Energy

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CH5102

CHALLENGES TO SUSTAINABALITY

- ✓ Population and earth's carrying capacity (> 9 billion by 2030)
- ✓ Irreversible changes in global climate (+2-3°F ⬆)
- ✓ Depletion of earth resources (excessive consumption of natural capital and rapid urbanization)
- ✓ **Access to affordable clean energy (social and quality of life inequities)**

Current World Population

8,252,363,685

view all people on 1 page >

@10.41 AM: 15-10-2025

TODAY	THIS YEAR
Births today **161,429**	Births this year **104,273,273**
Deaths today **76,066**	Deaths this year **49,134,055**
Population Growth today **85,363**	Population Growth this year **55,139,218**

https://www.worldometers.info/world-population/

WORLD POPULATION SECTIONS

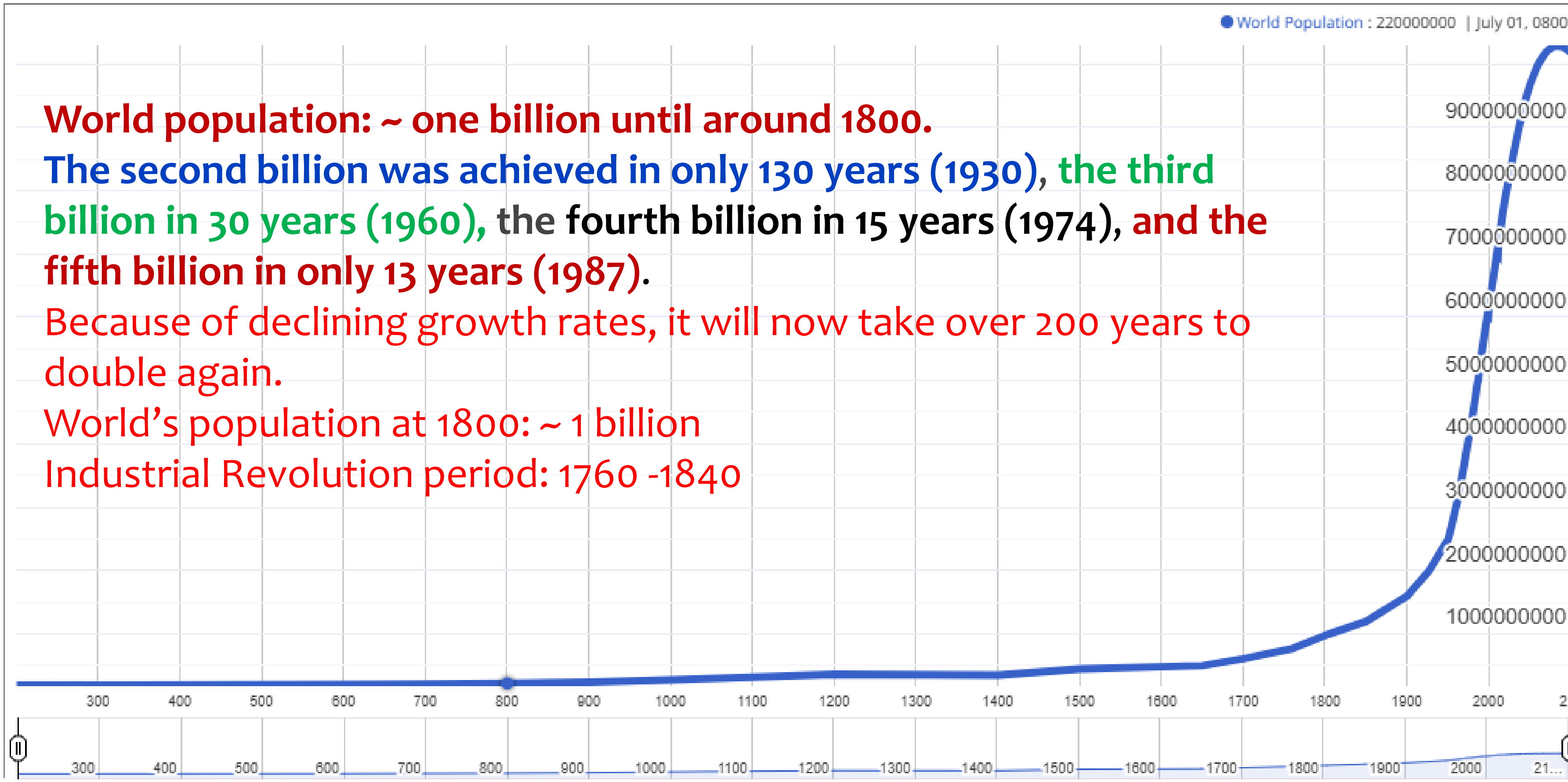
The January–September global surface temperature: Warmest in the 175-year record at 1.28°C above the 1901–2000 average of 14.1°C. National Centres for Environmental Information data indiçâtes a 99.8% chance that 2024 will rank as the warmest year on record. In the best-case scenario, with all policies in place/implemented, the global temperature is still expected to rise by 1.8 °C compared to the pre-industrial average.

Statista: https://www.statista.com/statistics/1278800/global-temperature-increase-by-scenario/ and https://www.ncei.noaa.gov/access/monitoring/monthly-report.

World Population: Past, Present, and Future

(move and expand the bar at the bottom of the chart to navigate through time)

back to top ↑



World population: ~ one billion until around 1800.

The second billion was achieved in only 130 years (1930), the third billion in 30 years (1960), the fourth billion in 15 years (1974), and the fifth billion in only 13 years (1987).

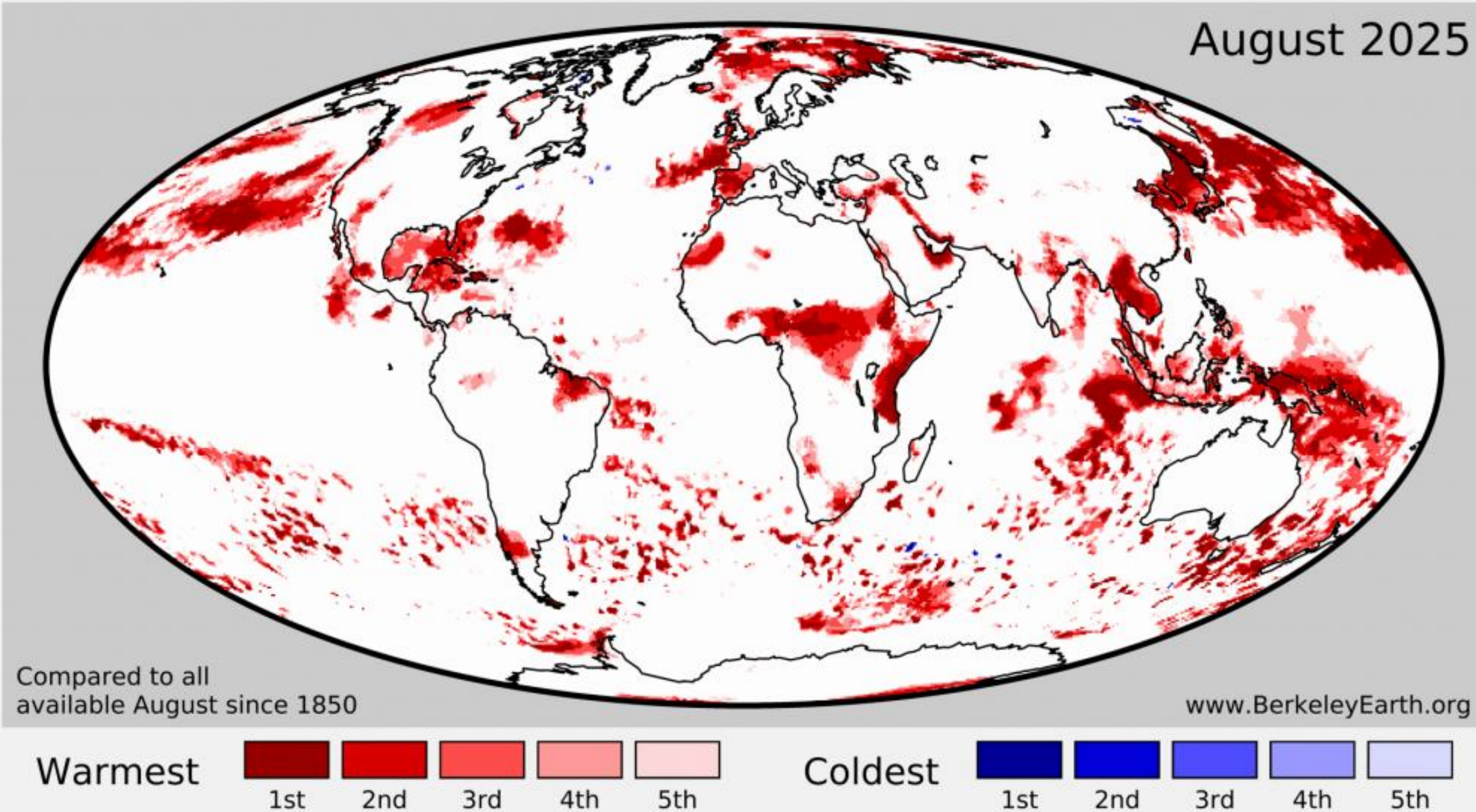
Because of declining growth rates, it will now take over 200 years to double again.

World's population at 1800: ~ 1 billion

Industrial Revolution period: 1760 -1840

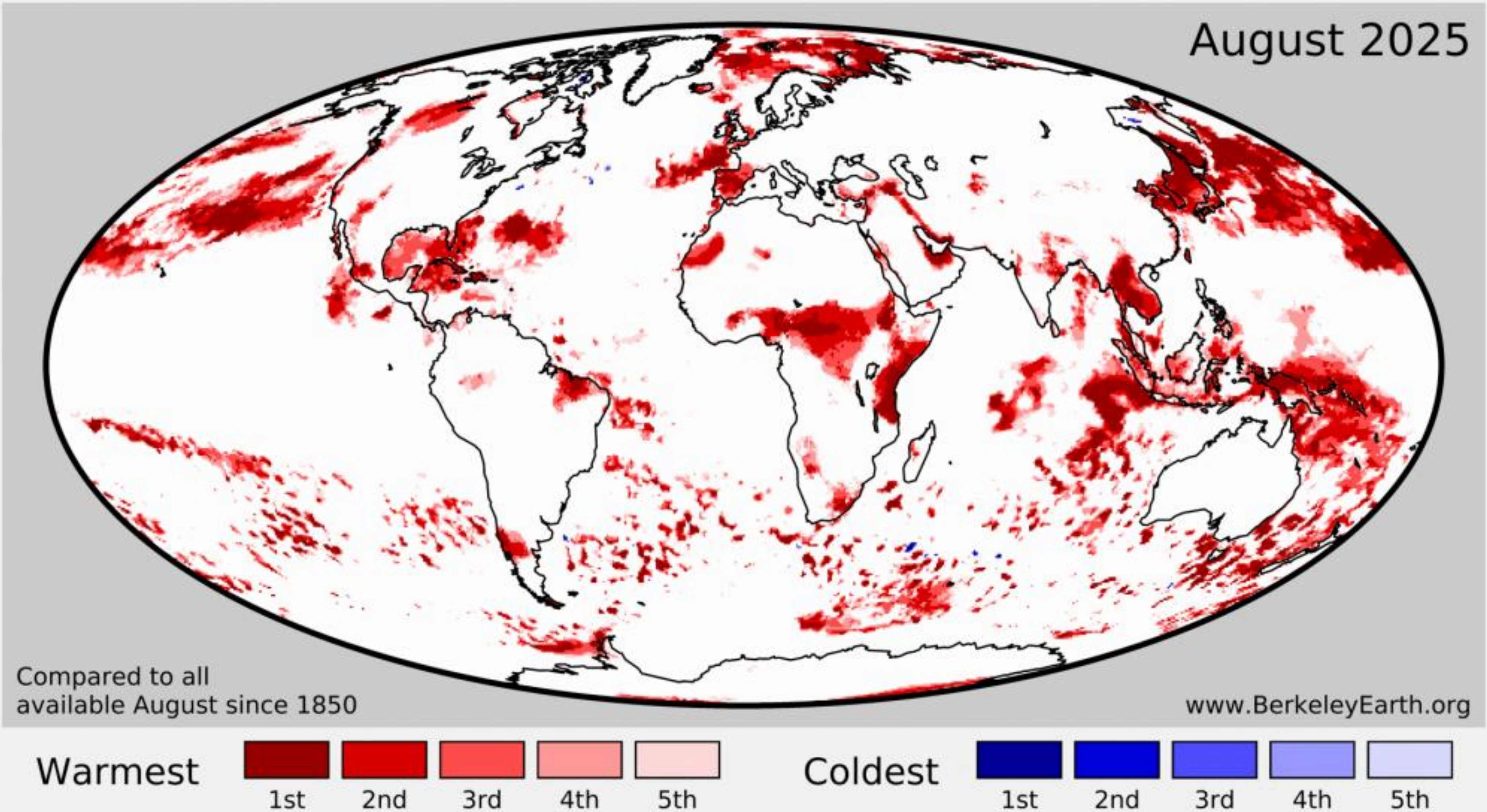
https://www.worldometers.info/world-population/

In August 2025, elevated temperatures were prevalent across Canada, parts of Antarctica, southern and western Europe, south and central Africa, as well as the North Pacific and the Arctic.



https://berkeleyearth.org/august-2025-temperature-update/

Approximately 4.6% of the Earth's surface experienced its locally warmest August on record (3.7% and 5.1% of land and ocean surfaces, respectively), with record warmth in the Northern Ocean basins and Central Africa, as well as in the oceans near Australia.



https://berkeleyearth.org/august-2025-temperature-update/

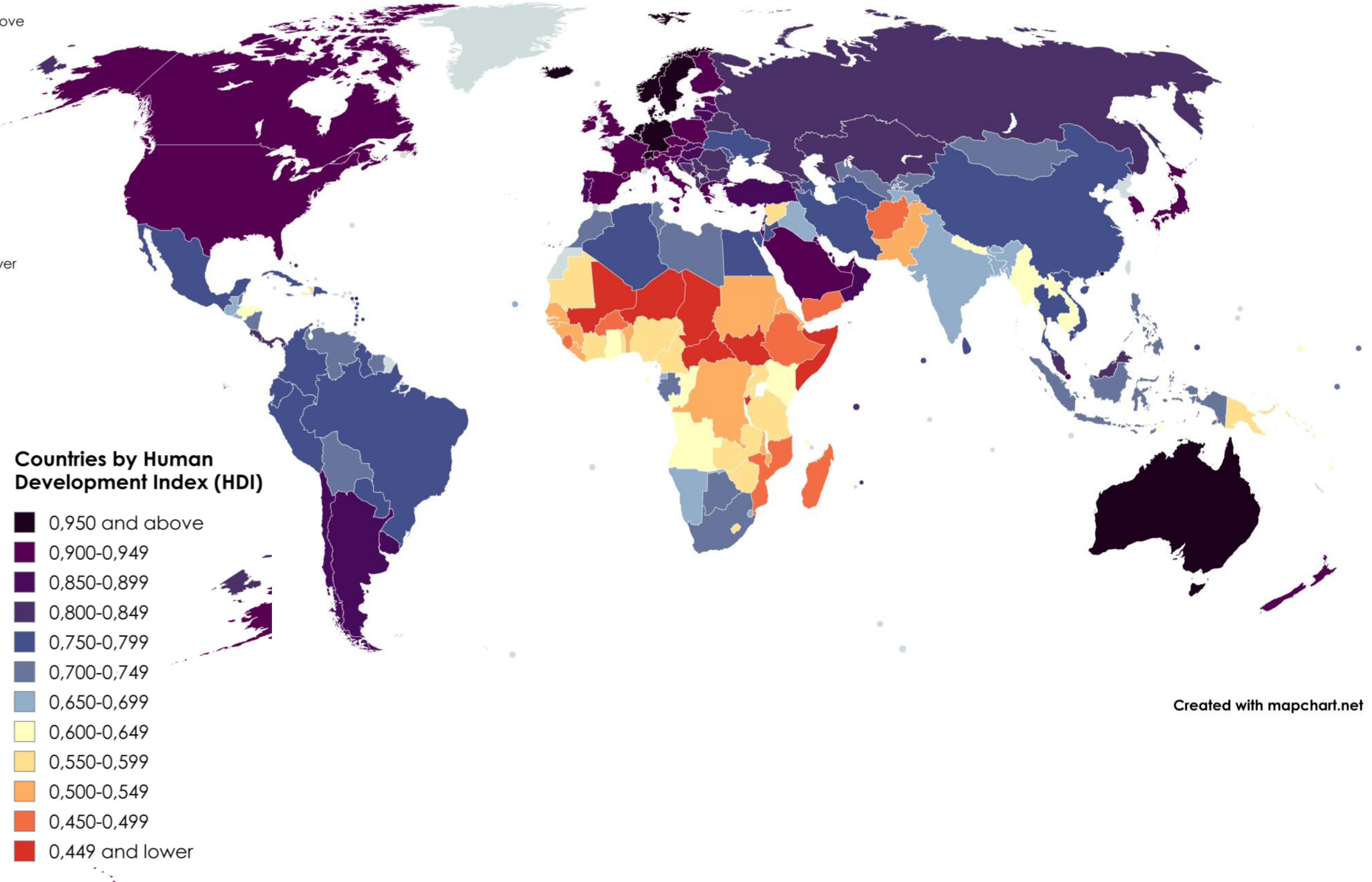
Components of the Human Development Index (HDI)

Source: United Nations Development Programme
Institute for Global Sustainability | Boston University | visualizingenergy.org |

visualizingEnergy

The Human Development Index, 2025

https://www.reddit.com/r/MapPorn/comments/1kg8cy1/map_of_countries_by_human_development_index_as_of/



The UNDP **introduced the Planetary Pressures**–adjusted Human Development Index (PHDI) in the Human Development Report 2020 (UNDP, 2020) and revised it in the 2021/2022 Report (UNDP, 2022). The PHDI adjusts the traditional HDI by factoring in a country's planetary pressures — specifically, its contributions to carbon dioxide (CO_2) emissions and material footprint. It reflects how much a nation's human development depends on environmentally unsustainable practices.

Formula (Simplified)

PHDI = HDI × (1–A)

A = adjustment factor based on CO_2 emissions per capita and material footprint per capita

Sustainability: Science, Practice and Policy, 21(1). https://doi.org/10.1080/15487733.2025.2454062

The **environmental pressures–adjusted Human Development Index** (eHDI) modifies the HDI by accounting for the ecological and environmental pressures exerted by a country's development model—such as carbon emissions, material footprint, or energy consumption—to provide a more sustainable and holistic measure of progress.

