How UK energy subsidies drove down consumption, pushed up prices and reduced our prosperity

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Brief summary

Overall UK energy consumption is at its lowest level since the 1950s and has fallen by 30 per cent since the early 2000s. The fall in electricity consumption is particularly notable, being 22 per cent below its peak in 2005 and now at levels last seen in the late 1980s and early 1990s. Far from being positive, the study suggests that these are deeply worrying trends suggesting a general decline in societal complexity.

> *"Overall UK energy consumption is at its lowest levels since the 1950s and has fallen by 30 per cent since the early 2000s."*

The analysis notes that the observed decline in energy consumption coincided with new environmental levies on consumer bills to fund renewable energy sources. Environmental levies on household bills and other carbon reduction policies and associated costs have risen from £500 million in 2010 to over £15 billion in 2021. It is more probable than not that this has discouraged energy use through price rationing, and has damaged our prosperity and wellbeing as industrial, commercial and domestic use of energy falls.

UK energy consumption

This document aims to put the question of falling UK energy consumption in the spotlight, and offer reasons for thinking that it is, or rather should be, a matter of profound concern rather than complacency or even self-congratulation. The study is by no means the final word on the subject, but is rather an invitation to reflection and debate.

Total UK Primary Energy consumption, that is to say energy measured before it enters conversion devices such as power stations, has fallen by about 30 per cent on its peak in the early 2000s (Figure 1), and is now back at levels last seen in the 1950s.[1]

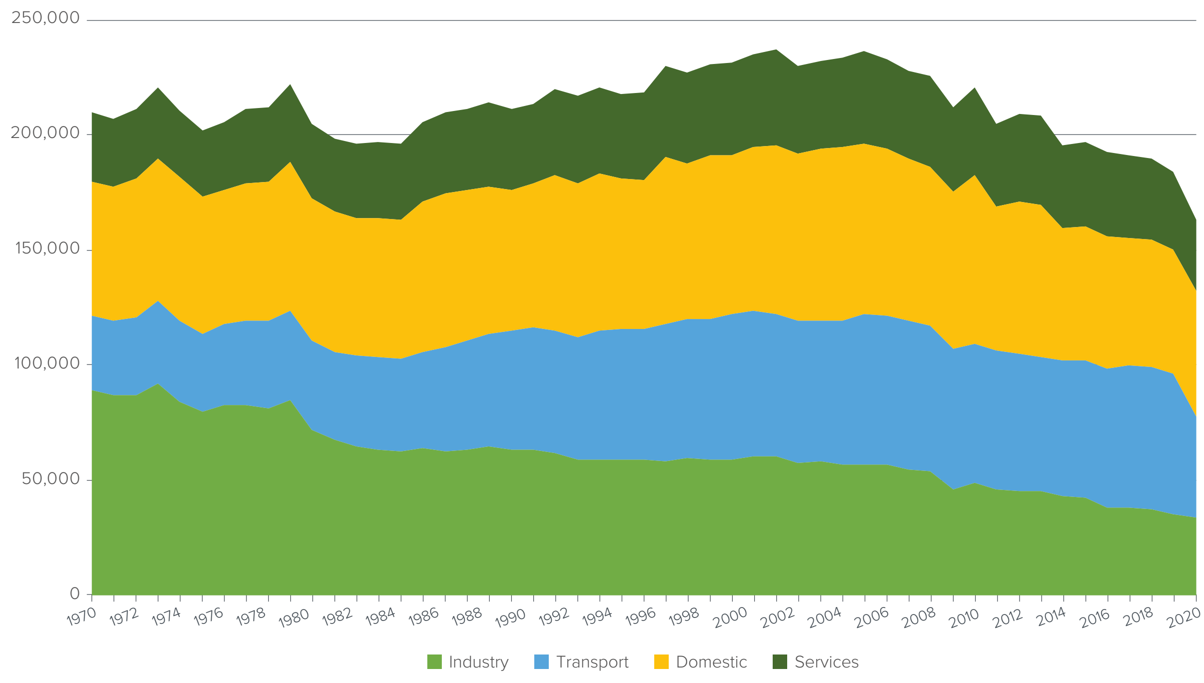

Figure 1: UK Total Primary Energy Consumption (kilotonnes of oil equivalent) by sector 1970 to 2020. Source: National Statistics,[1] chart by the author.

