Renegotiating British Energy Policy: An international comparison of energy costs and policies

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1. Introduction and summary

This report is the first of a suite of reports commissioned by Civitas to investigate the impact of energy policies and prices on UK manufacturers and consumers.

It estimates the expenditure on energy by UK manufacturing; the comparative prices of energy for manufacturers in 10 other countries; and calculates how much UK manufacturers would be paying directly for energy had they paid the prices prevailing in each of the other 10 countries.

UK manufacturers paid £16.6 billion directly for energy in 2024.

The bulk of this expenditure (£11.7 billion) is on electricity. The other main element is expenditure on gas (£3.3 billion).

The prices paid by manufacturers for both electricity and gas in the UK are significantly higher than in all the comparator countries.

For electricity, the UK price is six times that in the cheapest of the comparator countries (China) and four times that in the US. Even comparing with the higher prices paid in European countries, the UK price is double the cost in France, and 70–75 per cent higher than in Germany and Italy.

For gas, the UK price is five times that in the US. But even in the relatively higher cost countries like Japan, China, Korea and Germany, the UK price is between four per cent and 25 per cent higher.

Because of the higher prices that UK manufacturers pay for both electricity and gas, had they purchased the same quantities at the prices paid by manufacturers in the comparator countries, UK manufacturers would make big savings.

At US prices, UK manufacturers would pay only £5.2 billion directly for their energy, a saving of 69 per cent.

At Chinese prices, UK manufacturers would pay £6.4 billion, a saving of 61 per cent.

Even in the comparator country with the highest energy prices (Germany), UK manufacturers would have saved 32 per cent and paid £11.3 billion instead of £16.6 billion, had they paid German prices.

The full set of comparisons, with the savings, had UK manufacturers paid the prices in the comparator countries, is set out in Table 1.1.

Table 1.1: Savings if UK manufacturers in 2024 had paid the prices charged to their equivalents in other countries

	Total cost	Percentage of UK cost	Saving
Country	£ billion	%	£ billion
UK	16.6	100	0
China	6.4	39	10.2
United States	5.2	31	11.4
Japan	8.7	53	7.9
Germany	11.3	68	5.3
India	6.4	39	10.2
South Korea	9.8	59	6.8
Italy	10.8	65	5.8
France	9.5	57	7.1
Spain	8.5	52	8.0
Turkey	6.2	38	10.3

Source: Authors' analysis.

2. Background and objectives

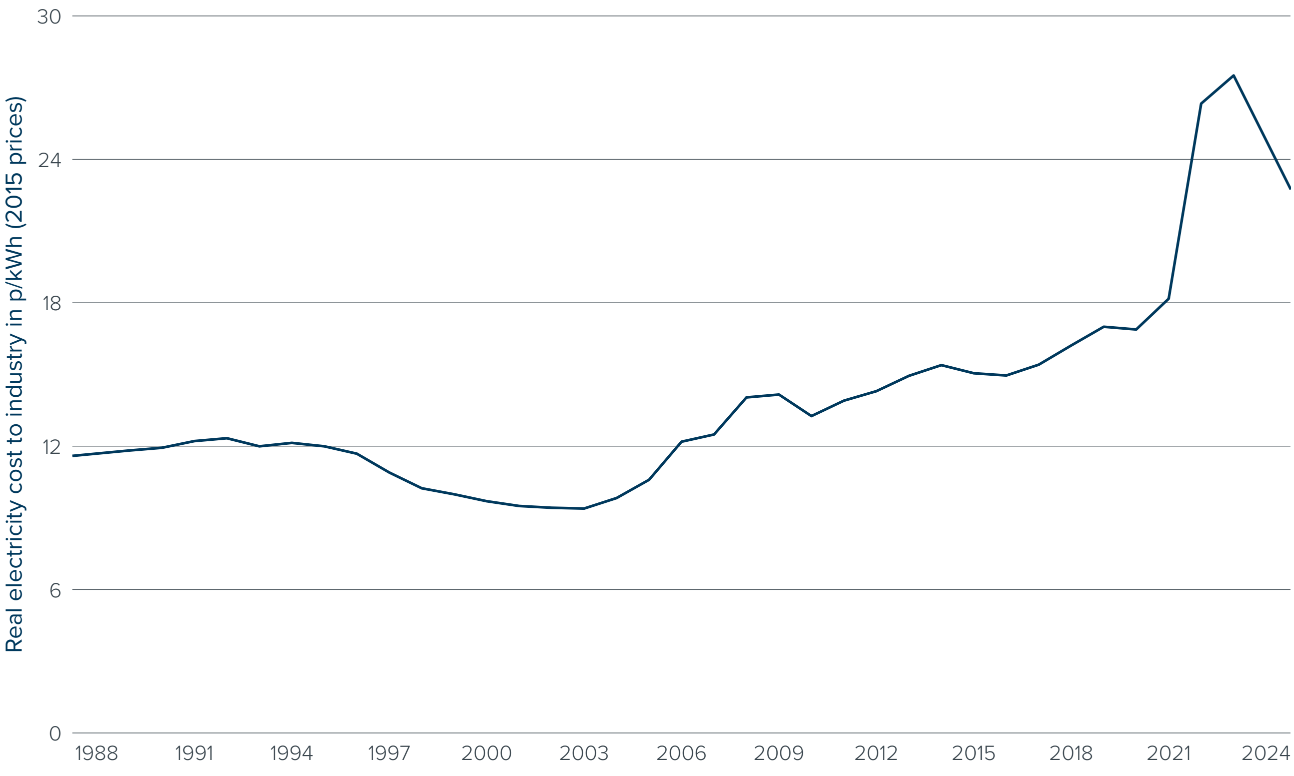
The report compares the UK with 10 countries that are trading partners or competitors in manufacturing, considering energy and environmental policies, pricing and the approach to infrastructure cost recovery.

Because the bulk of the direct energy expenditure by UK manufacturers is on electricity and because electricity prices vary more between countries than the prices of other forms of energy, the bulk of the analysis will focus on electricity.

2.1 Background

As shown in Figure 2.1, after nearly 2 decades of level electricity prices in real terms, the cost of electricity started to rise in 2008, and since then has doubled. British industry now has some of the highest electricity prices of major economies (Office for National Statistics, 2024), with prices nearly 50 per cent higher than the International Energy Agency median (2023 prices).

Figure 2.1: Real price of electricity for industry



Source: Authors' analysis of Department for Energy Security and Net Zero electricity prices and Office for National Statistics' Consumer Prices Index data.

Against this background, an analysis has been undertaken to consider how the cost of electricity to industry might be reduced if alternative policies are adopted.

2.2 Objectives

The objective of this report is to establish the comparative position of the UK in relation to international competitors, comparing energy policy, the costs of different forms of energy and the impacts of costs on competitiveness.

2.3 Metrics

The analysis considers the following metrics:

- energy policy, specifically focusing on decarbonsiation commitments;
- net zero target dates;
- historic trends in generation technology and fuel use;
- historic electricity demand growth;
- electricity tariff for industrial consumers;
- cost of electricity generation for the system, given the latest fuel and technology mixes;
- difference between the cost of production and the selling price; and
- an analysis of the taxes and subsidies embedded in the selling price.

2.4 Methodology and data sources

The methodology used in preparation of this report begins with identifying a selection of countries for comparison, based on their ranking as manufacturing nations, magnitude of non-fuel imports to the UK, and availability of energy data. It then proceeds with a review and analysis of nationally determined contributions under the Paris Agreement and declared national policies for decarbonisation and energy transition; and an analysis of technology and fuel usage for electricity generation in latest year.

We conduct an analysis of trend for consumption growth and technology and fuel usage for electricity generation over the period 1990 to 2024, and an assessment and comparison of international industrial electricity prices by nation.

The data for this analysis comes from recognised national and industry sources, including: the Department for Energy Security and Net Zero (UK), the Office for National Statistics (UK), the International Energy Agency, US Energy Information Administration, the United Nations Framework Convention on Climate Change, as well as national government and energy supplier websites. Data from these sources have been combined in the authors' models to undertake the analyses.

The main sources of data do not always cover all of the comparator countries, and hence alternative data sets have been used. These data sets have been cross-checked for consistency, cross-matching data from previous years and overlapping countries.

3. Selection of countries for comparison

In accordance with the study objectives, 10 countries are selected that are trading partners with the UK or competitors in manufacturing, for comparison of energy policy, historic generation development and costs of energy supply.

3.1 Rationale for selection

Countries have been selected for comparison largely on the basis of their size as manufacturing nations and their trading status with the UK. As part of the focus of this suite of reports, we wish to assess whether high energy prices in the UK have resulted in deindustrialisation and off-shoring of manufacturing. (The metric used for trading is the value of imports excluding fuel.)

Countries where the bulk of import value to the UK is for fuel, such as from Norway, have been omitted. Similarly, for countries where the value is for *entrepôt* trade, such as Ireland, Belgium and the Netherlands, have also been omitted.

The selected countries also illustrate a diverse range of electricity generation strategy, as illustrated by the charts setting out the generation mix in Section 3.3.

3.2 Countries selected

The countries selected are listed in Table 3.1.

Table 3.1: Countries selected for comparison

		Ranking		Data sources					
ID	Country	Top 10 manufacturing countries	Import (excl. fuel)	Nationally determined contributions sub date	US Energy Information Administration data 2024	Non-domestic electricity prices	Non-domestic in EU large	Industrial gas prices in International Energy Agency	GlobalPetrolPrices database
1	UK	10	n/a	03/01/2025	Y	2024	2024	2024	Y
2	China	1	2	03/11/2025	Y				
3	United States	2	3	19/12/2024	Y	2021		2023	Y
4	Japan	3	14	18/02/2025	Y	2024		2023	Y
5	Germany	4	1	05/11/2025	Y	2024	2024	2024	Y
6	India	5	13	24/04/2026	Y				Y
7	South Korea	6	17	26/12/2025	Y	2024		2024	Y
8	Italy	8	7	05/11/2025	Y	2024	2024	2024	Y
9	France	9	5	05/11/2025	Y	2024	2024	2024	Y
10	Spain		8	05/11/2025	Y	2024	2024	2024	Y
11	Turkey		12	09/11/2025	Y	2024		2024	Y

Source: Authors' analysis.

A brief synopsis of the reasons for selection of each country is provided in Table 3.2.

Table 3.2: Reasons for selection of comparator countries

ID	Country	Comment
1	UK	The UK is the base country for this analysis
2	China	Largest manufacturer and 2nd largest source of imported goods to the UK
3	United States	One of the largest manufacturers and leading UK trade partner
4	Japan	Top 3 manufacturer
5	Germany	Major manufacturer trade partner; largest source of imported goods to the UK
6	India	Major manufacturing nation
7	South Korea	Major manufacturing nation
8	Italy	Top 10 manufacturing nation and top 10 supplier of goods to the UK
9	France	Top 10 manufacturing nation and top 5 trading partner
10	Spain	Top 10 supplier of goods to the UK
11	Turkey	Top 12 supplier of goods to the UK

The selected countries, as well as being important manufacturers and trading partners, represent different approaches to electricity generation, and as discussed in Section 5, have widely different costs of electricity for industry.

3.3 Country generation snapshot

For each of the selected countries, the current (2024) electricity generation parameters are presented below, showing the share of energy generation by each technology in the pie charts, with the installed capacity and energy generation data presented in the accompanying tables. This data is derived from the US Energy Information Administration's international database for electricity of over 200 countries (US Energy Information Administration, 2026), processed and displayed using the authors' international energy comparison model.

Most countries are shaping their energy policies to align with their commitments to energy transition under the 2015 Paris Agreement that was adopted as a legally binding treaty by 195 countries at the UN Climate Change Conference (COP21) in Paris.

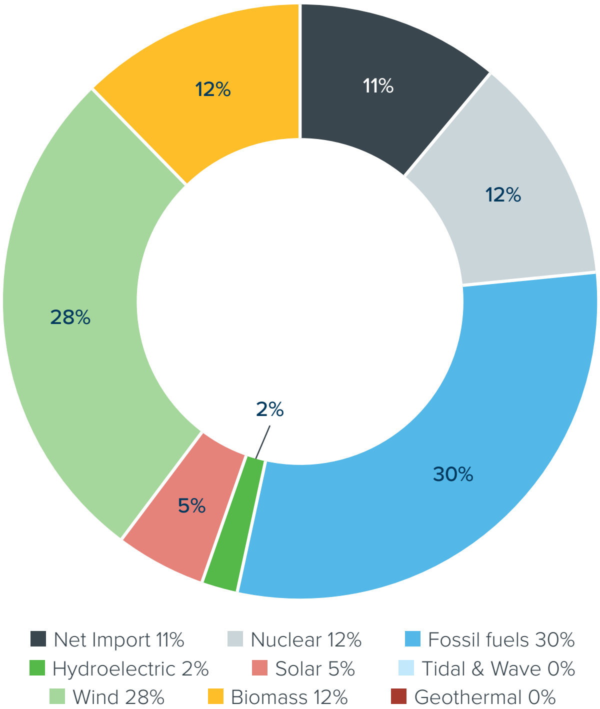
Hence a primary source of information on energy policies and strategies is found in the nationally determined contributions submitted by each country to communicate the actions they will take to reduce their greenhouse gas emissions.

While other policies and statements are issued by national governments from time to time, the nationally determined contributions provide a comparable basis for evaluation of each country's commitments. The energy policies are therefore compared on the basis of the current versions of the nationally determined contributions, as accessed from the Nationally Determined Contributions Registry (UNFCCC, 2026).[1]

1 United Nations Climate Change. *NDC Registry*. Available at: https://unfccc.int/NDCREG

3.3.1 United Kingdom

Figure 3.1: UK electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.3: UK electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Capacity / Generation	114.6	267,980	27%	
Est. Peak demand / Consumption	41.8	274,594	75%	
Capacity margin / export / losses	174%	-2%		
Export		10,325		3.9
Import		43,733		15.9
Net Import		33,408		12.2
Nuclear	5.9	37,341	72%	13.6
Fossil fuels	47.9	90,494	22%	33.0
Coal		1,980		0.7
Natural gas		85,554		31.2
Oil		1,326		0.5
Other gases		1,634		0.6
Renewables (all)	57.9	140,765	28%	51.3
Hydroelectric	1.9	5,914	36%	2.2
Non-hydro Renewables	56.1	134,851	27%	49.1
Solar	17.6	14,796	10%	5.4
Tidal & Wave	0.0	10	11%	0.0
Geothermal	0.0	0		
Wind	30.9	82,855	31%	30.2
Biomass	7.5	37,190	56%	13.5
Pumped storage (% of peak demand)	2.9	-620		7

Source: Authors' analysis of US Energy Information Administration data.

The UK currently has very diverse electricity generation technologies, with 51.3 per cent of consumption supplied by renewables, 33 per cent by fossil fuels (gas) and 13.6 per cent from nuclear. A further 12.2 per cent of consumption is supplied by net imports. Electricity supply (generation plus net imports) exceeds consumption by around 10 per cent, which reflects losses in transmission and storage. The UK's capacity margin (megawatt [MW] of capacity exceeding peak demand) of 74 per cent overstates the security of the system. However, with considerable capacity of underutilised fossil fuel plants still on the system (average capacity factor of 22 per cent), the despatchable capacity margin (MW of despatchable generation exceeding peak demand) is still a comfortable 58 per cent.

The UK's nationally determined contributions

Extracts from the Nationally Determined Contributions of January 2025 reveal that:

Main governing objective for energy:

Making Britain a clean energy superpower is one of the five national missions of this government. In December 2024, we published the Clean Power 2030 Action Plan: A new era of clean electricity, setting out how we will deliver ***clean power in Great Britain by 2030****.*

The UK is committed to transitioning away from fossil fuels to achieve ***net zero by 2050****.*

Actions and other targets:

We have lifted the onshore wind ban, consented large amounts of solar, delivered a record-breaking renewables auction, launched Britain's carbon capture industry and set out plans to increase the energy efficiency of rented homes to take a million households out of fuel poverty.

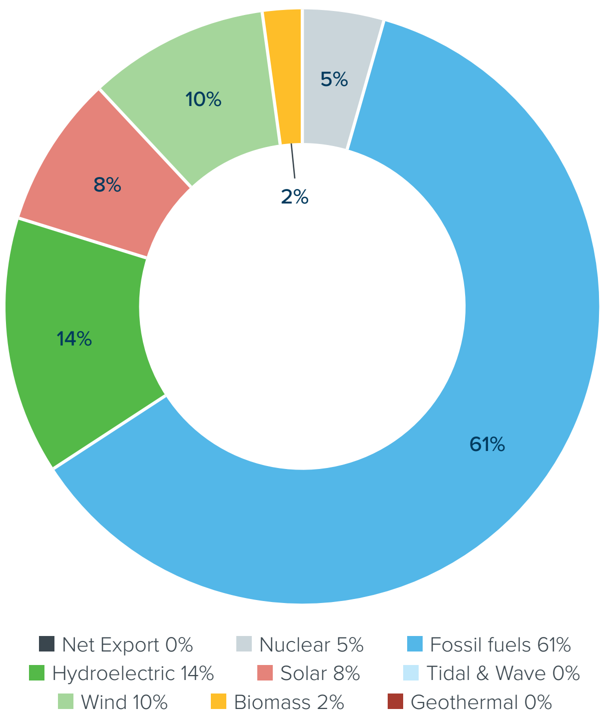
… at least 81% reduction in total net GHG emissions and removals in 2035 compared to the base year.

We will consult on our commitment to not issue new oil and gas licenses to explore new fields. Further emissions reductions from upstream oil and gas will be delivered through decarbonisation measures set out in the North Sea Transition Authority's 2024 OGA Plan36, such as ending routine flaring and venting by 2030 and platform electrification. The UK oil and gas sector has one of the lowest upstream methane emission intensities globally, having achieved the Oil and Gas Climate Initiative's 0.2% intensity target for 2025 early.

On 4th October 2024, the government reached commercial agreement with the private sector and announced up to £21.7bn of available funding over 25 years to launch the UK's new carbon capture, usage and storage (CCUS) and hydrogen industries to make the UK an early leader in these two growing global sectors.

3.3.2 China

Figure 3.2: China electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.4: China electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	1490.7	9,793,703	75%	
Capacity margin / export / losses	127%	4%		
Export		22,000		0.2
Import		5,000		0.1
Net Import		-17,000		-0.2
Nuclear	55.3	450,845	93%	4.6
Fossil fuels	1,444.5	6,248,396	49%	63.8
Coal		5,774,942		59.0
Natural gas		303,816		3.1
Oil		9,638		0.1
Other gases		160,000		1.6
Renewables (all)	1,818.3	3,480,263	22%	35.5
Hydroelectric	377.3	1,424,000	43%	14.5
Non-hydro Renewables	1,441.0	2,056,263	16%	21.0
Solar	886.7	839,040	11%	8.6
Tidal & Wave	0.0	7	17%	0.0
Geothermal	0.0	176	78%	0.0
Wind	521.7	997,040	22%	10.2
Biomass	32.6	220,000	77%	2.2
Pumped storage (% of peak demand)	58.7	-18,000		4

Source: Authors' analysis of US Energy Information Administration data.

China's electricity supply is still dominated by coal-fired generation, despite producing more photovoltaic and more wind energy than the rest of the comparator countries combined. China has continued its coal-fired power station construction for the past 25 years and now produces more than five times as much coal-fired energy as in 2000. There has been little progress in gas-for-coal substitution, and only around five per cent of generation comes from gas. Nuclear energy accounts for around five per cent of generation, which together with wind, photovoltaic, hydropower and biomass means that some 40 per cent of electricity comes from low carbon sources.

China's nationally determined contributions

From the Nationally Determined Contributions of November 2025 (submitted in Chinese), this analysis is extracted from the 2035 NDC Climate Action Tracker (Climate Action Tracker, 2026).

Main governing objective for energy:

China will, by 2035 reduce economy-wide net greenhouse gas emissions by 7-10% from peak levels, striving to do better.

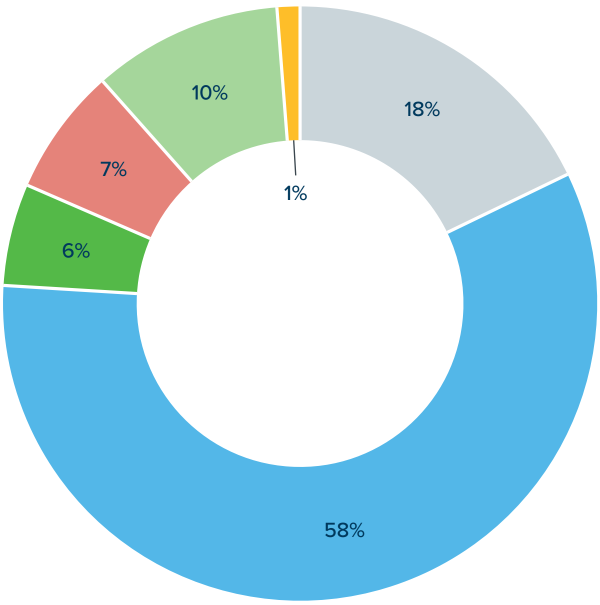
Net zero target year is 2060.

