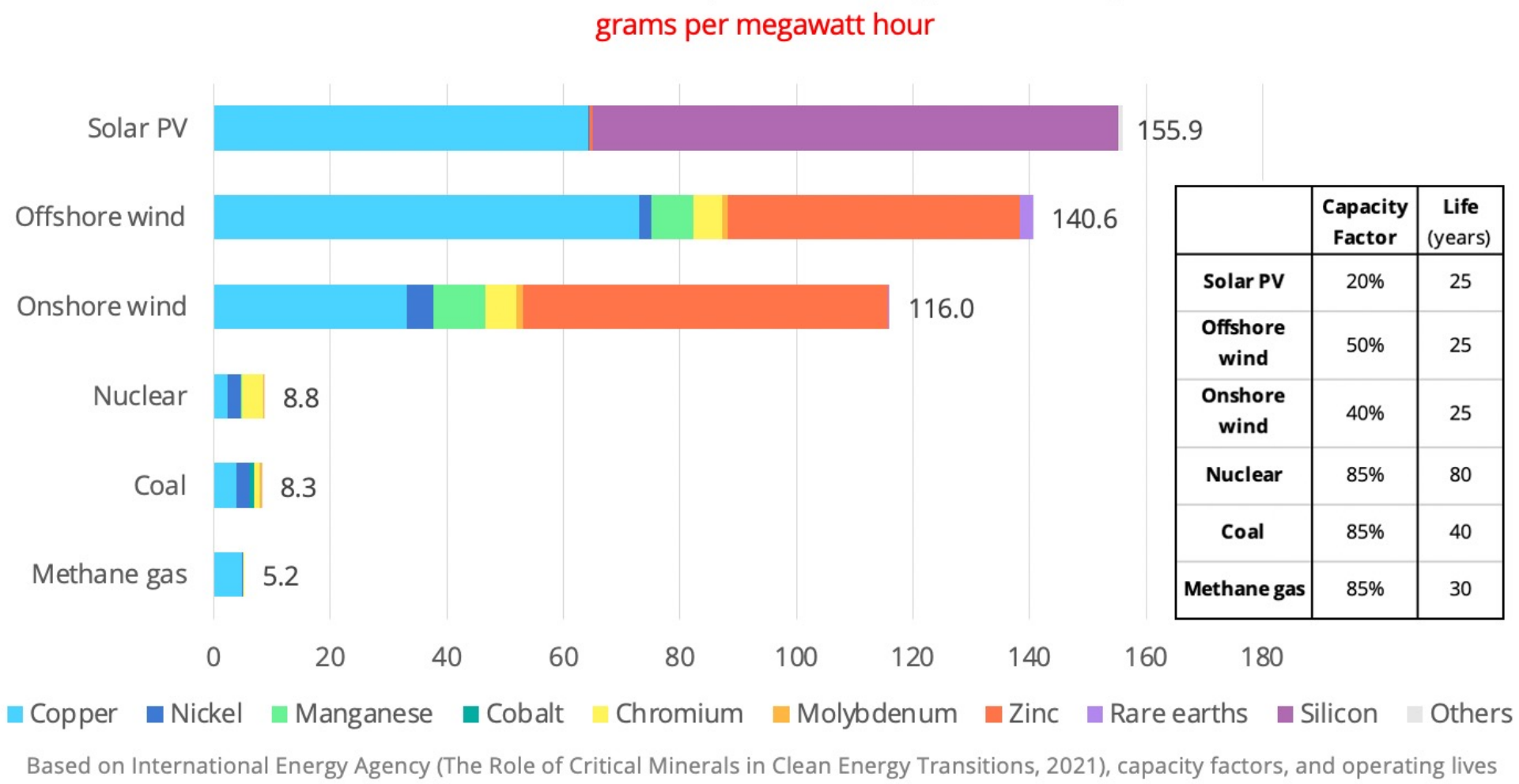
Lifecycle Land Use Intensity



Source: Life Cycle Assessment of Electricity Generation Options - United Nations ECE