After the uneven energy consumption profile of the 1970s, a period marked by energy shocks and internal industrial problems, consumption entered a two-decade long period of sustained growth up to the early 2000s, when it seems to have stalled, and then after 2005, entered a period of sustained decline.

This pattern affects all sectors, but not evenly, with industry exhibiting by far the most substantial fall in demand (Figure 2).

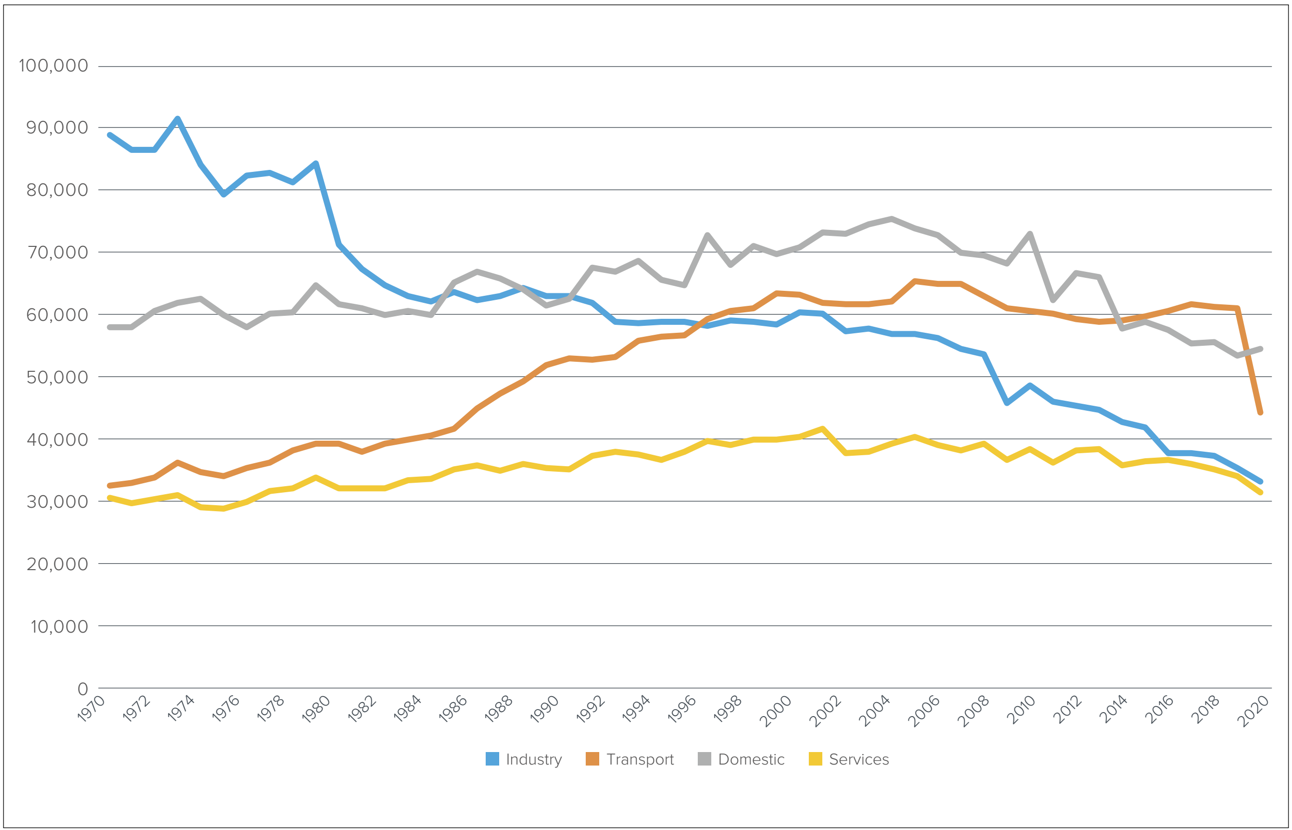

Figure 2: UK Total Primary Energy Consumption (kilotonnes of oil equivalent) by sector 1970 to 2020. Source: National Statistics,[2] chart by the author.