The eHDI adjusts HDI values downward when development is achieved through unsustainable resource use or high environmental degradation.

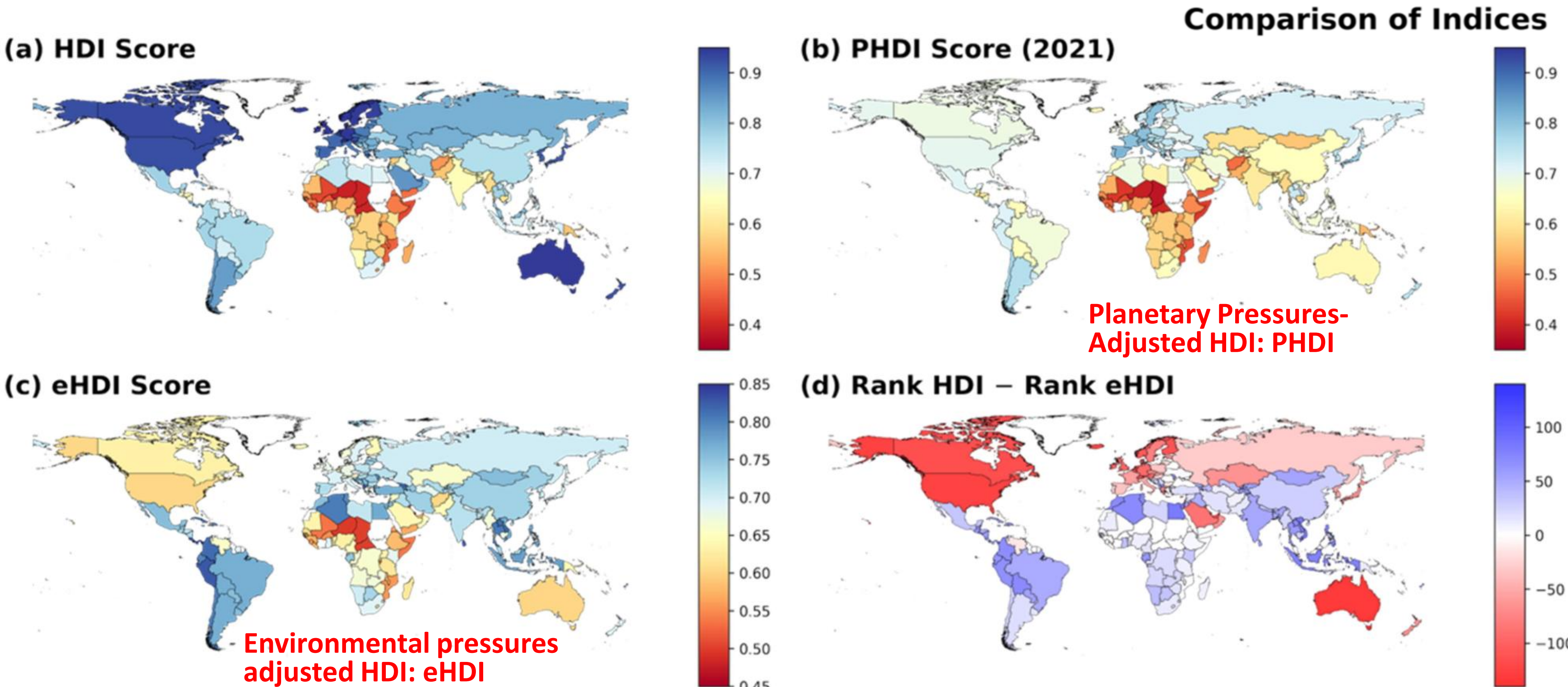
Thus, it highlights the trade-off between human well-being and ecological sustainability.

Formula (Conceptually)

$$\text{eHDI} = \text{HDI} \times (1 - \text{Environmental Pressure Index})$$

Ecological Indicators, 2023, 149, 110181

Spatial variations in (a) HDI, (b) PHDI, (c) eHDI, and (d) the difference in rank between HDI and eHDI. *Note:* In the latter, positive values indicate better performance on eHDI than on HDI. The colorbar scale is identical for panels (a) and (b) but differs for panels (c) and (d).



HDI: Highest scores in high-income countries.

PHDI: Spatial trends mirror HDI, with Europe leading; noticeable declines for the U.S., Canada, Saudi Arabia, and Australia.

eHDI: Distinct pattern—Central and South America emerge as top performers; lowest scores in North America, Australia, and the Middle East, followed by sub-Saharan Africa.

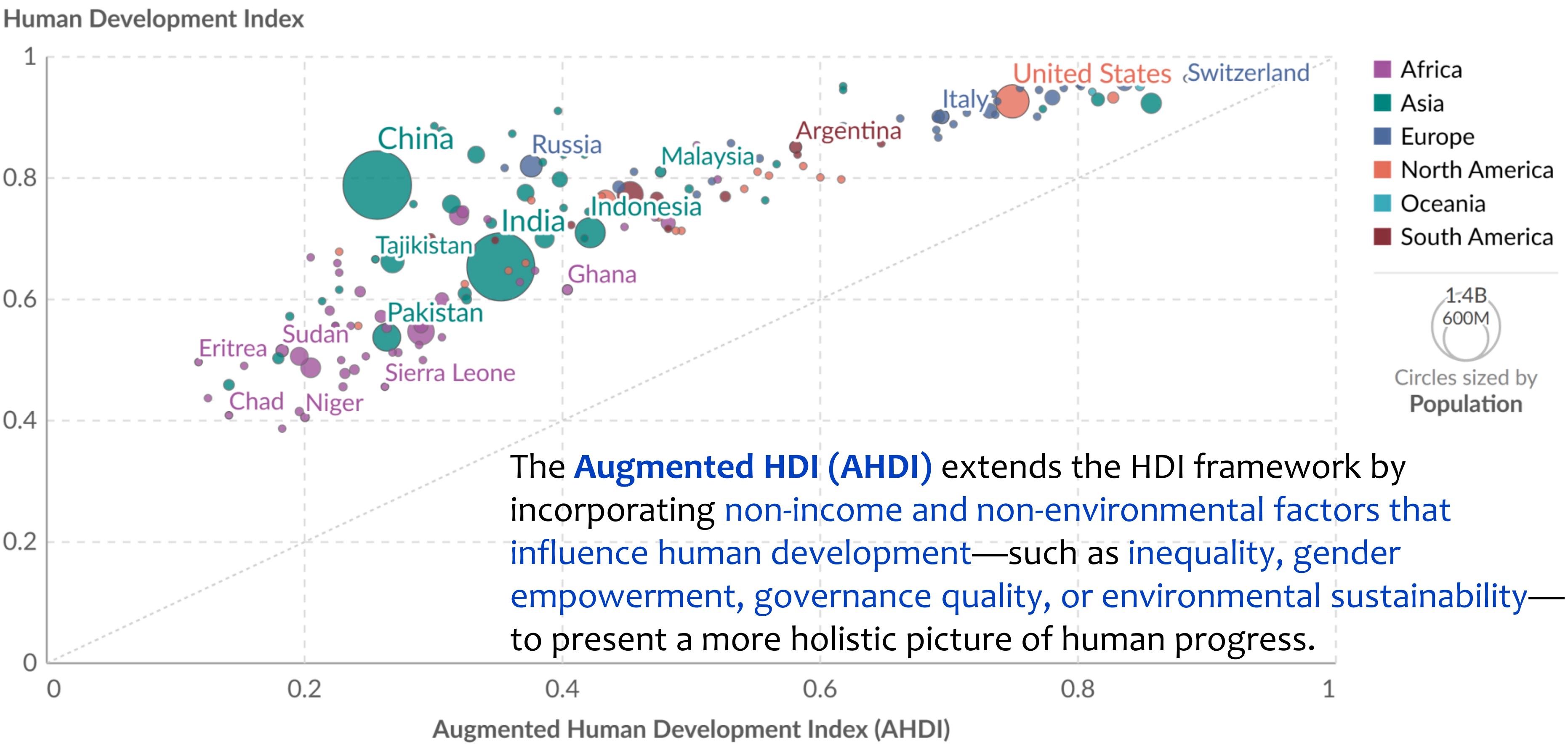
HDI–eHDI rank difference:

Sub-Saharan Africa ranks low due to limited human development. The U.S., Canada, and Australia lose rank positions as high HDI values are offset by substantial environmental pressures.

Sustainability: Science, Practice and Policy, 2025, 21(1). https://doi.org/10.1080/15487733.2025.2454062

Human Development Index vs. Augmented Human Development Index, 2020

The Human Development Index (HDI) is a summary measure of key dimensions of human development: a long and healthy life, a good education, and a decent standard of living. The Augmented Human Development Index (AHDI) includes a fourth dimension related to civil and political freedom.



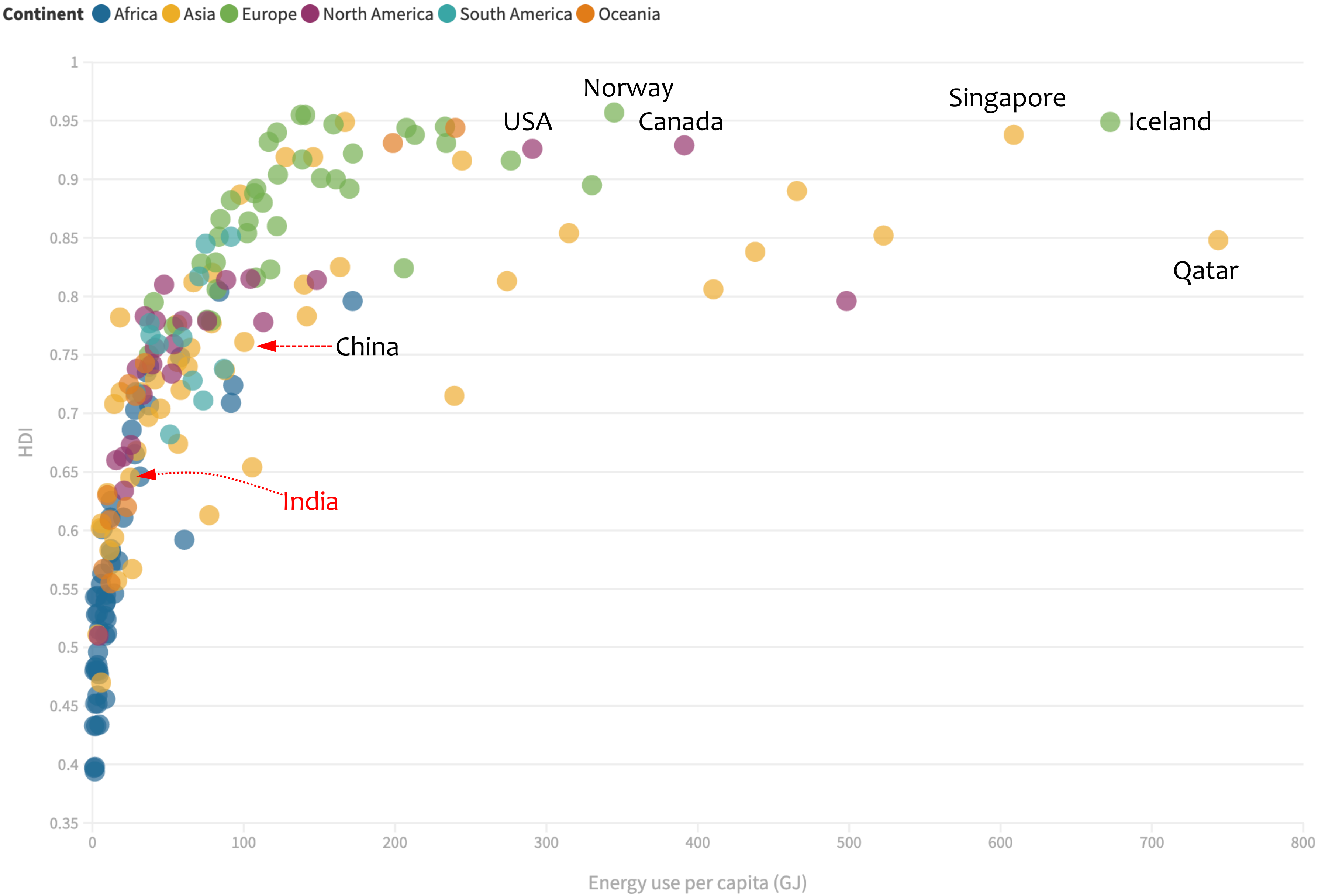
The **Augmented HDI (AHDI)** extends the HDI framework by incorporating non-income and non-environmental factors that influence human development—such as inequality, gender empowerment, governance quality, or environmental sustainability—to present a more holistic picture of human progress.

Data source: UNDP, Human Development Report (2025); Leandro Prados de la Escosura (2021)

Data source: UNDP, Human Development Report (2025); Leandro Prados de la Escosura (2021) – Learn more about this data

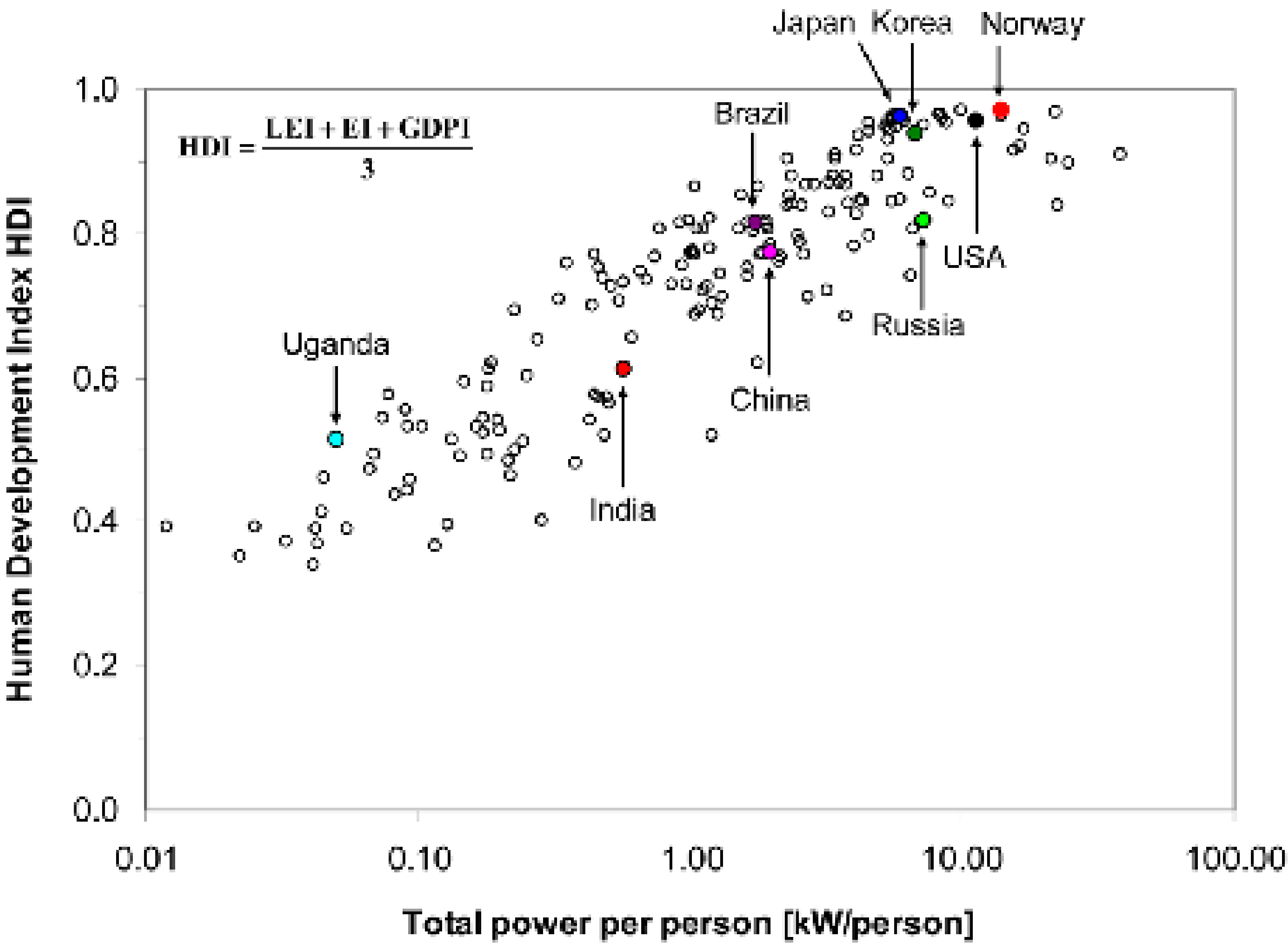
The Human Development Index (HDI) and energy use per capita, 2019

The HDI is a 0 to 1 composite index based on indicators for health, education, and income.