Actions and other targets:

The other two 2035 NDC targets — raising the share of non-fossil fuels in total energy consumption to over 30 percent and expanding installed wind and solar capacity to 3,600 gigawatts.

3.3.3 United States

Figure 3.3: United States electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.5: US electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	638.4	4,194,340	75%	
Capacity margin / export / losses	101%	5%		
Export		19,437		0.4
Import		33,254		0.8
Net Import		13,817		0.3
Nuclear	98.4	781,865	91%	18.6
Fossil fuels	710.9	2,547,988	41%	60.7
Coal		652,156		15.5
Natural gas		1,869,902		44.6
Oil		15,084		0.4
Other gases		10,845		0.3
Renewables (all)	451.2	1,068,551	27%	25.5
Hydroelectric	79.9	242,896	35%	5.8
Non-hydro Renewables	371.3	825,655	25%	19.7
Solar	176.7	303,752	20%	7.2
Tidal & Wave	0.0	0		
Geothermal	2.7	15,407	65%	0.4
Wind	152.1	451,904	34%	10.8
Biomass	39.8	54,592	16%	1.3
Pumped storage (% of peak demand)	23.2	-5,852		4

Source: Authors' analysis of US Energy Information Administration data.

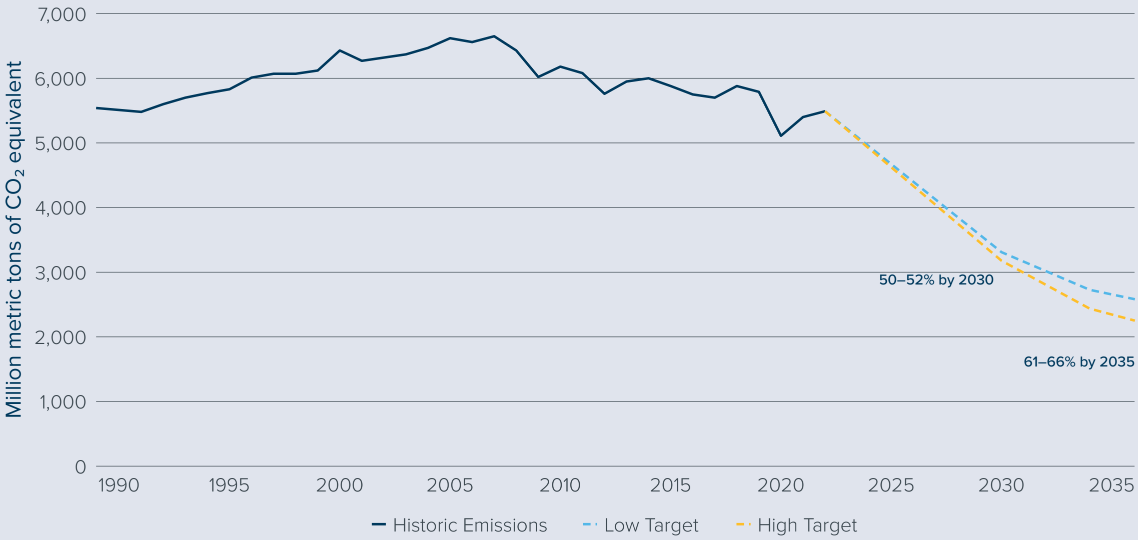
The United States is the second largest consumer of electricity of our comparator countries, some 43 per cent of the electrical energy consumed by China, and nearly 2.5 times as much as India, the next largest consumer. Despite being the second largest generator of renewable energy, in percentage terms the US is lagging behind our selected countries, with only South Korea producing less of its electricity from renewables. While the US still produces the majority (60 per cent) of its electricity from fossil fuels, most of this (75 per cent) is now produced from gas. Only 15 per cent of US electricity is now produced from coal, down from over 50 per cent at the turn of the century. Nuclear energy remains an important contributor to the system, accounting for 18 per cent of generation.

United States' nationally determined contributions

Extract from the Nationally Determined Contributions of December 2024 specifies that:

Main governing objective for energy:

… the United States is communicating an economy-wide target of reducing its net greenhouse gas emissions by 61-66 percent below 2005 levels in 2035. The entire 2035 range is on a straight line or steeper trajectory to ***net zero emissions by 2050*** *for all greenhouse gases.*



Actions and other targets:

New technology-neutral tax credits for zero-emissions electricity production, created by the IRA, are underpinning historic private-sector investment in clean electricity generation, with most 2024 capacity additions coming from wind, solar, and battery storage. New federal regulations require power companies to control pollution from coal and new gas-fired power plants, further cutting greenhouse gas emissions and protecting public health. States have also increasingly adopted policies to drive toward 100 percent clean electricity. Together, these policies put the power sector on track to meet ***nearly 80 percent of electricity demand with clean electricity by 2035****.*

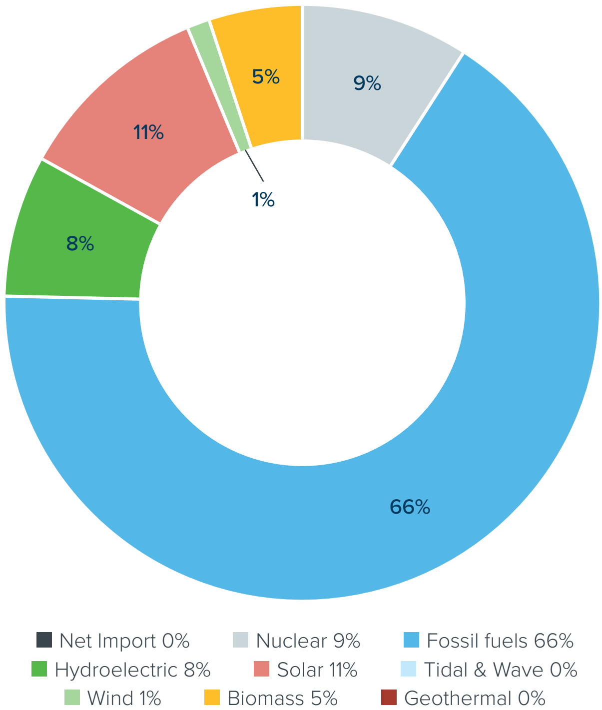
Subnational governments and Tribal governments across the United States will also continue to support the existing nuclear fleet and take advantage of carbon capture technologies to cut pollution from existing power plants, while ensuring those facilities meet robust and rigorous standards for worker, public, and environmental safety as well as environmental justice.

Research, development, demonstration, commercialization, and deployment of new and existing technologies, including storage, improved distribution system infrastructure and smart demand management, by private sector leaders with robust public sector support, will foster a clean, flexible, resilient, reliable, and affordable electricity system. By further accelerating deployment at the subnational level, the power sector can meet the national goal of ***100 percent clean electricity by 2035*** *and achieve additional reductions aligned with the 2035 U.S. NDC.*

(The US has formally withdrawn from the Paris Agreement, taking effect in January 2026. Hence this nationally determined contribution is no longer legally binding. However it, and its previous version, governed the direction of US energy policy in recent years.)

3.3.4 Japan

Figure 3.4: Japan electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.6: Japan electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	130.7	858,563	75%	
Capacity margin / export / losses	170%	6%		
Export		0		
Import		0		
Net Import		0		
Nuclear	12.6	82,963	75%	9.7
Fossil fuels	187.0	603,186	37%	70.3
Coal		258,666		30.1
Natural gas		308,997		36.0
Oil		17,541		2.0
Other gases		17,983		2.1
Renewables (all)	126.3	227,883	21%	26.5
Hydroelectric	22.2	69,886	36%	8.1
Non-hydro Renewables	104.1	157,997	17%	18.4
Solar	91.6	97,123	12%	11.3
Tidal & Wave	0.0	0		
Geothermal	0.5	3,520	87%	0.4
Wind	5.8	11,166	22%	1.3
Biomass	6.2	46,188	85%	5.4
Pumped storage (% of peak demand)	27.3	-7,018		21

Source: Authors' analysis of US Energy Information Administration data.

Despite having a population 80 per cent larger and a nominal gross domestic product (GDP) only just larger than the UK, Japan consumes more than 3 times as much electricity. Over two-thirds of Japan's electricity generation comes from fossil fuels, around 43 per cent of which is coal. Nuclear generation, which accounted for 25 per cent of generation in 2010 prior to the Fukushima accident (down from 30 per cent at the turn of the century), fell to zero in 2014. Since then, nuclear has increased progressively and now accounts for nearly 10 per cent of generation.

Japan's nationally determined contributions

An extract from the Nationally Determined Contributions for 2035–2040 of February 2025 states:

Main governing objective for energy:

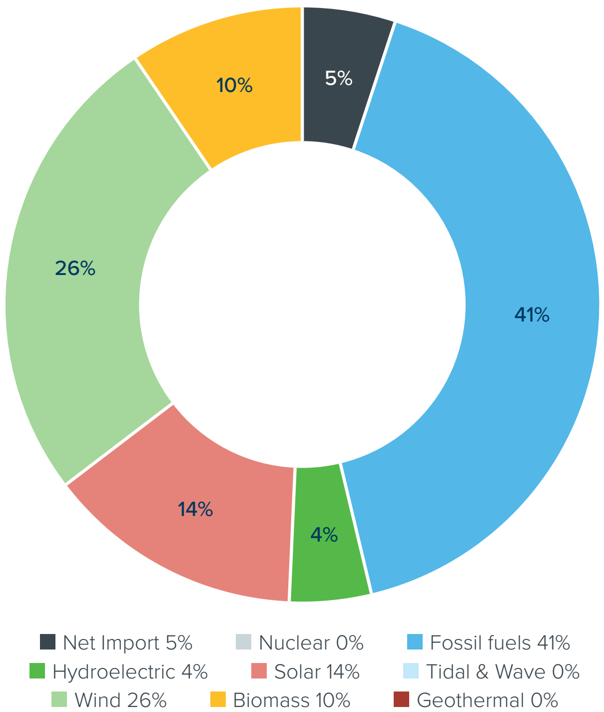
Japan aims to reduce its greenhouse gas emissions by 60 percent in fiscal year (FY) 2035 and by 73 percent in FY 2040, respectively, from its FY 2013 levels, as ambitious targets aligned with the global 1.5°C goal and on a straight pathway towards the achievement of ***net zero by 2050****.*

Actions and other targets:

… tripling renewable energy capacity globally and doubling the global average annual rate of energy efficiency improvements by 2030, as well as accelerating efforts towards the phase-down of unabated coal power, transitioning away from fossil fuels in energy systems, accelerating zero- and low-emission technologies.

3.3.5 Germany

Figure 3.5: Germany electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.7: Germany electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	74.6	490,353	75%	
Capacity margin / export / losses	285%	0%		
Export		55,389		11.3
Import		81,658		16.7
Net Import		26,269		5.4
Nuclear	0.0	0		
Fossil fuels	100.0	214,068	24%	43.7
Coal		109,158		22.3
Natural gas		91,992		18.8
Oil		4,913		1.0
Other gases		8,005		1.6
Renewables (all)	177.9	279,331	18%	57.0
Hydroelectric	5.1	23,085	52%	4.7
Non-hydro Renewables	172.8	256,246	17%	52.3
Solar	89.9	72,428	9%	14.8
Tidal & Wave	0.0	0		
Geothermal	0.0	138	36%	0.0
Wind	72.8	134,301	21%	27.4
Biomass	10.0	49,379	56%	10.1
Pumped storage (% of peak demand)	9.4	-3,222		13

Source: Authors' analysis of US Energy Information Administration data.

Germany produces its electricity from a diverse range of generation sources, although notably not from nuclear. In 2011 the Bundestag decided to phase out nuclear generation, and no nuclear energy has been produced since 2023. Germany has committed to renewable energy technologies, and now 57 per cent of its generation comes from renewables. This is equal highest percentage (with Spain) of our selected countries. Coal-fired generation remains an important part of the electricity grid, although gas-fired generation has caught up, so that coal and gas have approximately equal shares of generation. The country has a large capacity of variable renewables (wind and solar), equal to more than 200 per cent of peak demand. Hence generation swings from large surpluses to deficits, and hence German grid security depends on both imports and exports with its neighbours.

Germany's nationally determined contributions

One extract from the Nationally Determined Contributions of November 2025 (note, this is entirely based on the EU's and member states' nationally determined contributions and does not specifically address Germany):

Main governing objective for energy:

Overall, provisional data for 2023 shows that the EU's net GHG emissions are currently in line with a linear reduction from 2020 to the EU's 2030 target of reducing GHG emissions by at least 55% compared with 1990 levels.

*Transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner, accelerating action in this critical decade, so as to achieve **net zero by 2050**.*

Actions and other targets:

Tripling renewable energy capacity globally and doubling the global average annual rate of energy efficiency improvements by 2030.

The EU agreed to increase ambition on energy savings through an enhanced target to reduce final energy consumption at EU level by 11.7% in 2030 compared to the projections of the 2020 EU Reference Scenario and a new target to ensure that the share of energy from renewable sources in the EU's gross final consumption of energy in 2030 is at least 42.5%.

An additional endeavour to increase the share of energy from renewable sources in the EU's gross final consumption of energy in 2030 to 45%.

The EU and its Member States agreed that the energy sector should be predominantly free of fossil fuels well ahead of 2050 underlining the importance of aiming to achieve a fully or predominantly decarbonised global power system in the 2030s, leaving no room for new coal power.

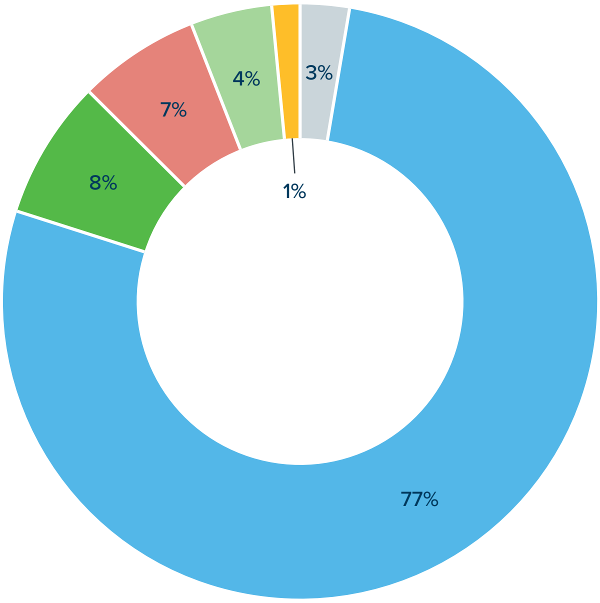
Accelerating efforts globally towards net zero emission energy systems, utilizing zero- and low-carbon fuels well before or by around mid-century.

Accelerating zero- and low-emission technologies, including, inter alia, renewables, nuclear, abatement and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors, and low-carbon hydrogen production.

As EU policy, this strategy also applies to Italy, France and Spain.

3.3.6 India

Figure 3.6: India electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.8: India electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	267.5	1,757,566	75%	
Capacity margin / export / losses	99%	17%		
Export		10,000		0.5
Import		7,700		0.4
Net Import		-2,300		-0.1
Nuclear	7.6	54,707	83%	3.1
Fossil fuels	315.0	1,584,996	57%	90.2
Coal		1,516,879		86.3
Natural gas		60,639		3.5
Oil		4,271		0.2
Other gases		3,207		0.2
Renewables (all)	204.1	412,082	23%	23.4
Hydroelectric	47.3	154,676	37%	8.8
Non-hydro Renewables	156.8	257,406	19%	14.6
Solar	97.4	135,373	16%	7.7
Tidal & Wave	0.0	0		
Geothermal	0.0	0		
Wind	48.2	90,733	22%	5.2
Biomass	11.2	31,300	32%	1.8
Pumped storage (% of peak demand)	4.8	0		2

Source: Authors' analysis of US Energy Information Administration data.

India's power system has grown rapidly since the turn of the century, with an average increase in consumption over this period of nearly six per cent per annum. Despite substantial investment in renewable generation, the grid remains dependent on fossil fuel for 80 per cent of electricity generation, with the great majority of this from coal.

India's nationally determined contributions

Extracts from the Nationally Determined Contributions 2031–2035 of April 2026 state:

Main governing objective for energy:

To achieve about 60 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2035, with the help of transfer of technology and low-cost international finance.

To reduce Emissions Intensity of its GDP by 47 percent by 2035, from 2005 level.

The NDC is structured to enable emission reductions consistent with India's long-term goal of achieving ***net-zero emissions by 2070****.*

Actions and other targets:

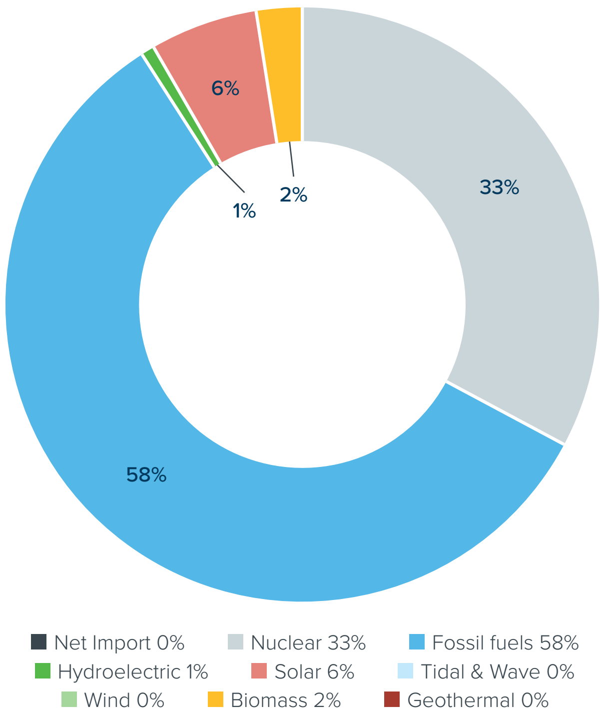
India intends to use voluntary cooperation under Article 6 of the Paris Agreement to facilitate adoption and/or transfer of emerging technologies for the activities as identified and notified by it to the interested Parties from time to time. Some of the key GHG mitigation activities intended to be considered under the Article 6 are green hydrogen; off-shore wind; emerging mobility solutions like fuel cells; green ammonia, carbon capture, utilization and storage; high-end technologies for energy efficiency, etc.

The country is on track to achieve its current NDC (2021-2030). As on 28.02.2026, India's non-fossil fuel based electric power installed capacity was 52.57% of the total installed capacity that demonstrates achievement of one of goals on the aspect five year ahead of the committed timeline. The emission intensity of India's GDP reduced by 36% between 2005 and 2020. India is also on track to create carbon sink of 2.5 to 3.0 billion tonnes through forest and tree cover by 2030 from the baseline of 2005. During 2005 to 2021, carbon sink of 2.29 billion tonnes of CO2 equivalent has been created.

Aligned with Article 2.1(a) of the Paris Agreement, India's NDC supports the shift to a low-emissions development pathway by integrating clean technology solutions across the energy, industrial, transport, and building sectors. This is supported by key national initiatives such as the Green Hydrogen Mission, the National Electricity Plan, and the Carbon Capture, Utilization and Storage (CCUS) framework. The NDC is structured to enable emission reductions consistent with India's long-term goal of achieving net-zero emissions by 2070.

3.3.7 South Korea

Figure 3.7: South Korea electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.9: South Korea electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	84.9	557,840	75%	
Capacity margin / export / losses	88%	4%		
Export		0		
Import		0		
Net Import		0		
Nuclear	25.6	188,754	84%	33.8
Fossil fuels	95.6	334,342	40%	59.9
Coal		154,787		27.7
Natural gas		159,524		28.6
Oil		3,918		0.7
Other gases		16,113		2.9
Renewables (all)	33.8	56,018	19%	10.0
Hydroelectric	1.8	4,230	27%	0.8
Non-hydro Renewables	32.0	51,788	18%	9.3
Solar	26.6	33,685	14%	6.0
Tidal & Wave	0.3	440	20%	0.1
Geothermal	0.0	0		
Wind	2.3	3,324	16%	0.6
Biomass	2.8	14,339	59%	2.6
Pumped storage (% of peak demand)	4.7	-1,307		6

Source: Authors' analysis of US Energy Information Administration data.

South Korea produces its electricity almost equally from coal, gas and nuclear energy. These proportions have persisted since the turn of the century, although coal-fired generation peaked in 2017. Since then, gas has caught up with coal. There has been some growth in renewables over this period, although renewable energy is only 10 per cent of generation – by far the lowest of the selected countries.