Industrial consumption presents three periods of decline, beginning with a sharp fall from the beginning of the data series, 1970, to the mid 1980s, after which there is a second period of very slow decline until the early 2000s, when it enters a new period of marked decline that continues to the present day.

Domestic consumption exhibits a rising trend up to the early 2000s and then a weak falling trend. Transport exhibits a rising trend to the early 2000s and then flatlines, followed by a major drop in 2020 due to the pandemic, which must be regarded as, in all probability, anomalous. Consumption in services exhibits a weak rising trend to the early 2000s and then a slow decline.

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A naïve analysis might suggest that these declines are the result of improvements in the efficiency of final energy conversion devices, such as engines or industrial processes or domestic appliances. However, the Jevons Paradox reminds us that improvements in efficiency only serve to either (a) increase demand for the now more efficient process or (b) economise energy for use in in another area.

That is to say, demand for the more efficient energy conversion will rise to the point of inelasticity, after which energy is economised to serve as yet unmet human requirements. Far from being a speculative theory empty of data, both W. S. Jevons (1835–1882) and its ultimate originator, Justus von Liebig (1803–1873), saw it as a chain of reasoning grounded in historical facts and so explaining the observed economic growth. Jevons remarked that: *'It needs but little reflection, indeed, to see that the whole of our present vast industrial system, and its consequent consumption of coal, has chiefly arisen from successive measures of economy.'*

Paraphrasing the German chemist Liebig's profound and parallel observations to the effect that '*Civilization [...] is the economy of power*', Jevons continues: *'It is the very economy of the use of coal that makes our industry what is, and the more we render it efficient and economical, the more will our industry thrive, and our works of civilization grow'.*[3]

Thus, efficiency measures cannot in principle explain reductions in consumption. When such measures are effective, total consumption should rise even at the Primary level, so they fail to explain the observations that have been reported here.[4]

Final Energy Consumption, in end use devices, is also falling, and in a pattern very similar to that of Primary Energy (Figure 3).