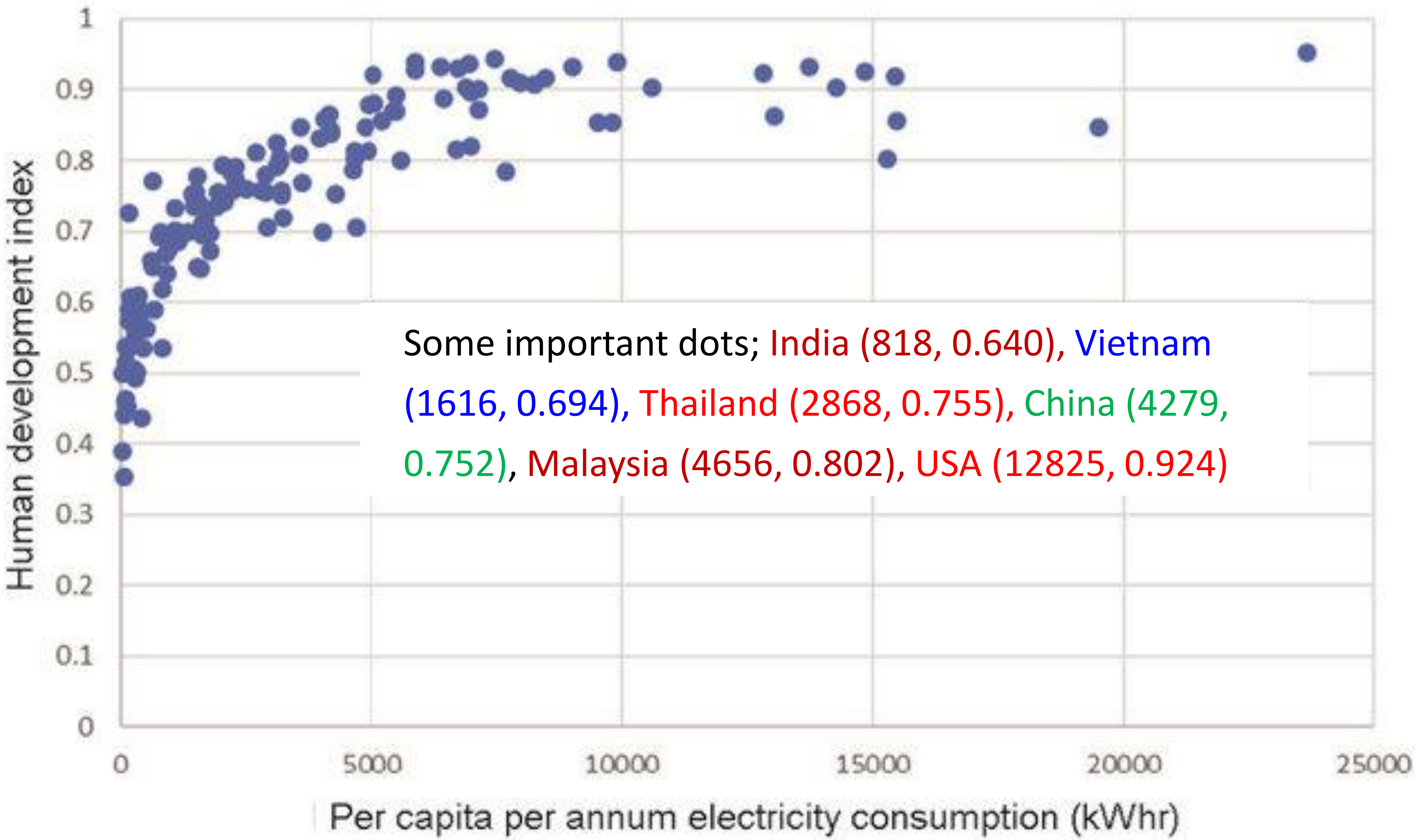


Sources: Our World in Data; United Nations Development Programme
Institute for Global Sustainability | Boston University | visualizingenergy.org |

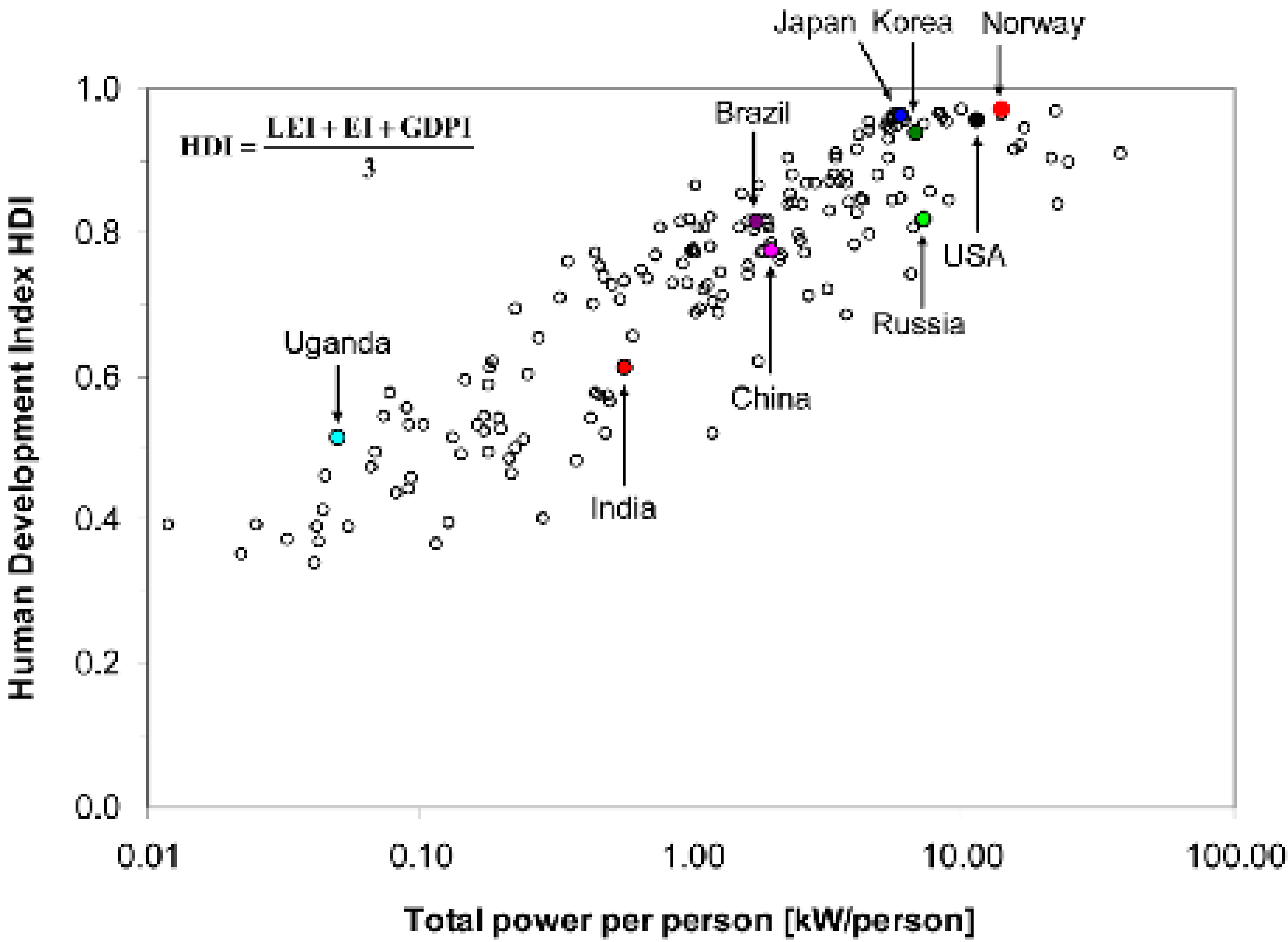
visualizingEnergy



Japan
Korea
Norway
Brazil
USA
Russia
China
India
Uganda
$$HDI = \frac{LEI + EI + GDPI}{3}$$
1.0
0.8
0.6
0.4
0.2
0.0
Human Development Index HDI
0.01
0.10
1.00
10.00
100.00
Total power per person [kW/person]

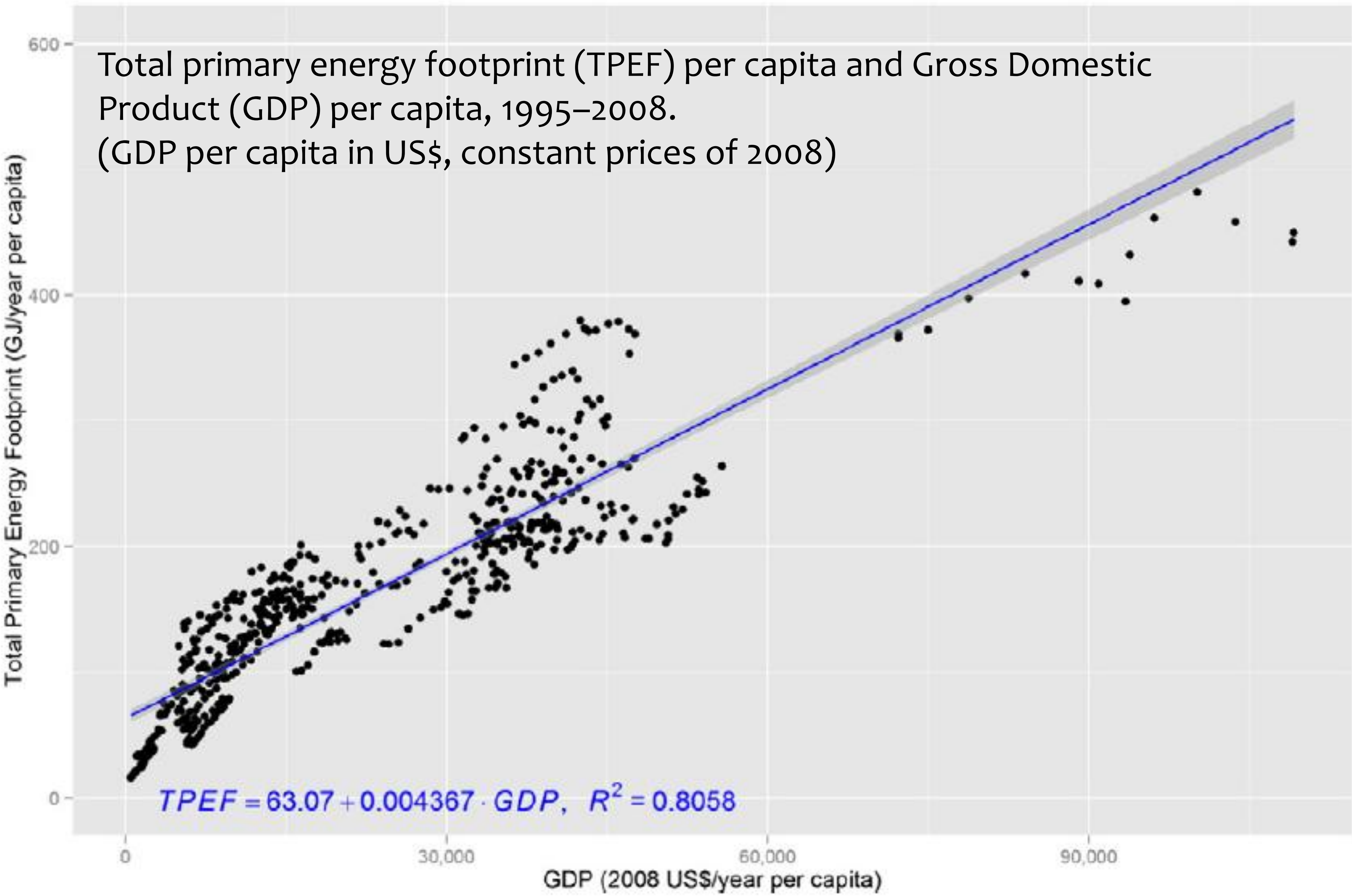


- ✓ R. Grover, Current Science, 2020, 119, 25
- ✓ Data for electricity consumption:Key World Energy Statistics, International Energy Agency, 2018
- ✓ Human Development Index: Human Development Indices and Indicators, Statistical Update, United Nations Development Programm, 2018



KSCE Journal of Civil Engineering, 2011, 15, 611-621

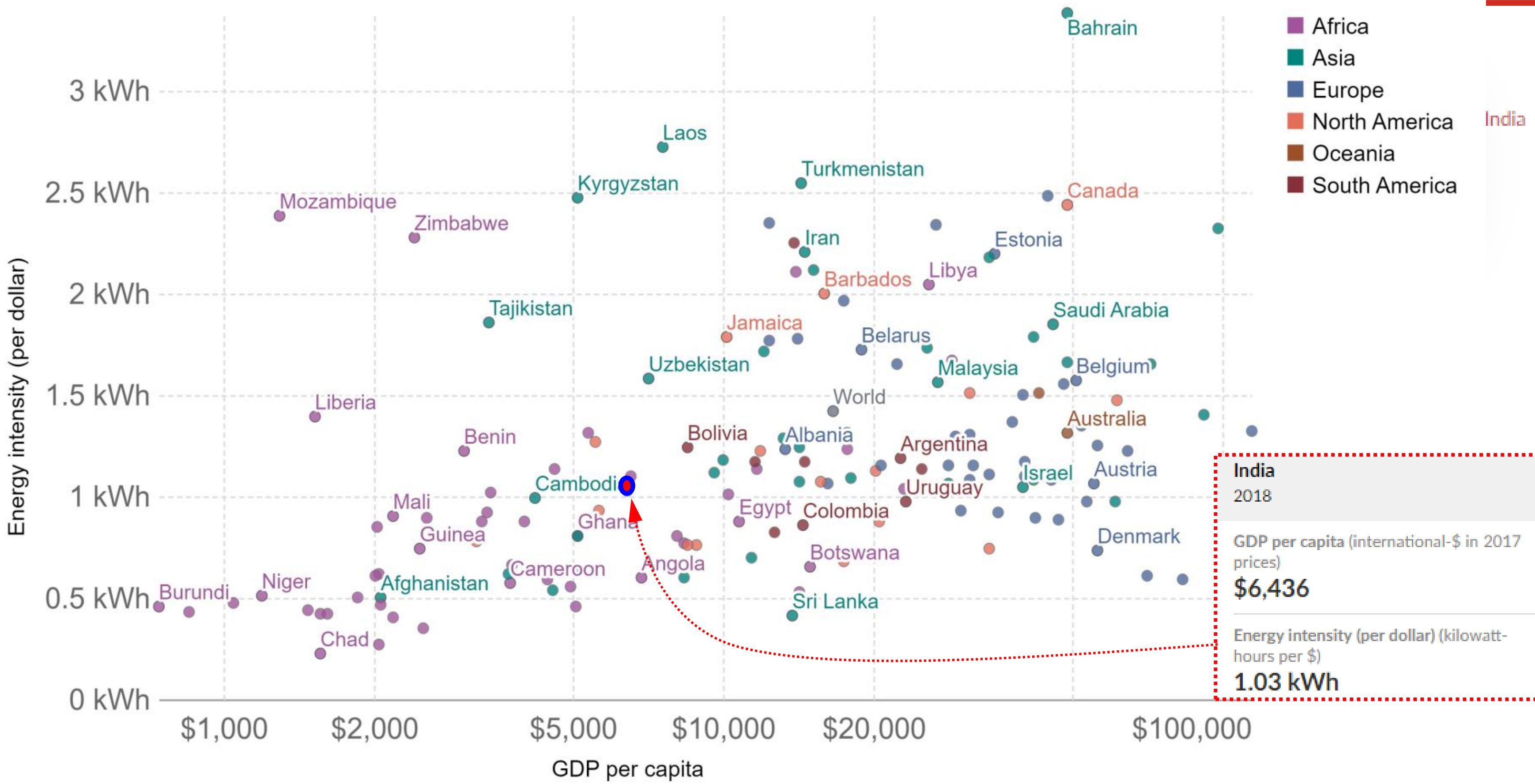
I. Arto et al. / Energy for Sustainable Development 33 (2016) 1–13



Alternate model: Energy-environmental Kuznets curve

Energy intensity vs. GDP per capita, 2018

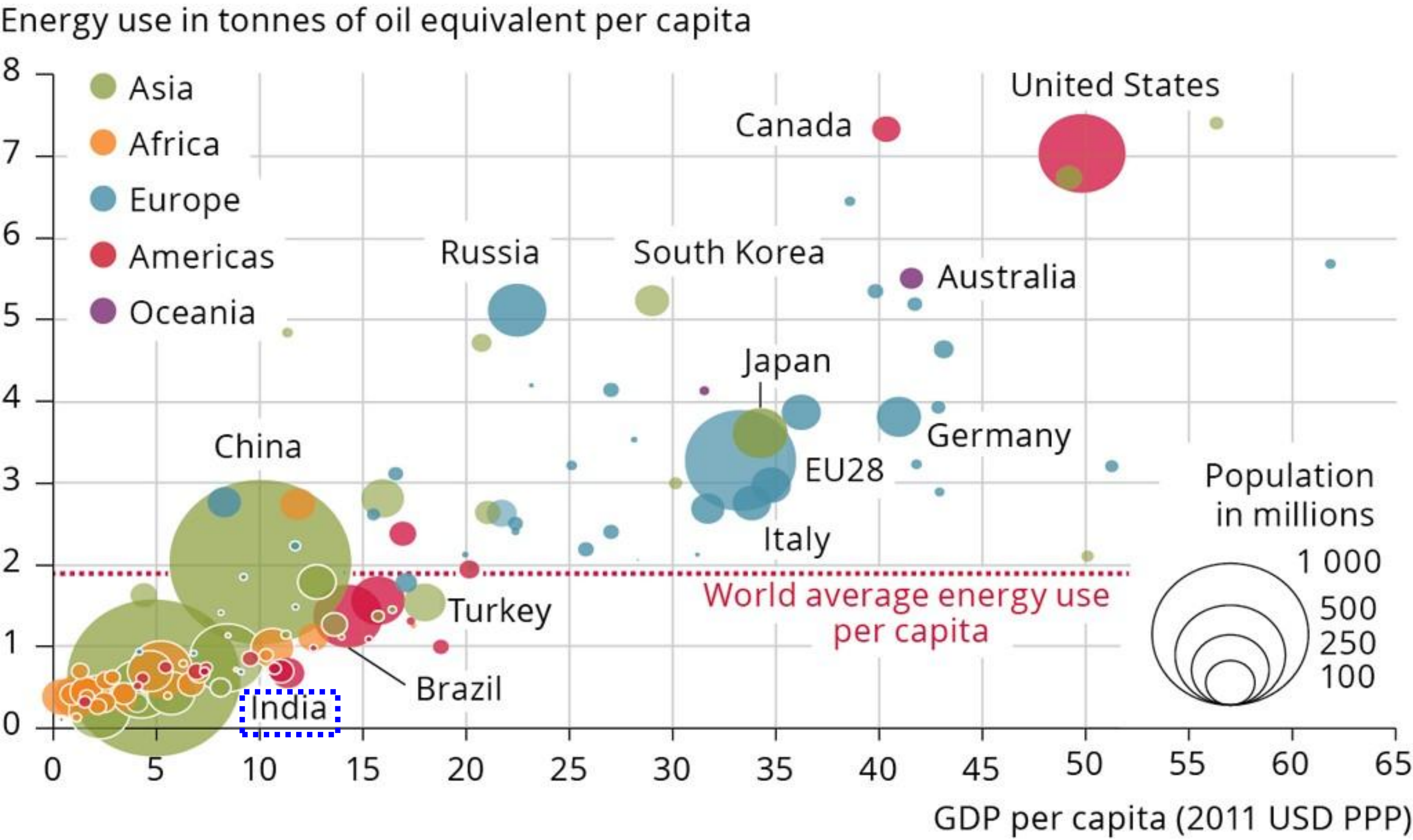
Energy intensity represents energy consumption per unit of GDP – it's measured in kilowatt-hours per international-$.



Source: U.S. Energy Information Administration (EIA); Energy Institute Statistical Review of World Energy (2023), Data compiled from multiple sources by World Bank

Note: GDP per capita is measured in constant international-$[1] which corrects for inflation and cross-country price differences.