South Korea's nationally determined contributions

The following extract from the Nationally Determined Contributions for 2035 of December 2025 reveals:

Main governing objective for energy:

The Republic of Korea has adopted a more ambitious target to achieve ***carbon neutrality by 2050.***

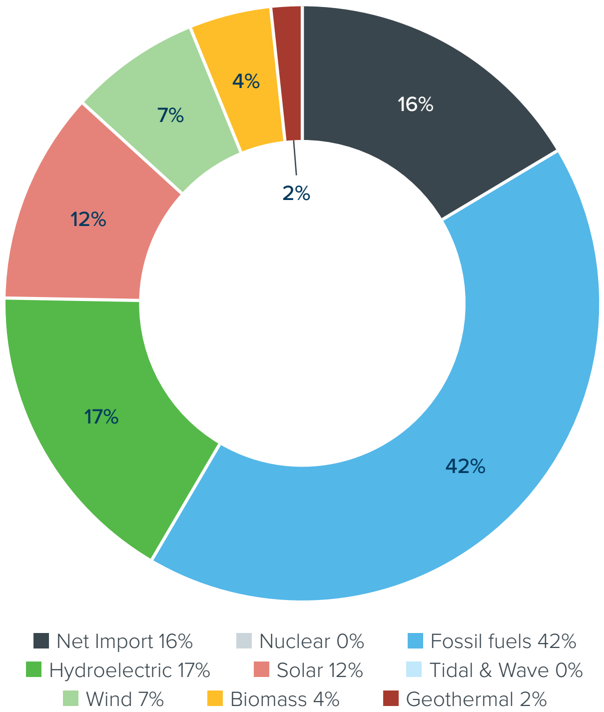
The Republic of Korea's 2035 NDC sets a target at 53 to 61% reduction in net GHG emissions by 2035 compared to the 2018 level (742.3 $MtCO_2eq$). The 53% reduction represents a target along the linear pathway from the base year, 2018, to the target year for carbon neutrality, 2050, while the 61% reduction reflects a more ambitious target enabled by enhanced government efforts, technological innovation and industrial transformation.

Actions and other targets:

The Republic of Korea will expand the deployment of renewable energy and reduce coal and other fossil fuel-based power generation. The share of renewables in power generation, which stands at around 9% in 2024, aims to increase to at least 30% by 2035, while coal-fired power generation is expected to be phased down with a view to achieving a coal phase-out by 2040. The Republic of Korea will diversify sites for solar power installations, including agrivoltaics, floating and industrial-complex solar projects, expand onshore and offshore wind power infrastructure, and reinforce the power grid, including through the establishment of an "energy highway."

3.3.8 Italy

Figure 3.8: Italy electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.10: Italy electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	44.2	290,279	75%	
Capacity margin / export / losses	208%	-11%		
Export		4,908		1.9
Import		55,908		19.3
Net Import		51,000		17.6
Nuclear	0.0	0		
Fossil fuels	61.0	130,522	24%	45.0
Coal		16,675		5.7
Natural gas		103,426		35.6
Oil		9,405		3.2
Other gases		1,017		0.4
Renewables (all)	68.0	129,012	22%	44.4
Hydroelectric	14.8	52,265	40%	18.0
Non-hydro Renewables	53.1	76,746	16%	26.4
Solar	36.0	35,641	11%	12.3
Tidal & Wave	0.0	0		
Geothermal	0.8	5,274	78%	1.8
Wind	13.0	22,010	19%	7.6
Biomass	3.4	13,822	47%	4.8
Pumped storage (% of peak demand)	7.3	-689		16

Source: Authors' analysis of US Energy Information Administration data.

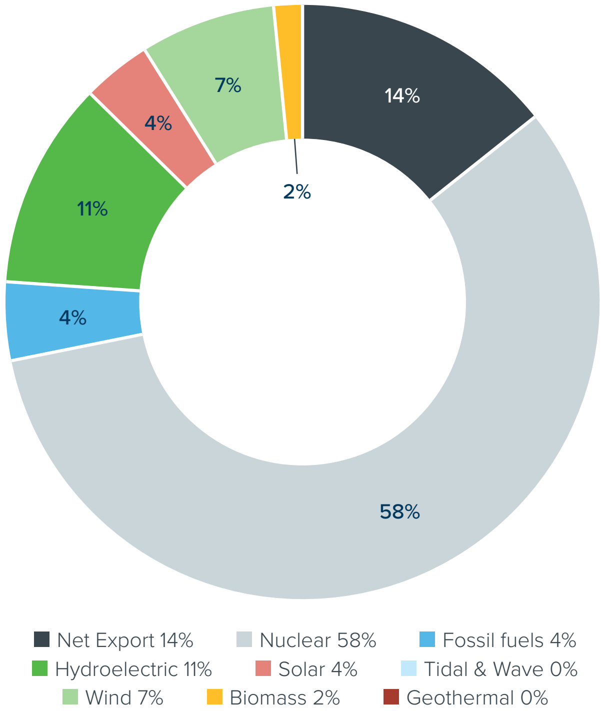
In common with many Western industrialised nations, electricity consumption in Italy has remained fairly constant over the past 25 years. In 2024, electricity consumption was almost identical to that in 2000, and production has fallen. Consequently, Italy's dependency on imports has increased from 15 per cent to nearly 20 per cent over this period. Italy has good hydroelectric resources, producing around 20 per cent of consumption from hydropower. Recent construction of solar and wind generation has increased the share of renewables to 50 per cent of generation, or 44 per cent of consumption. Coal-fired generation in Italy has fallen by two-thirds since 2012 and now accounts for 6 per cent of generation.

Italy's nationally determined contributions

As a member of the EU, Italy follows the same policy as other EU member states, as described for Germany in Section 3.3.5.

3.3.9 France

Figure 3.9: France electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.11: France electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	62.4	409,682	75%	
Capacity margin / export / losses	158%	31%		
Export		104,960		19.5
Import		15,109		3.7
Net Import		-89,851		-21.9
Nuclear	63.0	361,700	66%	88.3
Fossil fuels	21.0	26,754	15%	6.5
Coal		993		0.2
Natural gas		18,430		4.5
Oil		7,004		1.7
Other gases		327		0.1
Renewables (all)	70.1	150,862	25%	36.8
Hydroelectric	20.4	70,817	40%	17.3
Non-hydro Renewables	49.7	80,045	18%	19.5
Solar	21.5	23,513	12%	5.7
Tidal & Wave	0.2	450	24%	0.1
Geothermal	0.0	102	72%	0.0
Wind	24.6	46,182	21%	11.3
Biomass	3.4	9,798	33%	2.4
Pumped storage (% of peak demand)	6.8	-2,089		11

Source: Authors' analysis of US Energy Information Administration data.

The electricity sector in France is dominated by nuclear energy. In 1974, just after the Organisation of Arab Petroleum Exporting Countries (OAPEC) oil embargo, France embarked on construction nuclear energy plants, increasing capacity from less than five gigawatts (GW) in 1977 to 63 GW in 1997, the capacity which remains in place today. EDF, which owns the nuclear plants, has embarked on a programme to replace its ageing plants and increase nuclear generation, following abandonment in 2023 of the 2014 bill requiring nuclear generation to halve by 2025.

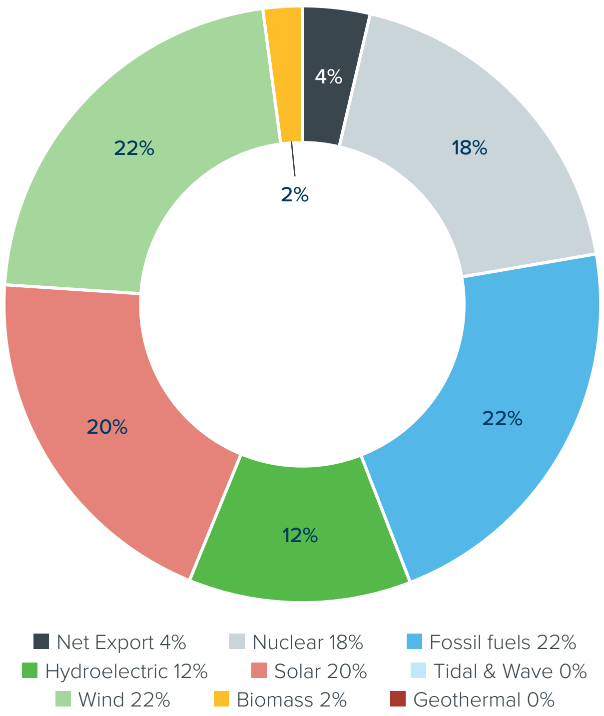
With installed nuclear capacity close to its peak demand, and a further 100 GW of capacity, France generally has surplus low-cost electricity for export, which helps to reduce the cost of electricity and provide additional supply security for its neighbours, including the UK.

France's nationally determined contributions

As a member of the EU, France follows the same policy as other EU member states, as described for Germany in Section 3.3.5.

3.3.10 Spain

Figure 3.10: Spain electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.12: Spain electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	35.5	233,089	75%	
Capacity margin / export / losses	297%	15%		
Export		24,581		9.2
Import		14,354		6.2
Net Import		-10,227		-4.4
Nuclear	7.1	52,084	83%	22.3
Fossil fuels	39.4	60,945	18%	26.1
Coal		2,684		1.2
Natural gas		47,648		20.4
Oil		10,084		4.3
Other gases		529		0.2
Renewables (all)	88.5	156,228	20%	67.0
Hydroelectric	16.8	33,738	23%	14.5
Non-hydro Renewables	71.7	122,490	20%	52.6
Solar	38.6	55,520	16%	23.8
Tidal & Wave	0.0	20	48%	0.0
Geothermal	0.0	0		
Wind	31.8	61,020	22%	26.2
Biomass	1.3	5,931	53%	2.5
Pumped storage (% of peak demand)	5.7	-2,077		16

Source: Authors' analysis of US Energy Information Administration data.

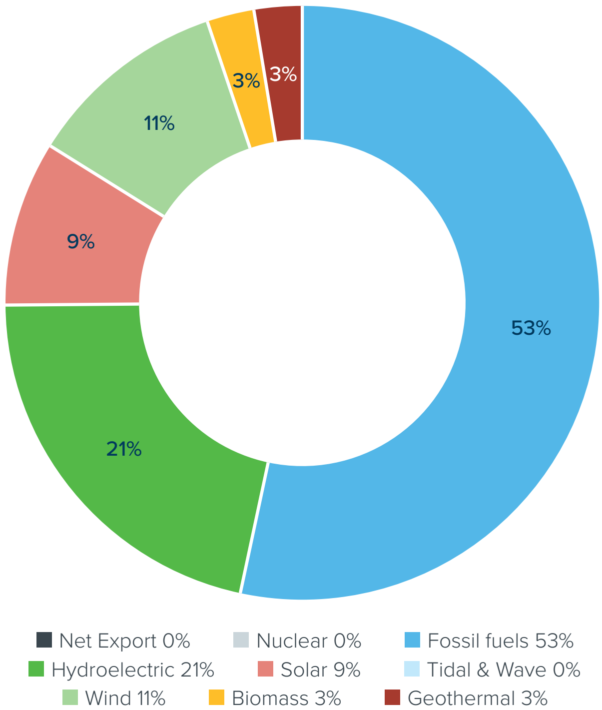
Spain has embarked on a massive renewable energy programme, adding some 60 GW of wind and solar generation to its system since 2005. With the capacity of variable renewables (wind and solar) approximately double the peak demand, the grid swings from large surpluses to needing most of its fossil-fuelled capacity. Spain has virtually eliminated coal-fired generation from its grid, but gas-fired generation is needed to complement the renewable energy generators and provide stability to the grid. Some 10 per cent of Spain's electricity generation is exported, which in reality means some 20 per cent of its wind and solar generation.

Spain's nationally determined contributions

As a member of the EU, Spain follows the same policy as other EU member states, as described for Germany in Section 3.3.5.

3.3.11 Turkey

Figure 3.11: Turkey electricity generation mix



Source: Authors' analysis of US Energy Information Administration data.

Table 3.13: Turkey electricity generation parameters

Parameter	Power (GW)	Energy (GWh pa)	Capacity Factor	% of Demand Energy
Est. Peak demand / Consumption	46.1	303,068	75%	
Capacity margin / export / losses	158%	10%		
Export		3,661		1.1
Import		2,676		0.9
Net Import		-985		-0.3
Nuclear	0.0	0		
Fossil fuels	49.5	177,615	41%	58.6
Coal		110,860		36.6
Natural gas		64,871		21.4
Oil		335		0.1
Other gases		1,549		0.5
Renewables (all)	69.4	155,305	26%	51.2
Hydroelectric	32.8	71,667	25%	23.6
Non-hydro Renewables	36.6	83,637	26%	27.6
Solar	19.9	29,910	17%	9.9
Tidal & Wave	0.0	0		
Geothermal	1.7	8,702	57%	2.9
Wind	13.0	36,464	32%	12.0
Biomass	2.0	8,562	49%	2.8
Pumped storage (% of peak demand)	0.0	0		0

Source: Authors' analysis of US Energy Information Administration data.

Turkey has seen its electricity demand grow by a factor of nearly three since the turn of the century, a rate of growth of nearly 5 per cent per annum. With good hydroelectric resources, hydropower has been able to meet some 20 per cent of this growth, although its share of generation has fallen from 25 per cent to 20 per cent over this period. Non-hydro renewables have overtaken hydro and now account for 25 per cent of generation. Fossil-fuelled generation, which accounts for more than 50 per cent of supply, is shared around two-thirds to one-third between coal and gas, with coal remaining the largest single generation technology.

Turkey's nationally determined contributions

The extract from the Second Nationally Determined Contribution of November 2025 reveals:

Main governing objective for energy:

In line with Article 4.1 of the Paris Agreement, Türkiye is committed to pursuing long-term, low-emission development. To this end, Türkiye has prepared and communicated its LTS [long-term strategy], which outlines the pathway toward achieving ***net-zero emissions by 2053****.*

Actions and other targets:

Türkiye aims to reduce its GHG emissions by 466 Mt CO_2 eq. compared to the BAU scenario, limiting GHG emissions to 643 Mt CO_2 eq. in 2035 (increase of 40 per cent on the 2018 reference level).

The LTS, which is aligned with the outcomes of the first Global Stocktake (GST), outlines key sectoral policies for 2035 and 2053, including an increase in the use of renewable energy sources and technologies, the development of battery and hydrogen infrastructure, the reduction of energy intensity, the utilization of nuclear power for further decarbonization, the protection and enhancement of natural areas and biodiversity, and sustainable forest management based on nature-based solutions and the bio-circular economy.

3.3.12 Summary of policy targets

A summary of the Paris Agreement targets for the selected countries is shown in Table 3.14 below.

Table 3.14: Summary of Paris Agreement nationally determined contributions targets

Country	Net zero target year	Other targets
UK	2050	• 2030: clean power • 2035 81% reduction of greenhouse gas (GHG)
China	2060	• 2035: 30% of total energy from non-fossil fuel • 2035: 3,600 GW of wind and solar capacity • 2035: 7% to 10% reduction of GHG from peak
United States[2]	2050	• 2035: 100% clean electrical energy • 2030: 50% reduction of GHG • 2035: 61% reduction of GHG
Japan	2050	• 2030: triple renewables capacity • 2035: 60% reduction of GHG • 2040: 73% reduction of GHG
Germany	2050	• 2030: triple renewables capacity • 2030: 42.5% of gross energy from renewables • 2030: 55% reduction of GHG from 1990
India	2070	• 2035: 60% of power capacity from non-fossil fuels • 2035: 47% reduction in emission intensity of GDP from 2005
South Korea	2050	• 2035: 30% share of renewables in power generation • 2040: coal generation phased out • 2035: 53% to 61% reduction of GHG
Italy, France and Spain	2050	• As for Germany
Turkey	2053	• 2035: limit GHG emissions to 40% above 2018 level • Increased use of renewables, batteries and nuclear energy

Source: Authors' analysis of nationally determined contributions.

2 The US' Paris Agreement commitments are currently non-binding. The US withdrew from the Paris Agreement, effective January 2026.

3.4 Comparison of electrical energy generation

In order to compare the electricity systems of the comparator countries in terms of size, imports and exports and generation sources, the following tables have been prepared. The tables are based on data from the US Energy Information Administration analysed by the authors, using the latest available data set for 2024.

3.4.1 Capacity, electrical energy and trading

The relative sizes of the power systems of the selected countries can be seen in Table 3.15, with China dominating the selection, and United States trailing a distant second. The installed capacity is a poor indicator of power demand: with their large shares of low-capacity factor[3] renewable energy, Germany and Spain have almost four times as much installed capacity as their peak demand.

Italy, the UK and Germany are major importers of electricity, although Germany is also a major exporter. France is the largest exporter of electricity in Europe and of our selected countries.

Table 3.15: Comparison of capacity, electrical energy and trading (2024)

Country	Installed capacity MW	Estimated peak demand MW	Electrical energy consumption TWh pa	Electrical energy generation TWh pa	Electrical energy imports TWh pa	Electrical energy exports TWh pa
UK	115	42	275	268	44	10
China	3,377	1,491	9,794	10,162	5	22
United States	1,284	638	4,194	4,393	33	19
Japan	353	131	859	907	0	0
Germany	287	75	490	490	82	55
India	531	268	1,758	2,052	8	10
South Korea	160	85	558	578	0	0
Italy	136	44	290	259	56	5
France	161	62	410	537	15	105
Spain	141	35	233	267	14	25
Turkey	119	46	303	333	3	4

Source: US Energy Information Administration data analysed by the authors.

One notable feature from Table 3.15 is that the UK has low electricity consumption relative to the size of its economy. The UK has the second lowest electrical energy consumption of the listed countries despite having the fifth largest economy.

3 Capacity factor (or load factor) is the actual electrical energy generation divided by the theoretical energy from generating 100 per cent of the time. Nuclear, fossil-fuelled and biomass generators can typically operate at capacity factors of 80 per cent to 95 per cent, producing up to 8,300 MWh per MW of installed capacity. In the UK, wind and solar generators operate at around 10 per cent and 30 per cent, respectively, although capacity factors for offshore wind are typically 35 per cent or more. In countries with better solar resources, including the US, the capacity factor for photovoltaic can exceed 20 per cent. The UK is at the top end for wind capacity factor. For example, in Korea, with low wind speeds, the capacity factor for wind is 16 per cent. The system capacity factor is around 70 per cent, meaning that 1 GW of demand requires 6,000 GWh of energy per annum. With variable renewables averaging around 25 per cent capacity factor, some 3 GW of variable renewables capacity is needed to produce this energy.

3.4.2 Fossil-fuelled and renewable generation

As can be seen in Table 3.16, several of the selected countries produce more than 50 per cent of electricity from fossil fuels, including India, Japan, China, the United States, South Korea and Turkey (in that order). The UK is near the bottom for fossil-fuelled generation, with only Spain and France below. France, with surplus nuclear and renewable generation, has little need for fossil-fuelled generation, other than for load following (ramping up or down to compensate for variations in supply or demand).

Spain, Germany and the UK (in that order) produce more than 50 per cent of their electricity from renewables. Italy produces 50 per cent of its generation from renewables, but domestic renewables only supply 44 per cent of consumption. South Korea is at the bottom of this league, producing only 10 per cent of generation from renewables.

France is the largest zero-carbon[4] (renewables plus nuclear) producer, with only five per cent of electricity not zero carbon. Spain and the UK are also high in this category. India has the lowest percentage of zero-carbon electricity.

Table 3.16: Comparison of fossil fuel and renewable energy generation (2024)

Country	Fossil-fuelled generation TWh pa	Fossil-fuelled generation %	Renewable energy generation TWh pa	Renewable energy generation %	Zero carbon generation TWh pa	Zero carbon generation %
UK	90	34	141	53	178	66
China	6,248	61	3,480	34	3,931	39
United States	2,548	58	1,069	24	1,850	42
Japan	603	67	228	25	311	34
Germany	214	44	279	57	279	57
India	1,585	77	412	20	467	23
South Korea	334	58	56	10	245	42
Italy	131	50	129	50	129	50
France	27	5	151	28	513	95
Spain	61	23	156	58	208	78
Turkey	178	53	155	47	155	47

Source: US Energy Information Administration data analysed by the authors.

3.4.3 Breakdown of fossil-fuelled generation

As illustrated in Table 3.17, the selected countries have a widely different fossil fuel dependency. India produces 77 per cent of its electricity from fossil fuels, and virtually all of this (96 per cent) is coal-fired, meaning that 74 per cent of India's electricity is generated from coal. Similarly, China produces 61 per cent of its electricity from fossil fuels, and 92 per cent of this is from coal, meaning 57 per cent of generation is coal-fired. Turkey, Japan, South Korea and Germany produce between one-quarter and one-third of their electricity from coal. Although the US produces 58 per cent of its electricity from fossil fuels, only one-quarter of this is from coal, meaning 15 per cent of its electricity is generated from coal. The UK, Italy, France and Spain have little or no coal-fired generation.

4 Zero carbon dioxide emissions from generation, or net zero emissions in the case of biomass from sustainable sources, although all generation has a significant whole life carbon footprint.

Table 3.17: Breakdown of fossil-fuelled generation (2024)

Country	Fossil-fuelled energy generation	Fossil-fuelled % of total generation	Coal generation	Coal % of fossil-fuelled generation	Gas-fired and other generation	Gas and other % of fossil-fuelled
	TWh pa	%	TWh pa	%	TWh pa	%
UK	90	34	2	2	89	98
China	6,248	61	5,775	92	473	8
United States	2,548	58	652	26	1,896	74
Japan	603	67	259	43	345	57
Germany	214	44	109	51	105	49
India	1,585	77	1,517	96	68	4
South Korea	334	58	155	46	180	54
Italy	131	50	17	13	114	87
France	27	5	1	4	26	96
Spain	61	23	3	4	58	96
Turkey	178	53	111	62	67	38

Source: US Energy Information Administration data analysed by the authors.

