Is it fair to expect developing countries to reduce greenhouse gas emissions?

V. Ismet Ugursal
Department of Mechanical Engineering, Dalhousie University, Halifax, NS Canada B3H 4R2
Ismet.Ugursal@Dal.Ca

If you cannot understand why someone did something, look at the consequences—and infer the motivation.
Carl G. Jung

Abstract
Using a comparative and critical analysis of economic and developmental data, this paper evaluates the potential consequences of the pressure exerted on developing countries to reduce greenhouse gas emissions. The analysis is extended to the low-income segments of the society in developed countries.

Keywords: Energy consumption, Greenhouse gas emissions, Human development, Wealth, Reduction of greenhouse gas emissions

1. Introduction

In order to avoid the presumed danger of an apocalyptic disaster resulting in global societal collapse and human extinction that will presumably be caused by climate change, which is presumed to be unprecedented in the 4.5 billion year history of the earth, due, presumably, to anthropogenic greenhouse gas (GHG) emissions, primarily carbon dioxide emitted from the combustion of fossil fuels, middle- and low-income developing countries are under intense pressure to reduce their greenhouse gas emissions, switch to renewable energy sources and achieve net-zero energy and GHG emission targets. The pressure is exerted through numerous mechanisms, including trade barriers, that directly affect the already struggling population and economy of these countries.

This paper does not discuss the nature and magnitude of the climate change, or its possible causes, potential consequences and remedies as the scientific literature discussing both sides of the arguments is abundant and comprehensive. The focus of this paper is less contentious, but more immediate as the paper explores the relationships amongst energy consumption, greenhouse gas emissions, development, and the state of the population and the economy. Using a comparative and critical analysis of economic and developmental data, the paper addresses these questions from the perspective of developing countries. The analysis is extended to the low-income and middle-income segments of the society in developed countries as people in those segments are vulnerable in similar ways as people in developing countries.

2. Proposed and legislated climate actions and costs

Influential international organizations widely declare that intensifying climate impacts across the globe require that anthropogenic greenhouse gas emissions must be reduced rapidly to slow and limit global warming to acceptable limits (IEA, 2021; UNEP, 2022). The International Energy Agency (IEA) states that with an unprecedented clean technology push to 2030 and a complete transformation of how energy is produced, transported, and consumed, global carbon dioxide emissions must be reduced to net-zero by 2050 to limit the long-term increase in average global temperatures to 1.5°C (IEA, 2021). The unprecedented clean energy push foreseen by the IEA requires further rapid deployment of available technologies such as installing the world's current largest solar park roughly every day and increasing electric vehicle sales from around 5% of global car sales to more than 60% by 2030, as well as widespread use of technologies that are not on the market yet (IEA, 2021). To achieve the global transformation from a "heavily fossil fuel- and unsustainable land use-dependent economy" to a "low-carbon economy" is expected to require investments of at least US$4–6 trillion a year, which is 20–28 per cent in terms of the additional annual resources to be allocated (UNEP, 2022). The IPCC assesses that global mitigation investments need to increase by a factor of three to six, and even more for developing countries (UNEP, 2022).

These and similar cost estimates are highly conservative and neglectful of the realities of such large scale and complete transition of the energy supply to solar and wind. Amongst the most worrisome realities are the sources of production of solar and wind hardware. In the last decade, effectively 100% of all solar photovoltaic cell production and close to 70%, and increasing, wind turbine production has shifted to China (IEA, 2022; Enerdata, 2024). Thus, the entire world is now almost wholly dependent on a single country for all its solar and wind energy generation needs. In the shock of the first oil crisis in 1973, the world had painfully witnessed the dangers associated with concentrated dependency, albeit at a much smaller scale[*], for energy to a single foreign source, and the urgent need to diversify supply. Similar lessons were delivered to the world several times since then, the latest one delivered to many European countries, especially Germany, due to their dependency on a single foreign source for natural gas. Now, ignoring the lessons of the recent past, the same mistake is being made in larger scale by relying on one country for the entire world supply of PV cells and vast majority of wind turbines, and planning to increase this dependency to much larger scales to "completely decarbonize" the energy supply.

Notwithstanding the single source problem, the cost of supplying the entire or close to the entire energy requirement by electricity produced from solar and wind resources is prohibitively high due to the intermittent (not dispatchable) nature of solar and wind energy that requires large scale storage to cover periods with low or no sun or wind. Consequently, the cost of electricity in a system with 100% or close to 100% solar and wind generation must account for the cost of storage and reflect the full system cost. In a recent study, the Levelized Full System Cost of Electricity (LFSCOE) for five dispatchable technologies (biomass, ultra-supercritical coal, natural gas combined cycle, combustion turbine (CT) and nuclear) was compared with that of wind, utility scale solar PV and an optimal combination of wind and solar for two markets (Germany and Texas) for 100% and 95% coverage (Idel, 2022). The results indicate that the LFSCOE are much higher

[*] In 1973, OPEC member countries were supplying 50% of the world's oil, and oil supplied 50% of the world's energy demand (Energy Institute, 2024).

for wind and solar than for conventional and dispatchable fuels. This is due to the large requirement for storage to overcome wind and solar's intermittency; and even if storage costs drop by 90%, renewables are still not competitive on an LFSCOE basis. If up to 5% of the annual demand can be supplied by a very inexpensive dispatchable source of electricity, thus intermittent renewables need to supply only 95% of the demand, the system costs will be cut in half, but still be prohibitively expensive. This finding indicates that 100% emission-free approaches are not reasonable due to the enormous costs of supplying the last 5%.

On the legislative front, the European Union (EU) announced the European Green Deal (EGD) in 2019, which envisions transforming Europe into the world's first "climate-neutral" continent by 2050 by reducing emissions by at least 55% by 2030 compared to 1990 levels (EC, 2019). One of the tools of the EGD to unilaterally impose its climate mitigation measures on non-EU countries is the Carbon Border Adjustment Mechanism (CBAM), which subjects covered carbon intensive imports to the same carbon price imposed on internal producers under the EU Emission Trading System (EP, 2022). The CBAM allows the EU to unilaterally impose a levy on such imports from countries that do not meet the environmental standards set by the European Union. Debate on the negative spill-over effects of the CBAM for developing and least developed countries has been intense (Ulgen, 2023).

These and similar legislated climate actions foisted upon developing countries and their peoples are without due attention to social or economic justice. Vulnerable populations are and will be increasingly and disproportionately affected by a swift and deep transition to renewables and/or net zero emission scenarios due to consequences such as increased cost of energy to achieve compliance and job losses in traditional industries. As discussed in the next section, these actions will certainly lead to halting and reversing the development of developing countries.

3. Energy consumption, wealth and human development

Poverty, the state of being extremely poor, is the source of greatest prolonged suffering for all living things. The magnitude of poverty, in terms of its depth, breadth, prevalence and persistence, is larger in humans than in any other life form. Poverty deprives the poor from the basic necessities of life - food, water, clothing, shelter and dignity, disallows the poor a decent life, raising healthy children and having hope, and condemns the poor to permanent dependence, subjugation and humiliation.