1. **International dollars**: International dollars are a hypothetical currency that is used to make meaningful comparisons of monetary indicators of living standards. Figures expressed in international dollars are adjusted for inflation within countries over time, and for differences in the cost of living between countries. The goal of such adjustments is to provide a unit whose purchasing power is held fixed over time and across countries, such that one international dollar can buy the same quantity and quality of goods and services no matter where or when it is spent. Read more in our article: What are Purchasing Power Parity adjustments and why do we need them?

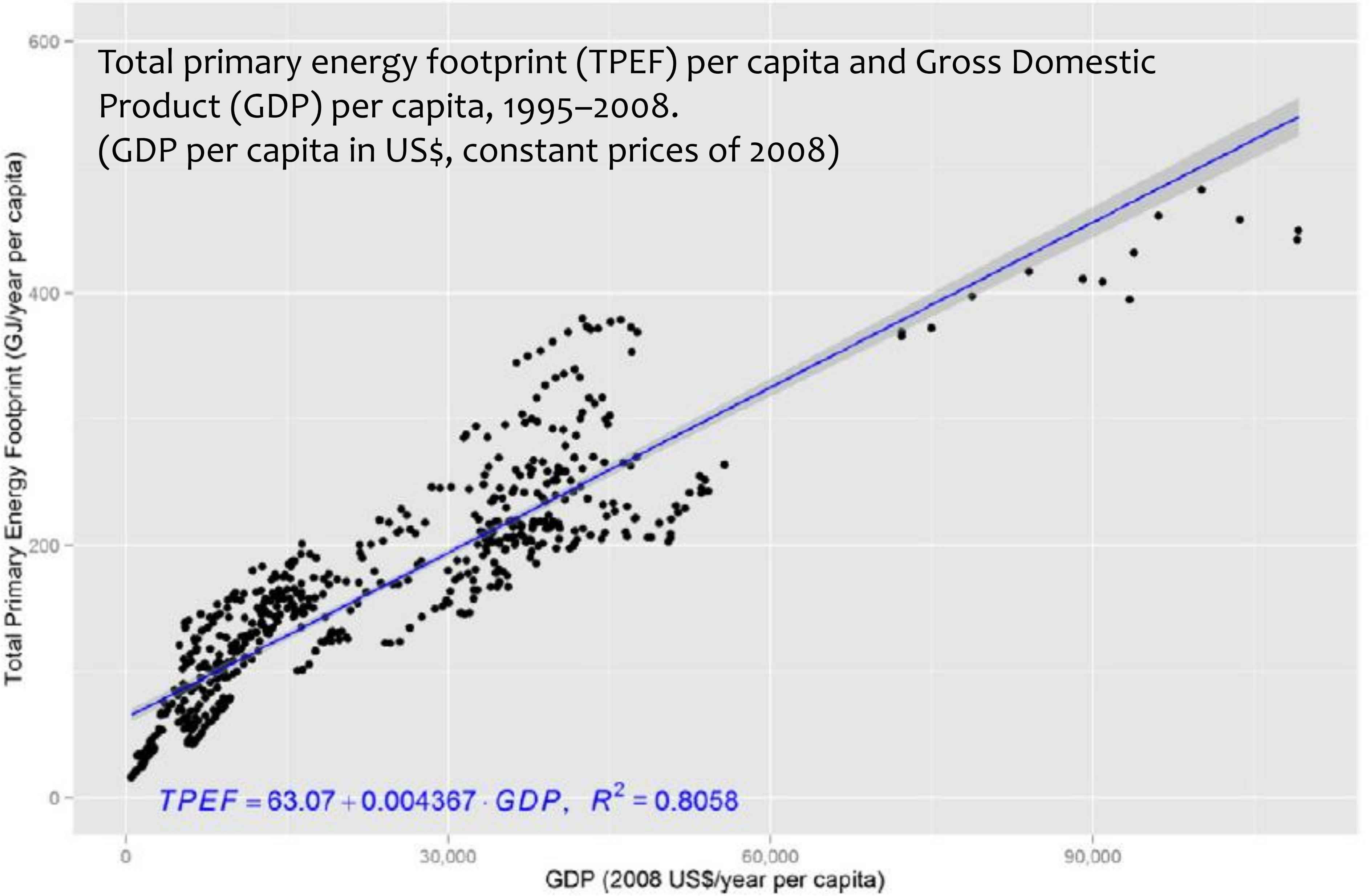


Correlation of energy consumption and GDP per person

Created 31 Oct 2014 Published 28 Feb 2015 Last modified 07 Jul 2016

The graph shows per capita energy consumption (kg oil equivalent) vs. per capita GDP, PPP (current international $). Bubble Size: Poulation per country. All values refer to the year 2011

https://www.eea.europa.eu/data-and-maps/figures/correlation-of-per-capita-energy

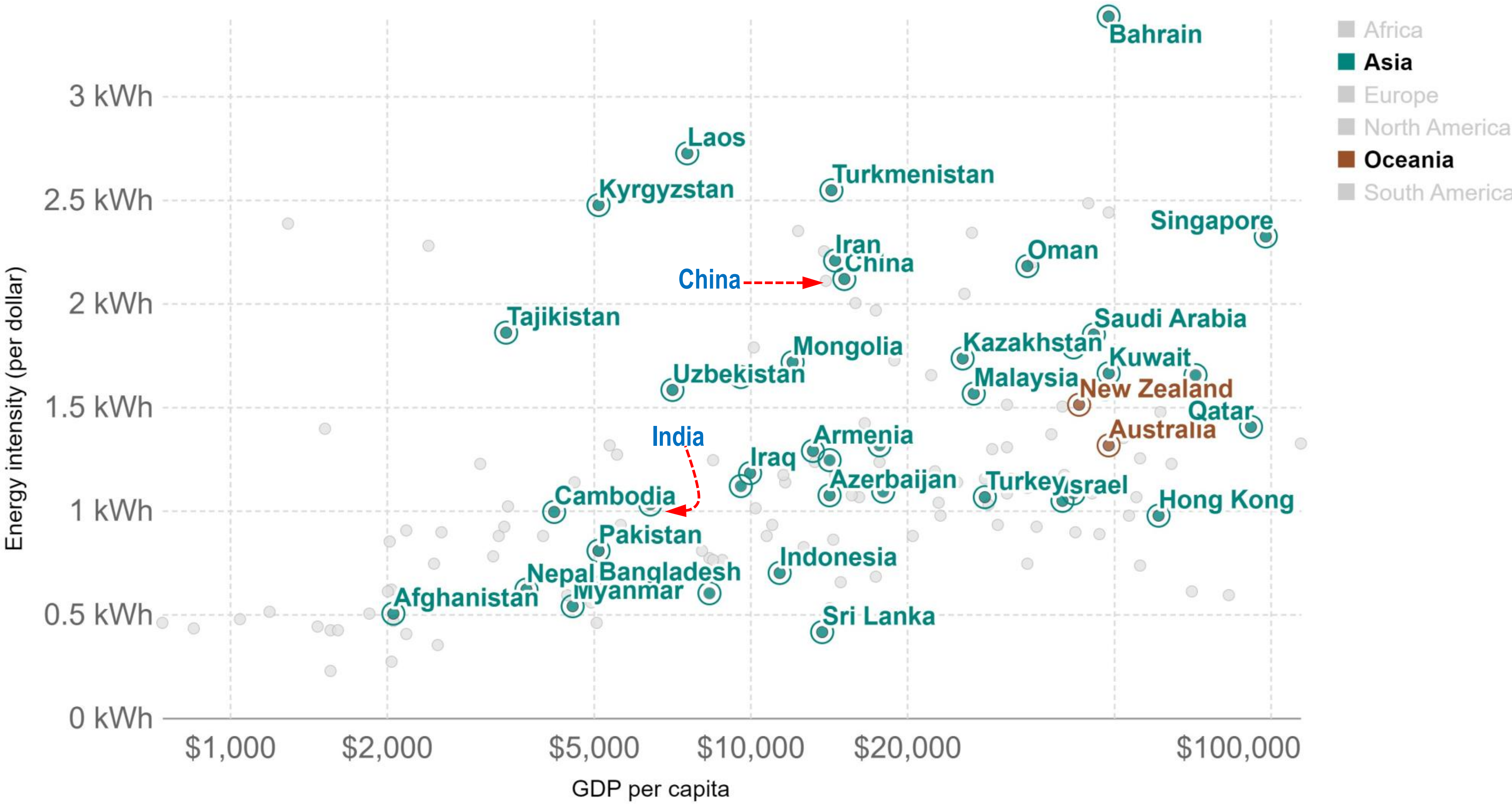


Alternate model: Energy-environmental Kuznets curve

Energy intensity vs. GDP per capita, 2018

Energy intensity represents energy consumption per unit of GDP – it's measured in kilowatt-hours per international-$.

Our World in Data



Primary energy consumption per unit of gross domestic product, measured in kilowatt-hours per international-$.

GDP per capita is based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States

Data compiled from multiple sources by the World Bank,
GDP per capita is measured in constant international-$ which corrects for inflation and cross-country price differences.

Per Capita Figures (Year: 2021)			
Country	GDP (US$)	Energy Consumed (Joules)	CO_2 Emission (Tonnes)
USA	70219	277.20	14.86
China	12618	110.80	8.05
Japan	39827	144.00	8.57
Germany	51204	153.20	8.09
India	2238	24.50	1.93
UK	46586	107.00	5.15
France	43659	145.70	4.74
Italy	35770	107.00	5.55
Canada	52359	362.70	14.30
South Korea	34998	242.40	11.89

Table-2: Per Capita Figures of 2021 (GDP, Energy Consumption and CO_2 Emissions)

https://energy.economictimes.indiatimes.com/news/renewable/relationship-between-gdp-growth-energy-consumption-andco2emissions-a-comprehensiveanalysis/104321989

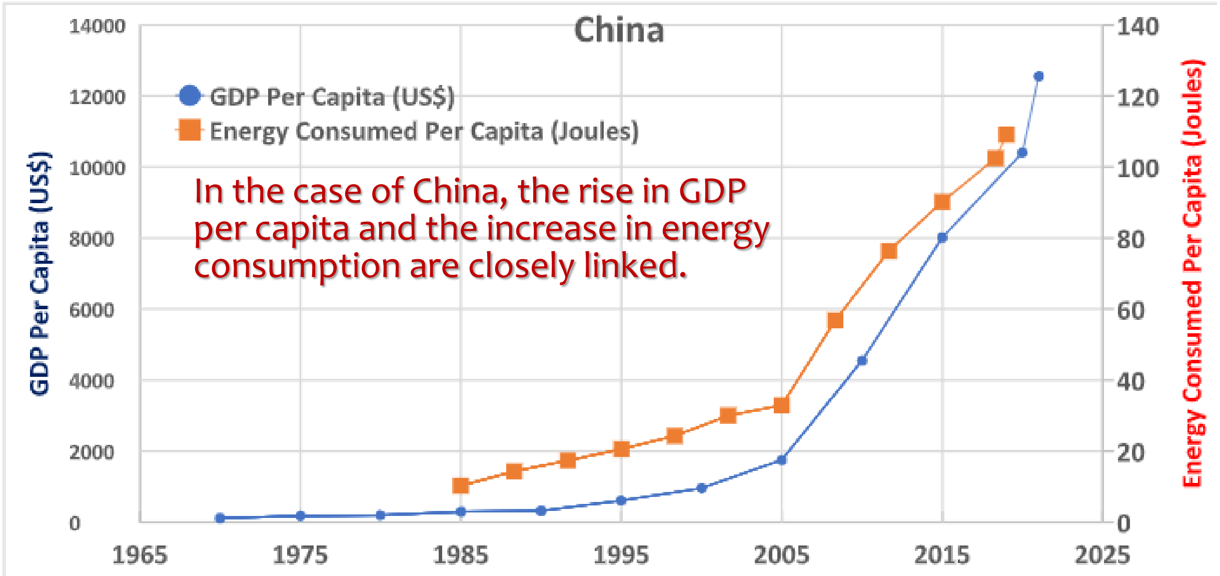


Chart - 1: GDP Per Capita (US$) ; Energy Consumed Per Capita (Joules) - China

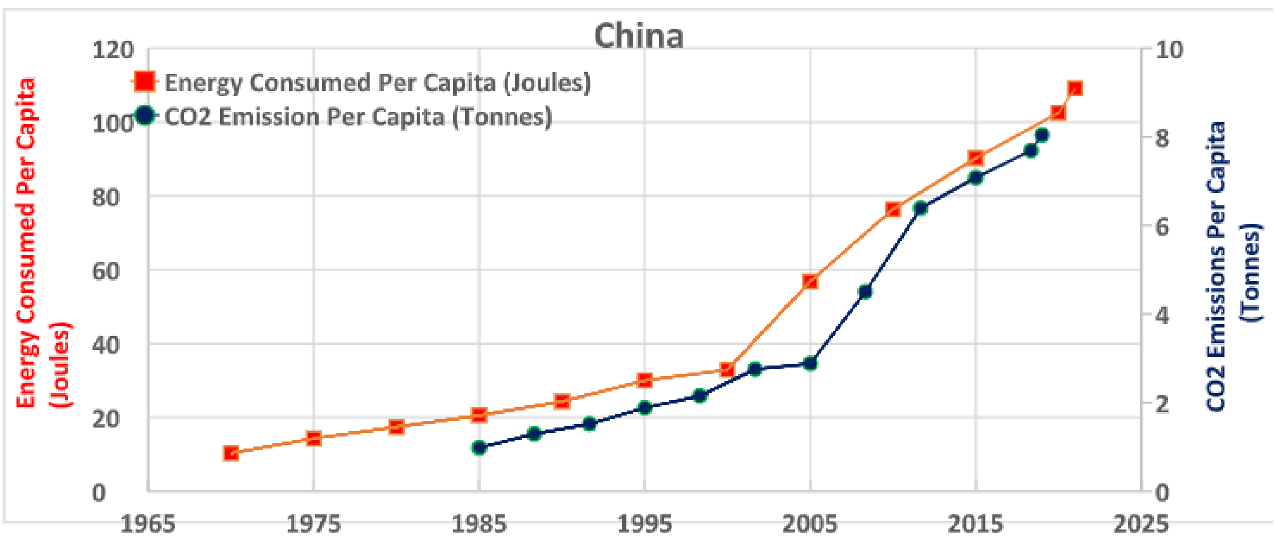


Chart - 2: Energy Consumed Per Capita (Joules) ; CO_2 Emission Per Capita (Tonnes) - China

https://energy.economictimes.indiatimes.com/news/renewable/relationship-between-gdp-growth-energy-consumption-andco2emissions-a-comprehensiveanalysis/104321989

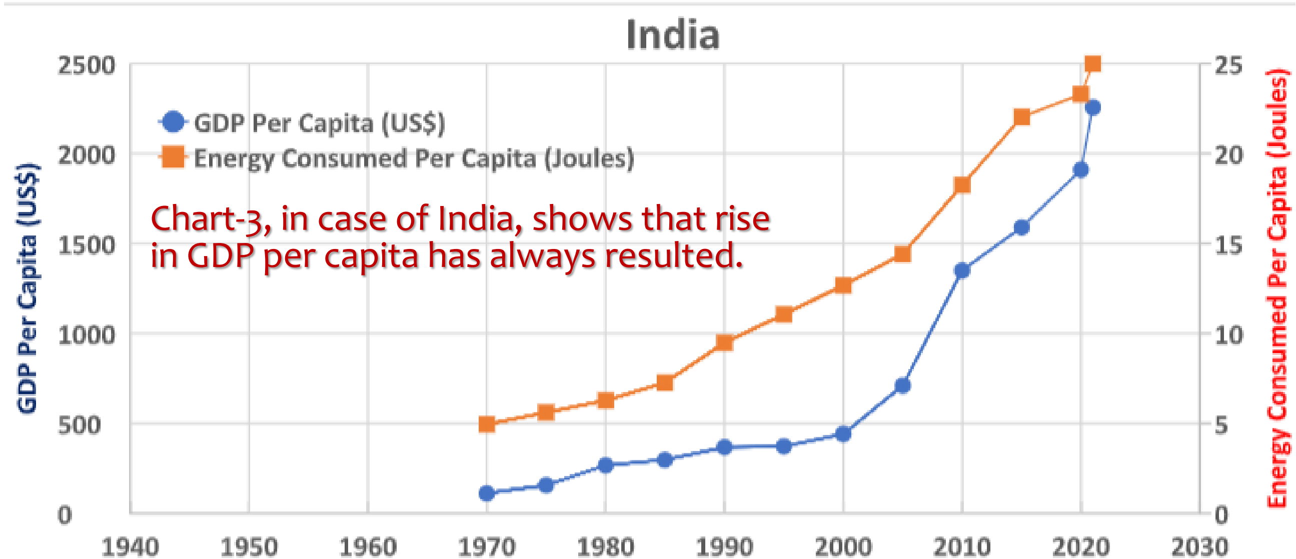


Chart - 3: GDP Per Capita (US$) ; Energy Consumed Per Capita (Joules) – India

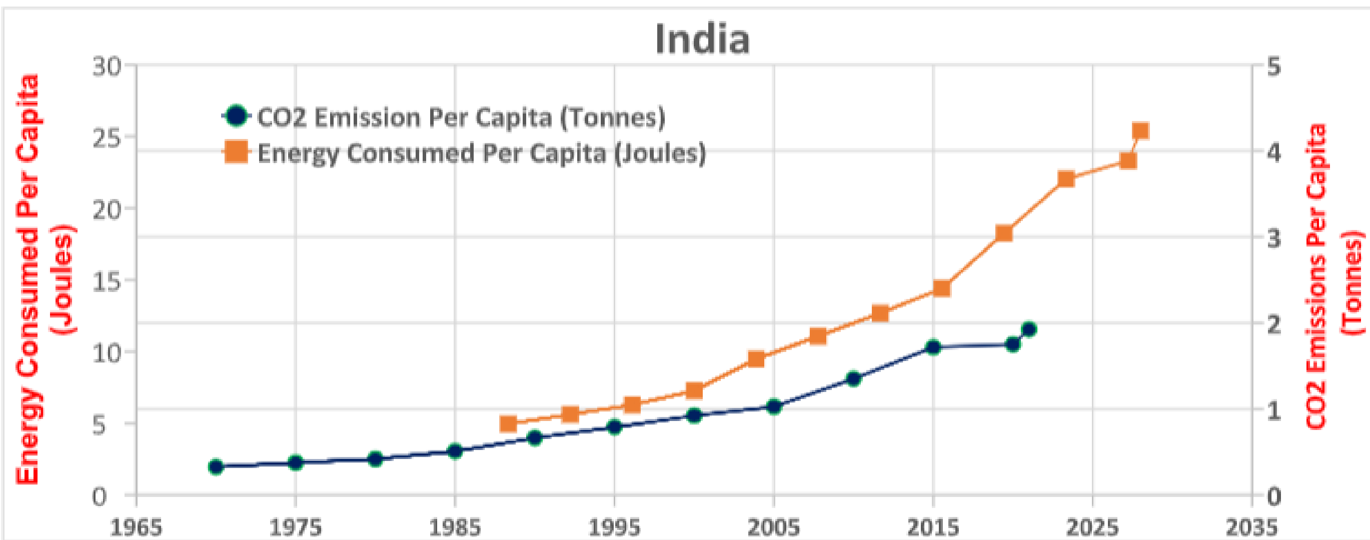


Chart - 4: Energy Consumed Per Capita (Joules) ; CO_2 Emission Per Capita (Tonnes) - India

https://energy.economictimes.indiatimes.com/news/renewable/relationship-between-gdp-growth-energy-consumption-andco2emissions-a-comprehensiveanalysis/104321989

Table 8.2: Per-Capita Energy Consumption and Energy Intensity

GoI, Ministry of Statistics and Program Implementation National Statistical Office https://www.mospi.gov.in/

Year	Energy Consumption in petajoules	Mid year population (in Thousands) *	GDP at 2011-12 prices (Rs. crore) **	Per Capita Energy Consumption (in Megajoules)	Energy Intensity (Megajoules per rupee)
2011-12	24,121	12,20,171	87,36,329	19,769	0.2761
2012-13	25,805	12,36,220	92,13,017	20,874	0.2801
2013-14	26,302	12,52,267	98,01,370	21,003	0.2683
2014-15	27,841	12,68,310	1,05,27,674	21,951	0.2645
2015-16	28,665	12,84,350	1,13,69,493	22,319	0.2521
2016-17	29,556	12,99,434	1,23,08,193	22,745	0.2401
2017-18	31,153	13,13,815	1,31,44,582	23,712	0.2370
2018-19	32,805	13,28,206	1,39,92,914	24,699	0.2344
2019-20	32,729	13,42,586	1,45,34,641	24,378	0.2252
2020-21	30,354	13,56,980	1,36,87,118	22,369	0.2218
2021-22 (P)	33,508	13,70,311	1,49,25,840	24,453	0.2245
Growth rate of 2021-22 (P) over 2020-21(%)	**10.39**	**0.98**	**9.05**	**9.32**	**1.23**
CAGR 2012-13 to 2021-22 (P) (%)	**2.94**	**1.15**	**5.51**	**1.77**	**-2.43**

(P): Provisional

Energy Intensity=Amount of energy consumed for producing one unit of Gross Domestic Product.