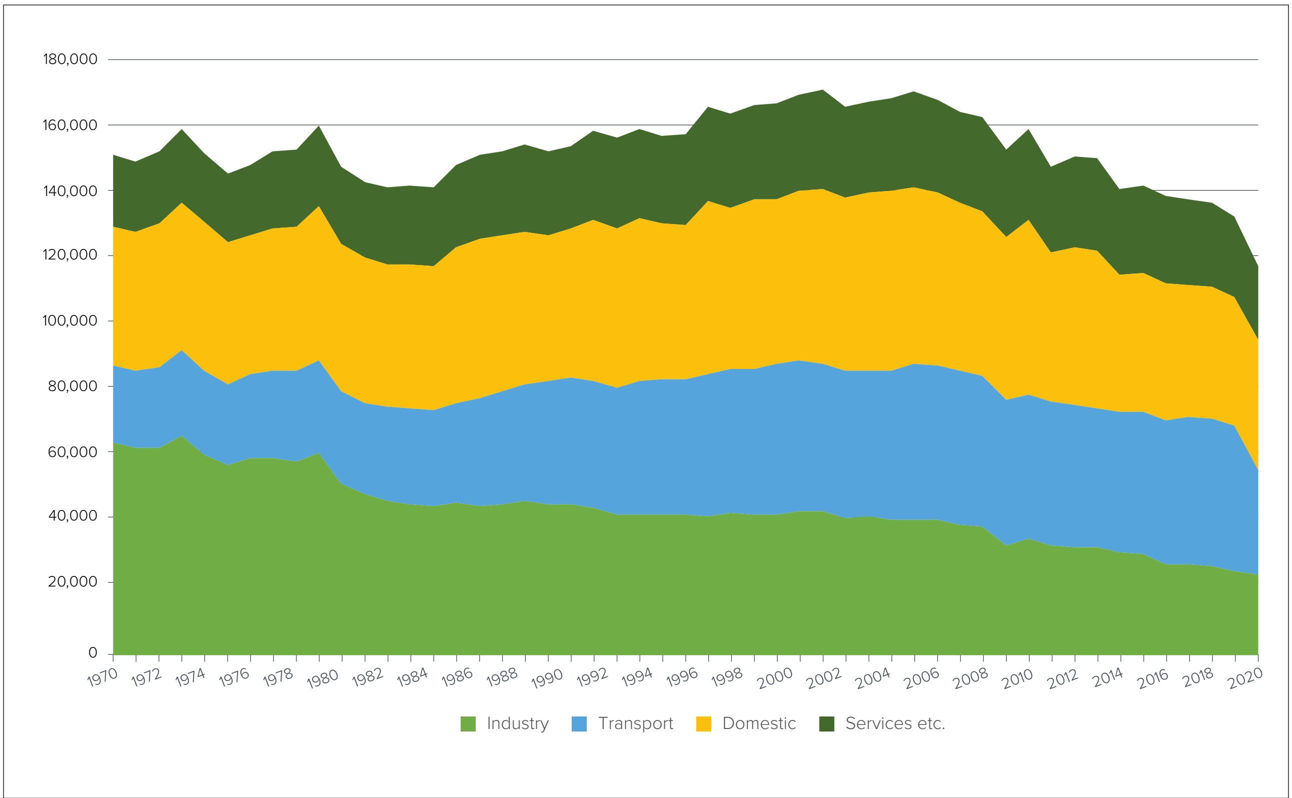

Figure 3: UK Total Final Energy Consumption (kilotonnes of oil equivalent) by sector 1970 to 2020. Source: National Statistics,[5] chart by the author.

The ratio of Total Primary Energy (TPE) to Final Energy Consumption (FEC), the approximate index of overall economy-wide efficiency in converting primary energy into energy available at the point of consumption, follows a peculiar pattern (Figure 4). The system is approximately stable from 1970 to 1995, when both TPE and FEC were growing, then somewhat less efficient as both stalled. Then after about 2010 the ratio fell significantly, presumably as the input of Primary Electricity from renewable energy reached high levels (this affects the ratio since its primary energy input, from wind or sun and before conversion in a wind turbine or a photovoltaic panel, is not featured in Total Primary Energy), as both TPE and FEC were dropping sharply.