France, China and India use little gas for electricity generation, whereas the UK, the US, Japan, South Korea and Italy produce between 30 per cent and 45 per cent of their electricity from gas. In Germany, Spain and Turkey, 20 per cent to 22 per cent of electricity generation is from gas.

3.4.4 Breakdown of renewable energy generation

Again, there is a wide range of penetration of renewable energy in the selected countries, as illustrated in Table 3.18. The UK, Germany and Spain use wind and solar, the new or variable renewables, for around 40 per cent of electricity generation. In the UK, and to a lesser extent Germany, the dominant technology is wind, whereas in Spain, wind and solar energy are more equal.

China, the US, Italy and Turkey use wind and solar for between 17 per cent and 22 per cent of generation. India, Japan and France use wind and solar for between 11 per cent and 13 per cent of generation. South Korea has the lowest wind and solar generation of the group.

Hydroelectric power is highly dependent on location, requiring a combination of good topography and hydrology to produce an economic resource. Most of the selected countries have already developed the best available resources. The UK and South Korea have the least hydroelectric resources and produce between 1.5 and two per cent of electricity from hydro. Italy and Turkey have the best resources relative to their electricity demand, with hydro accounting for around 20 per cent of generation.

In absolute terms, China is the largest hydroelectric producer, generating twice as much electricity from hydro as the other 10 countries. However, this only accounts for 14 per cent of its total electricity generation.

India, China and Turkey have very substantial, unused hydropower potential, and ongoing programmes to develop more hydro. The selected European countries have largely developed their conventional hydroelectric potential. The US has some unused hydropower potential, but environmental objections mean that little is being developed, other than small projects on existing dams.

Table 3.18: Breakdown of renewable energy generation (2024)

Country	Renewable energy generation	Renewables % of total generation	Wind energy	Solar energy	Hydro-electric energy	Other renewables
	TWh pa	%	TWh pa	TWh pa	TWh pa	TWh pa
UK	141	53	83	15	6	37
China	3,480	34	997	839	1,424	220
United States	1,069	24	452	304	243	70
Japan	228	25	11	97	70	50
Germany	279	57	134	72	23	50
India	412	20	91	135	155	31
South Korea	56	10	3	34	4	15
Italy	129	50	22	36	52	19
France	151	28	46	24	71	10
Spain	156	58	61	56	34	6
Turkey	155	47	36	30	72	17

Source: US Energy Information Administration data analysed by the authors.

3.4.5 Nuclear energy generation

With the exception of China, most of the nuclear generation in the selected countries was constructed in the 1990s.

China has continued to build nuclear power stations, and four per cent of total generation comes from nuclear.

France made a major commitment to nuclear technology in the 1970s, and has continued to maintain its capacity, refurbishing and replacing ageing plant.

The US has retained most of its 1990s nuclear plants, and after a hiatus, has committed to new projects including small modular reactors (SMRs).

The UK committed to nuclear technology around the same time as France but has not replaced its ageing fleet. The peak output for nuclear power was in 1998. Currently, one large nuclear plant is under construction, which when finished sometime after 2030, will be the only operating station. A fleet of new nuclear, including small modular reactors, is proposed but is unlikely to be operating before the mid-2030s.

Germany and Japan had strong nuclear generation capability, which was deliberately shut down following the Fukushima accident in Japan and due to environmental pressure in Germany.

Most of the selected countries, including Germany and Japan, will most likely need to expand their nuclear generation over the coming decades if they are to make progress with decarbonisation of electricity.

The current (2024) generation by nuclear power stations is shown in Table 3.19. In absolute terms, the US is the lead producer, with China catching up. However, France is the largest by share of electricity generation, with two-thirds of its electricity generation from nuclear.

Table 3.19: Comparison of nuclear energy generation

Country	Nuclear energy generation TWh pa	Nuclear % of total generation %
UK	37	14
China	451	4
United States	782	18
Japan	83	9
Germany	0	0
India	55	3
South Korea	189	33
Italy	0	0
France	362	67
Spain	52	19
Turkey	0	0

Source: US Energy Information Administration data analysed by the authors.

4. Technology and transition

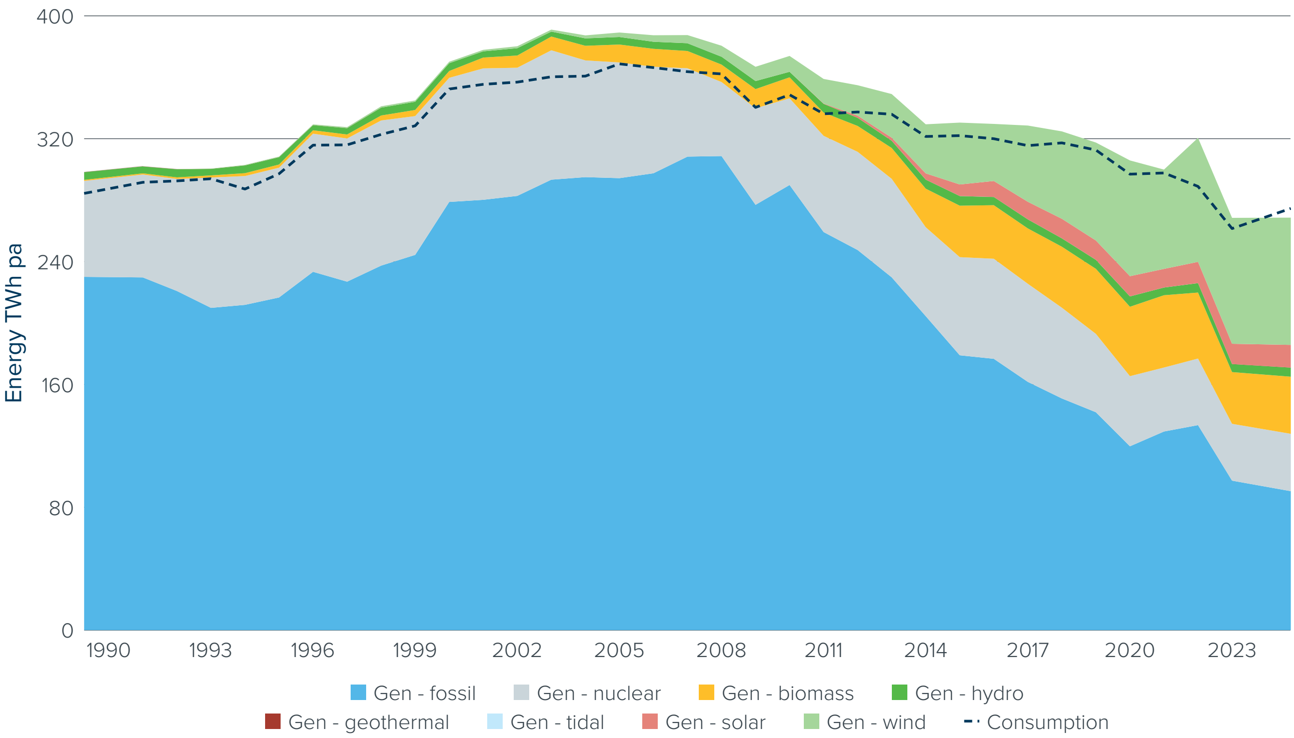
While statements of policy and targets included in the nationally determined contributions in Section 3.3 above give an indication of the commitment of nations to decarbonisation and the energy transition, a better indicator is the actual trend in electricity generation in recent years. In Section 4.1 below, the trends in the use of different technologies for generation are presented for each country, and in Section 4.2, key transition metrics are illustrated. The transition metrics are summarised in Section 4.3

4.1 Trends in generation technology

4.1.1 UK technology trends

In common with most industrialised nations, UK electricity consumption has remained relatively static over the past 3 decades, peaking around 2005. This trend is starting to reverse due to demand from technology and, in particular, data centres. Future demand will also increase due to the transition of space heating, transportation and industrial energy to electricity.

Figure 4.1: UK technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



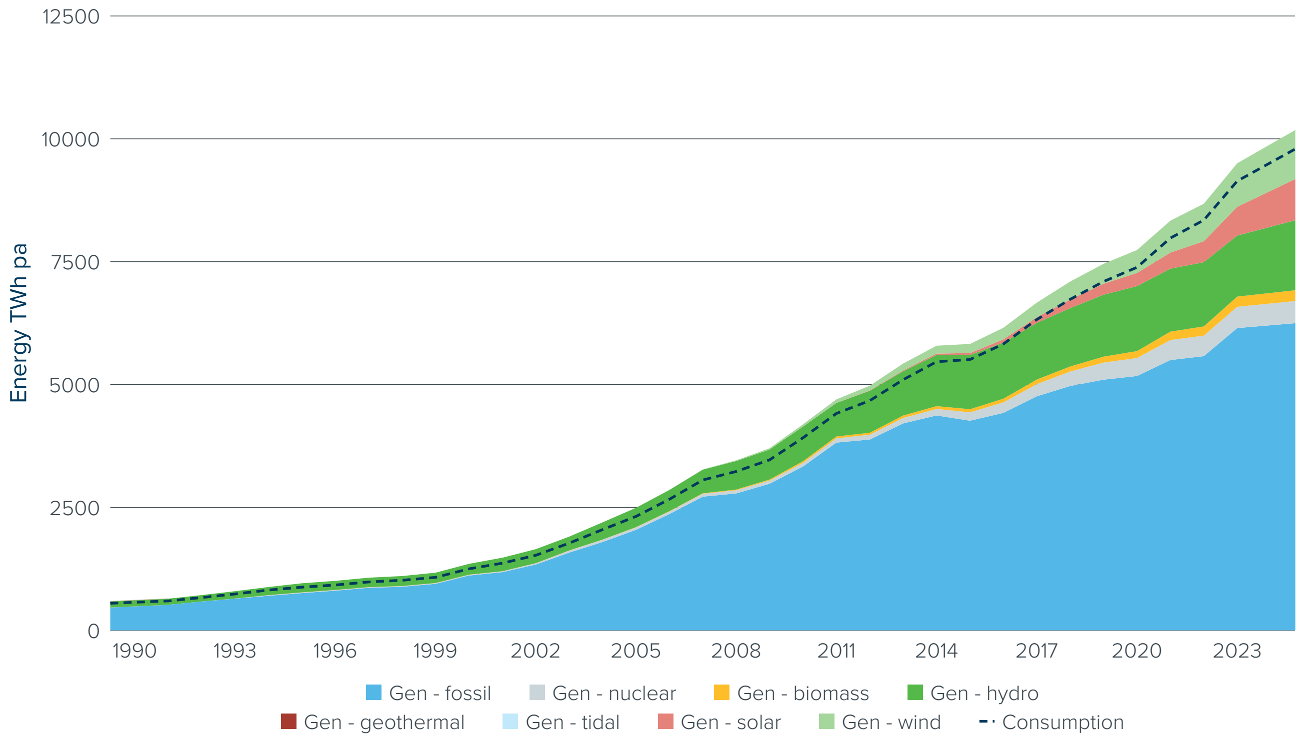
Source: Authors' analysis of US Energy Information Administration data.

Since the turn of the century, the UK (more accurately Great Britain, since Northern Ireland is part of the Irish National Grid) has seen a significant shift from fossil-fuelled generation to renewable energy. At the same time the contribution from nuclear energy has reduced. Some fossil-fuelled generation has been replaced by biomass (imported wood pellets) at Drax powerstation. There has been little change in the contribution of hydropower.

Renewable energy is dominated by wind generation, which by 2024 was almost matching gas as the largest source of electrical energy.

4.1.2 China technology trends

Figure 4.2: China technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

The huge increase in electricity consumption in China over the past 3 decades has been largely met by fossil-fuelled generation, although since 2012, renewables has started to make a significant contribution.

Between 1990 and 2012, generation increased from 590 GW per annum to 4,976 GW per annum (843 per cent, or over 10 per cent per annum), with fossil fuel remaining around 80per cent of generation. Over this period, hydropower production grew by 680 per cent, although its contribution fell from 21 per cent to 17 per cent. Nuclear and non-hydro renewable generation grew from nothing to around 5 per cent of generation.

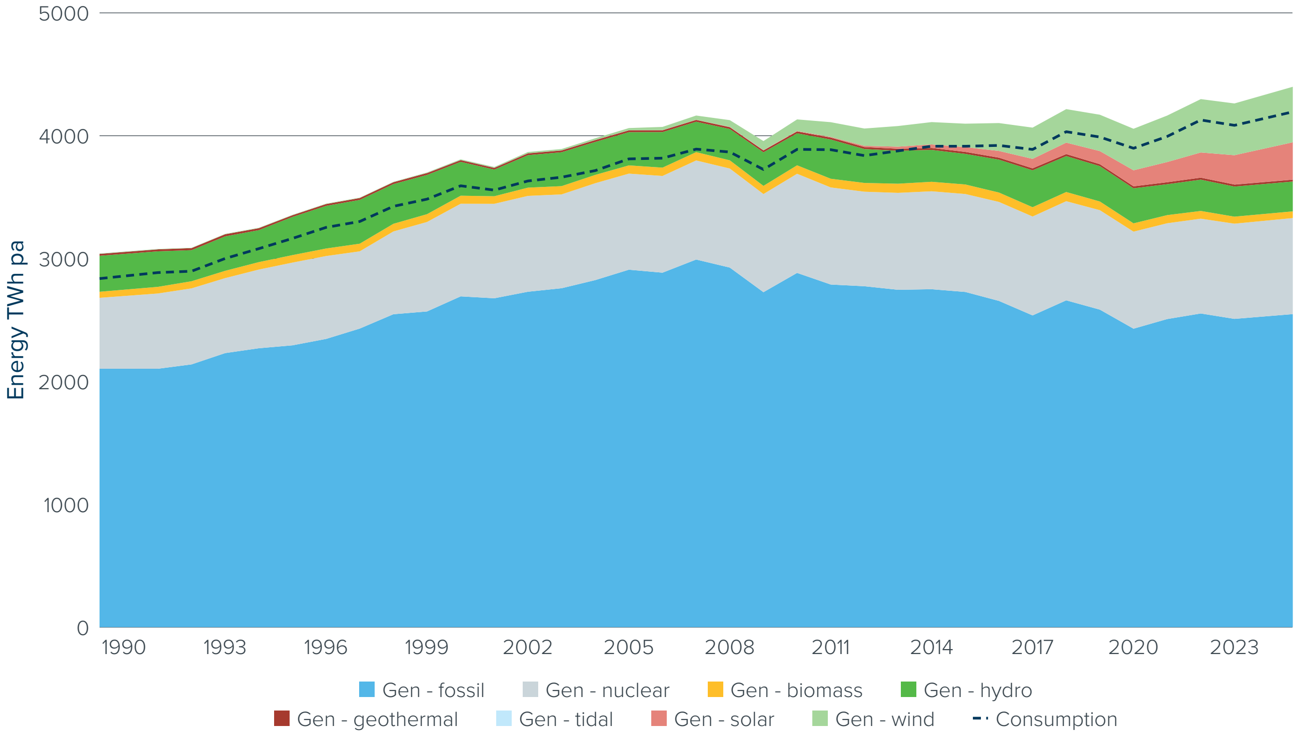
By 2024, generation had increased by a further 205 per cent from 2012 levels, from 4,976 TWh per annum to 10,180 TWh per annum. In 2024 the share of fossil-fuelled generation fell to 61 per cent, and hydropower contributed 14 per cent. Nuclear and non-hydro renewables contributed 4 per cent and 20 per cent, respectively.

4.1.3 United States technology trends

As an industrialised nation, the electricity demand in the US has been relatively stagnant, although it is now edging up largely due to data centre demand.

Since the turn of the century there has been some displacement of fossil fuels by renewable energy, and by 2024 some 25 per cent of generation is supplied by renewable energy.

Figure 4.3: US technology trend, 1990 to 2024. Electrical energy consumption and generation by technology

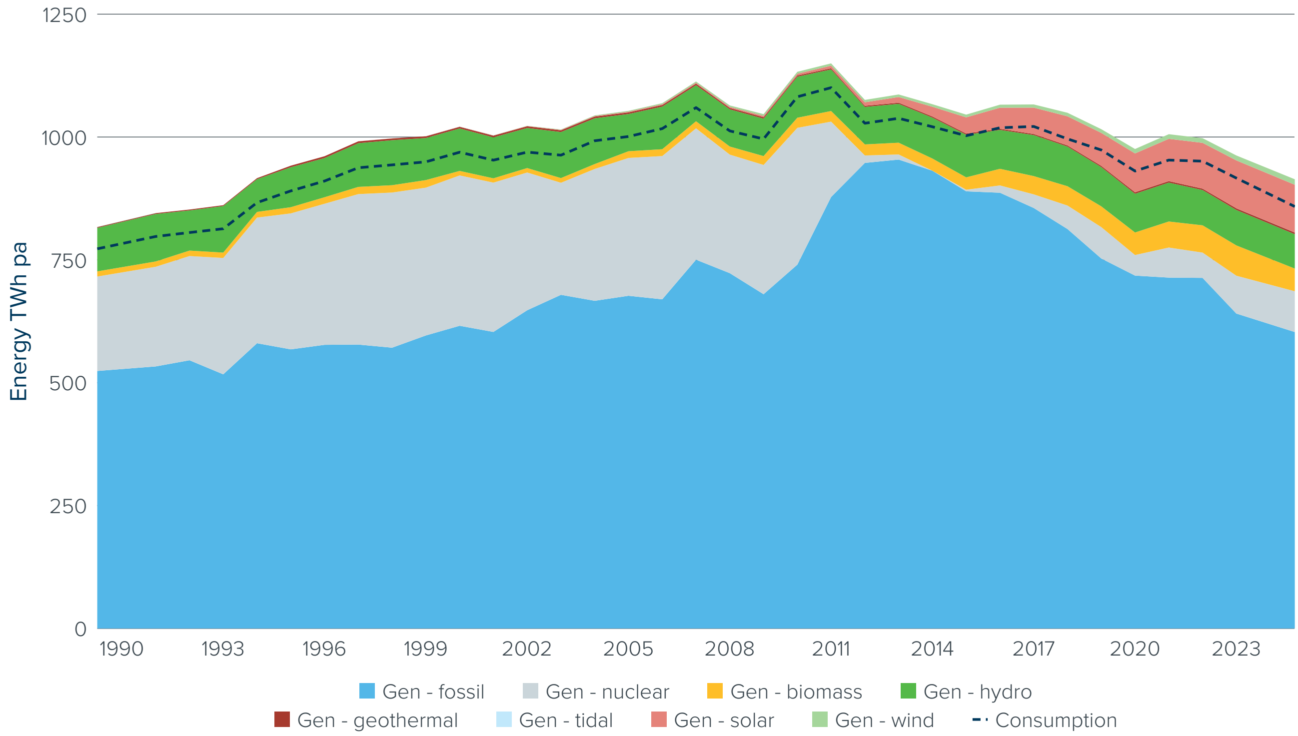


Source: Authors' analysis of US Energy Information Administration data.

4.1.4 Japan technology trends

Japan, as with other industrialised nations, has had stagnant growth in electricity consumption, with demand peaking in 2007 and 2011. However, the increase in consumption due to data centres and technology had not been observed by 2024.

Figure 4.4: Japan technology trend, 1990 to 2024. Electrical energy consumption and generation by technology

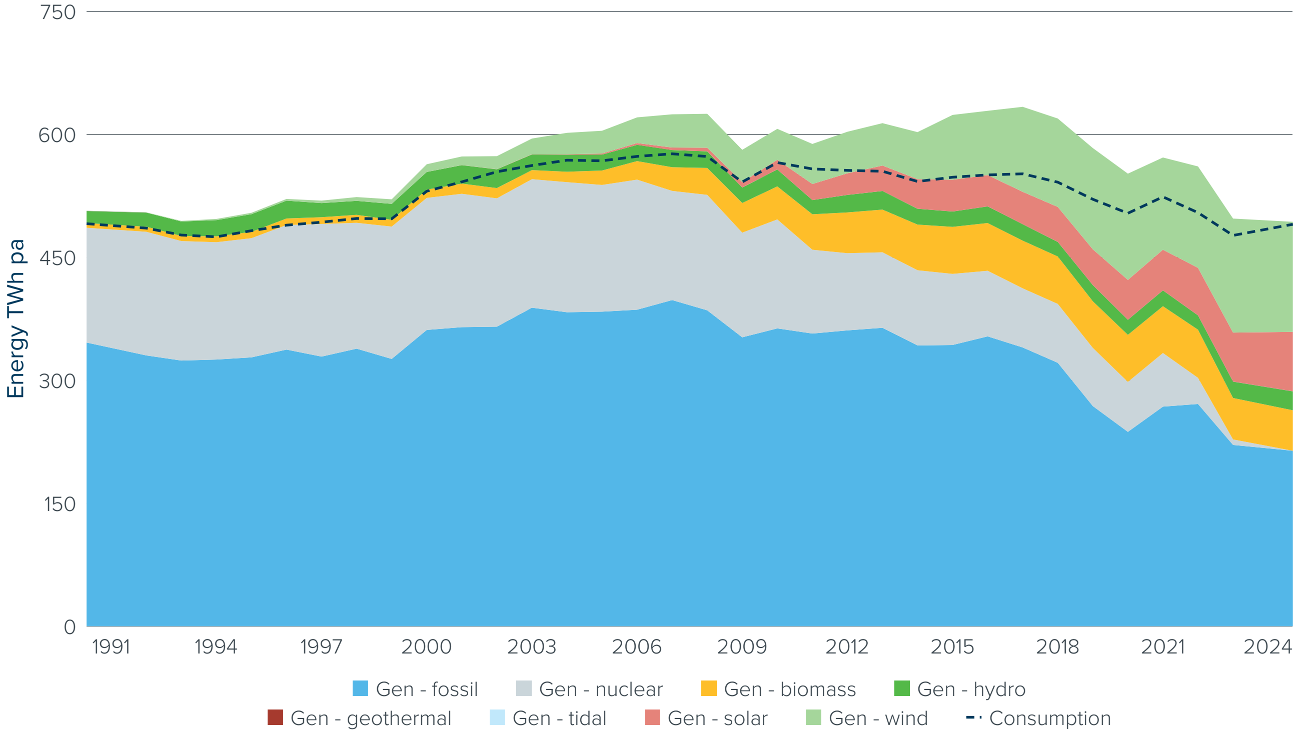


Source: Authors' analysis of US Energy Information Administration data.