** Mid-Year (as on 1st October) population has been taken from Population Projections for India and states 2011 – 2036 ; Report of the Technical Group On Population Projections , July, 2020*

** GDP estimates are at base 2011-12 price as per the National Accounts Divisions's, NSO, MoSPI.

Table 8.2: Per-Capita Energy Consumption and Energy Intensity					
Year	**Energy Consumption in petajoules**	**Mid year population (in Thousands) ***	**GDP at 2011-12 prices (Rs. crore) ****	**Per Capita Energy Consumption (in Megajoules)**	**Energy Intensity (Megajoules per rupee)**
2013-14	26,822	12,52,267	98,01,370	21,419	0.2737
2014-15	28,453	12,68,310	1,05,27,674	22,434	0.2703
2015-16	29,063	12,84,350	1,13,69,493	22,629	0.2556
2016-17	29,713	12,99,434	1,23,08,193	22,866	0.2414
2017-18	30,966	13,13,815	1,31,44,582	23,569	0.2356
2018-19	32,712	13,28,206	1,39,92,914	24,629	0.2338
2019-20	32,548	13,42,586	1,45,34,641	24,243	0.2239
2020-21	29,807	13,56,980	1,36,94,869	21,965	0.2176
2021-22	33,018	13,70,311	1,50,21,846	24,095	0.2198
2022-23(P)	35,159	13,82,894	1,60,71,429	25,424	0.2188
Growth rate of 2022-23 over 2021-22 (%)	**6.48**	**0.92**	**6.99**	**5.52**	**-0.47**
CAGR 2013-14 to 2022-23 (P) (%)	**3.05**	**1.11**	**5.65**	**1.92**	**-2.46**

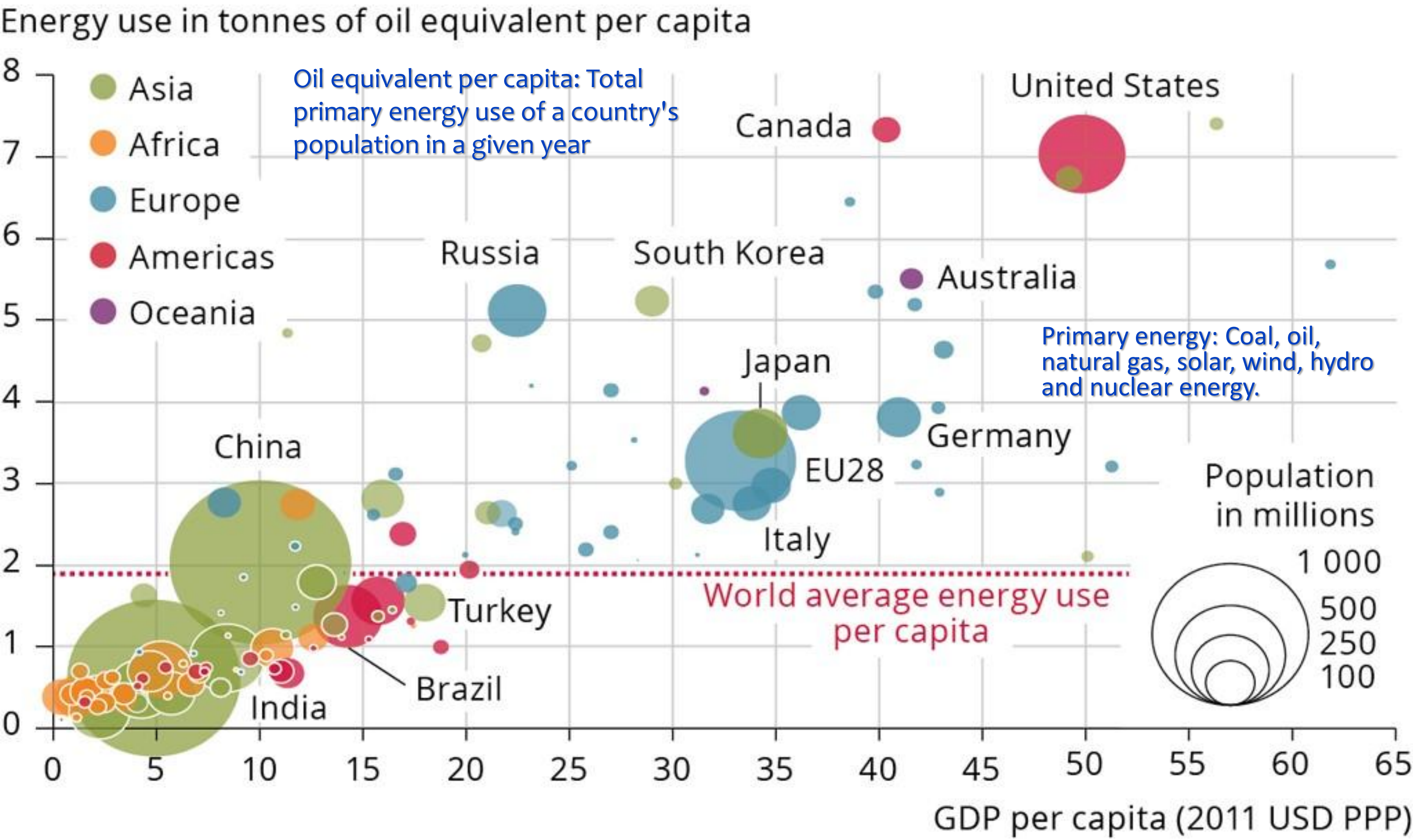
P: Provisional

Energy Intensity=Amount of energy consumed for producing one unit of Gross Domestic Product.

* *Mid-Year (as on 1st October) population has been taken from Population Projections for India and states 2011 – 2036; Report of the Technical Group On Population Projections, July, 2020*

** GDP estimates are at base 2011-12 price as per the National Accounts Divisions's, NSO, MoSPI.

https://www.mospi.gov.in/sites/default/files/publication_reports/EnergyStatistics_India_publication_2024N.pdf

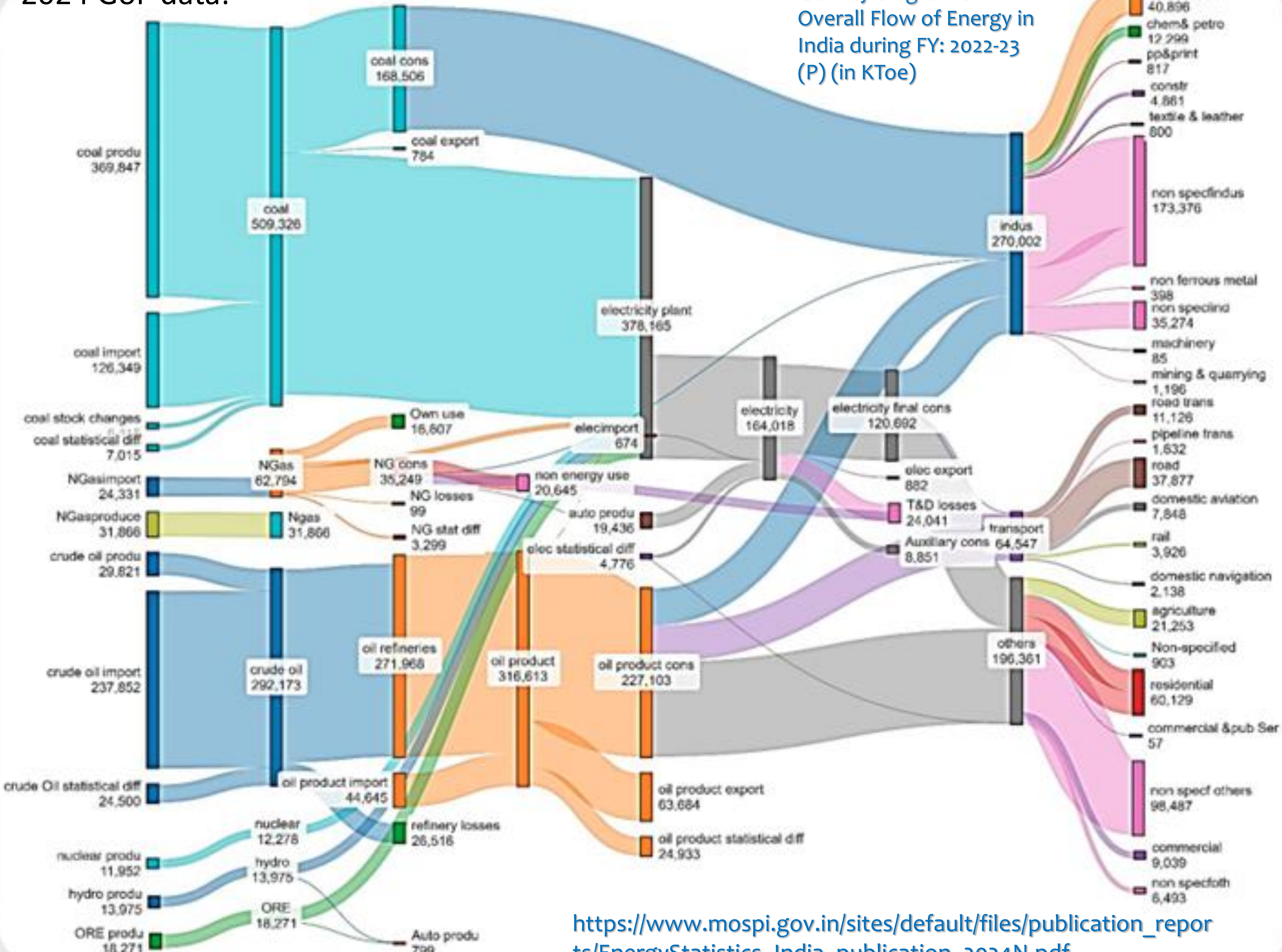


World Bank Data Catalogue: http://data.worldbank.org/summary-terms-of-use
The graph shows per capita energy consumption (kg oil equivalent) vs. per capita GDP, PPP (current international $). Size of the bubbles: total population per country. All values refer to the year 2011.

https://www.eea.europa.eu/data-and-maps/figures/correlation-of-per-capita-energy

2024 GoI data:

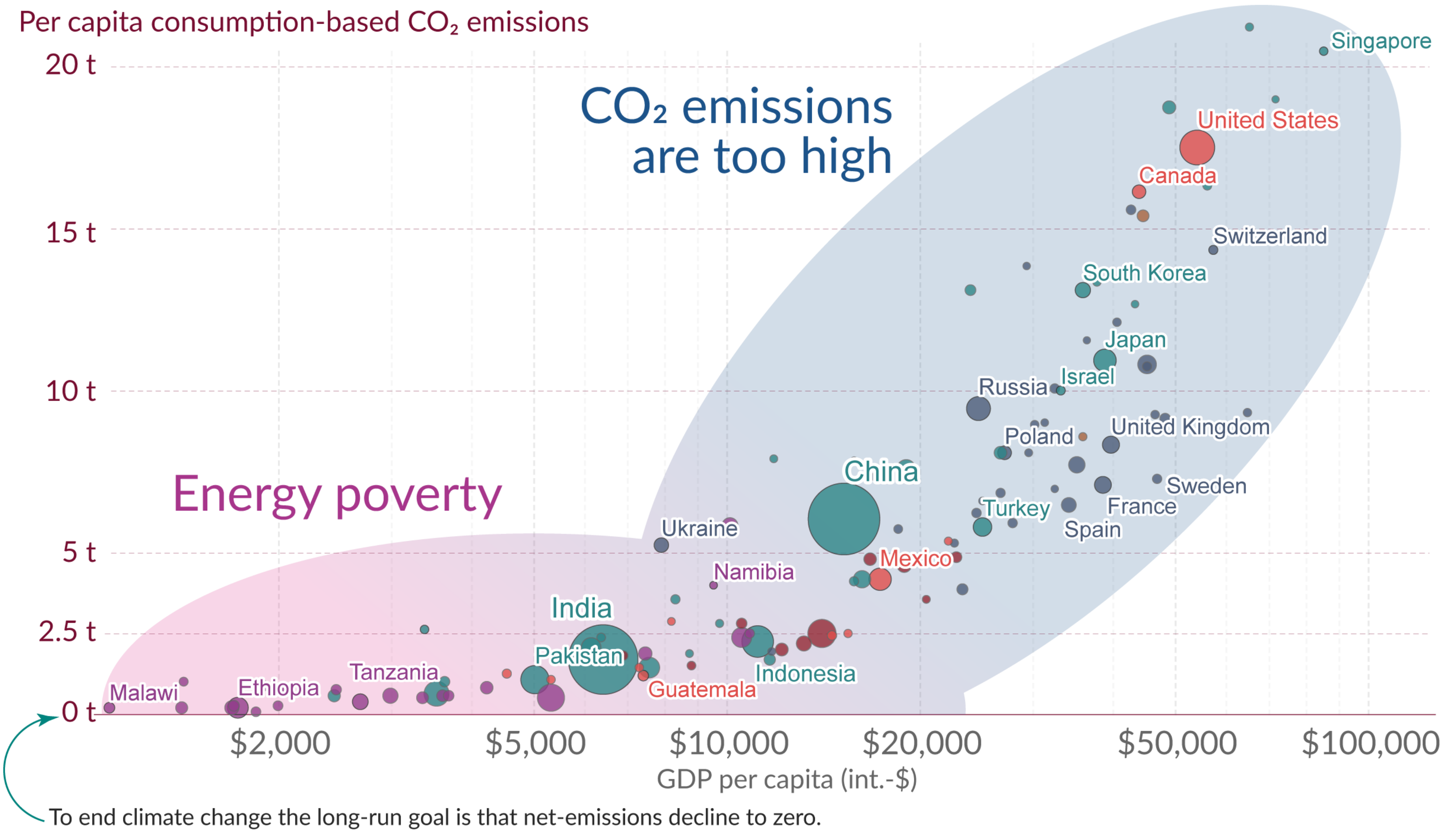
Sankey Diagram on Overall Flow of Energy in India during FY: 2022-23 (P) (in KToe)



https://www.mospi.gov.in/sites/default/files/publication_reports/EnergyStatistics_India_publication_2024N.pdf

CO_2 emissions per capita vs GDP per capita

Our World in Data



To end climate change the long-run goal is that net-emissions decline to zero.

Data for 2017: Global Carbon Project, UN Population, and World Bank.

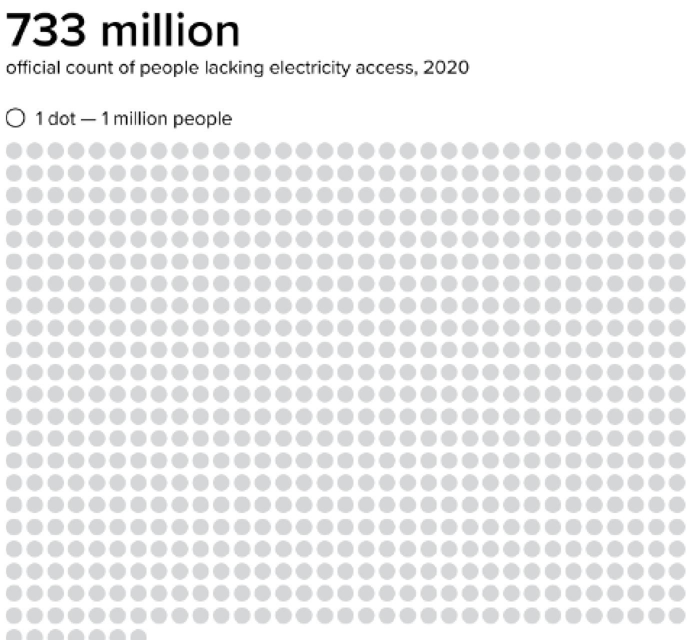
OurWorldinData.org – Research and data to make progress against the world's largest problems.