UNECE SUSTAINABLE DEVELOPMENT GOALS

Critical Mineral Use by Clean Energy Technologies

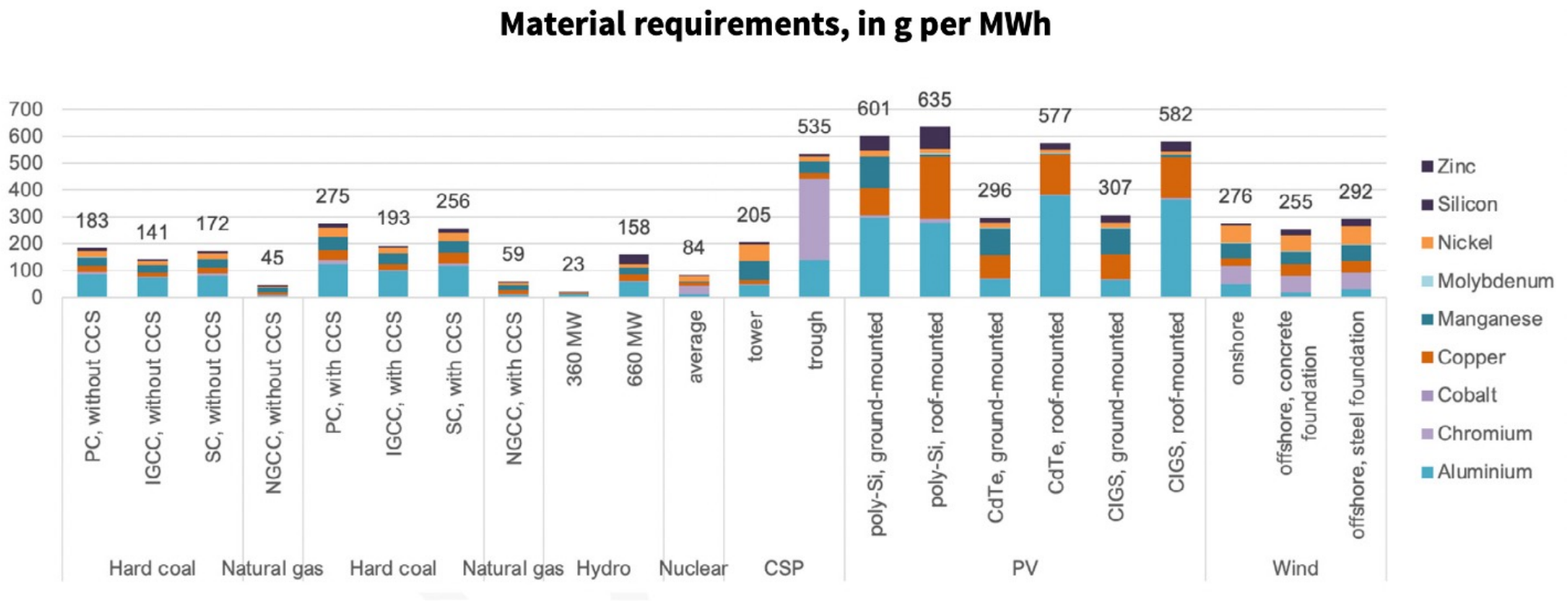


	Capacity Factor	Life (years)
Solar PV	20%	25
Offshore wind	50%	25
Onshore wind	40%	25
Nuclear	85%	80
Coal	85%	40
Methane gas	85%	30

Based on International Energy Agency (The Role of Critical Minerals in Clean Energy Transitions, 2021), capacity factors, and operating lives

Source: Role of Critical Minerals in Clean Energy Transitions – International Energy Agency