With the beginning of the post-bartering era due to the expansion of human population as well as trade in geographical reach and variety of goods, the measure of poverty became to be expressed in monetary units. Today, more than 250 years after the industrial revolution, almost half of the entire human population lives on less than US$6.85/day (2017 PPP), a quarter lives on US$3.65/day (2017 PPP), and one in every eleven lives in extreme poverty on less than US$2.15/day (2017 PPP) (WB, 2022).

To reduce, and eventually eradicate poverty, the poor require to have access to more and better food, water, clothing and shelter, and to be able to afford more and better food, water, clothing and shelter, the poor require to have access to more income, which will not only provide for these basic necessities but also will restore their birthright dignity.

Income is related with production. As shown in Figure 1, countries with high income also produce more, both in absolute terms as well as on a per capita basis. Therefore, to increase the income of people in low-income countries, the domestic product of these countries must also increase.

Production requires work, and work requires energy. As shown in Figure 2, countries that produce more, use more energy, both in absolute terms as well as on a per capita basis. Therefore, to increase the production in low-income countries, the energy use in these countries must also increase.

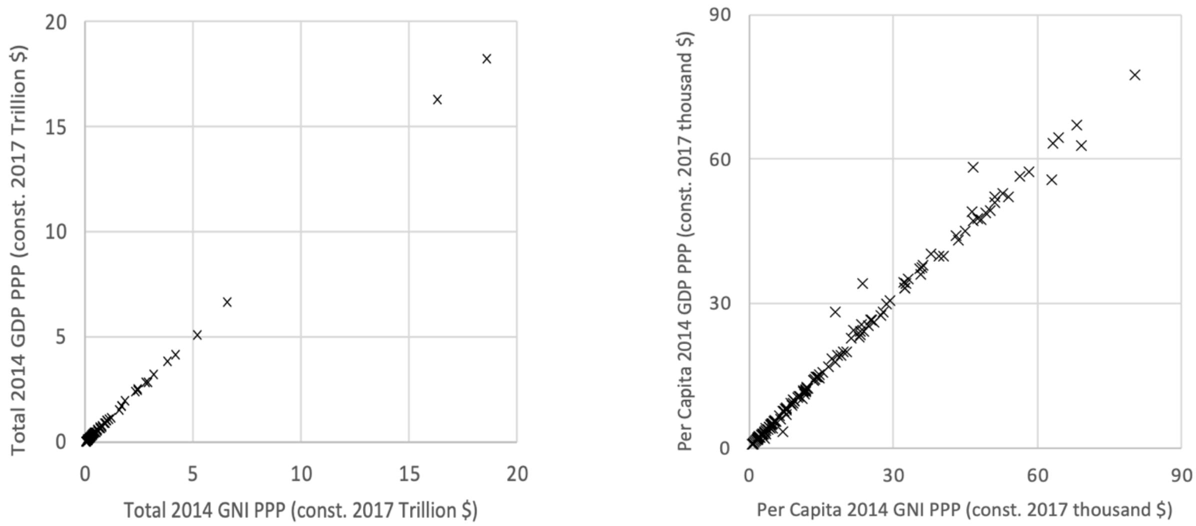

Figure 1. Total and per capita gross national income (GNI) vs. gross domestic product (GDP) of countries in 2014 (PPP constant 2017 \$) (Source of data: WB, 2023)†

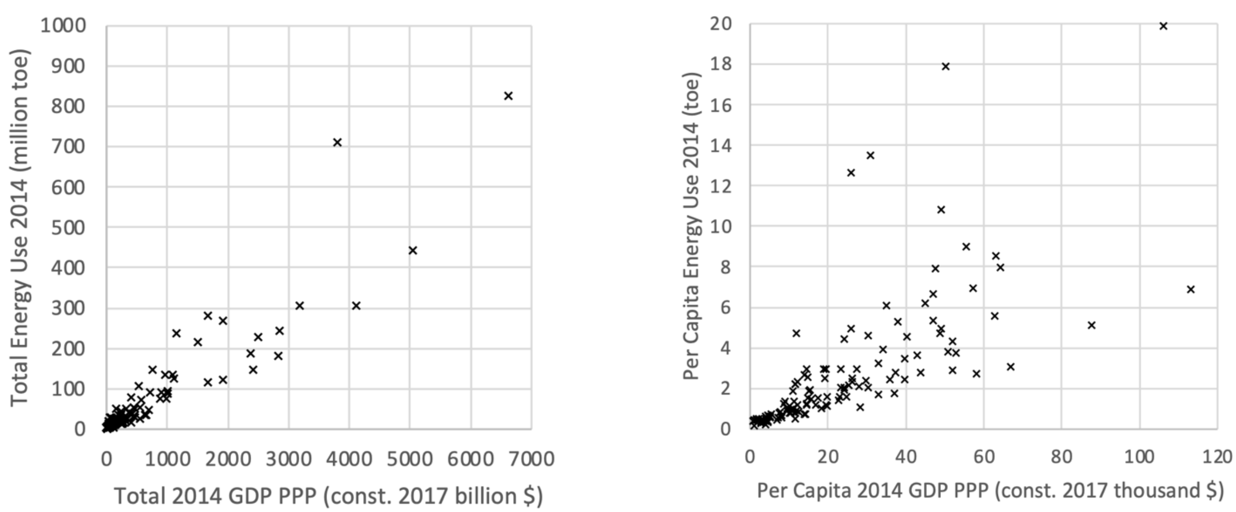

Figure 2. Total and per capita GDP (PPP constant 2017 \$) vs. total and per capita energy use (toe) of countries in 2014 (Source of data: WB, 2023) (Note: China and USA data are out of the bounds of the total GDP vs energy use chart)

† In all graphs, the latest available data are used.

The relationship between energy consumption and poverty is a manifestation of the laws of nature. Energy is required to do work, work is required to produce goods, production of goods brings income, income brings livelihood. As these relationships are based on the laws of nature that apply indiscriminately to all, lower energy consumption brings poverty while higher energy consumption brings better livelihood. As shown in Figure 3, the laws of nature have not changed over time.