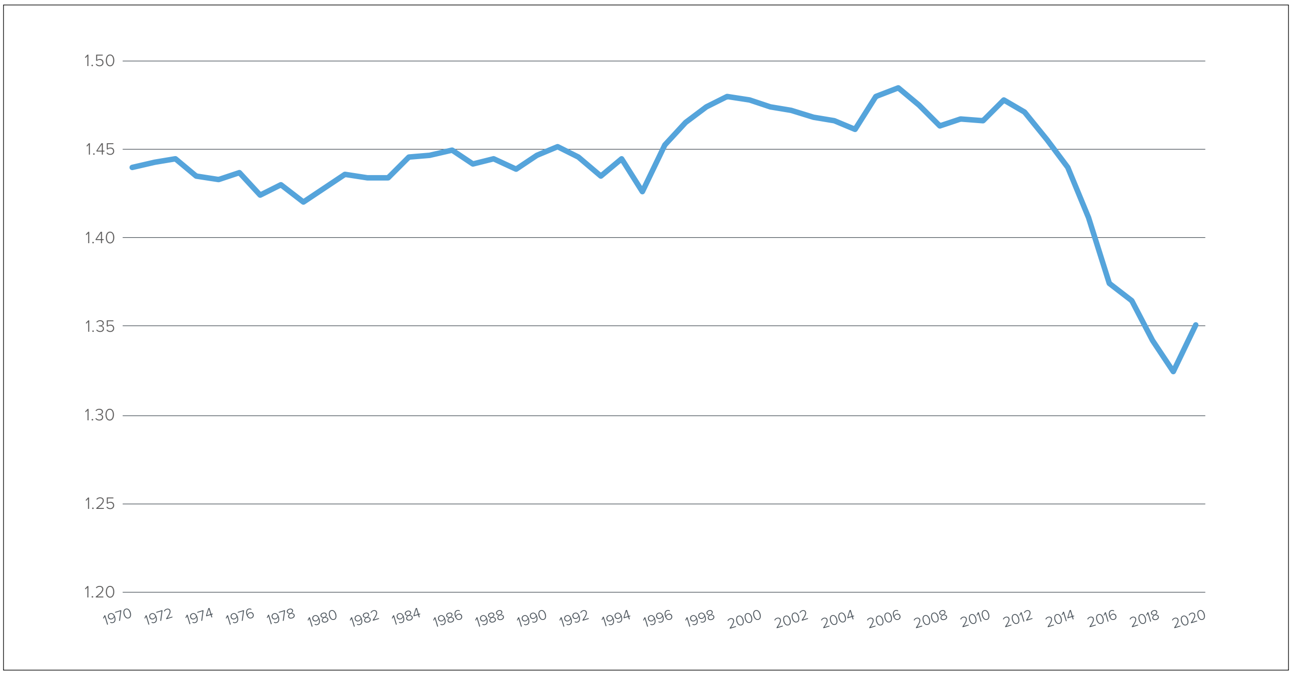

Figure 4: Ratio of Total Primary Energy to Final Energy Consumption 1970 to 2020. Source: National Statistics, calculations and chart by the author.

Indeed, electricity consumption itself is also falling (Figure 5). The use of electricity has been on a rising trend, with perturbations, from the introduction of this energy carrier up until 2005, when consumption flatlined until 2008. Then, and coincident with the financial crisis, it started to fall, a decline that has continued to the present day. Consumption is now 22 per cent below its 2005 peak, at levels last seen in the late 1980s and early 1990s, in spite of a marked increase in population.

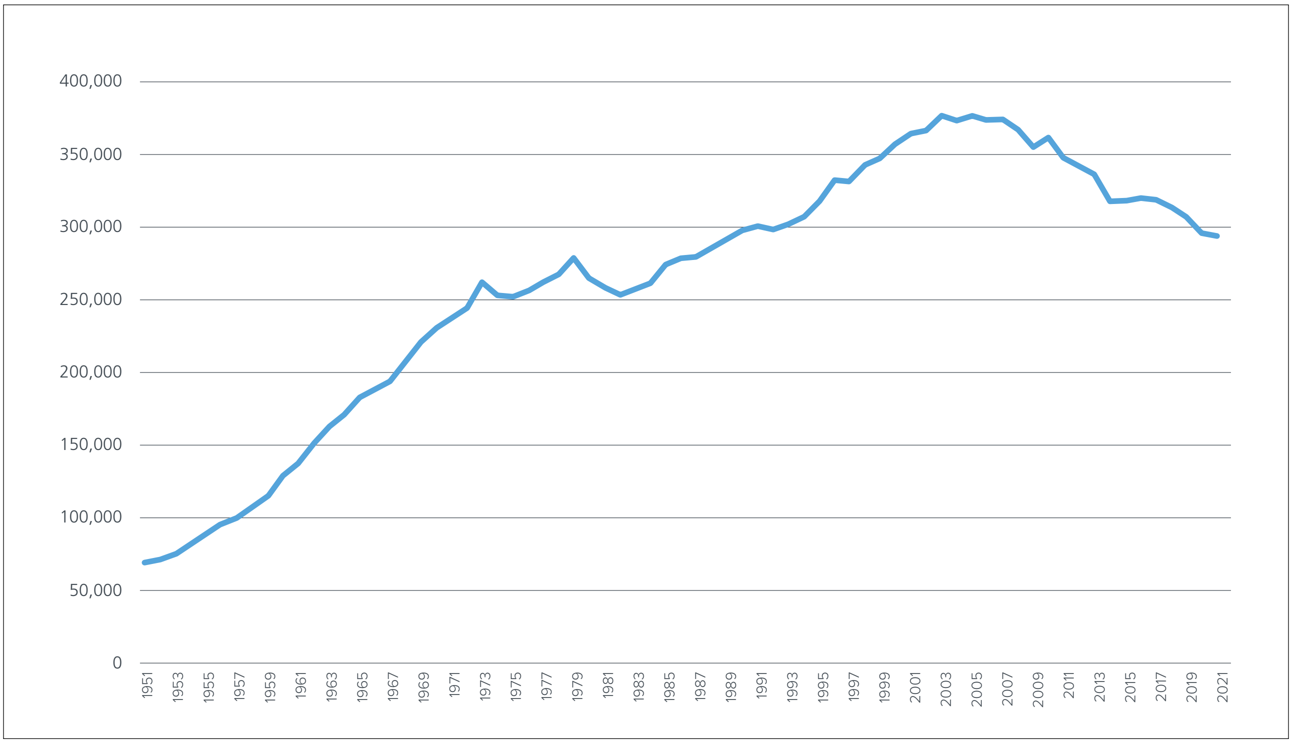

Figure 5: Electricity Supplied in United Kingdom (GWh) 1951 to 2021. Source: BEIS, chart by the author.[6]