Material Use

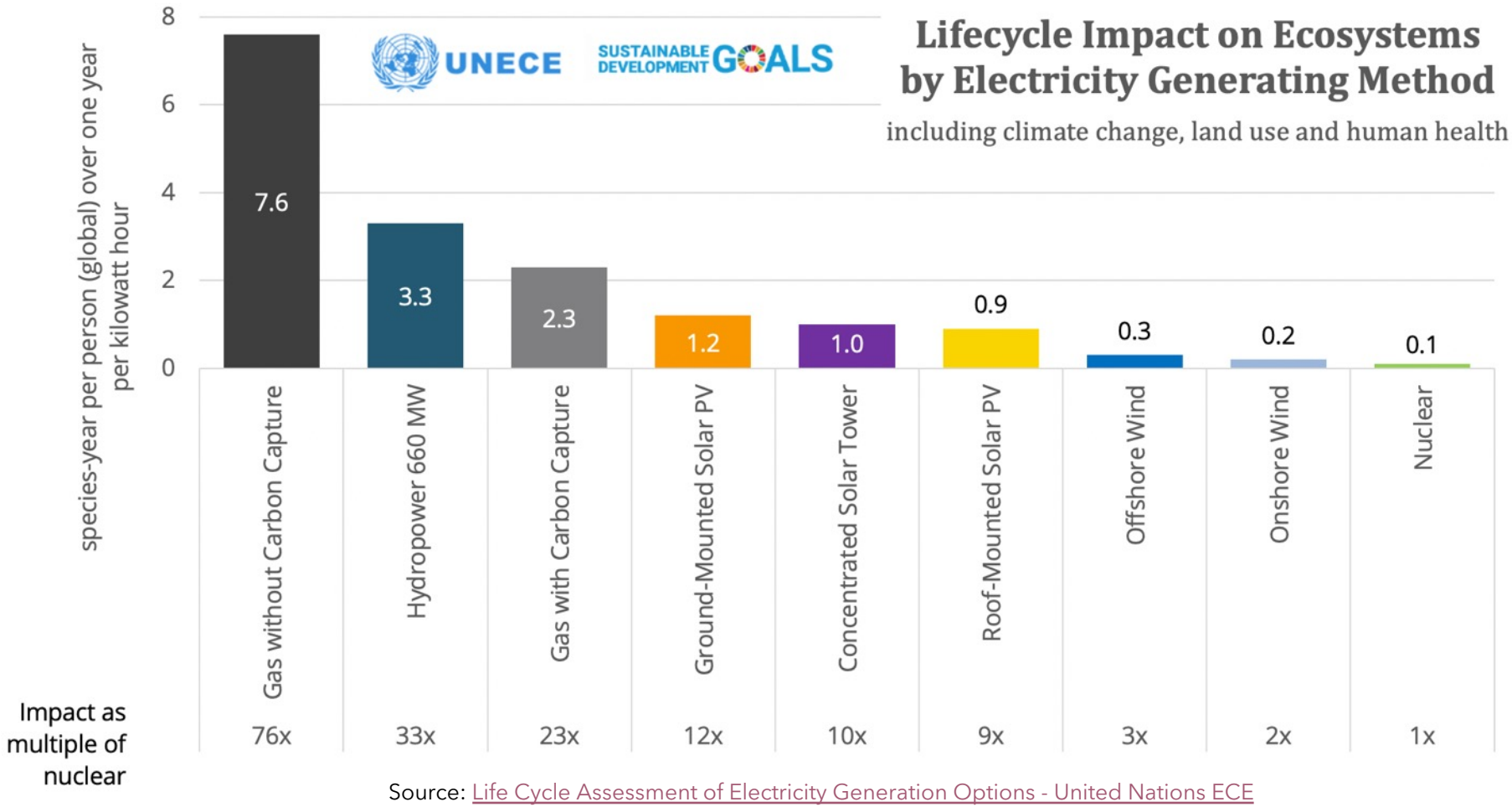


Source: Life Cycle Assessment of Electricity Generation Options - United Nations ECE