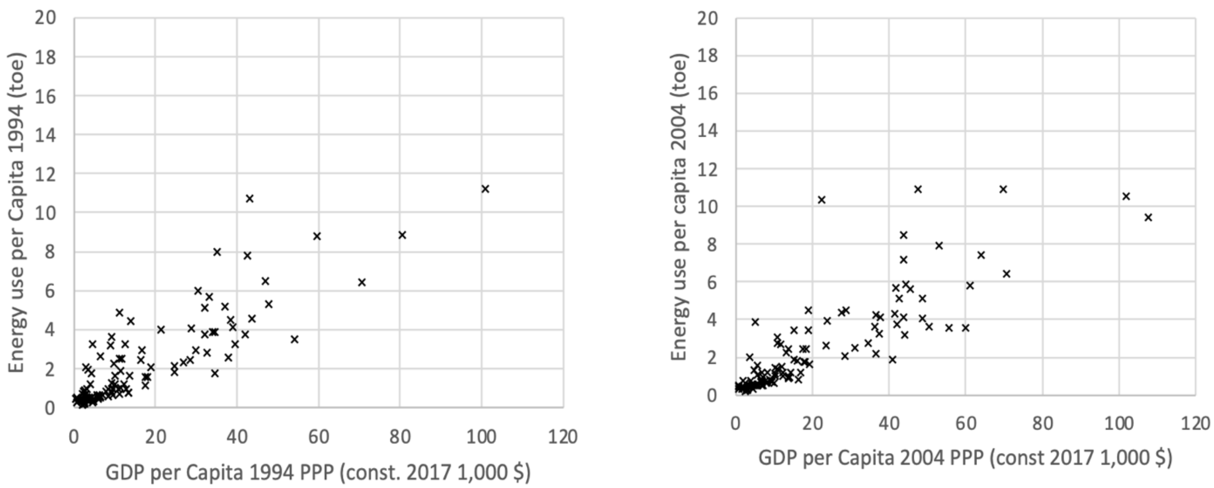

Figure 3. The relationship between per capita GDP and per capita energy consumption in 1994 and 2004 (Source of data: WB, 2023).

While it is difficult to define and more difficult to measure human development, a commonly accepted definition of human development is a composite concept that combines health, education and standard of living. Defined in this fashion, human development is measured by the Human Development Index (HDI). The HDI of countries published by the UNDP (UNDP, 2023) measures human development based on life expectancy at birth (as proxy for health), mean years of adult schooling (as proxy for education) and income per capita (as proxy for standard of living).

The relationship between energy consumption and human development is shown in Figure 4, where the annual per capita energy consumption of countries is plotted against their HDI for years 1990 and 2010 (the last year for which both data sets exist). As to be expected, countries with high HDI have a high energy consumption while nations with low energy consumption have low HDI. This conclusion is supported by the findings of Banerjee, Mishra and Maruta (2021) who studied the effect of energy poverty (lack of access to and usage of electricity and other types of energy) on health and education outcomes for 50 developing countries in the period 1990-2017. Their results show that “higher energy development leads to higher life expectancy rates, lower infant mortality rates, a higher progression from primary to secondary schooling and higher average years of schooling”, and “access to electricity has a higher and significant positive effect on development outcomes than energy use”.

As shown in Figure 5, energy consumption comes with CO_2 emissions because vast majority of fuels used to produce end-use energy are fossil fuels as shown in Figure 6.

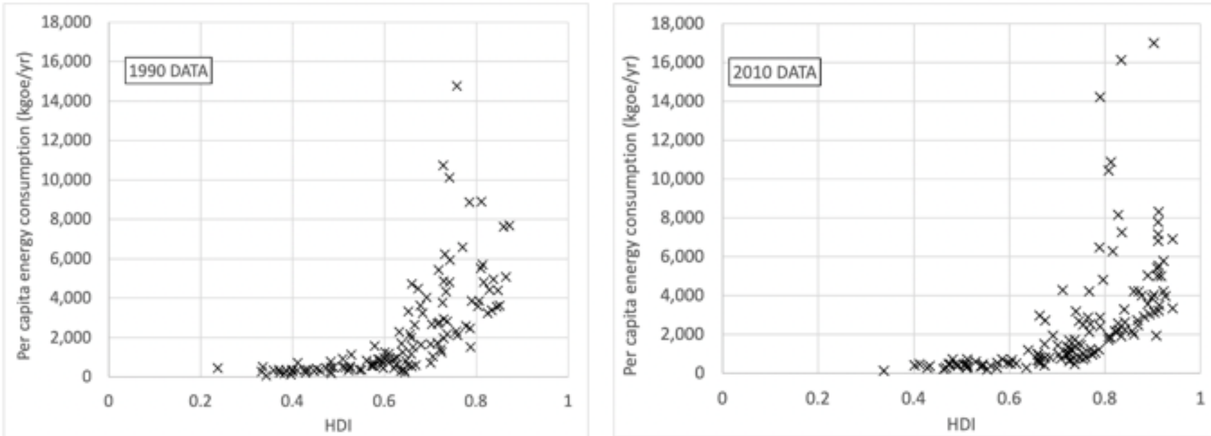

Figure 4. The relationship between HDI and per capita energy consumption (Source of data: WB, 2023; UNDP, 2023).

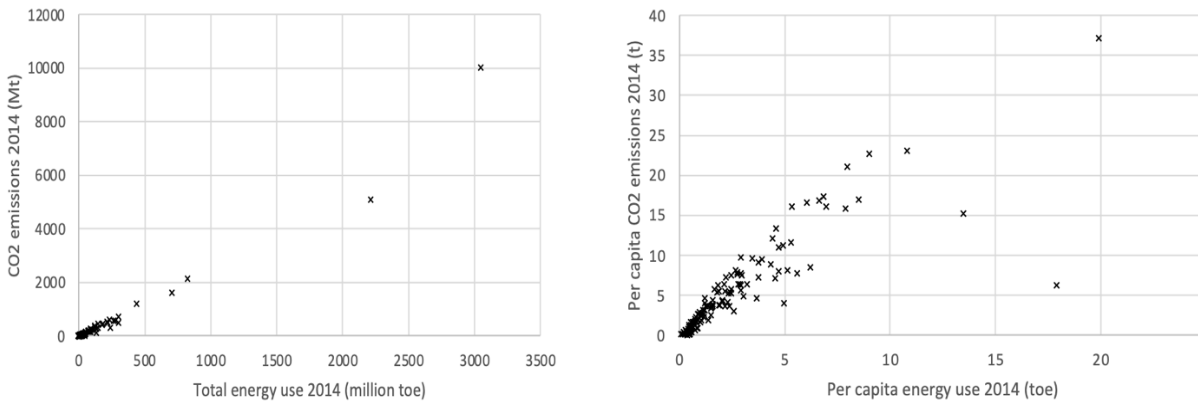

Figure 5. Total and per capita energy use vs. total and per capita CO_2 emissions of countries in 2014 (Source of data: WB, 2023)