The most notable feature of electricity production in Japan was the cessation of nuclear generation following the 2011 Fukushima nuclear accident. Nuclear energy fell from some 25 per cent of generation before the accident to zero in 2014. Since then, there has been a modest increase in nuclear generation, with around 9 per cent of generation from nuclear plants in 2024. In the aftermath of Fukushima, fossil-fuelled generation picked up the missing nuclear production, increasing by 29 per cent in 3 years. However, since then fossil fuel output has fallen, along with rising nuclear and renewables generation, with renewables accounting for 25 per cent of generation in 2024.

4.1.5 Germany technology trends

Figure 4.5: Germany technology trend, 1991 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

Figure 4.5 starts in 1991, following the unification of East and West Germany. The chart shows the same pattern of stagnant demand, peaking in 2007.

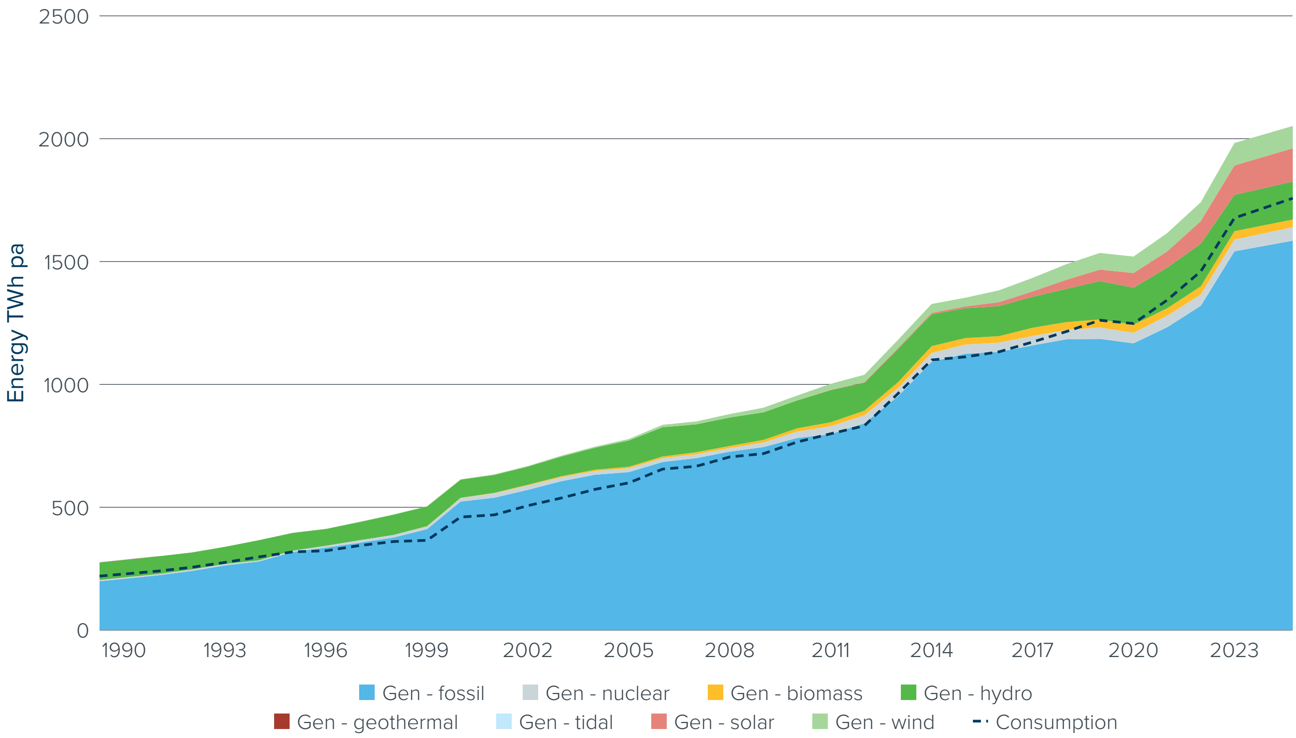
From the time of unification until 2000, Germany produced around 30 per cent of its electricity from nuclear plants, with most of the rest from fossil fuels. Anti-nuclear sentiment arose around the turn of the century, although it was not until 2011 the phase-out started in earnest, with the last plants shut in 2024 (delayed 2 years due to gas shortage following the Russian invasion of Ukraine).

The rise in renewables generation has mirrored the decline in nuclear energy, with renewables accounting for 57 per cent of generation by 2024. To achieve this high level of renewables penetration, Germany relies on its ability to export surplus generation at times of high production, and to import from its neighbours (notably France) at times of low wind and solar production. The installed capacity of wind and solar plant of 163 GW is around double the nation's peak demand, meaning that at times of high renewables production, electricity must be exported or curtailed.

4.1.6 India technology trends

As an industrialising nation, India has seen steady growth in its electricity demand, increasing by a factor of almost 8 between 1990 and 2024, a growth rate of nearly nine per cent per annum.

Figure 4.6: India technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

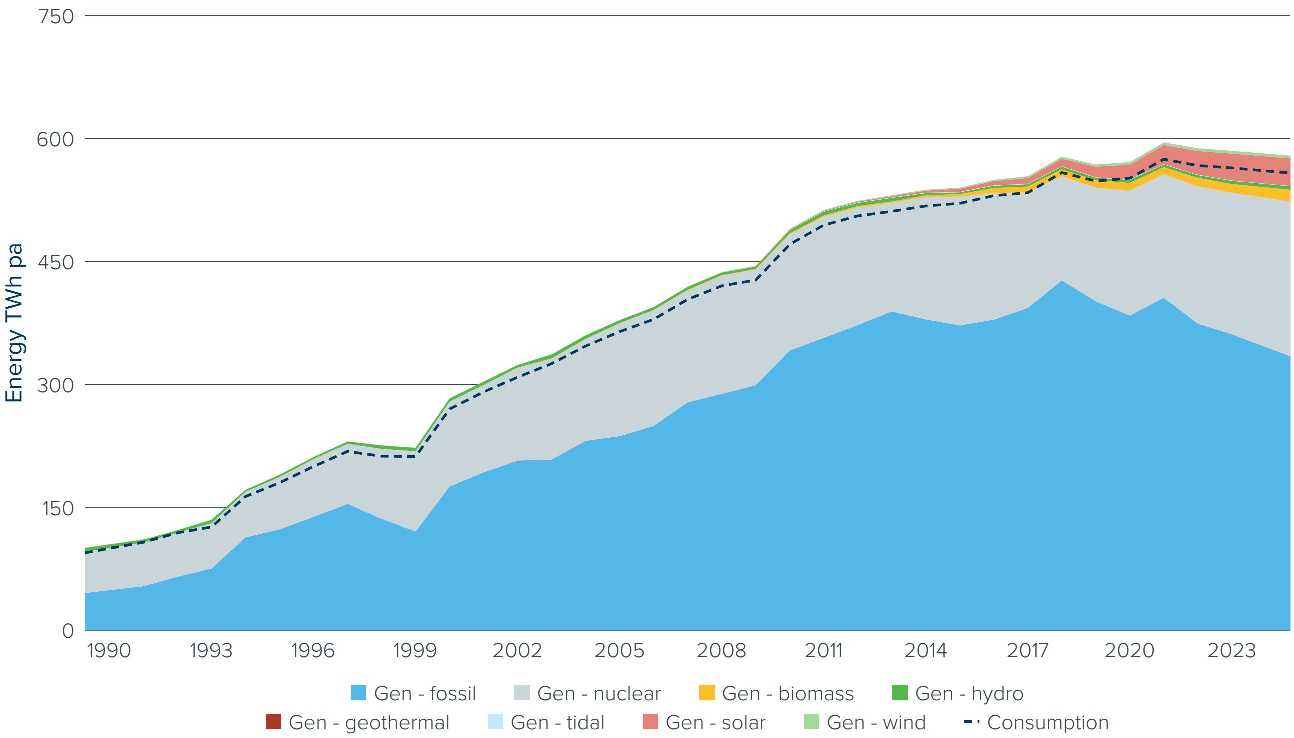
The great majority of India's demand growth has been met by fossil-fuelled generation. Hydropower remains the second largest technology, although its share has fallen from over 25 per cent in 1990 to under 10 per cent by 2024.

Since 2010, non-hydro renewables have increased their share from three per cent to 12 per cent in 2024.

4.1.7 South Korea technology trends

South Korea saw rapid demand growth as it industrialised, up to around 2010, although since then the growth in demand has tailed off, with the peak in 2021.

Figure 4.7: South Korea technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

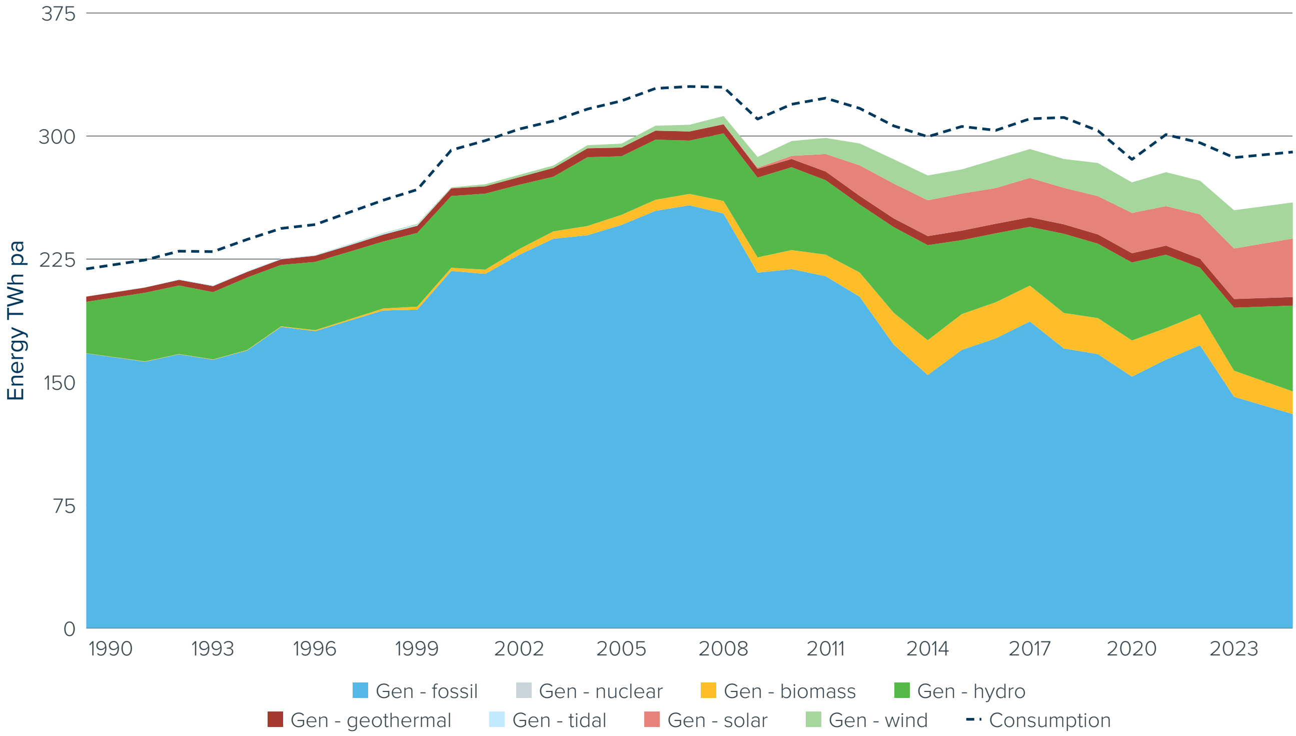
Electricity production in South Korea is dominated by fossil fuel and nuclear energy. In 1990, nuclear energy accounted for 50 per cent of generation and had fallen to 33 per cent by 2024, with a low of 22 per cent in 2018. Over this period, fossil fuel share increased from 45 per cent in 1990 to 58 per cent in 2024, peaking at 74 per cent in 2018.

Renewable energy generation started late in South Korea, with only two per cent of generation from renewable energy in 2015. Since then, there has been some increase, particularly of solar energy, although in 2024, renewables' share of electricity generation remained below 10 per cent.

4.1.8 Italy technology trends

Italy, as with the other industrialised nations, has had stagnant growth in electricity demand, peaking in 2007.

Figure 4.8: Italy technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

Italy has significant hydroelectric resources, most of which were developed by the turn of the century. In years with good hydrology, Italy can produce 20 per cent of its generation from hydropower, although this falls close to 10 per cent in drought years.

Historically, the majority of Italy's electricity generation comes from fossil fuels. From 1990 to 2008, Italy produced around 80 per cent of its electricity from fossil fuels. With the increase in non-hydro renewables since then, fossil fuels' share fell to 50 per cent by 2024.

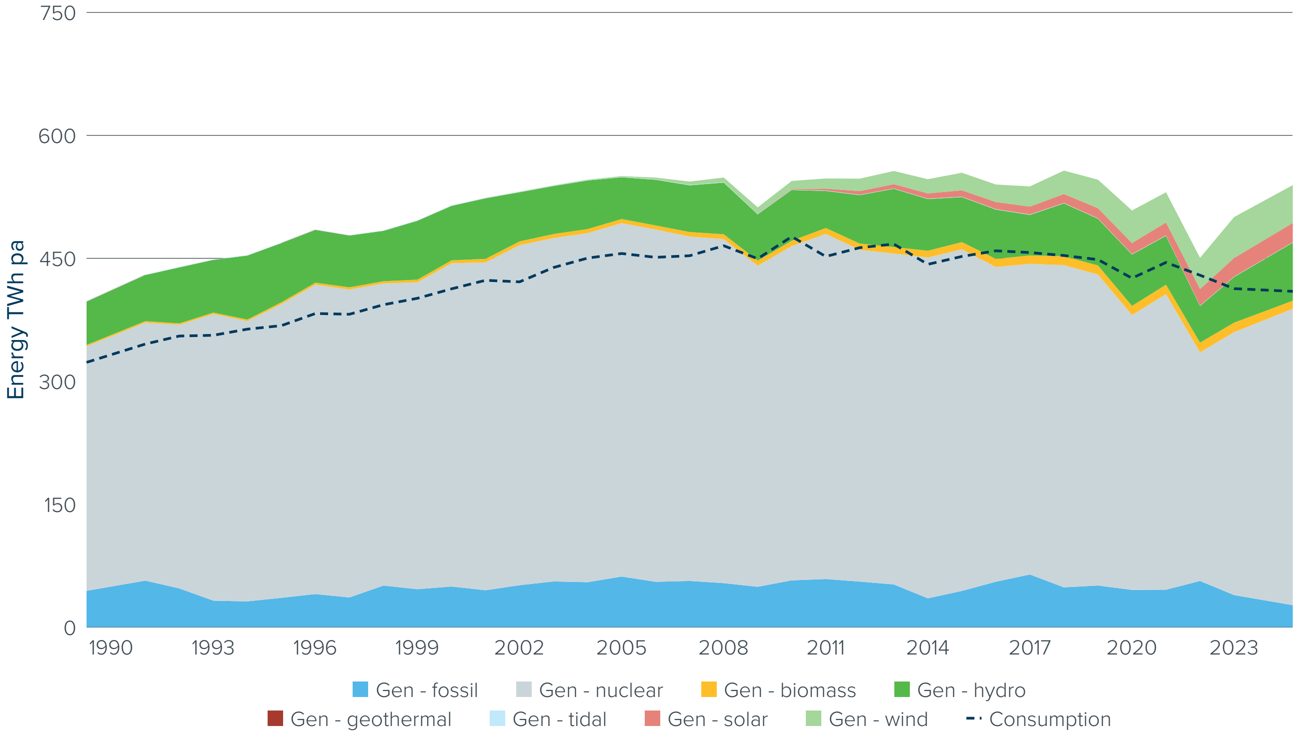
The reduction in fossil-fuelled generation has been mirrored by a rise in non-hydro renewables, which by 2024 accounted for nearly 30 per cent of generation.

4.1.9 France technology trends

In common with other industrialised nations, France's electricity demand has been fairly stagnant since 1990, peaking in 2010.

France's electricity generation is dominated by nuclear power, with nuclear energy at times almost equalling annual electricity demand. The dominance of nuclear energy makes system operation complex, since it is difficult for nuclear generators to vary their output to respond to daily changes in demand, and more recently to variations in output of wind and solar generators. Although the French nuclear industry has been innovative in developing load-following capability in their nuclear plants, the system also benefits from the small (around 10 per cent of generation), but important hydropower resources and the ability to trade with France's neighbours, with a significant export balance.

Figure 4.9: France technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



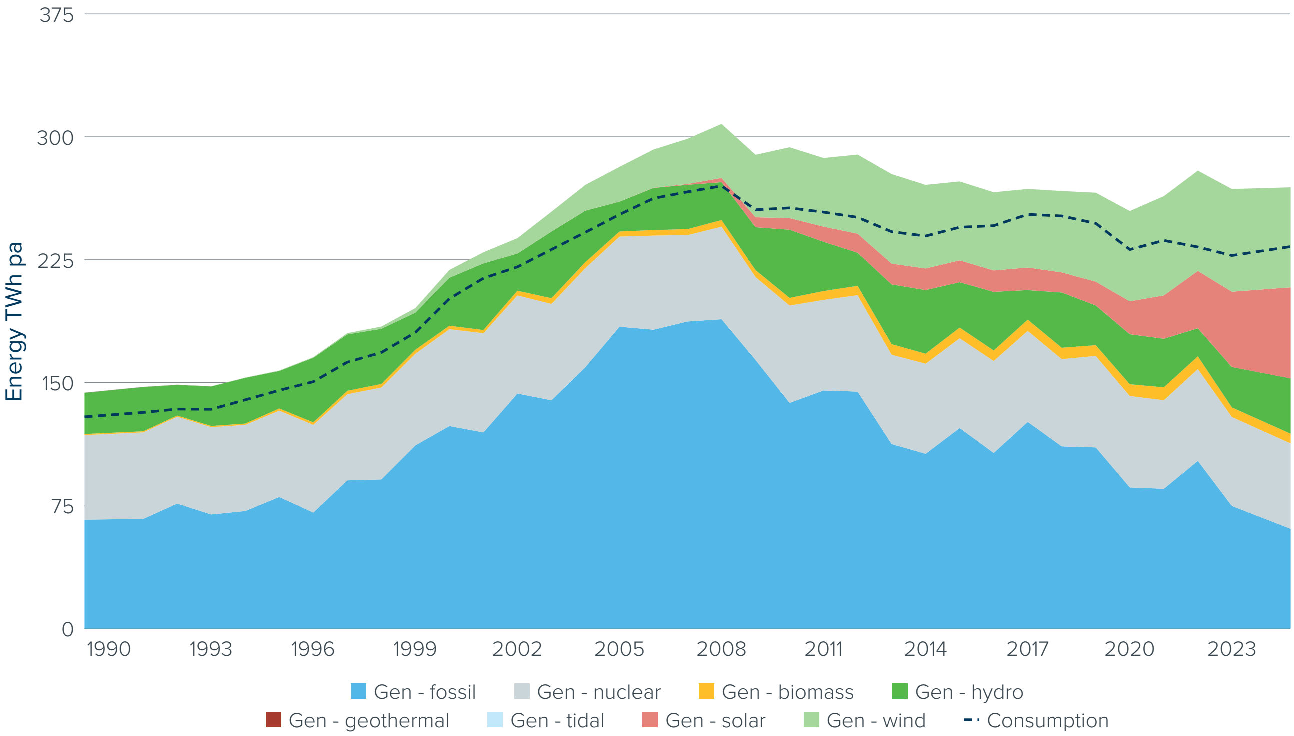
Source: Authors' analysis of US Energy Information Administration data.

By 2024, France had developed non-hydro renewables to produce around 15 per cent of generation. The system also requires some fossil-fuelled generation, mainly to provide load-following and grid balancing services, although in 2024, fossil fuels only provided five per cent of electricity generation.

4.1.10 Spain technology trends

The Spanish electricity system recorded significant demand growth up to 2007/08, with demand more than doubling from 1990. However, since then, demand as remained stagnant, with a decline of around 15 per cent since the peak.