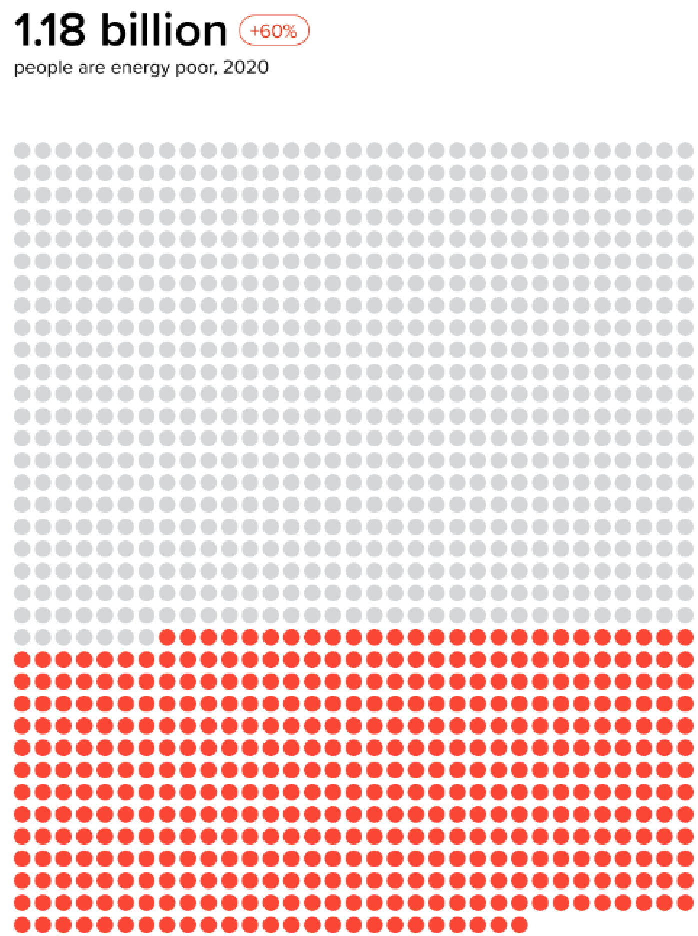
Our challenge: find large-scale energy alternatives to fossil fuels that are affordable, safe and sustainable

Energy poverty is a lack of adequate, reliable, and affordable energy for lighting, cooking, heating, and other daily activities necessary for welfare and economic development.

Without consistent access to reliable and affordable energy, even those in electrified areas miss out on the many benefits of electricity.

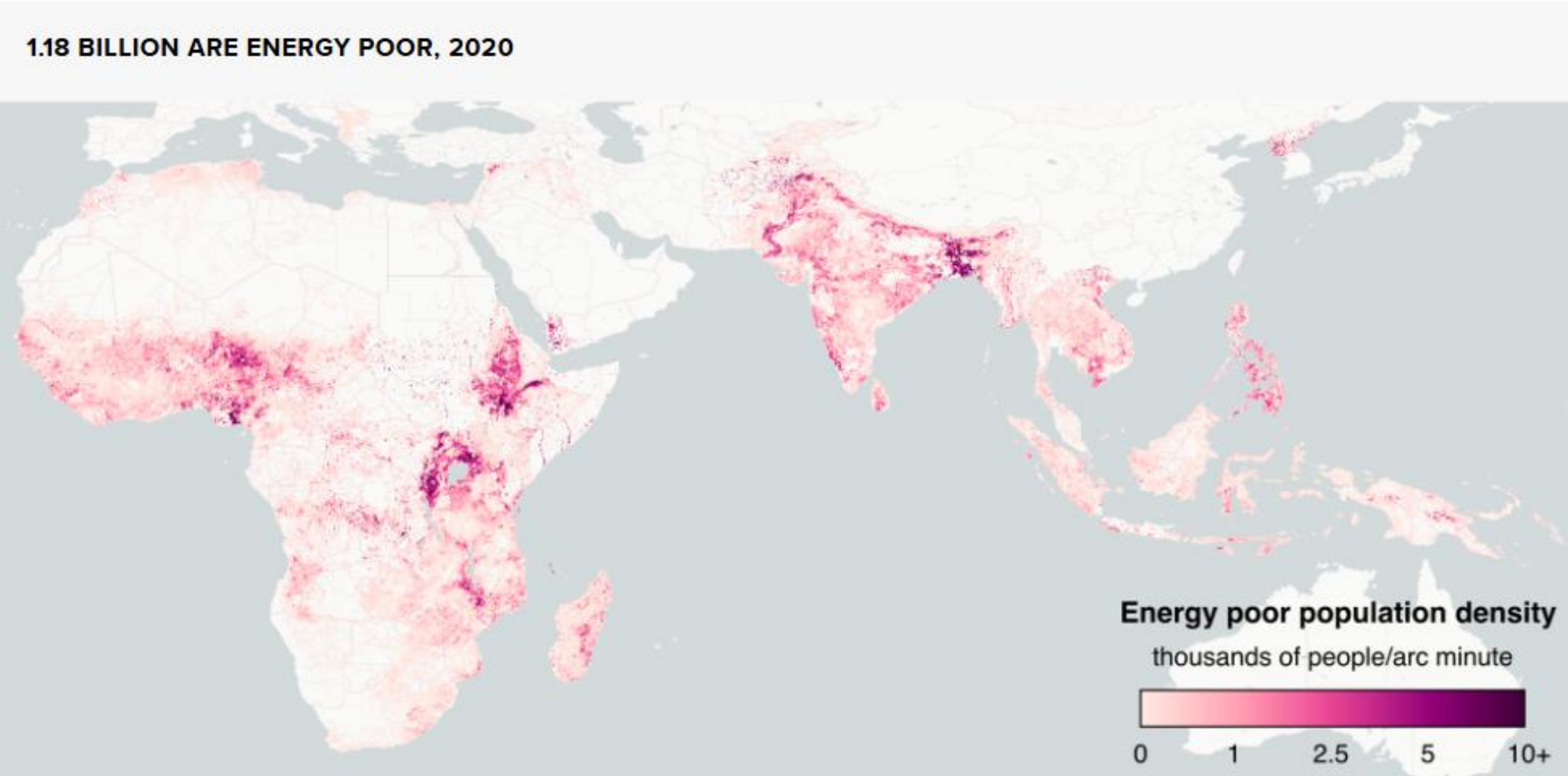
Consequences of energy poverty: Poor HDI





~ 1.18 billion are energy-poor, 60% higher than the 733 million people who lack any electricity connection at all in 2020.

https://data.undp.org/blog/1-18-billion-around-the-world-in-energy-poverty



Leveraging recent advances in satellite image analysis, we provide the first computational classifications of electricity poverty across the developing world, combining high-resolution nighttime and daytime satellite imagery to evaluate light output signatures across up to 3,000 nights overall human settlements in the developing world.

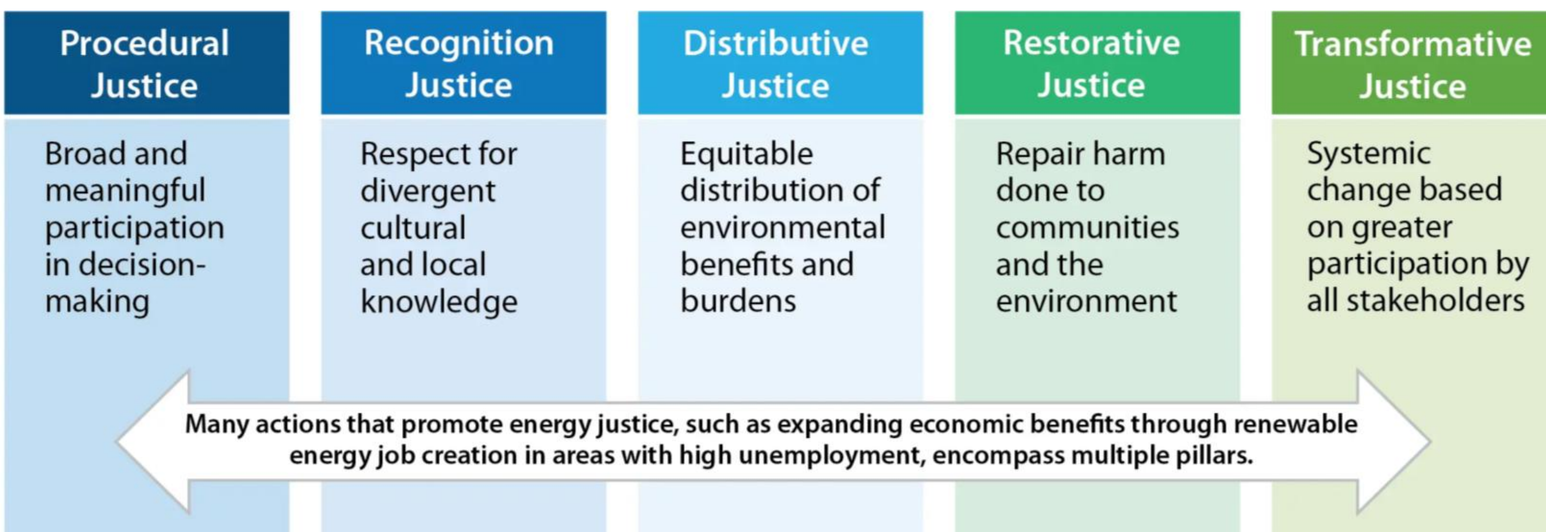
https://data.undp.org/blog/1-18-billion-around-the-world-in-energy-poverty
Joule (2024), https://doi.org/10.1016/j.joule.2024.05.001

Energy justice is commonly defined as an energy system that fairly distributes both the benefits and burdens of energy activities and contributes to more representative, inclusive, and impartial energy decision-making.

Energy justice builds on the environmental justice movement to address the inequities that stem from energy systems and related extractive economies that span multiple sectors. These inequities are associated with different commonly invoked energy justice tenets: procedural, distributional, and recognitional.

What are the pillars of energy justice?

For energy justice to become a reality across the globe, the energy sector must embrace the five pillars of social justice, which are human rights, equal access, meaningful participation by all, equity, and diversity in opinions and leadership.



https://pr100.gov/about/energy-justice

Energy as a Human Right:

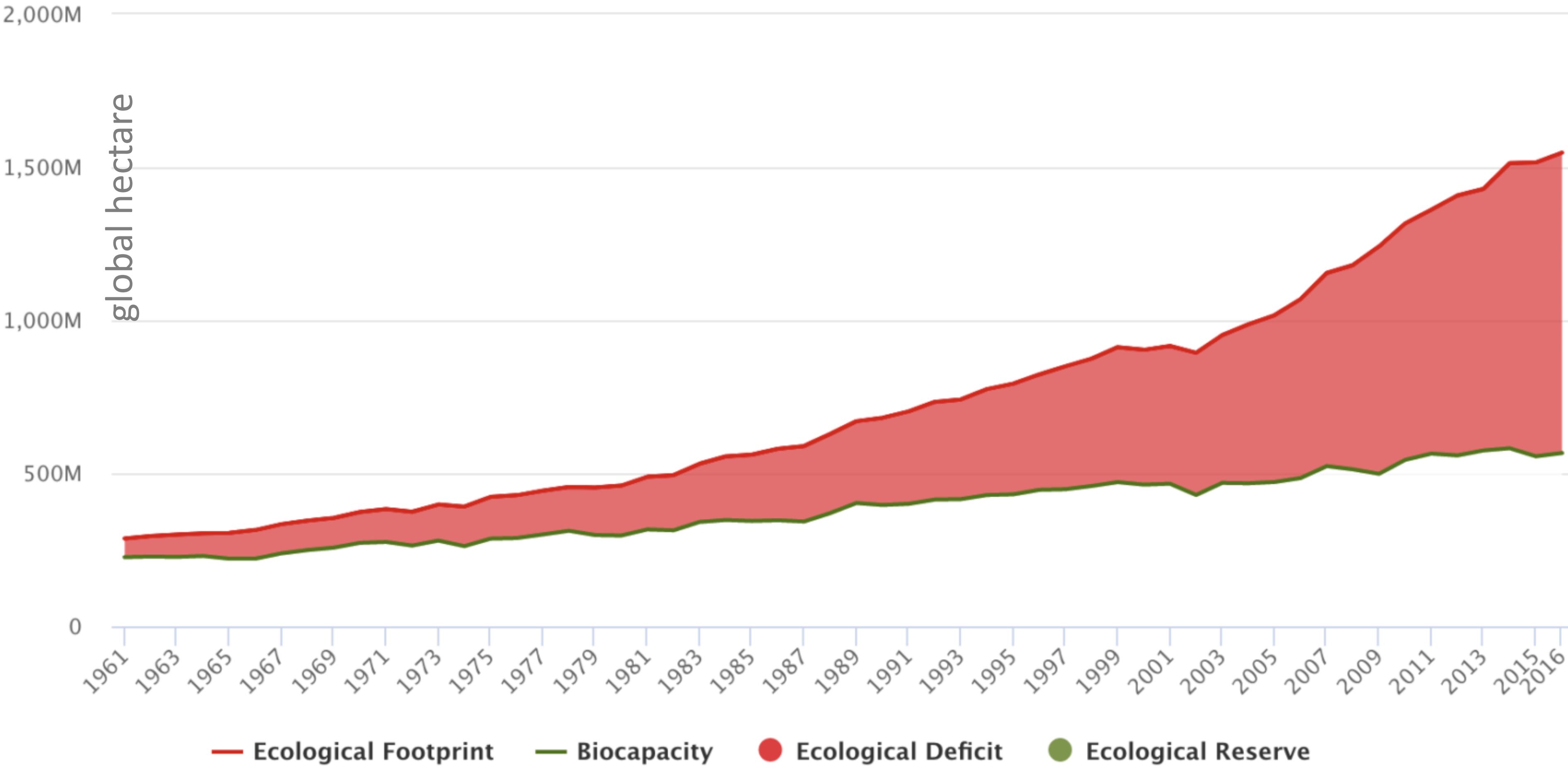
Electricity consumption is closely and positively related to global economic and HDI across different geographical, social, and cultural contexts. The seventh goal (SDG 7) aims to ensure access to affordable, reliable, sustainable, and modern energy for all. Despite these, access to electricity is not explicitly recognized as a universal human right.

While not legally binding, the 17 goals of SDGs have multiple links to human rights law and explicitly 'seek to realize the human rights of all'. Access to energy is not codified in human rights law (like the right to life, for example), it can be a prerequisite for the enjoyment of other human rights (such as the right to life, among other rights). It is a derivative human right entirely reliant on its links with existing human rights obligations enshrined in international human rights law.

https://blogs.ethz.ch/energy/human-rights/

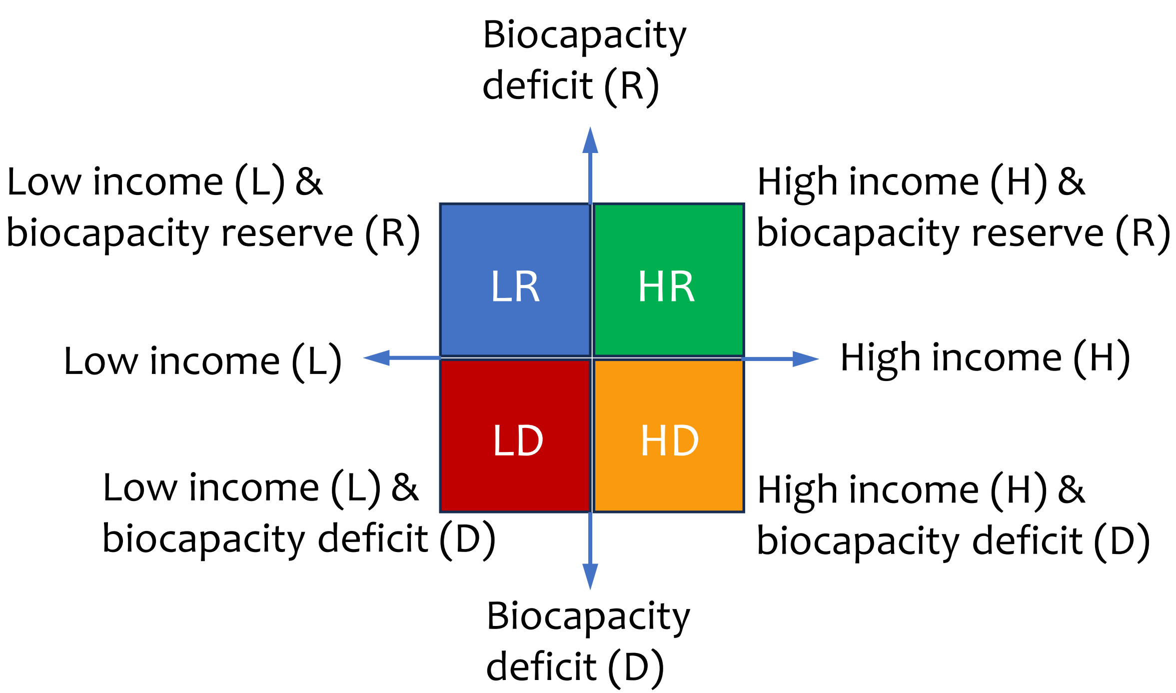
The global hectare (gha) is a measurement unit for the ecological footprint of people or activities and the biocapacity of the earth or its regions.

In 2016, India's per capita biocapacity stood at 0.4 gha (global hectares), but its ecological footprint per person stood at 1.2 gha, meaning that if all the bioresources needed for India have to be found within India, the country's area should increase 2.5 times. What is worrying is that the per capita biocapacity has declined 20 pc in the past 55 years, from 0.5 gha in 1961 to 0.4 gha in 2016.



As humanity's demand on natural resources is increasingly exceeding Earth's biological rate of regeneration, environmental deterioration such as greenhouse gas accumulation in the atmosphere, ocean acidification and groundwater depletion is accelerating. As a result, the capacity of ecosystems to renew biomass, herein referred to as 'biocapacity', is becoming the material bottleneck for the human economy. Yet, economic development theory and practice continue to underplay the importance of natural resources, most notably biological ones.