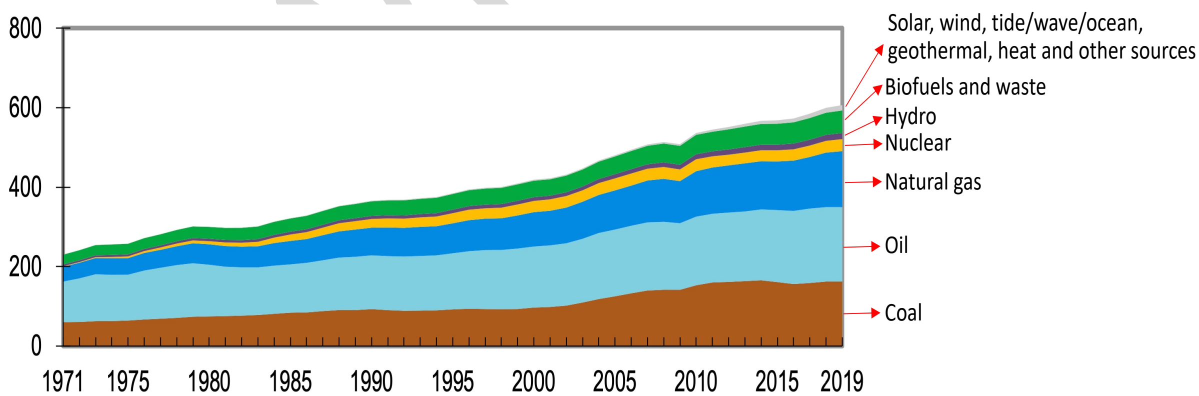

Figure 6. World total energy supply by source, 1971-2019 (EJ). (Source of graph: IEA, 2021b)

To enhance the discussion, the evolution of per capita GDP, per capita energy consumption and per capita CO_2 emissions are compared below for selected developed countries and developing countries. To avoid extremes, the EU average and four European countries (Belgium, France, Germany and Italy) are selected to represent developed countries, and five countries representing close to 30% of the world's population (Bangladesh, Nigeria, India, Indonesia and Pakistan) are selected to represent developing countries.

For the selected countries, the evolution of per capita GDP, per capita energy consumption and per capita CO_2 emissions are plotted in Figures 7, 8 and 9, respectively. Figure 7 shows the huge (as much as an order of magnitude), and over time expanding difference in wealth between the selected developed and developing countries. Figures 8 and 9 show similarly large, but recently decreasing, differences in per capita energy consumption and per capita CO_2 emissions. There are several reasons for the decrease in per capita energy consumption and CO_2 emissions in developed countries:

- Developed countries have a mature infrastructure. The road, rail and airport networks, residential, commercial and institutional building stocks, industrial and agricultural facilities are well developed with little need for new construction, and hence require reduced energy consumption and associated CO_2 emissions for incremental improvements[‡].
- Energy efficiency in developed countries has been high due to highly developed human capital and better technology, resulting in reduced energy consumption and associated CO_2 emissions, as shown in Figure 10.
- Developed countries have been shunting energy intensive industrial production to developing countries, thereby increasing the energy consumption and associated CO_2 emissions in developing countries while reducing their own (Liu, et al., 2015; CarbonBrief, 2017; Huang, Lenzen and Malik, 2019; Ritchie, 2019; Our World in Data, 2021; Hubacek, et al., 2021; Chen and Tan, 2022). As stated in the IMF report Data for a Greener World (Yamano, et al., 2024) "Since the mid-2000s total emissions by advanced economies, both production- and consumption-based, have fallen, while for emerging market and developing economies they have increased. For the advanced economies, this reflects the efforts being made in many of these countries to reduce total emissions. For emerging market and developing economies, the increases are a consequence of economic development; that is, on one hand emissions related to a significant increase in exports to meet demand in advanced economies, and on the other hand, the growth of these economies to meet basic needs and improve the quality of life of their population. However, as can be seen in Figure 11, advanced economies still have much higher per capita emissions than emerging market and developing economies."

The data given in Figures 7-9 show that on a per capita basis, the selected EU countries and the EU average have been substantially wealthier, consumed substantially more energy, and produced more CO_2 emissions throughout the period for which World Bank DataBank (2023) provides data publicly. Including other developed and developing countries into the analysis does not change the conclusions. From the available data, the accumulated difference in wealth, energy consumption, and CO_2 emissions over the years can be calculated. With access to more data, it is possible to expand these plots to longer periods and calculate accumulated values of wealth, energy consumption, and CO_2 emissions, as shown in Figure 12.

[‡] For example, recently, the Canadian government announced its decision to stop investing in new road infrastructure (NP, 2024)

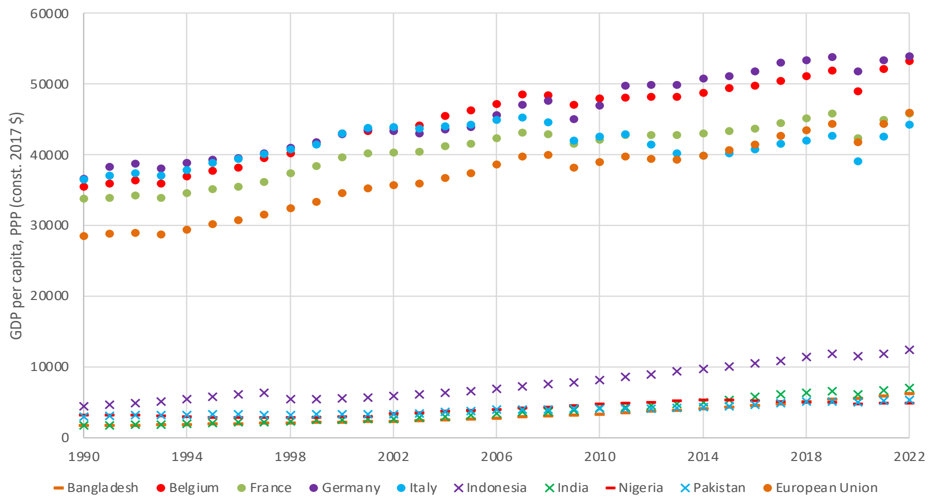

Figure 7. Evolution of GDP per capita PPP of selected countries (Source of data: WB, 2023)

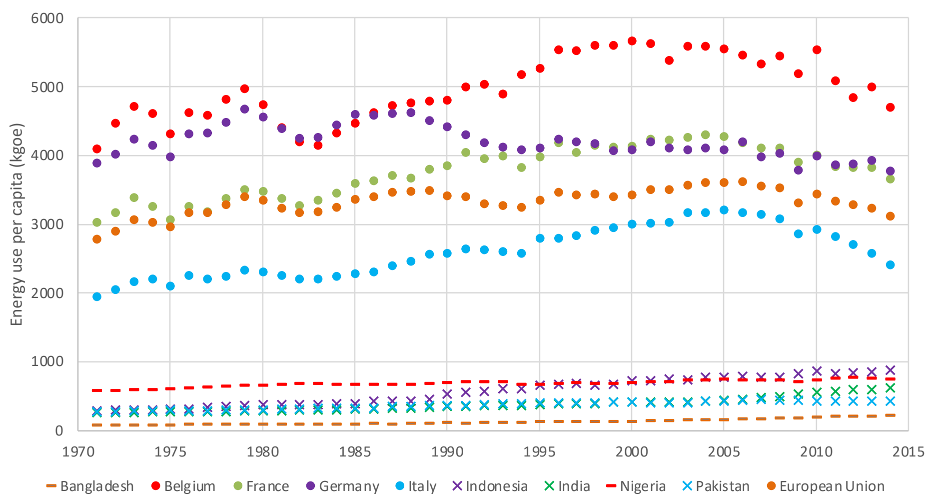

Figure 8. Evolution of energy use per capita of selected countries (Source of data: WB, 2023)