Figure 4.10: Spain technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

Spanish nuclear generation has remained fairly constant over the period under consideration, although its share declined from 36 per cent in 1990 to around 20 per cent in 2024.

Spain has developed its hydropower resources, which contribute between eight per cent and 15 per cent of electrical energy, depending on the flow in its rivers. However, the ability of the hydropower to vary its output rapidly has become increasing important, as the amount of variable renewables (wind and solar) on the grid has increased.

Fossil-fuelled generation has been an important part of the generation fleet, producing some 46 per cent of electrical energy in 1990, and increasing to over 60 per cent at its peak. However, since 2008, fossil fuels' generation share has declined to around 23 per cent in 2024.

Spain has seen a great increase in non-hydro renewables since 2008, with the share rising to over 45 per cent in 2024. The installed capacity of wind and solar of over 70 GW is around double the peak demand, meaning that at times of high wind and solar production, Spain must export electricity or curtail production.

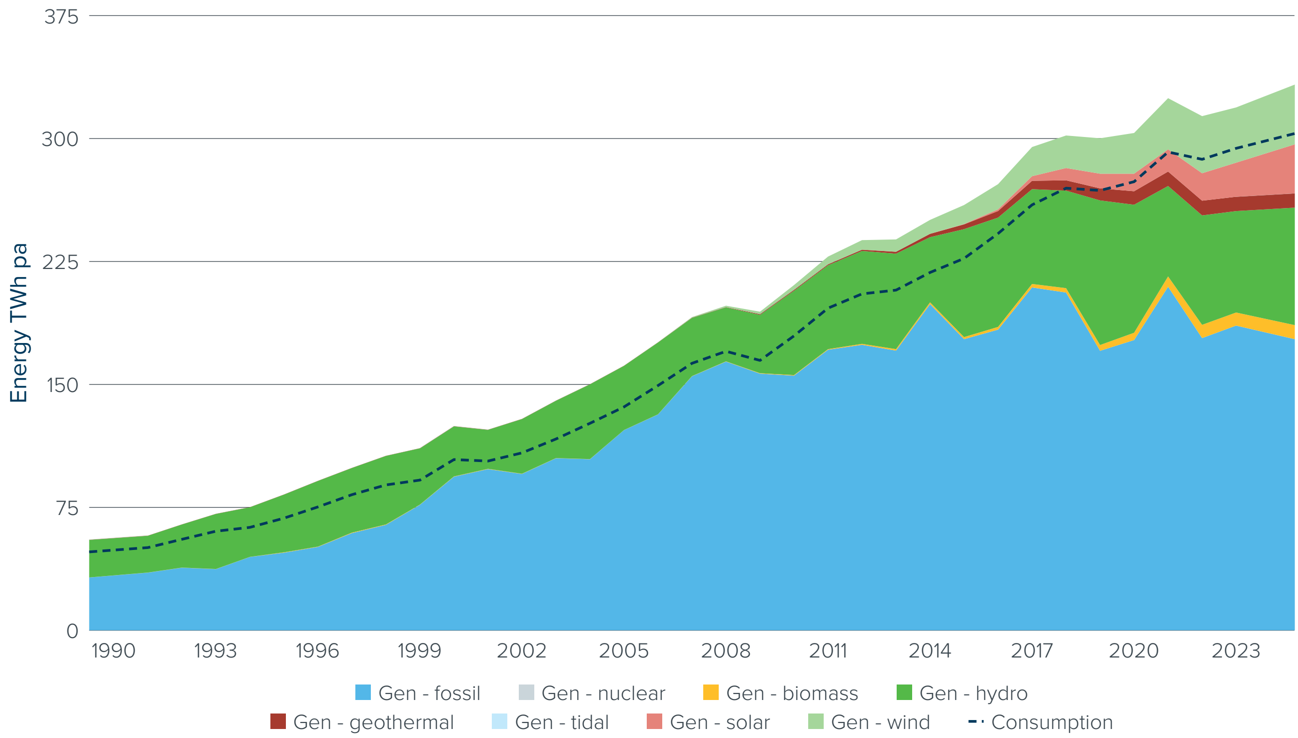
4.1.11 Turkey technology trends

Turkey has recorded steady growth in electricity demand, with consumption rising from 48 TWh per annum in 1990 to 303 TWh per annum in 2024.

The great majority of this demand increase has been met from fossil-fuelled generation, although hydropower has also made a significant contribution. In 1990, hydropower provided over 40 per cent of generation. Despite hydropower doubling by 2010, its share had dropped to 24 per cent. By 2024, hydropower accounts for between 15 per cent and 25 per cent of generation, depending on whether it is a wet or dry year.

Fossil fuels' share of generation has peaked at over 80 per cent, but by 2024 had fallen to just over 50 per cent. This reflects the introduction of non-hydro renewables, which by 2024 provide around 25 per cent of generation.

Figure 4.11: Turkey technology trend, 1990 to 2024. Electrical energy consumption and generation by technology



Source: Authors' analysis of US Energy Information Administration data.

4.2 Transition trends

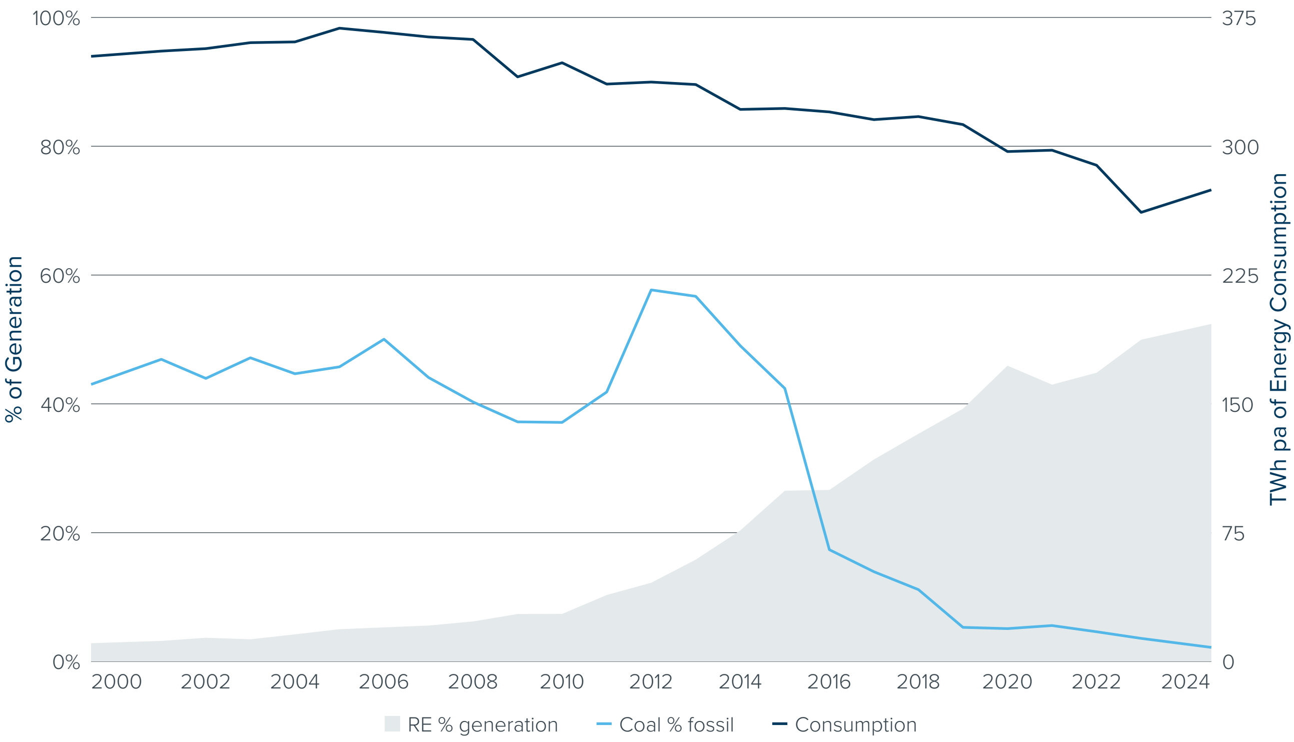
The graphs in this section illustrate the progress towards decarbonisation and the energy transition made by each of the selected countries. The indicators comprise:

- **Consumption:** Improvement in energy efficiency is one of the main tools used to reduce electricity consumption. Considerable efforts have been made to reduce the energy consumption of domestic appliances and lighting, and of industrial processes. This accounts for the stagnating demand in most industrialised countries and some of the reduction in demand since around 2010. However, in the industrialising countries this has been overshadowed by increasing electricity requirements from increased access, increased household wealth and increasing gross domestic product. The deindustrialisation of some Western countries has been mirrored by increased industrialisation of developing countries.
- **Coal as a percentage of fossil fuel:** The transition of coal-fired generation to gas-fired generation is one of the most important tools for reduction in greenhouse gas. Typically, greenhouse gas emission from gas-fired generation is around half that of coal-fired generation. Replacing old, inefficient coal plants with modern, efficient combined cycle gas turbines, or displacing lignite can achieve more than this – with lignite plants producing up to three times as much as modern combined cycle gas turbines. Hence a declining share of coal in the fossil fuel generation is a good indicator of progress in the energy transition.
- **Percentage of renewables:** The other main tool in decarbonisation of electricity is the introduction of renewable energy, which does not emit greenhouse gas while generating. Hence a rising trend in renewables as a percentage of generation is a good indicator of progress in decarbonisation.

With all of these trends the progress is linked. For example, great increases in demand can overshadow even quite substantial increases in renewable energy percentage, as seen in the case of China.

4.2.1 United Kingdom transition trends

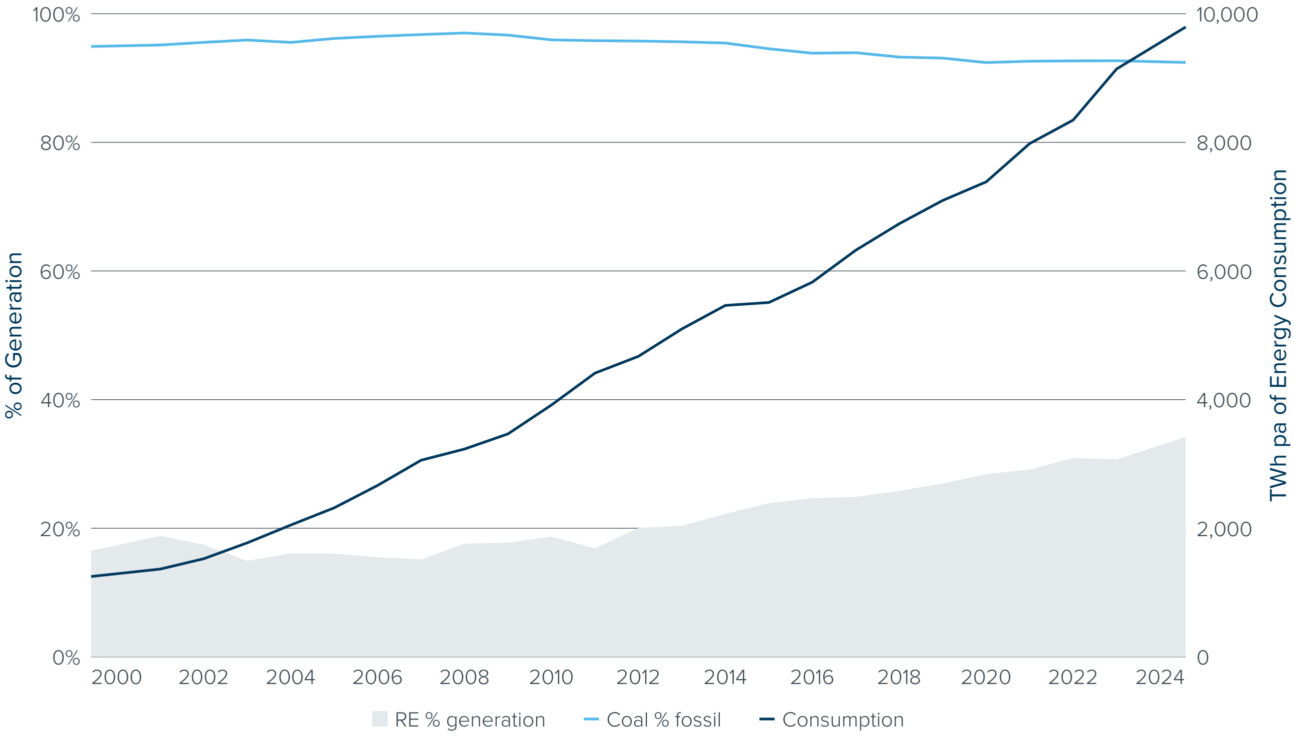
Figure 4.12: UK energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.2 China transition trends

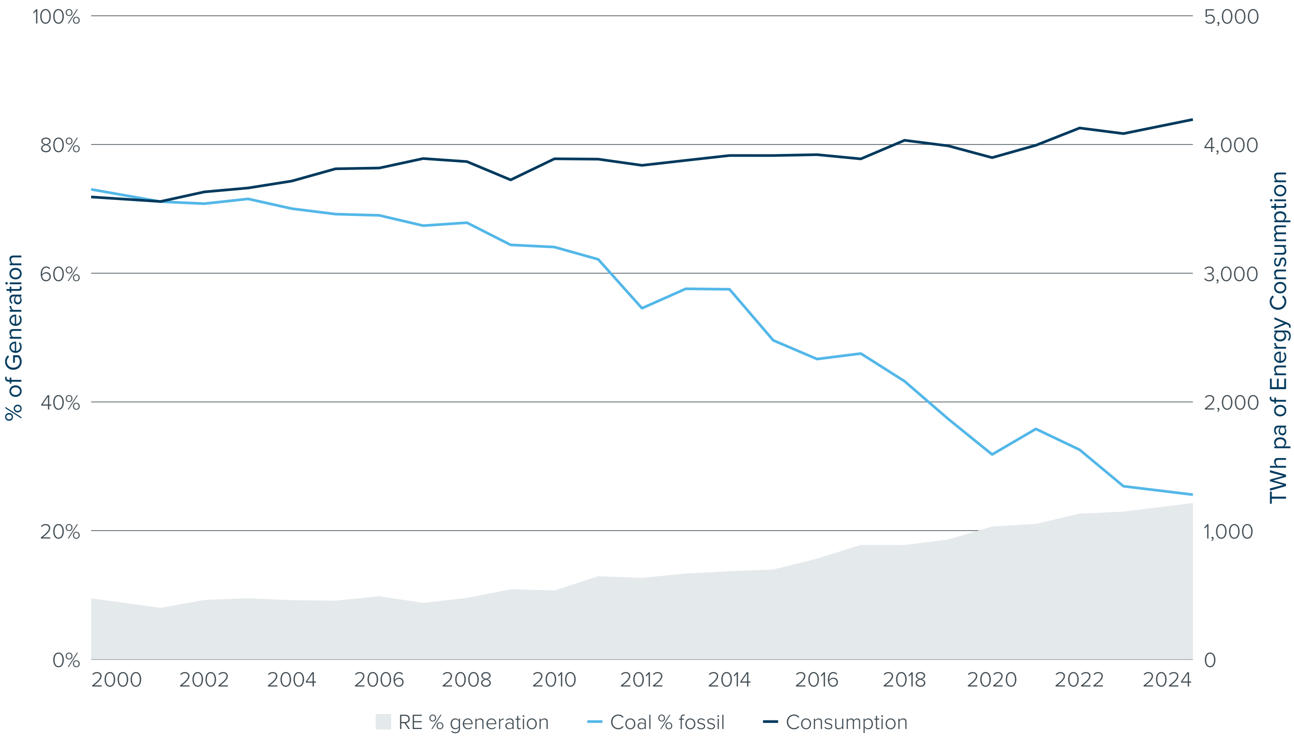
Figure 4.13: China energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.3 United States transition trends

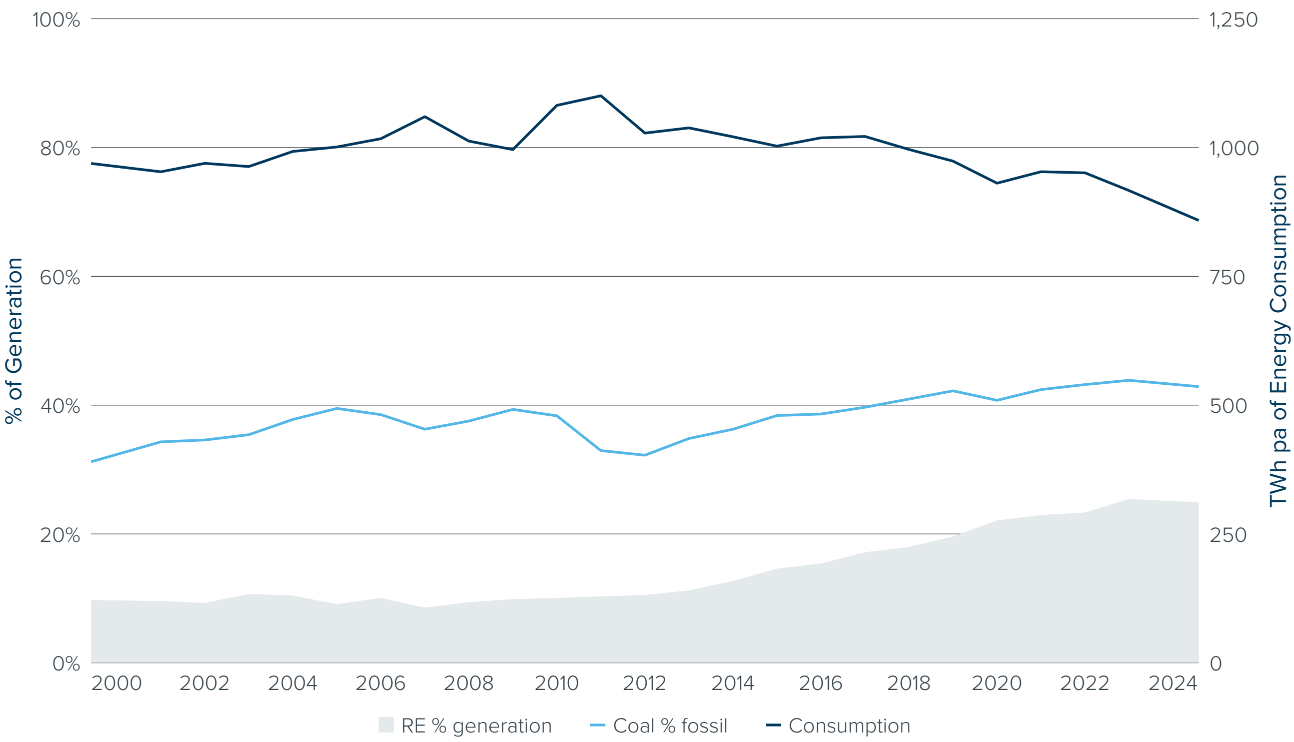
Figure 4.14: US energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.4 Japan transition trends

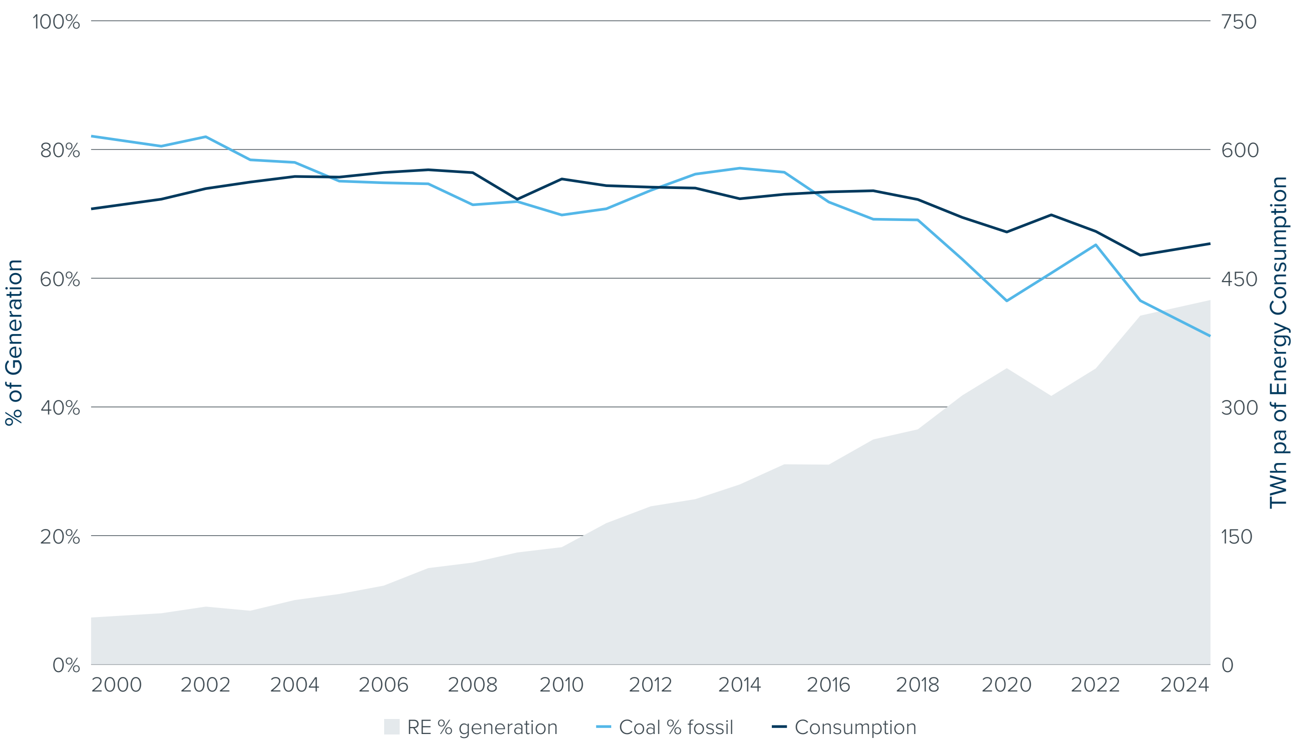
Figure 4.15: Japan energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.5 Germany transition trends