UNECE

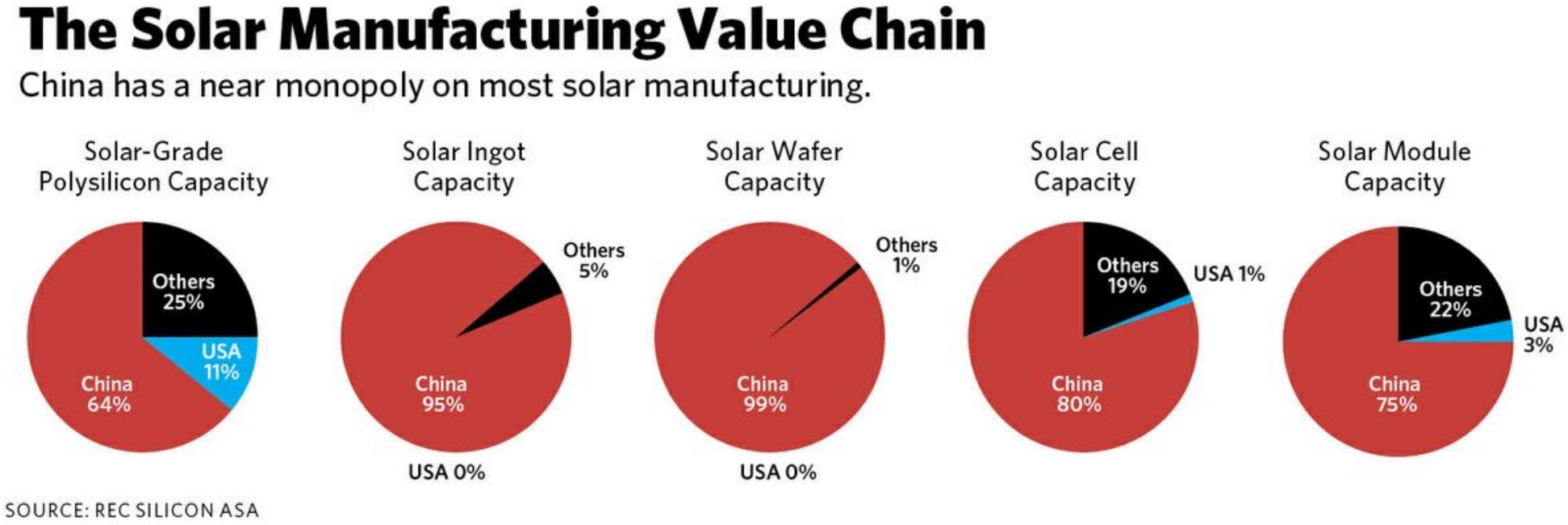
SUSTAINABLE DEVELOPMENT GOALS

Ecological & Health Impact



Source: Life Cycle Assessment of Electricity Generation Options - United Nations ECE