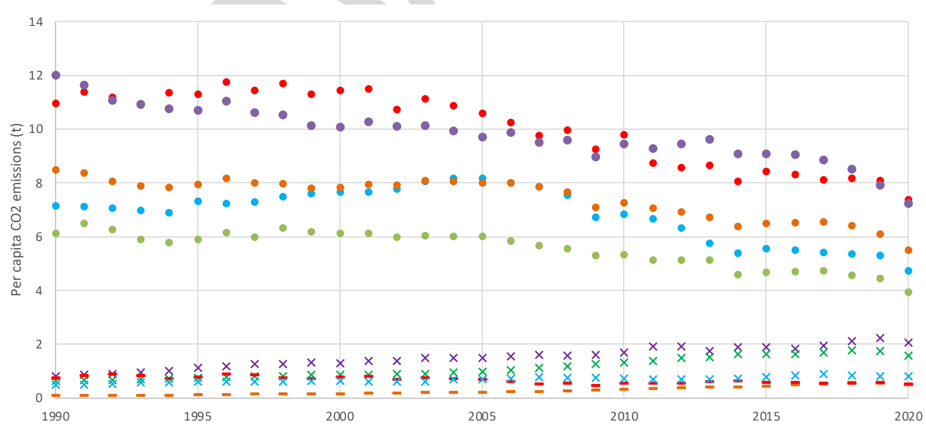

Figure 9. Evolution of per capita CO_2 emissions of selected countries (Source of data: WB, 2023)

Figure 10. Evolution of energy use per $1000 GDP of developed and developing countries (Source of data: WB, 2023)

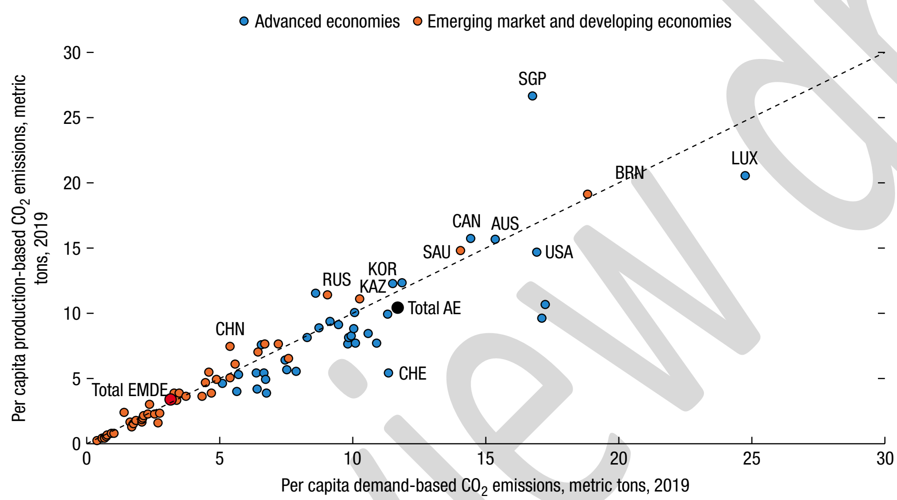

Figure 11. Per capita production-based and demand-based CO_2 emissions from fuel combustion, 2019 (Figure from: Yamano, et al., 2024)

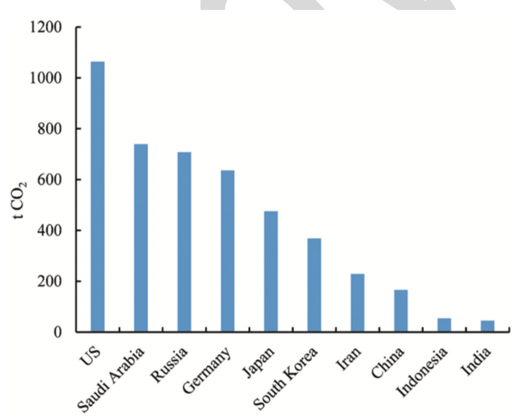

Figure 12. The cumulative CO_2 emission per capita from 1965 to 2019 (Source of Figure: Chen, Lu and He, 2022)

From the discussion above, two conclusions are apparent: (1) to reduce and eradicate poverty and to improve human development, developing countries must increase their energy consumption, and consequently, their CO_2 emissions, (2) to be able to increase energy consumption, developing countries need to have access to affordable energy.

Even with the current low prices of energy and electricity in developing countries, energy is unaffordable to their people. As shown in Table 1, although energy prices are substantially lower in the selected developing countries, they are substantially less affordable to the population. Thus, a swift and deep transition to renewables and/or net zero emission scenarios will make energy even more unaffordable in developing countries, which will certainly lead to halting and reversing development.

	EP (1)	GP(2)	DP(3)	GNI per capita(4)	EA(5)	GA(6)	DA(7)
Belgium	0.416	1.74	1.90	53,890	4.6	1.5	1.7
France	0.257	1.94	1.92	45,290	3.4	2.1	2.0
Germany	0.399	1.9	1.89	54,030	4.4	1.7	1.7
Italy	0.431	1.99	1.95	38,200	6.8	2.5	2.5
Bangladesh	0.061	1.14	0.99	2,820	13.0	19.4	16.9
India	0.079	1.25	1.13	2,390	19.8	25.1	22.7
Indonesia	0.097	0.87	0.98	4,580	12.7	9.1	10.3
Nigeria	0.046	0.44	0.81	2,160	12.8	9.8	18.0
Pakistan	0.056	0.98	1.00	1,560	21.5	30.2	30.8

Table 1. Energy prices and affordability in selected countries. (Source of data: WB, 2023 for per capita GNI, GlobalPetrolPrices.com for energy prices)

(1) EP: Electricity prices for households, US$/kWh, June 2023
(2) GP: Gasoline prices, US$/L, February 2024
(3) DP: Diesel prices, US$/L, February 2024
(4) GNI per capita 2022, Atlas method, current US$
(5) EA: Electricity affordability expressed in cost of 500 kWh of electricity as percent of monthly income
(6) GA: Gasoline affordability expressed in cost of filling a 40-liter tank of gasoline as percent of monthly income
(7) DA: Diesel affordability expressed in cost of filling a 40-liter tank of diesel as percent of monthly income

Not only developed countries have been consuming much and inexpensive energy and emitting high levels of CO_2 for decades with impunity to acquire their wealth, high human development, mature infrastructure and energy efficiency, they intensely protect these against perturbations. Recently, in reaction to increasing natural gas prices, wealthy countries did not hesitate to turn to inexpensive "dirty" coal as soon as natural gas prices escalated to levels that they considered unacceptable (NPR, 2022; Bloomberg, 2022; Latestly, 2023). However, using tools such as the CBAM, they are prepared to economically punish poor developing countries for doing the same.