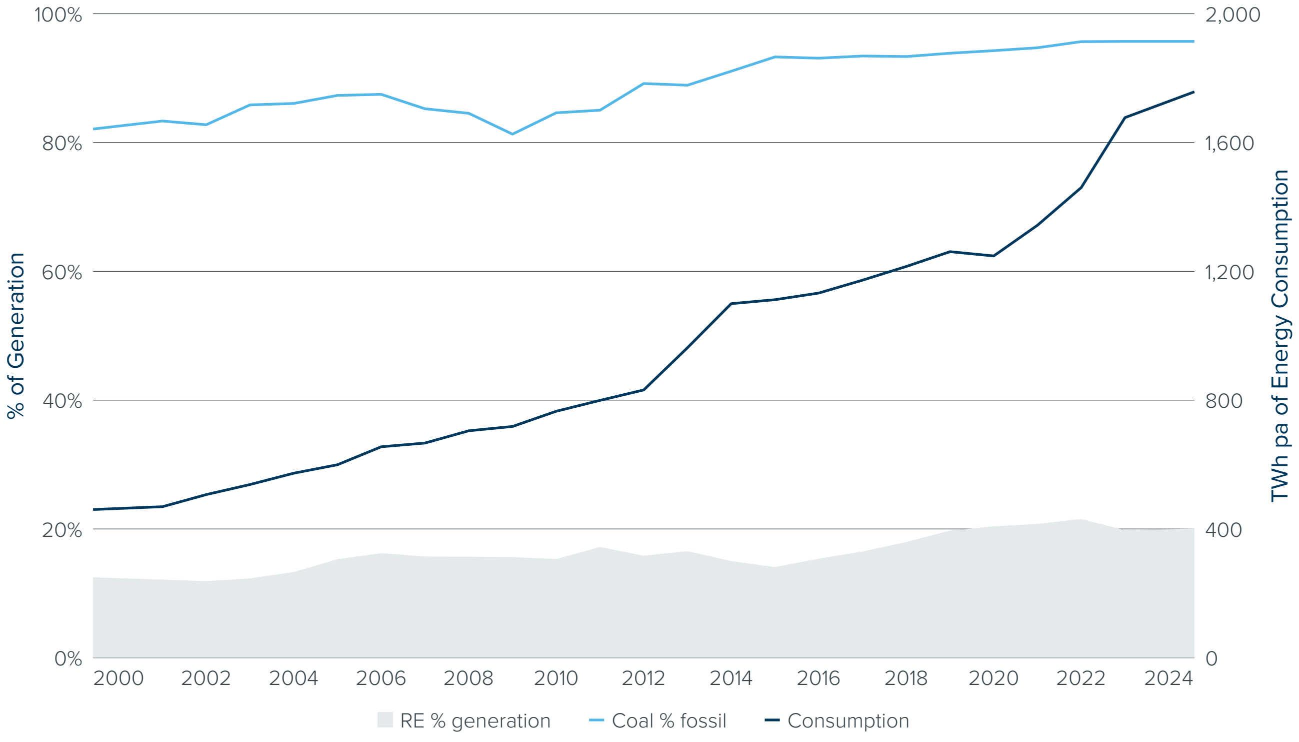
Figure 4.16: Germany energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.6 India transition trends

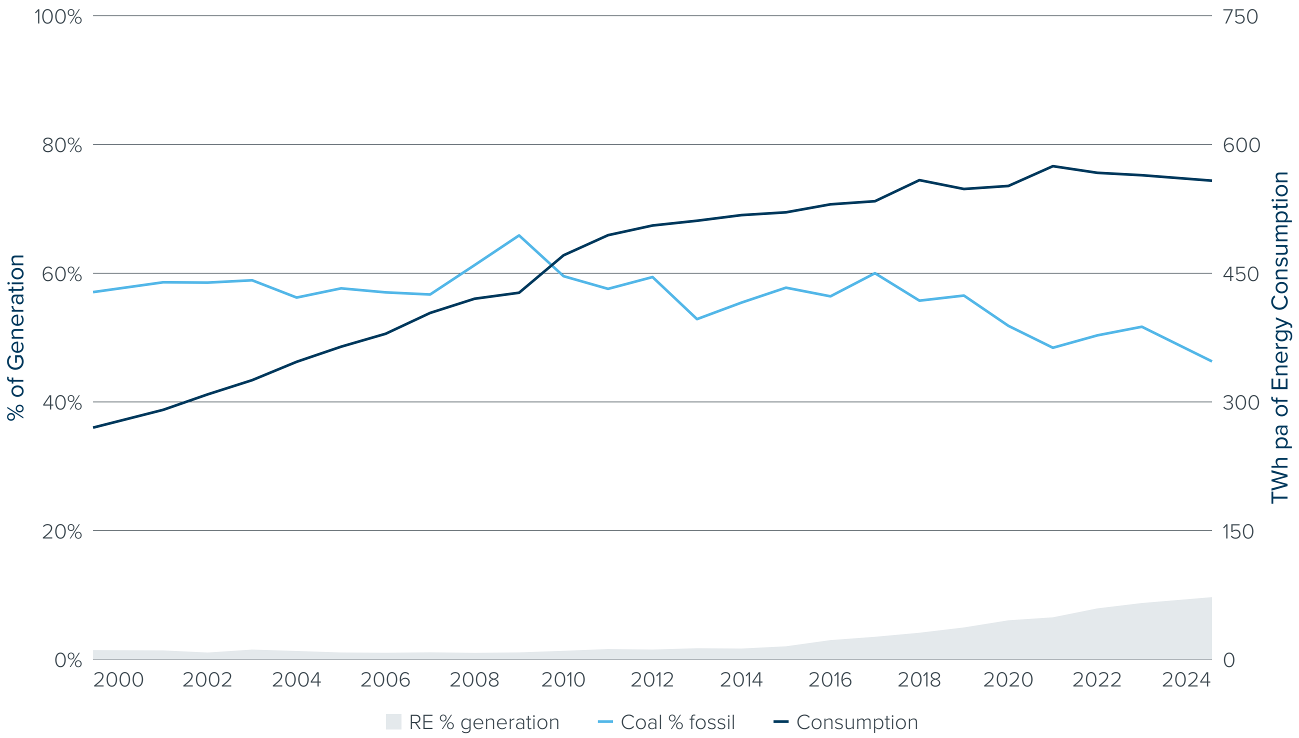
Figure 4.17: India energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.7 South Korea transition trends

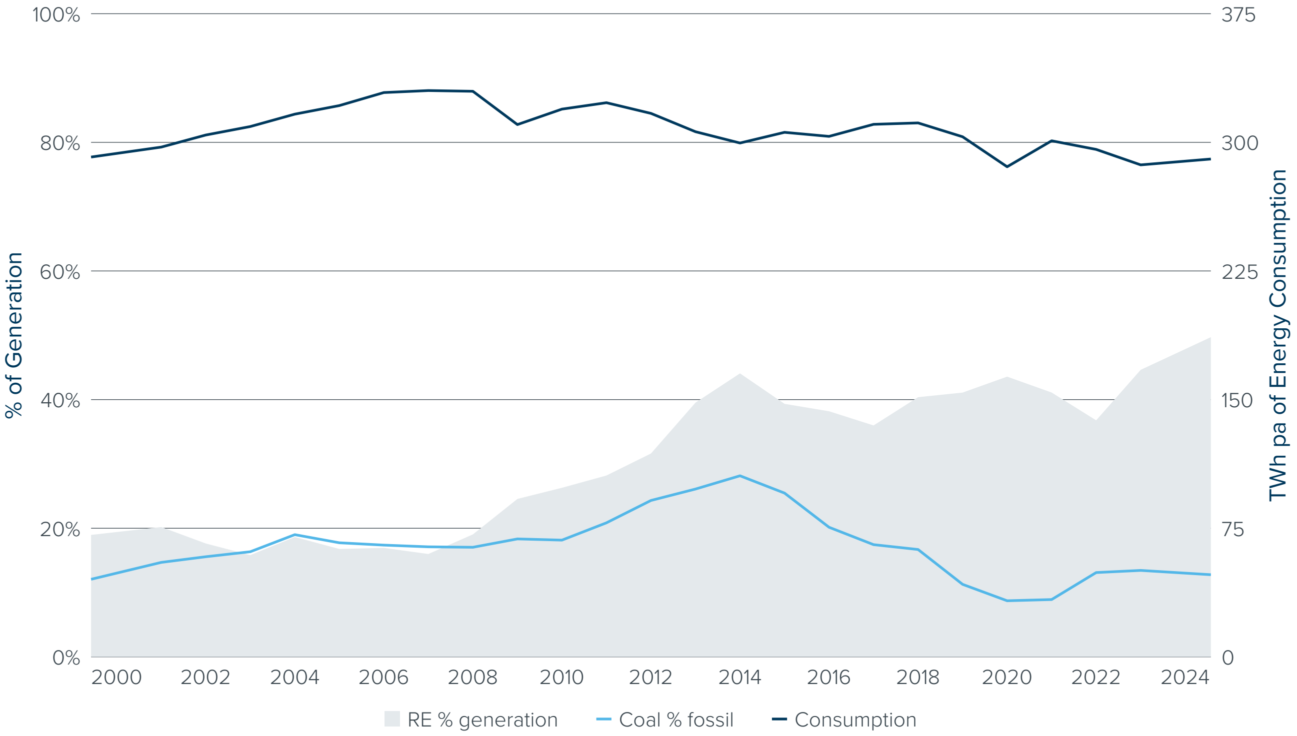
Figure 4.18: South Korea energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.8 Italy transition trends

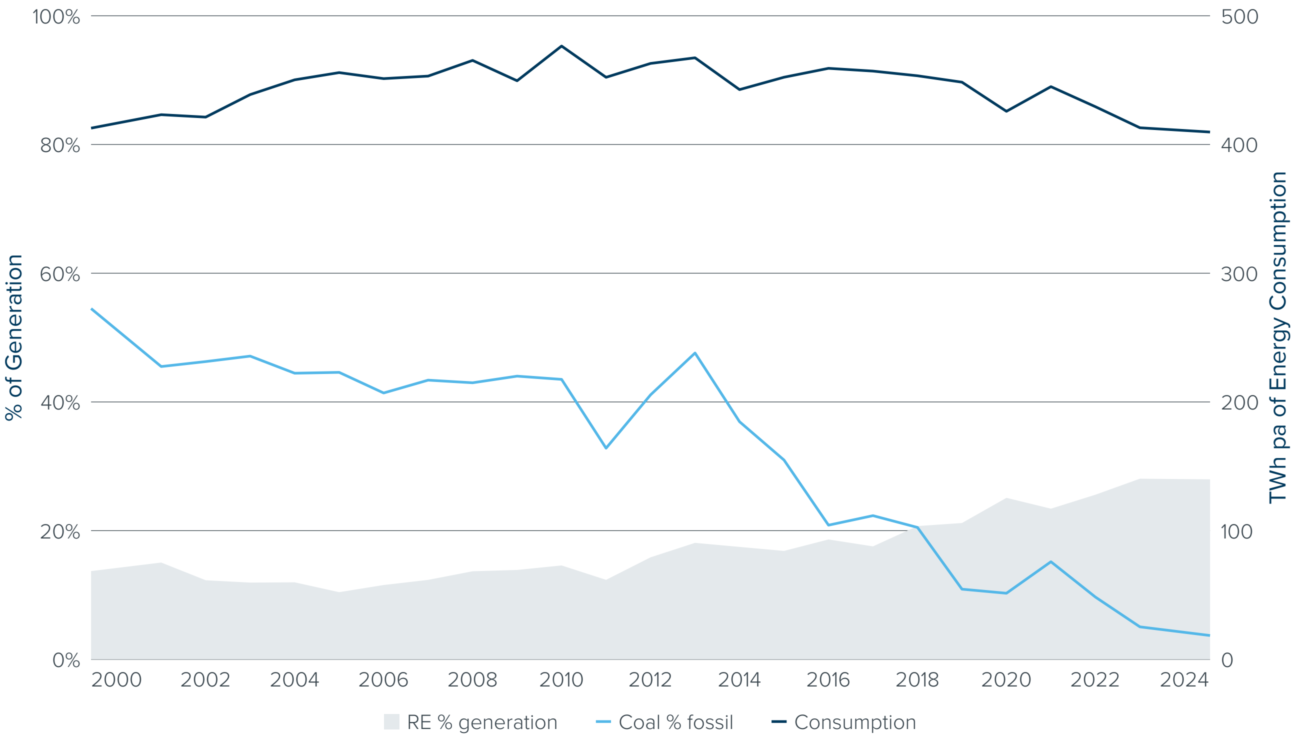
Figure 4.19: Italy energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.9 France transition trends

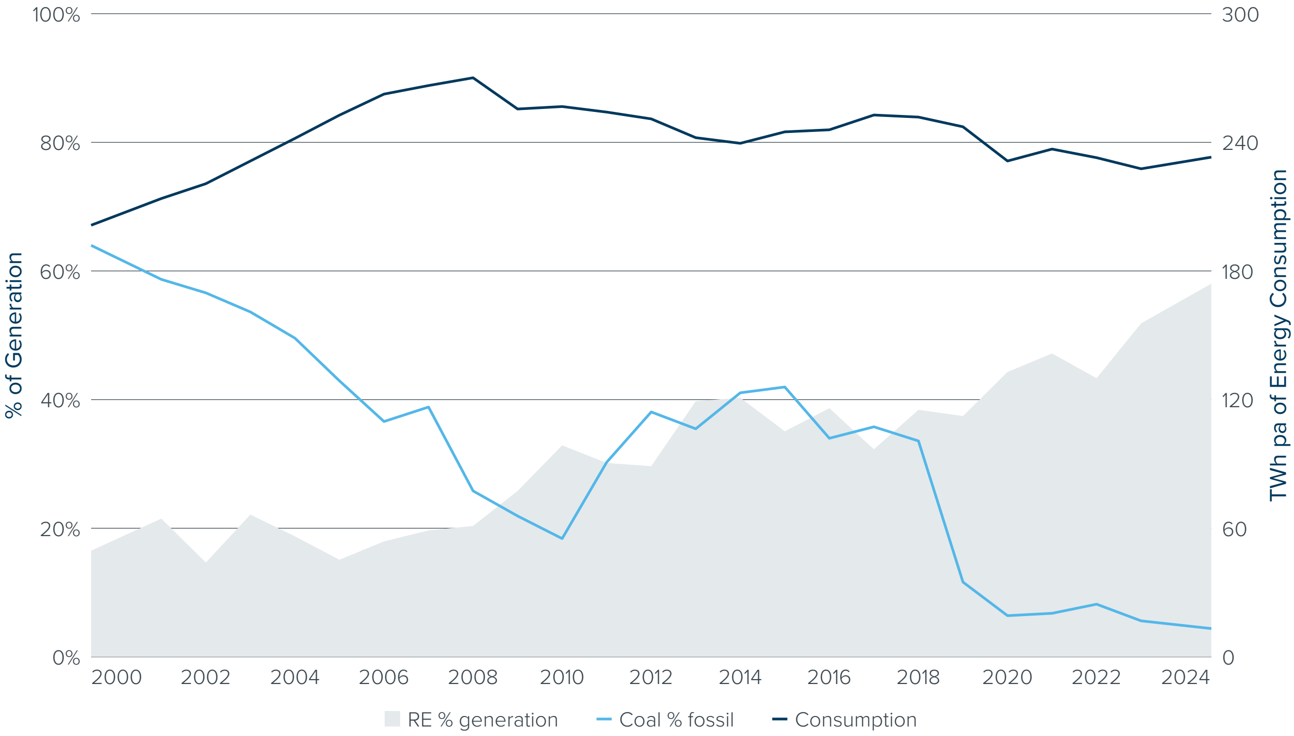
Figure 4.20: France energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.10 Spain transition trends

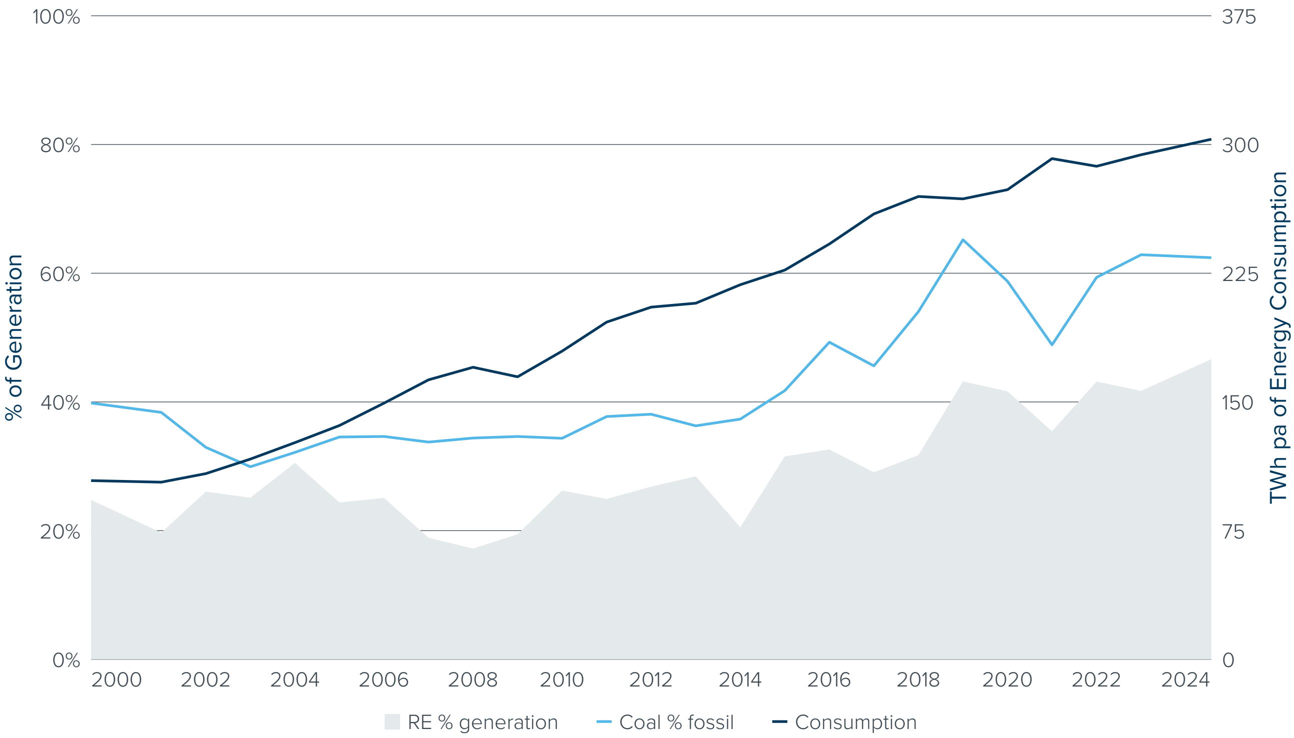
Figure 4.21: Spain energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.2.11 Turkey transition trends

Figure 4.22: Turkey energy transition indicators, 2000 to 2024



Source: Authors' analysis of US Energy Information Administration data.

4.3 Transition Metrics

The data in the following tables is based on the data used in the graphs in Section 4.2, to illustrate the relative progress of each country towards decarbonisation and the energy transition.

4.3.1 Consumption Growth

As discussed in Section 4.2, energy efficiency is a key tool for decarbonisation. The Western nations at the bottom of Table 4.1 illustrate some of the results of energy efficiency improvement, although they also show the results of deindustrialisation, and changes to the nature of their economies.

Similarly, the high growth at the top of the table reflects economic growth and increased access to electricity rather than reductions in efficiency.

Table 4.1: Consumption growth, 2000 to 2024

Country	Growth (TWh)	Growth (%)
China	8,544	684
India	1,297	282
Turkey	199	191
South Korea	288	107
United States	602	17
Spain	32	16
Italy	-1	0
France	-3	-1
Germany	-40	-8
Japan	-111	-11
UK	-78	-22

Source: Authors' analysis of US Energy Information Administration data.

4.3.2 Reduction in fossil fuel for generation

Changes in the amount of electricity generated from fossil fuel is a major indicator of decarbonisation, as shown in Table 4.2. As might be expected, the UK and the EU countries lead the table, with India and China at the bottom.