National Security & Energy Independence

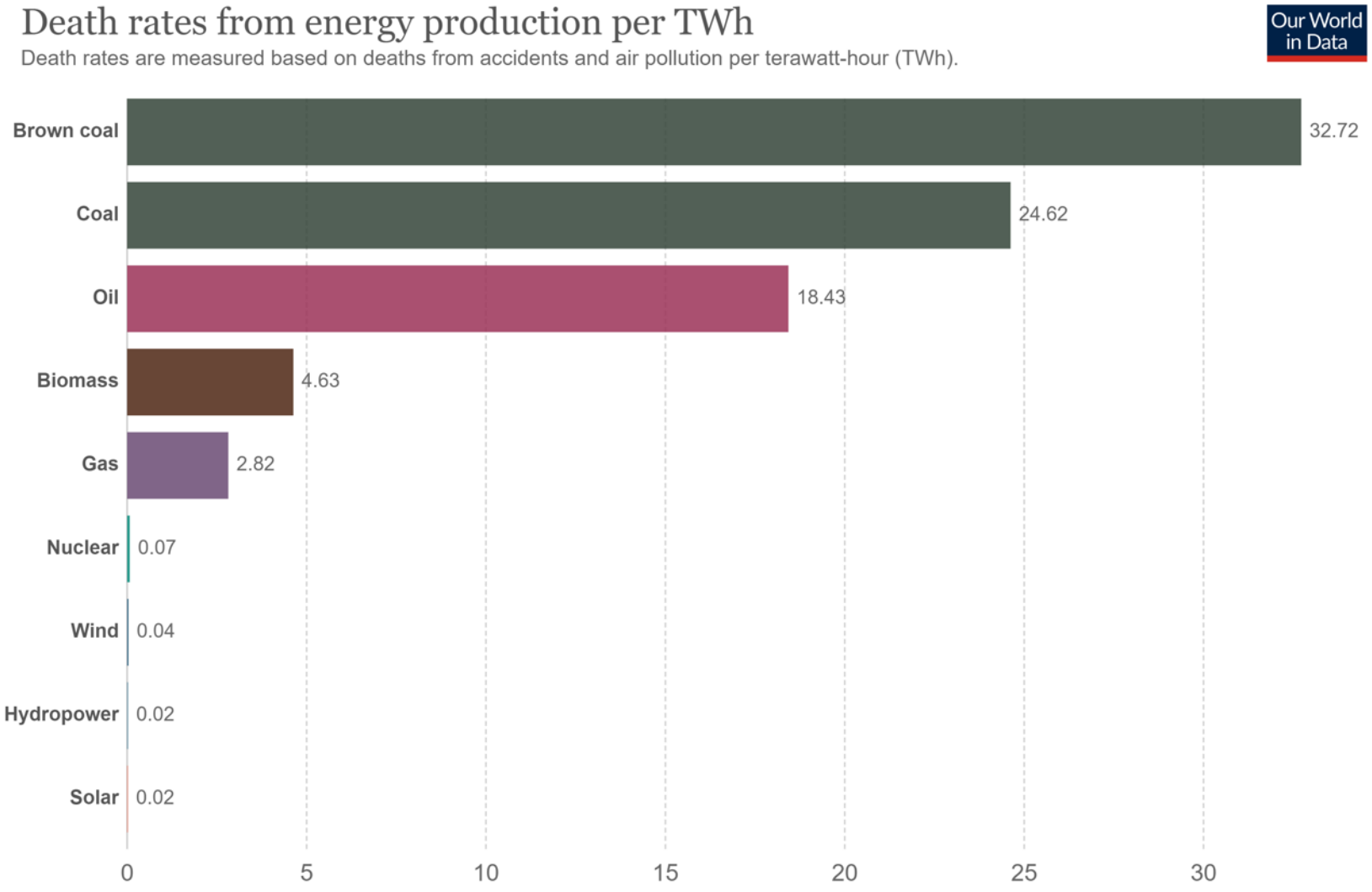


Labor Impact

Electricity generation	Unionization	Median wage	Carbon-free energy?	Firm energy?	Benefits concentrated in local community?
Nuclear	19.5%	$80,000	Yes	Yes	Yes
Methane gas	15.1%	$65,000	No	Yes	Yes
Coal	14.7%	$65,000	No	Yes	Yes
Solar	9.6%	$50,000	Yes	No	No
Wind	9.5%	$45,000	Yes	No	No