Over the past decade, it is observed that in some developed countries the growth in per capita GDP has been decoupled from the growth in per capita CO_2 emissions (Aden, 2016; Hubacek, et al., 2021; Ritchie, 2021; Singh, 2024). The decoupling is attributed numerous factors, including changes in energy and industrial structures reducing energy and carbon intensity that overwhelm the effects of increases in population, income and production (Ritchie, 2021; Han, Liu and Liu, 2022; Chen, Lu and He, 2022). Also, the composition of the GDP and the changes in its composition over time, with a low and declining share of energy intensive manufacturing sector and a high and increasing share of low energy services sector, are important factors for achieving decoupling as shown in Figure 13. The issue of decoupling between economic development and CO_2 emissions for developing countries, especially for the expanding economy of China, has been extensively studied (Cohen, et al., 2018; Han, Liu and Liu, 2022; Hubacek, et al., 2021; Zhao, Jiang and Zhang, 2022). Collectively, the findings indicate that for developing countries decoupling is unlikely unless low carbon and energy intensity, and near complete decarbonization of supply chains, is achieved, which will destroy their economy, further lower human development and increase poverty due to reasons discussed earlier.

There are however strong opinions and positions that object to just decoupling because it is argued that decoupling does not go far enough (Parrique, et al., 2019; Widenhofer, et al., 2020; Haberl, 2020; Vogel and Hickel, 2023), and to achieve the objective of complete decarbonization of the energy supply, as well as the attendant objectives of reduced resource use, degrowth is necessary. The problem with the concepts of decoupling, degrowth, and its less punitive sounding versions "beyond growth" and "post-growth", is that these concepts ignore the fact that there is huge poverty in the world, and poverty must be eradicated, and to eradicate poverty growth in production of products and the consequent energy consumption is a requirement, not an option. Sadly, this fact is denied, or perhaps not understood by those who never lived and woke up with poverty day after day, year after year.

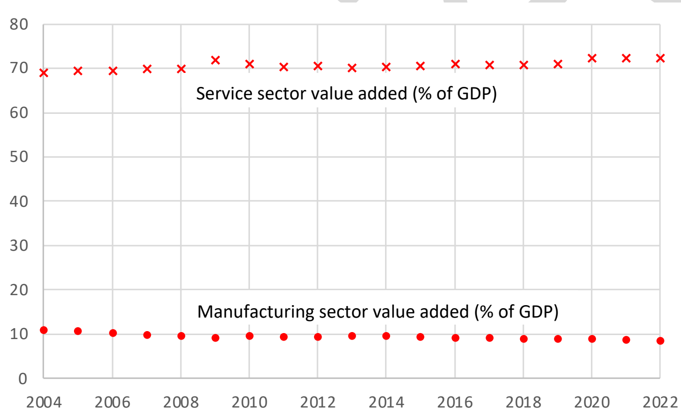

Figure 12. Evolution of the value added by manufacturing and services sector in the UK (Source of data: WB, 2023)

4. Meanwhile in Developed Countries

While poverty is largely and primarily a problem of developing countries, large percentages of the population of developed countries are not immune to this problem. Economic inequality, in terms of both income and wealth inequality, has steadily increased in high income countries in the past four decades, and this increasing inequality manifests itself in increasing poverty. In addition to unjust societal structures, intergenerational immobility and reduced productivity, economic poverty leads to energy poverty, which comes with cold and damp homes, reduced access to energy services, and low thermal quality homes in part due to decreasing home ownership (Galvin and Sunikka-Bland, 2018; Galvin, 2020).

The magnitude of poverty as well as energy poverty in developed countries has become alarming: the population who live below the poverty line in Belgium is 7.8%, in France 8.5%, in Germany 11.6%, in Italy 12.8% and in the USA 18% (OECD, 2023). The problems associated with the poor in developed countries are similarly grim as the problems of the poor in developing countries: one in five children in Canada are at risk of going to school hungry on any given day (Government of Canada, 2022); in the USA 44 million people live in food-insecure households (USDA, 2023); over 41 million people in the EU (9.3 % of the population) were unable to keep their home adequately warm in 2022, 65 million (almost 15%) lived in dwellings with leak, damp or rot in 2020 (EP, 2023); around 13% of households in England, 25% in Scotland, 14% in Wales, and 24% in Northern Ireland were fuel poor in 2022 (UK Parliament, 2023), and the number of excess winter deaths in Great Britain caused by living in a cold, damp home climbed to 4,950 in 2022/23 winter despite the relatively mild weather (O’Donoghue, 2024).

The rapid increase over the past two decades in the production of electricity from solar and wind that has led to regressive pricing structures for electricity in the EU (Haar, 2020), which has contributed to the increase in energy poverty. The electricity pricing structure is regressive in the way that on a per kWh basis electricity is more expensive for poor households than for wealthy households and companies. This is due to several reasons, including the way subsidies are granted for solar and wind generation and the dominant fixed charges in renewable electricity pricing to recover high capital costs with low (about 25%) capacity factors (Haar, 2020).

The regressive nature of solar and wind pricing structures also presents itself in indirect ways. In many developed countries, governments provide grants and subsidies to household PV installations. Since poor households are invariably unable to afford installing PV systems, even with generous (?) government grants and subsidies, they cannot benefit from such programs although perversely it is their taxes that pay for the programs.

In the face of these alarming trends, decisions are being made for the populations of many countries by unelected and elected people of power and wealth that ignore these realities while applying different standards and practices for themselves.

To reduce emissions, C40, the “global network of mayors of the world’s leading cities that are united in action to confront the climate crisis”, with a membership of mayors from 96 cities from all continents has declared that it will be necessary to control, amongst other things, the diet, clothing and travel habits of citizens (C40, 2019; C40, Arup and University of Leeds, 2019). Among the actions the C40 cities agreed to take are:

- move citizens to a plant-based diet and reduce meat consumption to a maximum of 16 kg per person per year and dairy to 90 kg per person per year by 2030, down from an average of 58 kg of meat and 155 kg of dairy at present, and eventually to even lower levels of consumption,

- reduce new items of clothing to as low as three per person per year by 2030,
- reduce and eventually eliminate car ownership by 2030,
- reduce number of flights to one short-haul return flight (less than 1500 km) every three years per person by 2030.

These declarations are in line with the "8 predictions for the world in 2030" of the WEF (WEF, 2018).

However, these and other "degrowth", or less punitive sounding "beyond growth" or "post-growth", policies and strategies are achieved through myriad of policies including carbon taxation and other similar measures that result in a higher cost of energy. Higher cost energy results in reduced energy use by large segments of the society with stretched budgets, and that reduces the standard of living in developed countries as in developing countries.

5. Conclusion

Although there has been substantial progress in reducing poverty over the past century due to economic growth, there is still much poverty in the developing and developed countries, both in terms of its magnitude and prevalence.