Nature Sustainability, 2021, 4, 731–738

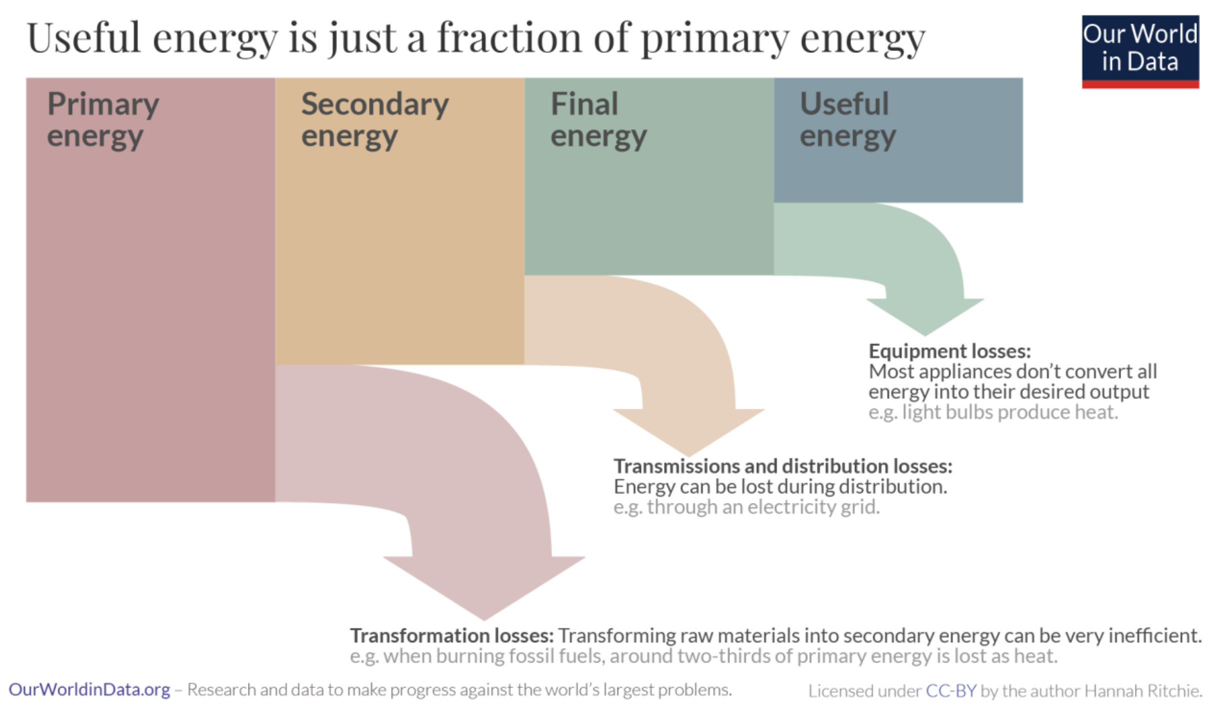


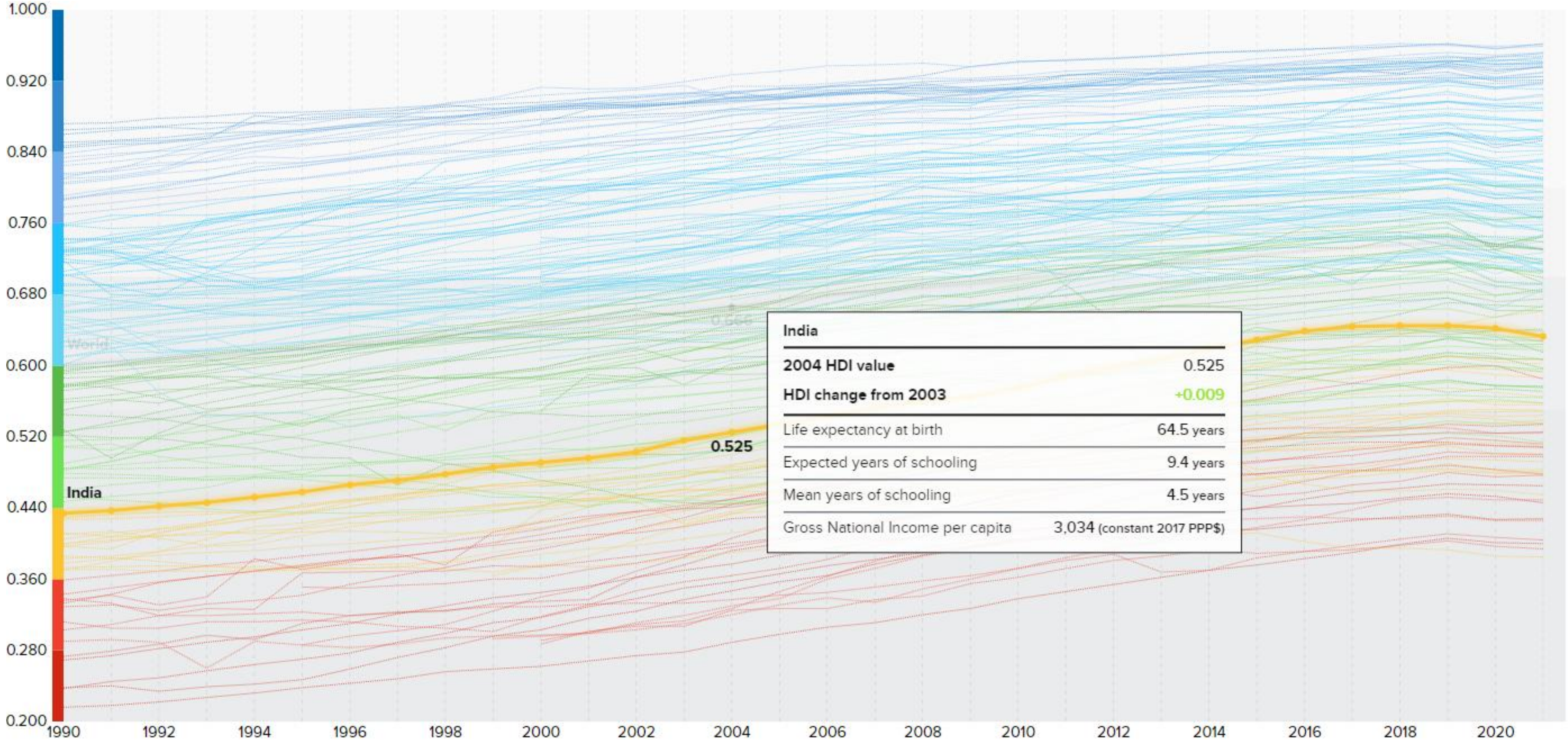
Primary energy: Primary energy is the energy that is available as resources.

Secondary energy: When we convert primary energy into a transportable form we speak of secondary energy.

Final energy: Once we've transported secondary energy *to the consumer* we have final energy. Final energy is what a consumer buys and receives, such as electricity in their home; heating; or petrol at the fuel pump.

Useful energy: This is the last step. It is the energy that goes towards the desired output of the end-use application.





HDI value of 0.9 by 2070: HDI of a nation is positively correlated with its energy consumption. The final energy requirement will be more than a three-fold rise from the current consumption. About 30–40% of the final energy may be consumed in the form of hydrogen, whereas the rest will be used directly as electricity. Rapid infrastructure creation for high development and extensive digitalization may require an additional 4400–4800 TWh/yr in the initial phases of rapid growth.

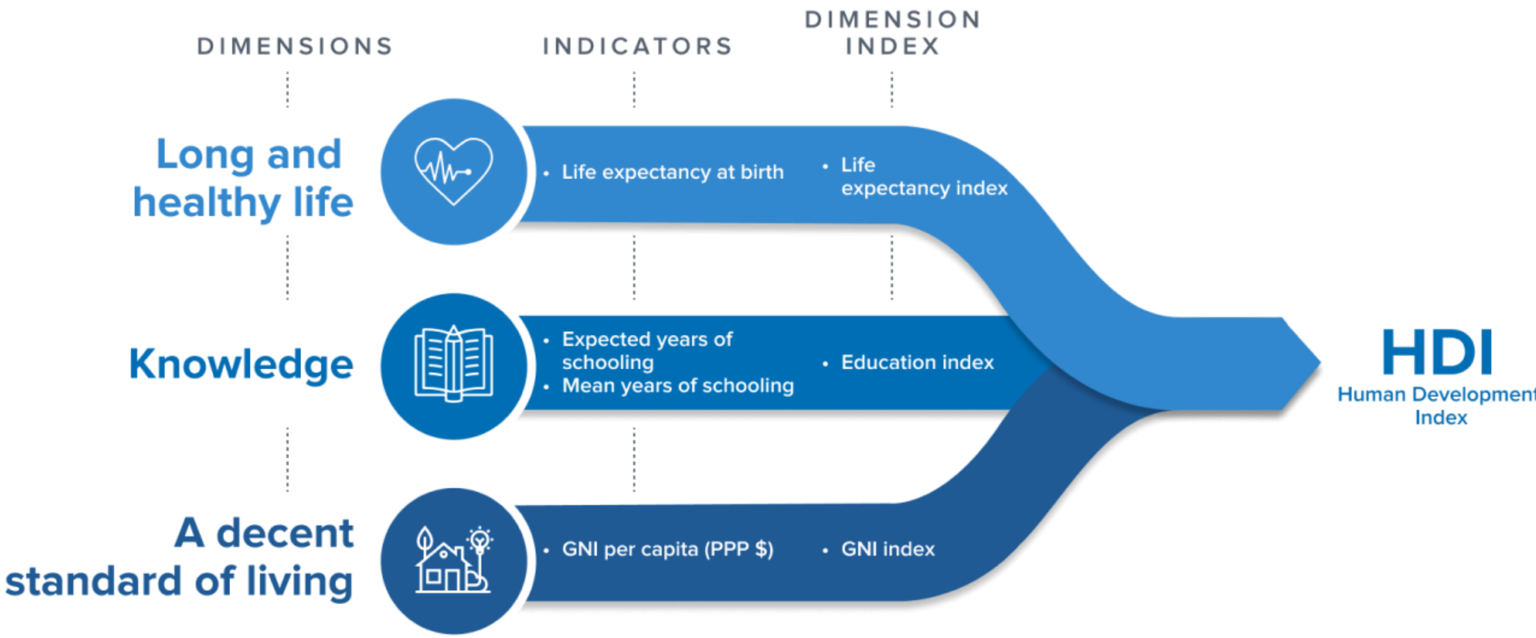
[Current Sci. 2022, 122, 5, 517]

GDP: $3.95 trillion (2024 est.);
GDP per capita: $2,698 (2024 est.)

India	
2021 HDI value	0.633
HDI change from 2020	-0.009
Life expectancy at birth	67.2 years
Expected years of schooling	11.9 years
Mean years of schooling	6.7 years
Gross National Income per capita	6,590 (constant 2017 PPP$)

HDI

HDI Dimensions and Indicators



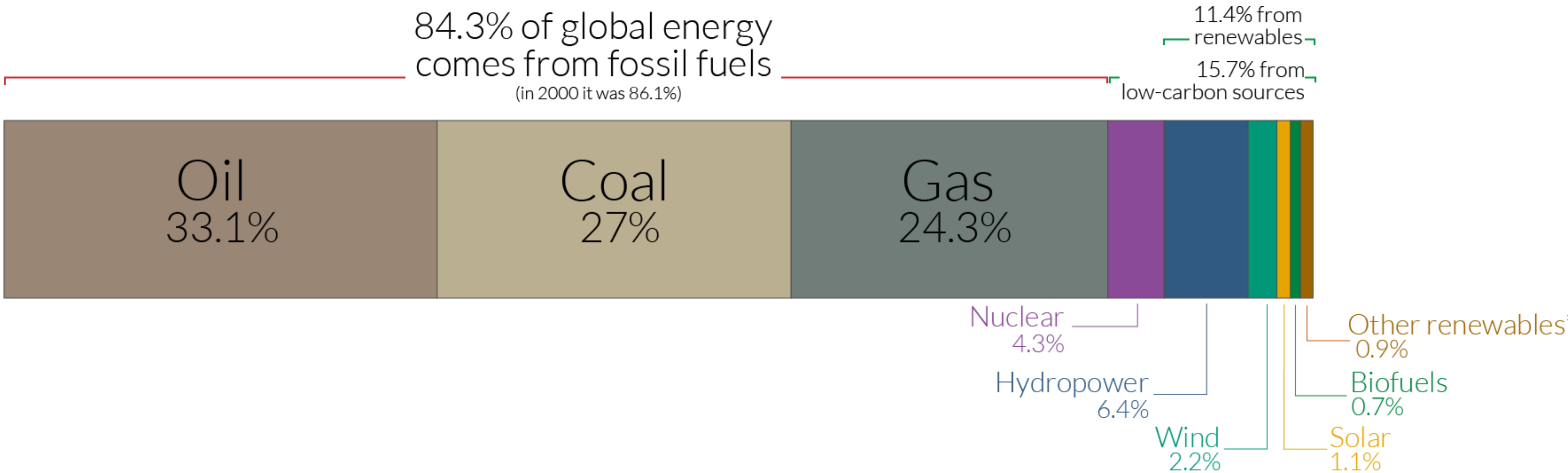
Energy consumption by source, World

Primary energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor (the 'substitution' method) has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.

Our World in Data

Global primary energy consumption by source

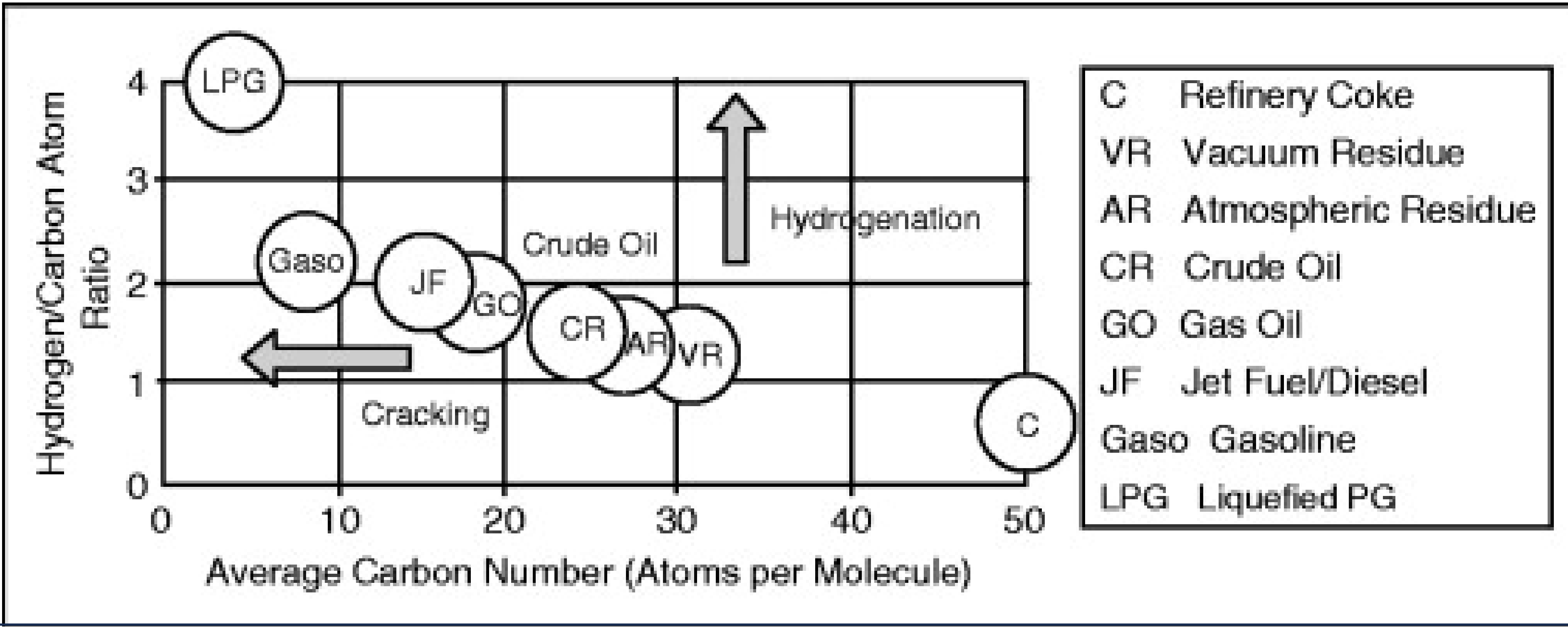
The breakdown of primary energy is shown based on the ‘substitution’ method which takes account of inefficiencies in energy production from fossil fuels. This is based on global energy for 2019.



*'Other renewables' includes geothermal, biomass, wave and tidal. It does not include traditional biomass which can be a key energy source in lower income settings.

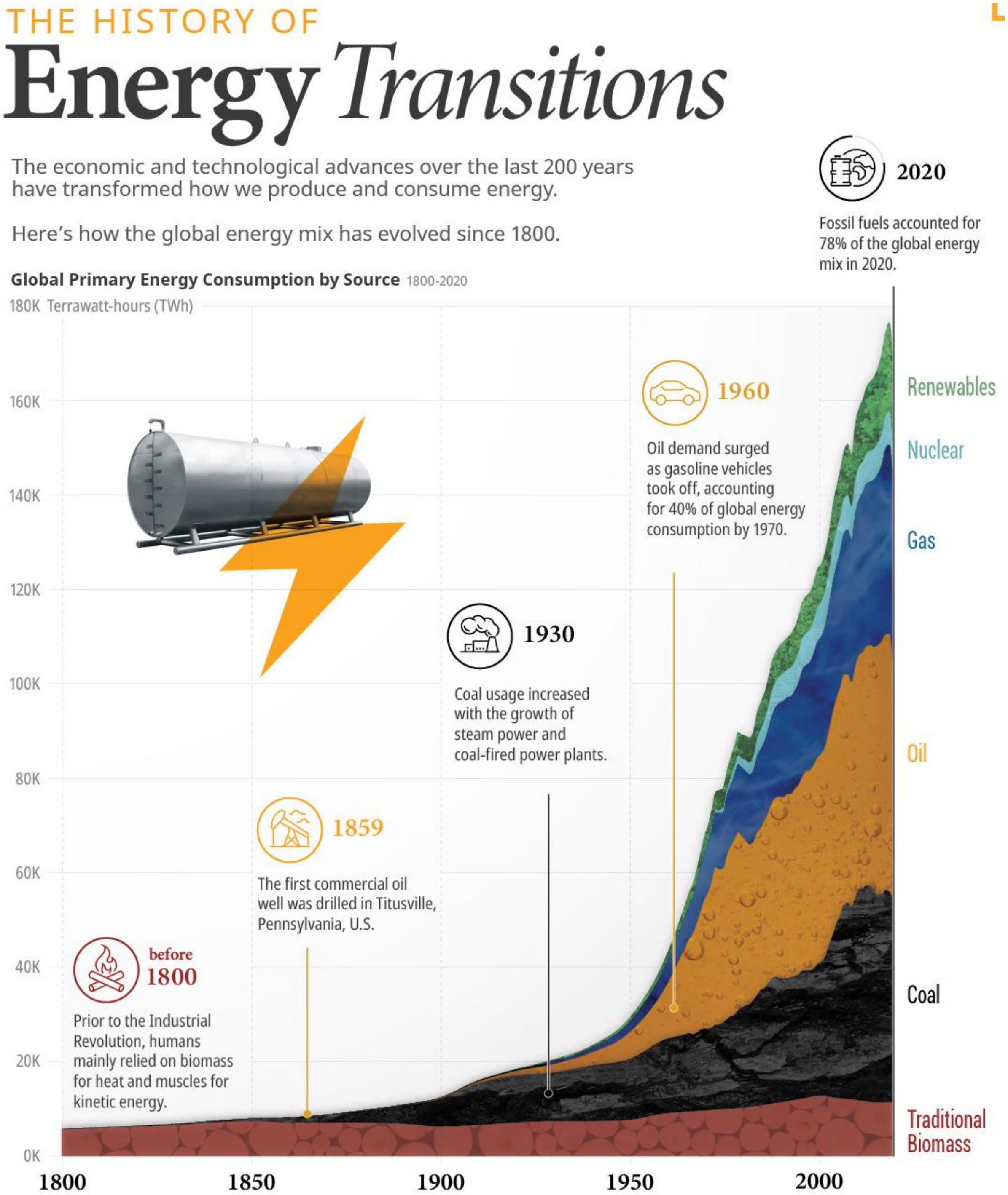
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Source: Our World in Data based on BP Statistical Review of World Energy (2020).