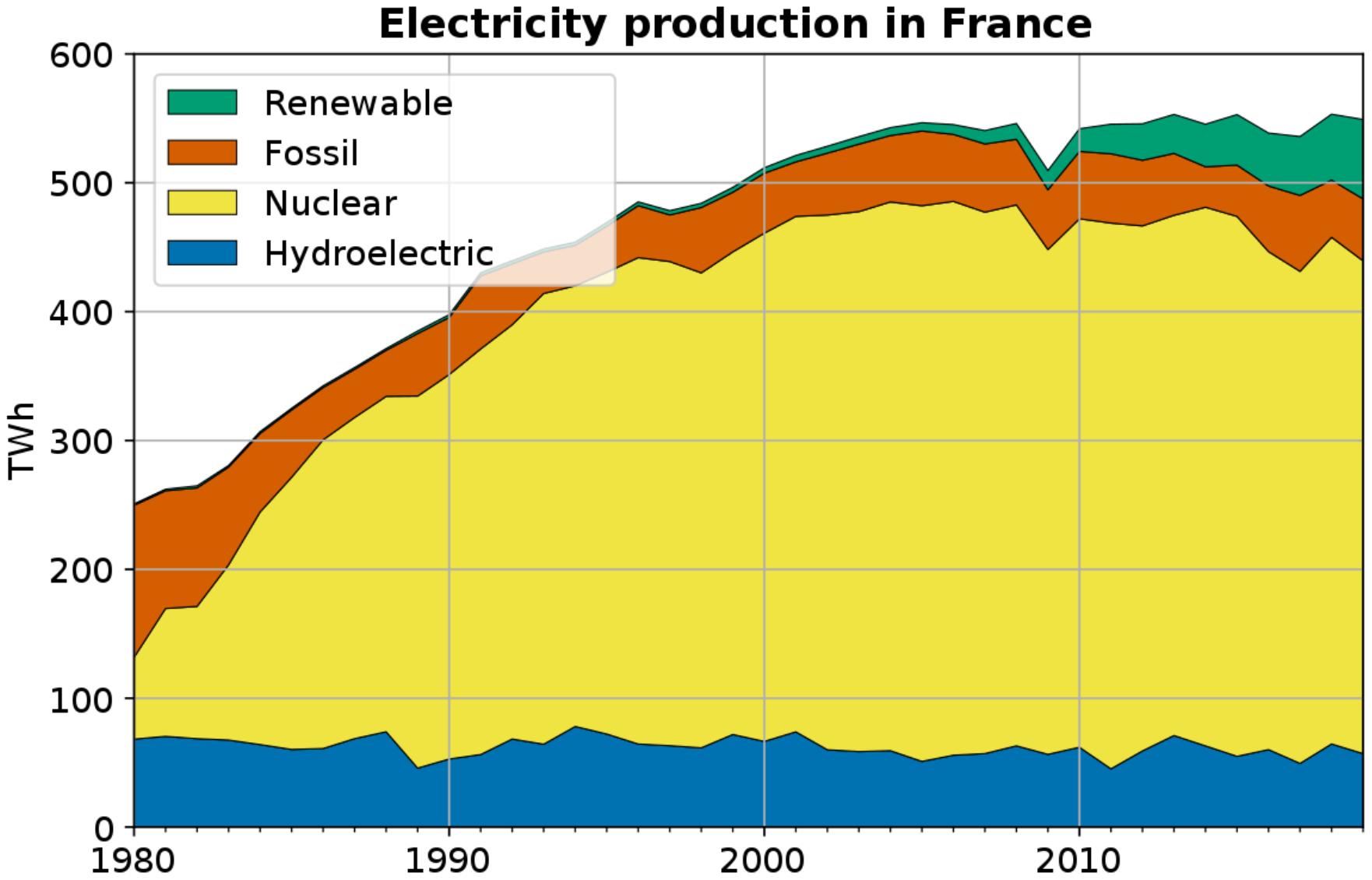
Sources: Bright Future, Nuclear New York, U.S. Energy & Employment Jobs Report

Safety

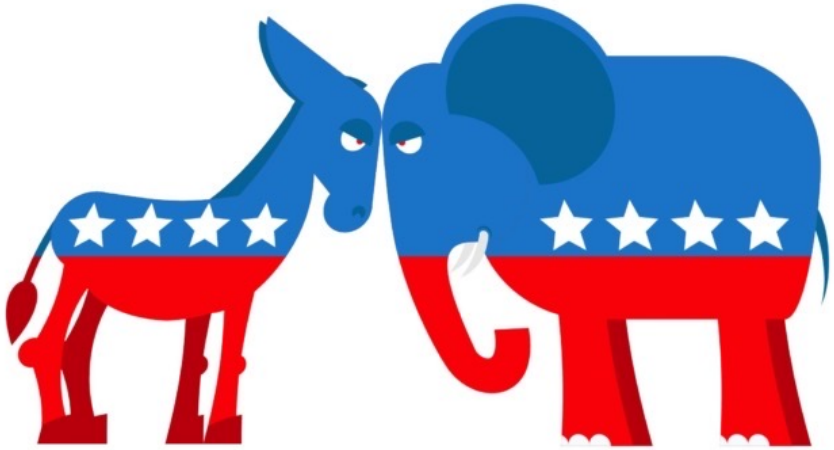


Sources: Our World in Data, Markandya & Wilkinson (2007), Sovacool et al (2016)

Scalability



Bipartisanship



Being for something is a stronger argument than merely being against something.


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS


ENVIRONMENTAL
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