It was shown in this article that to get out of poverty, people need things; to obtain things they need income; to produce things and income, energy is necessary since without using energy it is not possible to move or make anything; to produce more things for more people, more energy must be accessed; and to access more energy, energy must be affordable. Without energy it is not possible to do anything, and each time energy is used, more of it needs to be made available from primary sources. Thus, to reduce and eradicate poverty, economic growth and increased energy use are necessary, not optional.

None of this should be surprising because these are facts due to the way nature works, and those who have even a rudimentary understanding of the laws of nature understand and recognize that these facts are indisputable because nature is indisputable.

The amount of energy needed to improve the wealth and quality of life in all people of the world to acceptable levels requires a lot of energy, about 40% more energy than that is used today even with a substantial increase in the average efficiency with which energy is used (Ugursal, 2014). It is empirically clear that renewable energies solar and wind cannot affordably satisfy such an increased level of energy consumption as renewables can satisfy only a miniscule fraction of the energy demand right now, and with substantially higher cost, which will become higher if the fraction increases due to the increased requirement for energy storage to compensate the intermittent nature of solar and wind energy.

It is thus not possible to find proclamations of objectives such as net-zero energy and emission, de-carbonization and de-growth credible, but see them as misguided follies that will be discarded sooner than later as fundamental errors of judgement that cause large scale damage to the well-being of the vast majority of the population, especially the extremely poor who could hardly suffer any more than they already do. It is a necessity to abandon all forms of economic and political forcing in the name of "fighting climate change" and the highly questionable rhetoric of "saving the planet for future generations" at the expense of the billions of people who are suffering right now.

So, then, what needs to be done to satisfy the need for more energy to achieve higher income, development and production? As solar and wind are not feasible to provide for the energy needs, so is extracting and using more fossil fuels as fuel. Fossil fuels are much more valuable when they are used as chemical feedstock than by just combusting them to produce heat as combustion is a highly irreversible process that destroys way too much of the intrinsic value of their useful content (a.k.a. exergy). The answer to the question is and has been obvious for decades, but widely denied and repudiated: nuclear energy. Nuclear energy is abundant, safe and inexpensive, and in spite of the immense barriers put up by unintelligent politicians influenced by narrow minded 'environmentalists' that highjack the attention of sensation seeking mass media that succeed in scaring the gullible parts of the society, nuclear energy technology is advancing. If a fraction of the public money wasted on climate change and related "research" was spent on nuclear energy technology, the advancement would have been much bigger, and benefitted from bigger economies of scale. Furthermore, and notwithstanding the obstacles and narrow minds, with the recent breakthrough in controlled fusion (Paddison, 2023), the future is even brighter for nuclear energy, and in turn, for the people. It should be remembered that it took only twelve years from the first sustained nuclear fission reaction created by humans in Chicago in 1942 to the first nuclear power plant connected to the electricity grid in 1954 in Moscow. We shall see how long it will take to make the same leap with fusion. And once that leap is made, people shall no longer suffer from demeaning and repugnant ideas such as degrowth. Developed and developing countries need to focus on nuclear energy to satisfy the growing needs for energy to ensure higher human development and quality of life.

Acknowledgement

The author acknowledges that he is personally and deeply concerned about the future of his grandchildren, his extended family, his recent students, and the world's youth in general, and hopes that they will collectively and successfully reform the current climate policies and prevent the widespread human suffering that seems an inevitable consequence of the present agenda.

References

Aden, N., 2016. Decoupling: 21 Countries Are Reducing Carbon Emissions While Growing GDP. World Resources Institute. https://www.wri.org/insights/roads-decoupling-21-countries-are-reducing-carbon-emissions-while-growing-gdp

Bloomberg, (2022). Germany Revives Coal as Energy Security Trumps Climate Goals. Dec. 22, 2022. https://www.bloomberg.com/news/articles/2022-12-22/germany-returns-to-coal-as-energy-security-trumps-climate-goals#xj4y7vzkg

C40, 2019. Back to News and Insights - New Research Shows How Urban Consumption Drives Global Emissions. C40 Cities. https://www.c40.org/news/new-research-shows-how-urban-consumption-drives-global-emissions/

C40, Arup and University of Leeds, 2019. The future of urban consumption in a 1.5°C World – C40 Cities – Headline Report. https://www.c40knowledgehub.org/s/article/The-future-of-urban-consumption-in-a-1-5-C-world?language=en_US

Chen, C., Lu, Y. and He, G., 2022. Driving mechanisms for decoupling CO2 emissions from economic development in the ten largest emission countries. Ecosystem Health and Sustainability. 2022, 8, 1, 2059016. doi/10.1080/20964129.2022.2059016

Chen, Z., Tan, Y. 2022. The Imbalance of Embodied CO2 in China's Imports, Exports and Its Causes. Sustainability. 14, 6460. https://doi.org/10.3390/su14116460

Cohen, G., Jalles, J., Loungani, P., Marto, R., Wang, G., 2018. Decoupling of Emissions and GDP: Evidence from Aggregate and Provincial Chinese Data. International Monetary Fund. IMF Working Paper, WP/18/85.

EC, 2019. A European Green Deal. European Commission (EC). https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Enerdata, 2024. Evolution of the Wind Turbines Manufacturers' Market Share. https://www.enerdata.net/publications/executive-briefing/wind-market-share.html#:~:text=Evolution%20of%20the%20Wind%20Turbines%20Manufacturers%27%20Market%20Share&text=The%20overall%20world%20market%20by,year%2Dover%2Dyear%20increase.

Energy Institute, 2024. Energy Charting Tool. https://www.energyinst.org/statistical-review/energy-charting-tool/energy-charting-tool

EP, 2022. EU carbon border adjustment mechanism. European Parliament. https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)698889

EP, 2023. Energy Poverty in the EU. European Parliament. https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733583/EPRS_BRI(2022)733583_EN.pdf

Galvin, R. and Sunikka-Blank, M. 2018. Economic Inequality and Household Energy Consumption in High-income T Countries: A Challenge for Social Science Based Energy Research. Ecological Economics. 153, 78–88

Galvin, R. (Editor), 2020. Inequality and Energy: How Extremes of Wealth and Poverty in High Income Countries Affect CO2 emissions and Access to Energy. Academic Press/Elsevier. ISBN 978-0-12-817674-0

Government of Canada, 2022. Government of Canada launches consultations on a pan-Canadian school food policy. https://www.canada.ca/en/employment-social-development/news/2022/11/government-of-canada-launches-consultations-on-apan-canadian-school-food-policy.html

Haar, L. 2020. Inequality and renewable electricity support in the European Union. In Galvin, B. 2021. How to Avoid a Climate Disaster. Random House. ISBN: 978-0-593-21577-7.