The perturbations in the early 1970s should be noted as broadly similar to those evident in both TPE and FEC, with the subsequent steady increasing trend from the early 1980s to the early 2000s also being similar. The collapse in demand for electrical energy after 2005 is unprecedented. This is particularly striking since the use of this flexible energy carrier is practically the index of an increasingly modern society, being easily transmitted with low losses over long distances, clean at the point of use, and adaptable to a very wide range of purposes from heating and cooling, the operation of machines and the energisation of digital computers. Falling electricity consumption is an unequivocally alarming indicator.

"Consumption is now 22 per cent below its 2005 peak, at levels last seen in the late 1980s and early 1990s."

It is clear that something occurred in the early 2000s, and particularly after about 2005/2008, that has affected both total primary and final energy consumption. The question is: What? One strong candidate explanation arises from the fact that in broad terms the observed fall coincides with the introduction of environmental policies, including Emission Trading and the use of subsidies levied on consumer bills to fund the coerced introduction of otherwise uneconomic renewable energy. The Renewables Obligation, for example, introduced in 2002 to support renewable electricity generation, is now closed to new entrants but continues to add just £7 billion a year to consumer bills, with a grand total since its introduction of about £50 billion.

The Office for Budget Responsibility (OBR's) successive Economic and Fiscal Outlooks from 2010 record that Environmental Levies rose from about £500 million per year in 2010 to about £8.5 billion per year in 2020-2021, not including, for technical reasons, the costs of the Feed-in Tariff to small scale renewables, which now amounts to about £1.75 billion per year,[7] giving a total cost to consumers of about £10 billion a year.[8]

Table 1. Environmental Levies (£ billion)

	£ billion Outturn 2020-21	Forecast 2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Renewables obligation	6.3	6.3	6.8	7.2	7.5	7.7	7.9
Contracts for difference	2.2	0.2	-0.7	1.4	3.2	3.3	4.5
Capacity market[1]	0.0	0.9	0.7	0.9	1.1	1.5	1.5
Green gas levy	0.0	0.0	0.1	0.1	0.2	0.2	0.1
Environmental levies	8.5	7.4	6.9	9.6	11.9	12.6	14.1
Memo: Expenditure on renewable heat incentive (RHI)	0.9	1.0	1.1	1.2	1.2	1.2	1.2

Note:

The 'Environmental levies' line above is consistent with the 'Environmental levies' line in Table 3.4 of the March 2022 Economic and fiscal outlook.

Redrawn from Office for Budget Responsibility, Economic and fiscal outlook – March 2022, Supporting Documents, Supplementary fiscal tables: receipts and other, Tab 2.7.[9] Note that the OBR does not, though it should, include the costs to consumers of the Feed-in Tariff for small scale renewables.

The ONS have yet to include capacity market auctions in their outturn numbers. If they were included, they would have been £1.1bn.

To this must be added the increased costs of electricity system balancing, which have risen from about £400 million a year in the early 2000s to about £3 billion a year in 2021/2022,[10] and the cost of emissions trading, which at the beginning of the 3rd Phase of the EU ETS added about £500 million per year, but has risen and under the successor UK ETS is reported by the OBR to be adding about £1.5 billion a year to energy costs.

"Environmental Levies rose from about £500 million per year in 2010 to about £8.5 billion per year in 2020-2021"

Taken together these additional policy costs will be adding some £15 billion a year to the national energy bill, exerting a price rationing effect that discourages energy consuming activity within the UK. About one third of this total impact – £5 billion, or about £170 per household per year – will hit the household directly through electricity bills, and the other two thirds – £10 billion, or about £350 per household per year – through cost of living as industrial, commercial consumers pass on their share of the burden in prices of goods and services.[11] If Tesco has to pay more to refrigerate milk, then it must recover that cost at the checkout. It is also worth remarking that these costs affect households via downward pressure on wages and reduced rates of employment.