Hydrogen/Carbon Atom Ratio
Average Carbon Number (Atoms per Molecule)
LPG
Gaso
JF
GO
CR
AR
VR
C
Crude Oil
Hydrogenation
Cracking
C Refinery Coke
VR Vacuum Residue
AR Atmospheric Residue
CR Crude Oil
GO Gas Oil
JF Jet Fuel/Diesel
Gaso Gasoline
LPG Liquefied PG

Visualizing the History of Energy Transitions



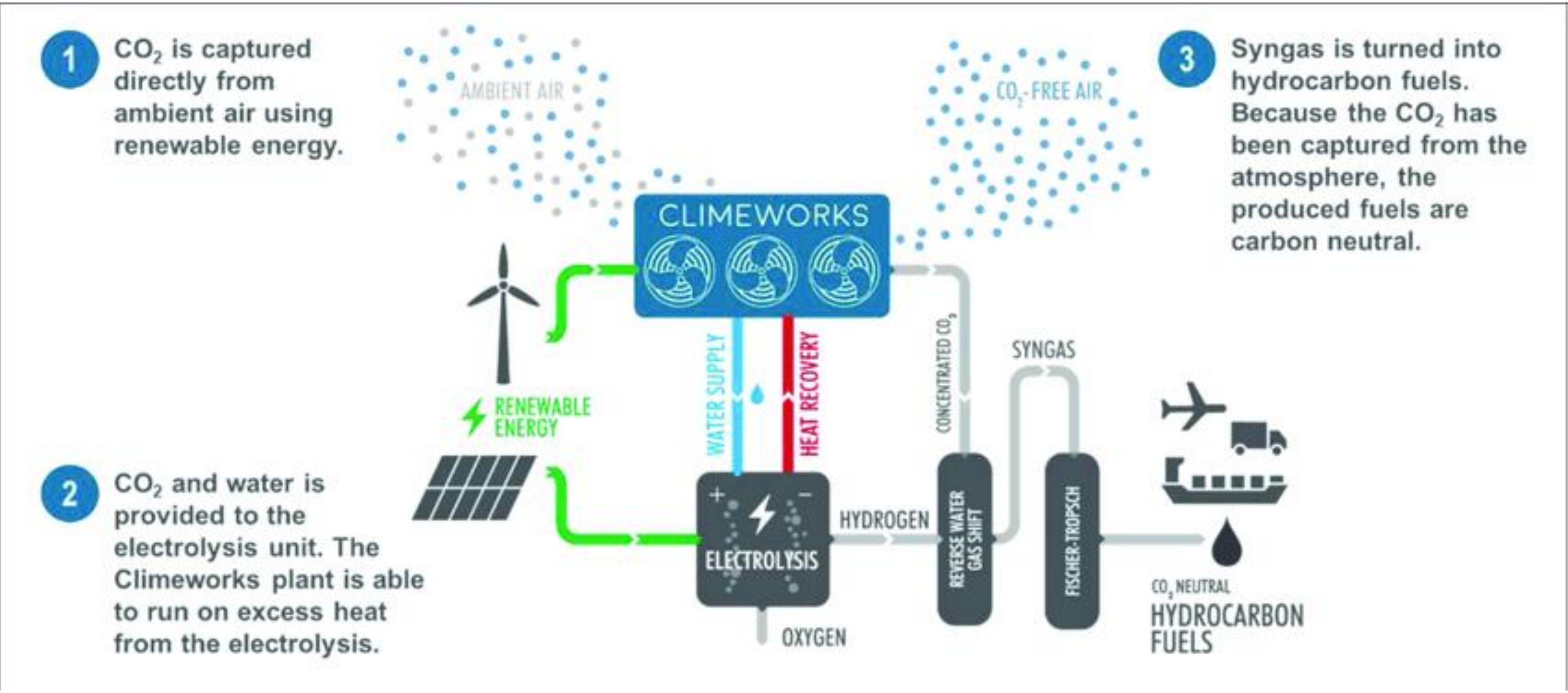
Demand and technological innovations are the biggest drivers of these shifts, and they are playing a key role in the current move towards cleaner energy.

- Coal as fuel contributes to ~ 50% of the electricity generation in India. Coal is more abundant than oil and coal reserves are far more abundant than oil reserves in this world.
- Coal burning enhances the CO_2 footprint. Burning coal results in NOx and SOx, heavy metals (such as Hg), and radioactive metals, which need to be cleaned. Apart from these coal burning adds to a significant amount of ash.
- This is why we need clean coal technology.

Mercury in coal is released to flue gases in the form of Hg^0 during combustion in a thermal power plant. Decreasing temperature from over 800°C to below 300°C in flue gases leaving boilers or furnaces promotes oxidation of Hg^0 to gaseous Hg^{2+}, with a portion of Hg^{2+} adsorbed onto fly ash to form particulate-bound mercury (Hg_p)

The overall trend is not on track with the Net Zero Emissions by 2050 Scenario, which calls for immediate reductions and a global decline in unabated coal-fired generation of around 55% by 2030 compared to 2022 levels, and a complete phase-out by 2040. About 70% of world steel production depends on coal feedstock. Coal is the world's most abundant and widely distributed fossil fuel source.

The world's first commercial plant for direct air capture of CO_2 is located in Hinwil, Switzerland @ 2017. In recent years Direct Air Capture (DAC) has established itself as a promising approach to atmospheric Carbon Dioxide Removal (CDR) also referred to as Negative Emissions.

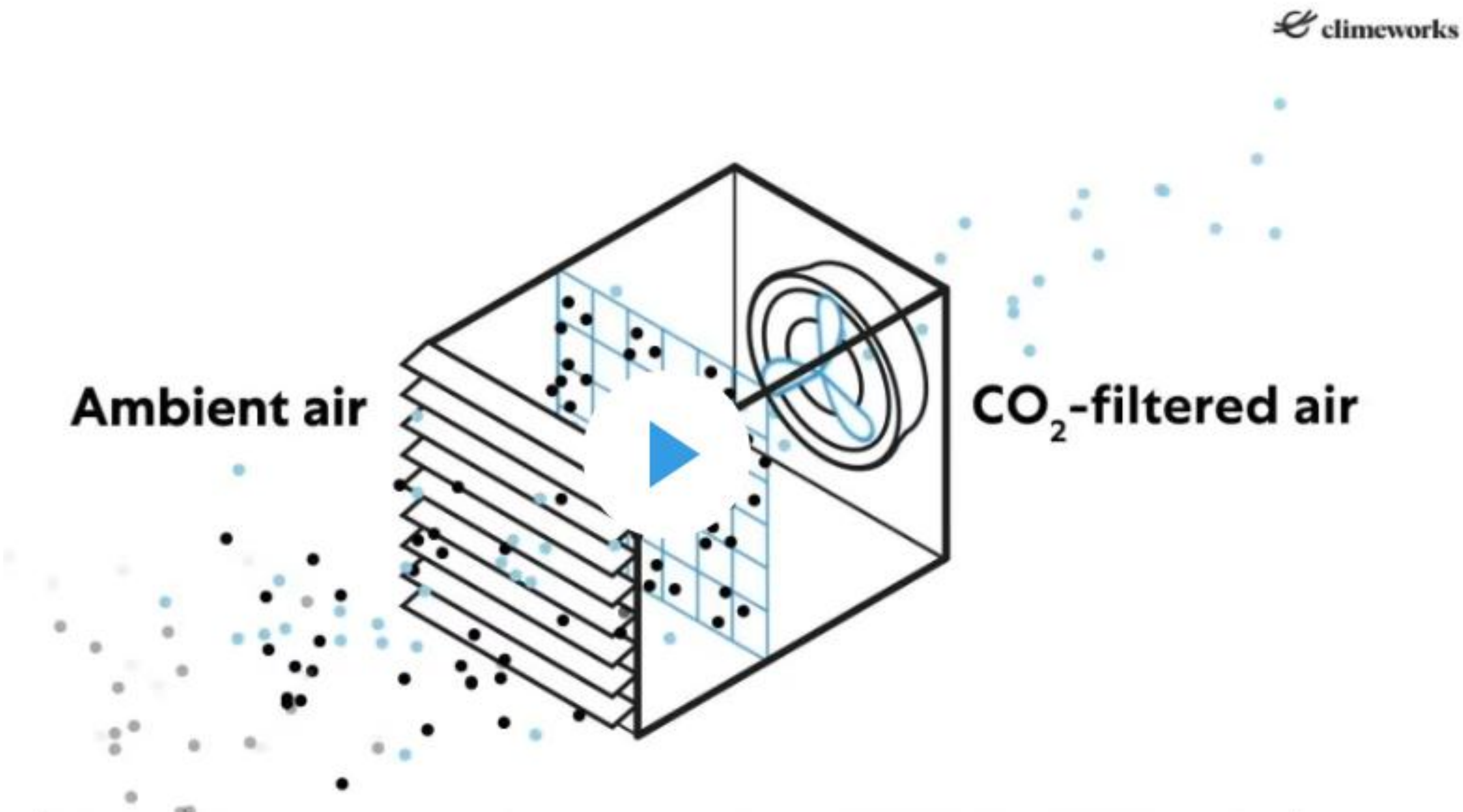


Reverse water gas shift (RWGS)

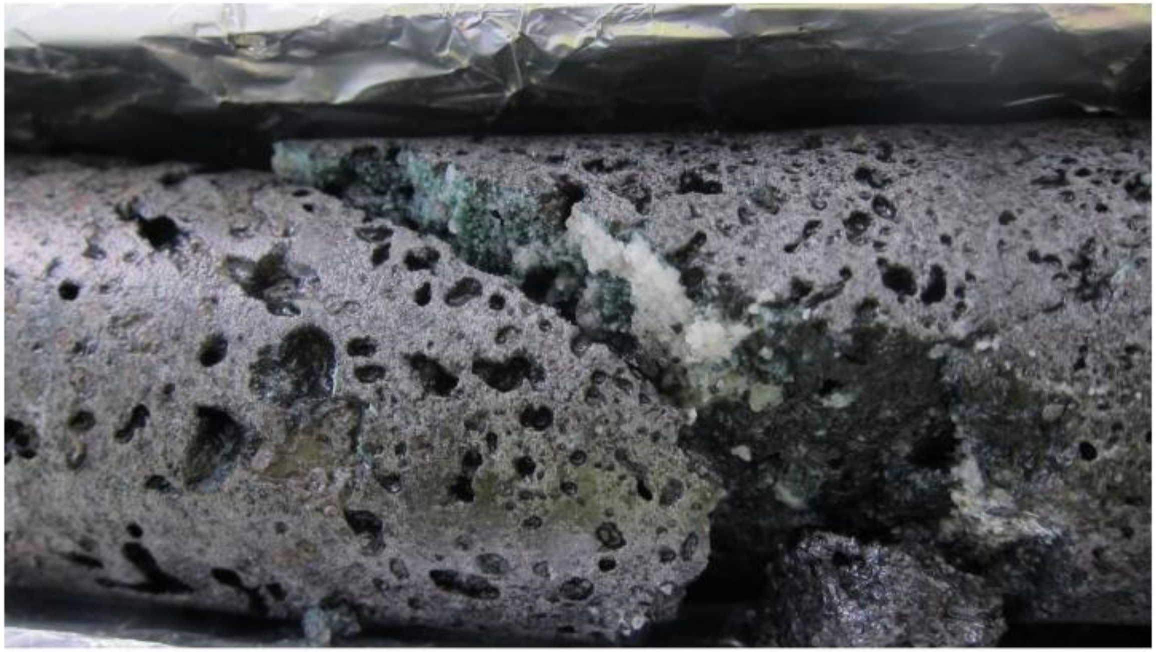
$CO_2 + H_2 \leftrightarrow CO + H_2O \quad \Delta H^0 = 42.1 \text{ kJ mol}^{-1}$ (1)

CO_2 methanation (CDM) : $CO_2 + 4H_2 \leftrightarrow CH_4 + 2H_2O \quad \Delta H^0 = -165 \text{ kJ mol}^{-1}$ (2)

CO methanation (CMM): $CO + 3H_2 \leftrightarrow CH_4 + H_2O \quad \Delta H^0 = -206 \text{ kJ mol}^{-1}$



The air is drawn into a collector with a fan, and CO_2 is captured on the surface of a highly selective filter material that sits inside the collector.



One type of geological storage includes injecting carbon dioxide underground into certain types of rock where it is stored permanently. This rock core, from the Carbfix project in Iceland, shows carbonates created from the injected CO_2.

https://www.wri.org/insights/direct-air-capture-resource-considerations-and-costs-carbon-removal

Status of the Leading DAC Companies

	Cimeworks	Carbon Engineering	Global Thermostat
Location	Switzerland	Canada	United States
System type	Solid sorbent	Liquid solvent	Solid sorbent
Thermal energy needs	80-120°C / 176-248°F	900°C / 1652°F	105-120°C / 221-248°F
Thermal energy source	Non-fossil energy resources (geothermal, waste heat, etc.)	Natural gas with CCS	Energy resource agnostic
Projects	15 plants around Europe with a collective capacity of just under 6,000 tCO_2/yr	Pilot plant in Canada; developing 1 $MtCO_2$/yr capacity plant in Southwest United States	2 plants in the United States with a collective capacity of 1,500 tCO_2/yr
Investments	Most recent round of funding, in March 2022, reached $650 million	Received $70 million in total investment from governments and corporates	Received investments of $68 million in most recent round of funding in 2019

Source: Climeworks 2022, IEA 2022, McQueen et al. 2021, NASEM 2019, Carbon Engineering 2019, Bipartisan Policy Center 2020

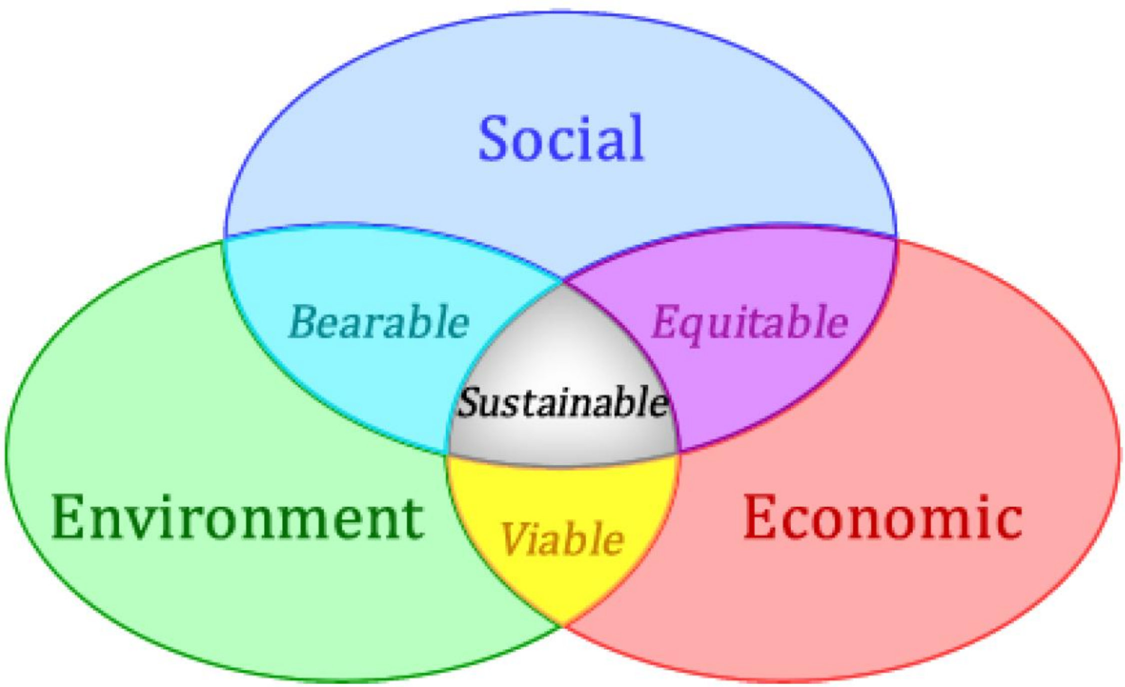
2011.30

WORLD RESOURCES INSTITUTE

World's largest plant capturing carbon from air starts in Iceland @ 2021

The Orca plant, a reference to the Icelandic word for energy, consists of eight large containers similar in looks to those used in the shipping industry, which employ high-tech filters and fans to extract carbon dioxide.

The isolated carbon is then mixed with water and pumped deep underground, where it slowly turns into rock. Both technologies are powered by renewable energy sourced from a nearby geothermal power plant.



CLEANER FUELS IS ONLY ONE OF THE SOLUTIONS

- Electricity is a clean and sustainable fuel only if it is produced from renewable resources.
- If electricity is generated from oil or coal, it increases the carbon load in the environment. This must be considered when we move from internal combustion engines (ICE) to electric vehicles for mobility. ICE allows fuel combustion with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit.

India Specific Goal:

The country's **solar installed capacity** reached 57705.72 MW as of 30 June 2022. **India** has the lowest capital cost per MW globally of **installing solar power** plants.

Renewable energy has a share of 26.53% of India’s installed generation capacity the to total installed generation capacity in India.

Data Source: https://mnre.gov.in/