Haberl, H., Wiedenhofer, D., Virag, D., Kalt, G., Plank, B., Streeck, J., Pichler, M., Mayer, A., Krausmann, F., Brockway, P., Schaffartzik, A., Fishman, T, Hausknost, D., Leon-Gruchalski, B., Sousa, T., Creutzig, F., 2020. A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights. Environ. Res. Lett. 15 (2020) 065003. doi.org/10.1088/1748-9326/ab842a

Han, Y., Liu, Y. and Liu, X., 2022. Decoupling Re-Analysis of CO2 Emissions and Economic Growth from Two Dimensions. Front. Energy Res. doi.org/10.3389/fenrg.2022.896529

Hausfather, Z., 2017. Mapped: The world's largest CO2 importers and exporters. CarbonBrief. https://www.carbonbrief.org/mapped-worlds-largest-co2-importers-

exporters/#:~:text=China%20is%20the%20largest%20net,twice%20as%20much%20as%20Japan.
Huang, R., Lenzen, M., Malik, A., 2019. CO_2 emissions embodied in China's export. The J. of Int. Trade and Economic Development. 28, 8, 919–934.
Hubacek, K., Chen, X., Feng, K., Wiedmann, T., Shan, Y., 2021. Evidence of decoupling consumption-based CO_2 emissions from economic growth. Advances in Applied Energy. 2021, 4, 100074. doi.org/10.1016/j.adapen.2021.100074
IEA, 2021. Net Zero by 2050. International Energy Agency. https://www.iea.org/reports/net-zero-by-2050
IEA, 2021b. Key World Energy Statistics 2021. International Energy Agency. https://iea.blob.core.windows.net/assets/52f66a88-0b63-4ad2-94a5-29d36e864b82/KeyWorldEnergyStatistics2021.pdf
IEA, 2022. Special Report on Solar PV Global Supply Chains. International Energy Agency. https://www.iea.org/reports/solar-pv-global-supply-chains
Idel, R., 2022. Levelized Full System Costs of Electricity. Energy, 259, 124905.
Latestly. (2023). World News | UK: Rishi Sunak to Delay Climate Targets to "ease Burden" on People. October 31, 2023. https://www.latestly.com/agency-news/world-news-uk-rishi-sunak-to-delay-climate-targets-to-ease-burden-on-people-5428816.html
Liu, H., Liu, W., Fan, X., Zou, W., 2015. Carbon emissions embodied in demand–supply chains in China. Energy Economics 50 (2015) 294–305.
NP, 2024. MPs to demand that Guilbeault explain his 'no more new roads' policy in committee. National Post, 20 February 2024. https://nationalpost.com/news/mps-demand-guilbeault-explain-no-more-new-roads-policy#:~:text=Guilbeault%20said%20in%20a%20conference,call%20for%20further%20road%20expansions.
NPR. (2022). Amid an energy crisis, Germany turns to the world's dirtiest fossil fuel. Sept. 22, 2022. https://www.npr.org/2022/09/27/1124448463/germany-coal-energy-crisis
O'Donoghue, 2024. UK records 4,950 excess winter deaths amid cost of living crisis. Euronews, 19 January 2024. https://www.euronews.com/2024/01/19/uk-records-4950-excess-winter-deaths-amid-cost-of-living-crisis#:~:text=Stark%20new%20figures%20estimate%20that,recorded%20during%20winter%202022%2F23.
OECD, 2023. Poverty Rate. https://data.oecd.org/inequality/poverty-rate.htm
Our World in Data, 2021. Imported or exported CO_2 emissions per capita. https://ourworldindata.org/grapher/imported-or-exported-co-emissions-per-capita?tab=chart
Paddison, L., 2023. Scientists successfully replicate historic nuclear fusion breakthrough three times. CNN. December 21, 2023. https://www.cnn.com/2023/12/20/climate/nuclear-fusion-energy-breakthrough-replicate-climate/index.html
Parrique T., Barth J., Briens F., C. Kerschner, Kraus-Polk A., Kuokkanen A., Spangenberg J.H., 2019. Decoupling Debunked Evidence and arguments against green growth as a sole strategy for sustainability. European Environmental Bureau. https://eeb.org/library/decoupling-debunked/
Ritchie, H., 2019. How do CO_2 emissions compare when we adjust for trade? Our World in Data. https://ourworldindata.org/consumption-based-co2

Ritchie, H., 2021. Many countries have decoupled economic growth from CO2 emissions, even if we take offshored production into account. OurWorldInData.org. https://ourworldindata.org/co2-gdp-decoupling
Singh, S., 2024. The relationship between growth in GDP and CO2 has loosened; it needs to be cut completely. International Energy Agency. https://www.iea.org/commentaries/the-relationship-between-growth-in-gdp-and-co2-has-loosened-it-needs-to-be-cut-completely
Ugursal, V. I., 2014. Energy consumption, associated questions and some answers. Applied Energy 130 (2014) 783–792.
Ulgen, S. (2023). A Political Economy Perspective on the EU's Carbon Border Tax. Carnegie Europe. https://carnegieeurope.eu/2023/05/09/political-economy-perspective-on-eu-s-carbon-border-tax-pub-89706
UNDP, 2023. Human Development Index (HDI). https://hdr.undp.org/data-center/human-development-index#/indicies/HDI
UNEP, 2022. Emissions Gap Report 2022: The Closing Window — Climate crisis calls for rapid transformation of societies. https://www.unep.org/emissions-gap-report-2022
UK Parliament, 2023. Fuel poverty in the UK. https://commonslibrary.parliament.uk/research-briefings/cbp-8730/
USDA, 2023. Food Security in the US. US Department of Agriculture. https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/
Vogel, H., Hickel, J., 2023. Is green growth happening? An empirical analysis of achieved versus Paris-compliant CO2–GDP decoupling in high-income countries. Lancet Planet Health 2023; 7: e759–69.
WB, 2022. "Poverty and Shared Prosperity 2022: Correcting Course." Overview booklet. World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO
WB, 2023. World Bank Databank, World Development Indicators Database, 2023. https://databank.worldbank.org/source/world-development-indicators/preview/on
WEF, 2018. 8 predictions for the world in 2030. World Economic Forum. https://twitter.com/wef/status/983378870819794945
Wiedenhofer, D., Virag, D., Kalt, G., Plank, B., Streeck, J., Pichler, M., Mayer, A., Krausmann, F., Brockway, P., Schaffartzik, A., Fishman, T, Hausknost, D., Leon-Gruchalski, B., Sousa, T., Creutzig, F. and Haberl, H. 2020. A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part I: bibliometric and conceptual mapping. Environ. Res. Lett. 15 (2020) 063002. doi.org/10.1088/1748-9326/ab8429
Yamano, N, Guilhoto, J., Han, X., Webb, C., Girouard, N., Monteiro, J-A., 2023. Measuring CO_2 Emissions Embodied in International Trade and Domestic Final Demand. Ch.2 in Data for a Greener World: A Guide for Practitioners and Policymakers. Editors: S. Arslanalp, K. Kostial, G. Quiros-Romero. Int. Monetary Fund. doi.org/10.5089/9798400217296.071.
Zhao, X., Jiang, M., Zhang, W., 2022. Decoupling between Economic Development and Carbon Emissions and Its Driving Factors: Evidence from China. Int. J. Environ. Res. PublicHealth. 2022, 19, 2893. doi.org/10.3390/ijerph19052893