As can be seen in the author's just-published study of the impact of energy and climate policies on the EU member states, Europe's Green Experiment (2022),[12] similar though still greater impacts are registered in the EU, where emissions trading added somewhere in the region of €78 billion to consumer costs between 2013 and the present day, with the annual cost in the EU-27 now amounting to about €17 billion a year. Subsidies to renewables, excluding tax expenditures, cost EU consumers about €770 billion between 2008 and the present day, with annual costs to the EU-27 now amounting to about €69 billion a year. Unsurprisingly, retail energy costs in the EU are significantly higher than those in the non-EU G20, domestic electricity prices being 80 per cent higher and industrial electricity prices some 30 per cent higher.

The European Union also exhibits the marked falling trends in energy consumption observed in the UK, which contrasts sharply with the rising energy consumption of the Asian economies. Chinese energy consumption in 2019 was almost four times consumption in 1990, and nearly double that in 2005, the majority of these increases being accounted for by thermodynamically competent fossil fuels.

It is objectively surprising that the falling consumption of energy, and particularly electricity, is not more widely discussed. Seen through the lens of statistical thermodynamics, economic wealth may be described as an improbable state of matter serving a human requirement, with rich societies being typically characterised as extremely distant from equilibrium, which is to say that they are, statistically speaking, extremely improbable. Such highly unlikely and, for humans, desirable states of affairs are created, and, crucially, maintained by a continuous and adequate energy input. Otherwise, the system will begin to decay towards equilibrium, becoming more and more probable and progressively less and less hospitable to human needs.

“Falling energy consumption implies a strong likelihood of societal decay.”

This not arguable, being axiomatic; without adequate energy input the society will be far less wealthy; there will be a reduction in human well-being. There is therefore good reason for concluding that the historically unprecedented falls in energy consumption registered in the United Kingdom are already jeopardising our prosperity. To a large degree the population has been anaesthetised by imports of consumer goods, improbable states of matter realised very largely in Asia, but these are not a reliable substitute for local production, being vulnerable to tactical and strategic interruption. Furthermore, and crucially, they can only play a limited role in maintaining, let alone increasing, the non-equilibrium status of the total human sphere in the United Kingdom, stretching from infrastructure to institutions and through to the reproduction of knowledge in intellectual traditions. Falling energy consumption implies a strong likelihood of societal decay.

Notes

1. Gov.uk, 'Energy consumption in the UK 2021', https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2021

2. Gov.uk, 'Energy consumption in the UK 2021', https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2021

3. W. S. Coal Question (London, 1865), p.105. Liebig's remark appears in Justus von Liebig, *Familiar Letters on Chemistry* (Taylor, Walton, & Maberly: London, 1851), 462, and reads: 'Cultivation is the economy of force. Science teaches us the simplest means of obtaining the greatest effect with the smallest expenditure of power, and with given means to produce a maximum force.'

4. Recent academic literature on the Jevons Paradox can be sampled via Blake Alcott, 'Jevons' paradox', *Ecological Economics* 54 (2005), 9-21; and John Polimeni et al. eds, *w* (Earthscan: Abingdon, 2008); but there is no adequate or necessary substitute for a careful reading Jevons' original chapter on the subject.

5. Gov.uk, 'Energy consumption in the UK 2021', https://www.gov.uk/government/statistics/energy-consumption-in-the-uk-2021

6. Gov.uk, 'Historical electricity data', https://www.gov.uk/government/statistical-data-sets/historical-electricity-data

7. Ofgem, 'Feed-in Tariff (FIT): Annual Report 2020-21', https://www.ofgem.gov.uk/publications/feed-tariff-fit-annual-report-2020-21

8. OBR, 'Economic and fiscal outlook – March 2022', https://obr.uk/efo/economic-and-fiscal-outlook-march-2022/

9. OBR, 'Economic and fiscal outlook – March 2022', https://obr.uk/efo/economic-and-fiscal-outlook-march-2022/

10. National Grid ESO, 'Monthly Balancing Services Summary (MBSS)', https://data.nationalgrideso.com/balancing/mbss

11. Assuming approximately 28 million households in the UK: ONS, 'Families', https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families

12. The Global Warming Policy Foundation, 'Europe's Green Experiment', https://www.thegwpf.org/europes-green-experiment/

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