Table 4.2: Change in fossil-fuel generated electricity, 2000 to 2024

Country	Increase (TWh)	Growth (%)
UK	-188	-68
Spain	-63	-51
France	-23	-46
Germany	-147	-41
Italy	-87	-40

Country	Increase (TWh)	Growth (%)
United States	-144	-5
Japan	-13	-2
Turkey	84	90
South Korea	159	91
India	1,062	203
China	5,135	461

Source: Authors' analysis of US Energy Information Administration data.

4.3.3 Reduction in the use of coal for generation

The UK and the EU nations, as shown in Table 4.3, also demonstrate good progress in phasing out fossil fuel from electricity generation, although Germany and Italy are slower at achieving this. The US has made good progress in coal to gas substitution, although the current administration is reversing this trend. Again, India and China are at the bottom of this table, joined by Turkey. This is despite Turkey retaining its access to cheap Russian gas.

Table 4.3: Change in generation from coal, 2000 to 2024

Country	Increase (TWh)	Growth (%)
UK	-118	-98
Spain	-76	-97
France	-26	-96
United States	-1,314	-67
Germany	-188	-63
Italy	-10	-37
Japan	66	35
South Korea	55	55
Turkey	74	197
India	1,087	253
China	4,718	447

Source: Authors' analysis of US Energy Information Administration data.

4.3.4 Increase in renewable energy generation

China dominates Table 4.4, with the increase in amount of electricity produced from renewable energy. However as shown in Figure 4.13, the proportion of its electricity produced from renewable sources remains low. This is also the case for South Korea, where the large percentage increase results from its late start on the introduction of renewables. The UK's high position in this table is a true indication of its progress in the energy transition.

Table 4.4: Growth in renewable energy, 2000 to 2024

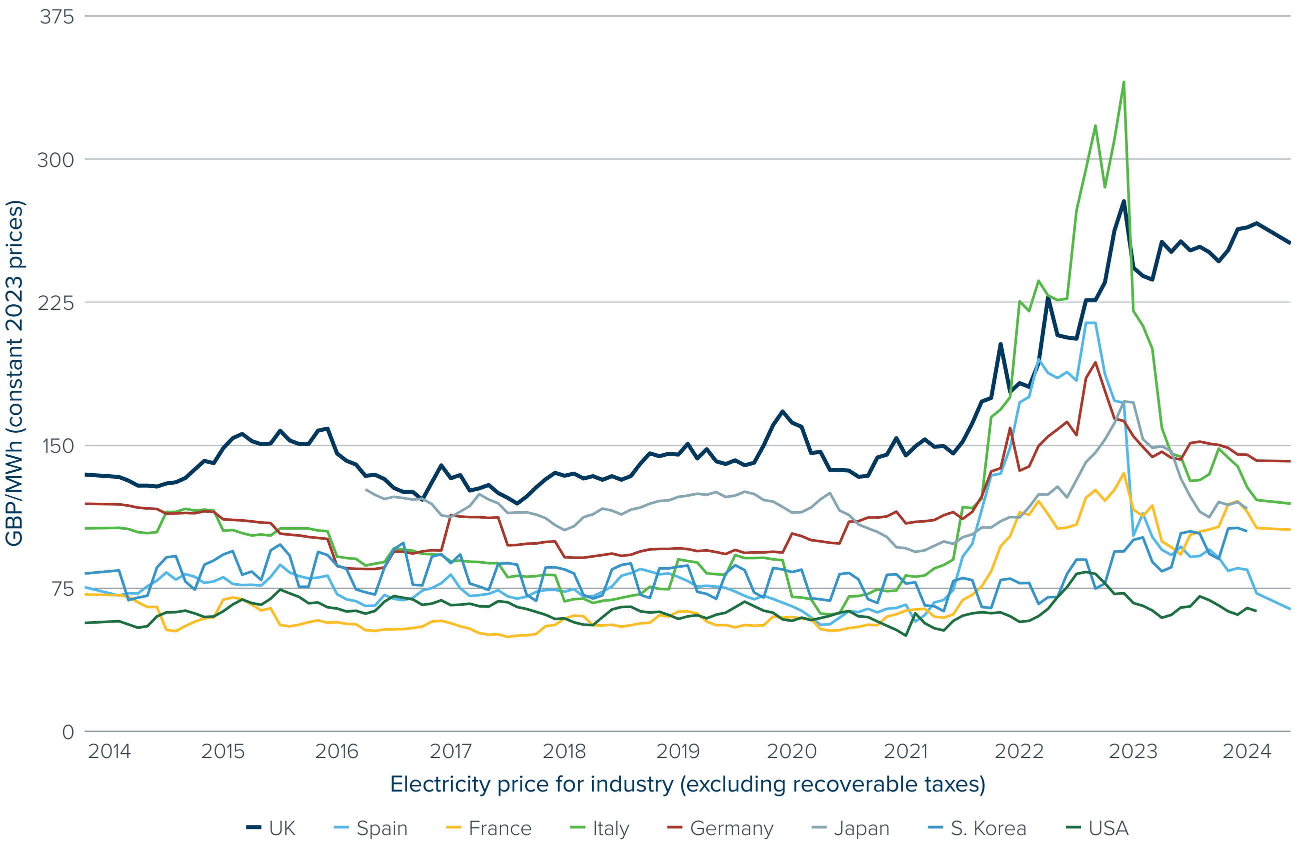
Country	Increase (TWh)	Growth (%)
China	3,257	1,459
South Korea	52	1,271
UK	130	1,242
Germany	238	580
India	335	437
Turkey	124	403
Spain	120	333
United States	707	196
Italy	78	153
Japan	128	129
France	80	114

Source: Authors' analysis of US Energy Information Administration data.

5. Electricity price comparison

The main focus of this study is a comparison between the cost of electricity in UK with that of its major trading partners and competitors. As can be seen in Figure 5.1, apart from a short period after the Russian invasion of Ukraine when it was supplanted by Italy, the UK has had the highest cost of electricity of our selected countries for over a decade. The gap between the UK and its competitors is getting larger, with industries in the UK paying around four times as much for electricity as competitors in China and United States.

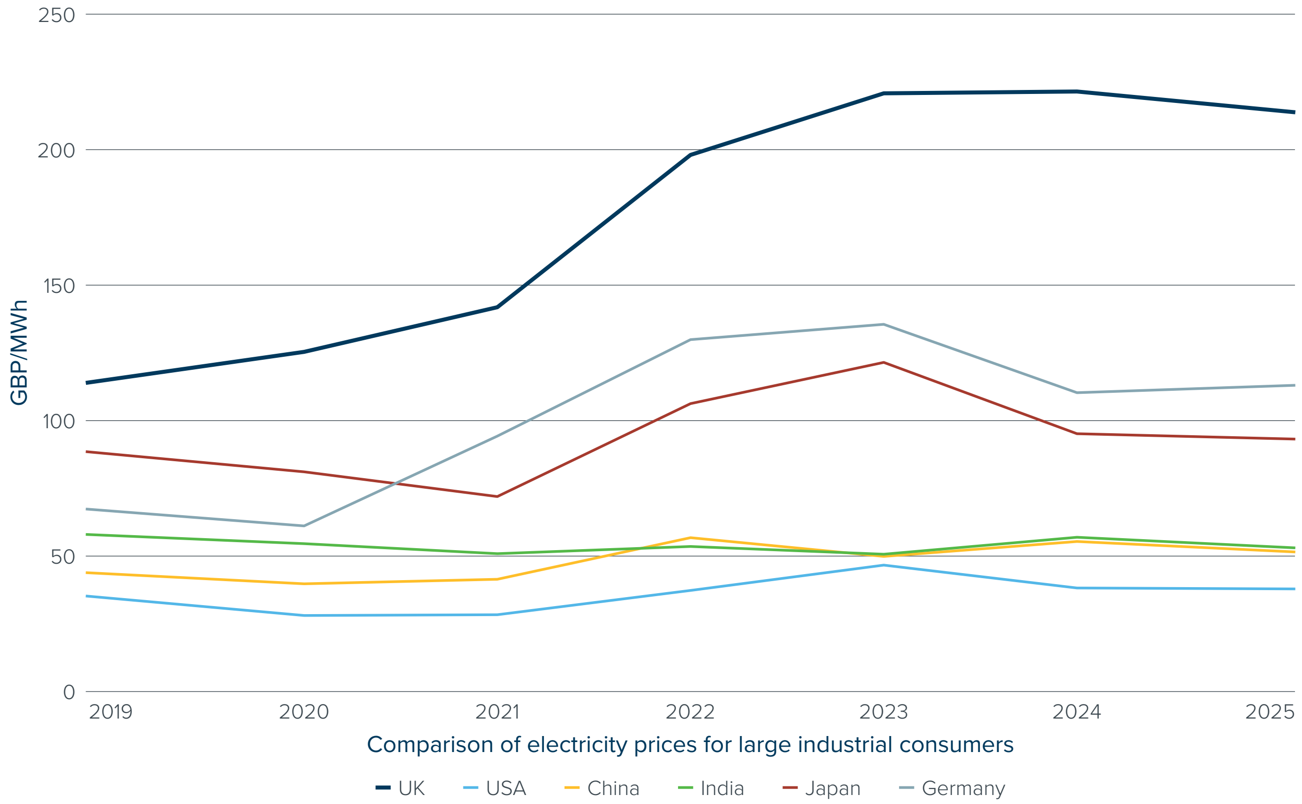
Figure 5.1: Electricity price for industry, 2014 to 2024 (constant 2023 prices)



Source: EU. Dashboard for Energy Prices – EU and main trading partners 2024.

Figure 5.2 shows that the cost of electricity for large industrial consumers (using more than 150 gigawatt hours [GWh] per annum) is similar to the average of all industries, with the UK being twice as expensive as Germany and Japan, and four times as expensive as China, India and USA. This is of particular relevance for major manufacturers, and in future for data centres: 150 GWh is the consumption for a relatively small 25 MW datacentre.

Figure 5.2: Comparison of electricity prices for large industrial consumers, 2019 to 2025



Source: USA, China, India and Japan data from IEA (2026); UK data from DESNZ; Germany data from Eurostat.

Assessing the average cost of electricity for industry is a complex exercise, with electricity prices varying by location, supplier, time of day, season and, increasingly, with the weather. The authors have undertaken detailed research into the available data to achieve consistency across the selected countries. However, the data presented in Table 5.1 comes from multiple sources and will not be exactly comparable or reflect the cost of electricity for an individual consumer.

Table 5.1 presents the same picture as Figure 5.1 and Figure 5.2, with UK electricity prices approximately double those of its European neighbours, and four or five times the price of the USA and China.

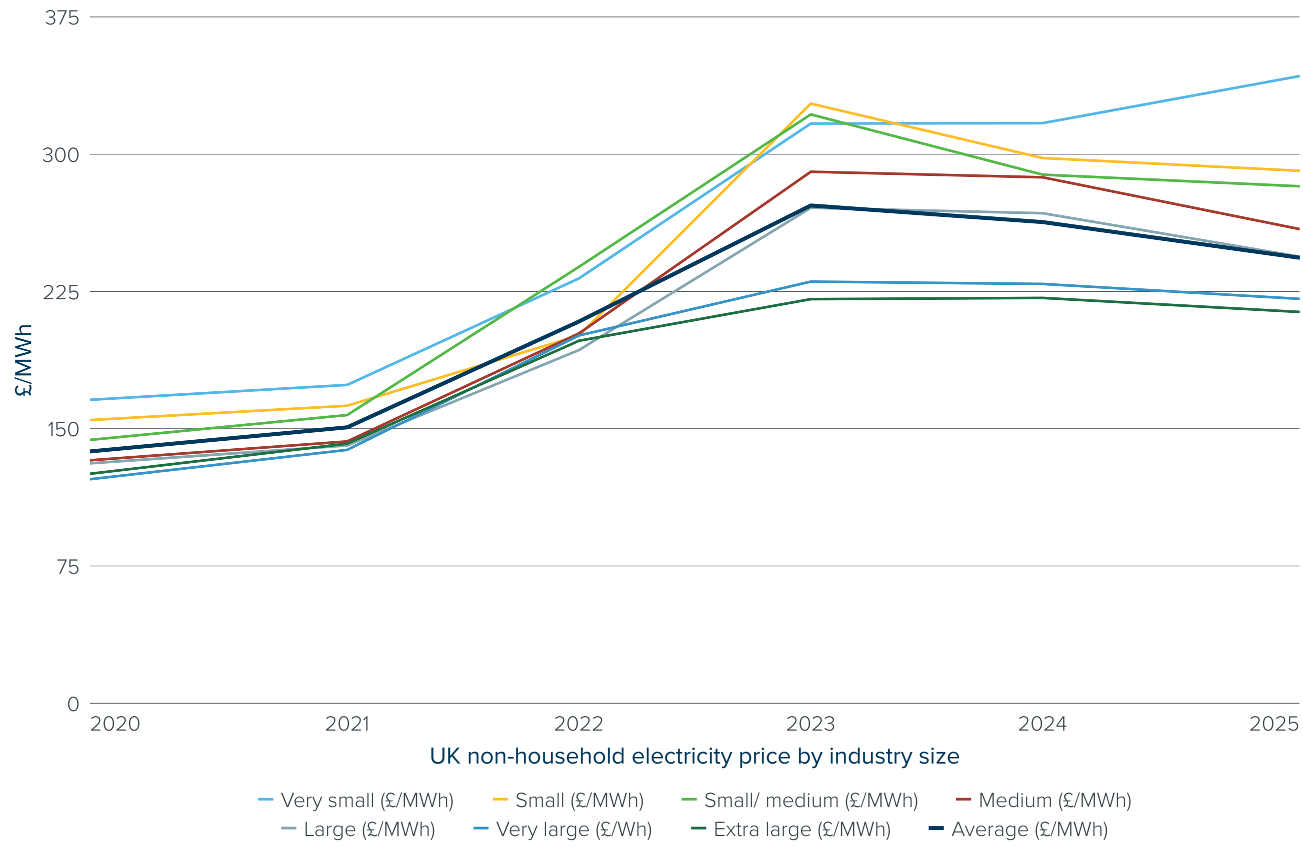
It is particularly interesting to note that electricity prices in the UK are more than double those in Japan and South Korea, which are countries with poorer domestic resources and are dependent on imported fuels for most of their generation.

Table 5.1: Electricity prices for industry, 2024 and 2025 (GBP/MWh)

	2024	2025	
Country	GBP/MWh	GBP/MWh	Source
UK	257	238	DESNZ Table 341.1
China	43	44	Climatescope (Bloomberg) 2024; no change in 2025 except exchange rate.
United States	64	65	US EIA
Japan	95	93	IEA 2026
Germany	150	138	Eurostat

Country	2024 GBP/MWh	2025 GBP/MWh	Source
India	78	73	India Climate and Energy Dashboard
South Korea	110	110	2024 DESNZ Table 5.3.1, author's analysis GBP price unchanged in 2025
Italy	147	158	Eurostat
France	129	112	Eurostat
Spain	104	103	Eurostat
Turkey	70	66	Eurostat

Figure 5.3: Electricity prices for different sized industries in UK, 2020 to 2025



Source: Department for Energy and Net Zero, Digest of UK Energy Statistics (Table 3.4.2).

An example of how the average price may not reflect the price to all consumers is shown in Figure 5.3 from the Department for Energy and Net Zero's Digest of UK Energy Statistics (Table 3.4.2). Most industry costs reduce between 2024 and 2025, in line with Table 5.1. However, the price for very small industry increases, so that in 2025 very small industries are paying 40 per cent more than the average and 60 per cent more than price for extra-large industries.

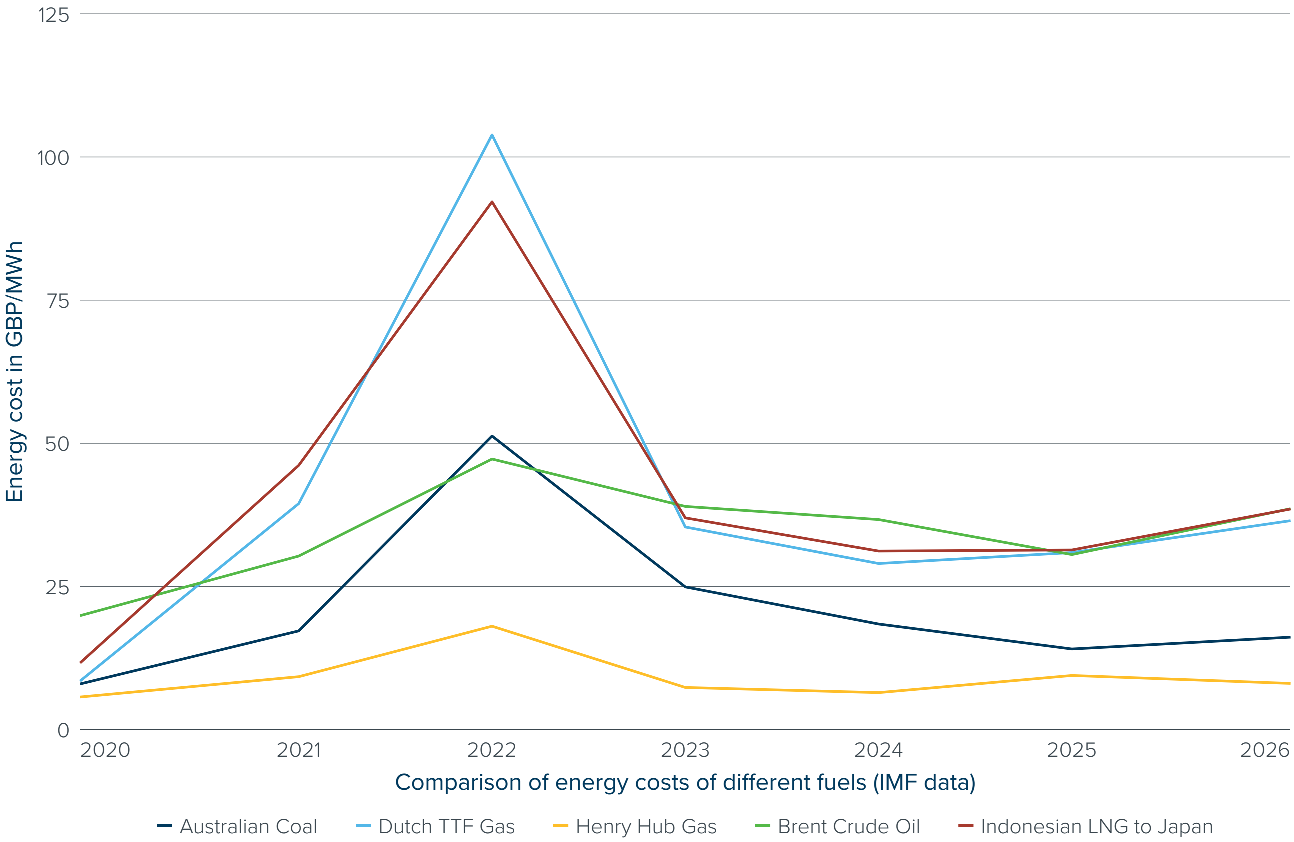
6. Other fuel prices

Although the focus of this report is comparison of the cost of electricity to industry, as this is where the majority of UK industry's cost lie,[5] in this section we examine the costs of other energy.

It can be difficult to compare the cost of energy from different fuels, as prices are quoted in different units, currencies and some by volume and others by energy content. In order to allow comparison, International Monetary Fund data has been converted to GBP/MWh for a range of energy commodities, as shown in Figure 6.1. Of particular note are the following:

- European gas prices closely track international liquefied natural gas prices (discussed further in Section 6.1).
- There is a wide gap between Title Transfer Facility and liquefied natural gas prices, and US Henry Hub prices (also discussed further in Section 6.1).[6]
- Apart from during period of market stress, liquefied natural gas prices and oil are very similar in price per unit energy content. However, liquefied natural gas appears more vulnerable to market imbalances.
- International coal prices are typically lower than oil prices per unit energy content, but above pipeline gas prices in the USA.

Figure 6.1: Comparison of energy costs for different fuels, 2020 to 2026



5 In 2024, electricity accounted for 70 per cent of UK industry's energy costs, with gas accounting for a further 20 per cent (refer to Table 7.1).
6 TTF is the main European natural gas trading market, and Henry Hub is the main US natural gas trading market.

6.1 Natural gas

Natural gas prices are largely dependent on whether the country has access to pipeline gas, either imported or from its own resources, or if it is dependent on liquefied natural gas from the international market.

Table 6.1: Price of natural gas for Industries for the selected countries, 2024 and 2025

	2024	2025	
Country	GBP/MWh	GBP/MWh	Source
UK	57.7	54.9	DESNZ data
China	49.4	40.9	Extrapolation for 2024/2025 based on IEA data
United States	11.1	13.9	US EIA data
Japan	48.3	40.0	Extrapolation for 2024/2025 based on EU data
Germany	50.8	61.3	EU data
India	21.3	19.2	GoI data cross-referenced with EU data
South Korea	55.5	45.0	Extrapolation for 2025 based on EU data
Italy	42.7	49.0	EU data
France	35.8	56.6	EU data
Spain	38.5	43.6	EU data
Turkey	25.0	25.6	EU data

Countries that have access to pipeline gas tend to have much lower gas prices than countries that are dependent on liquefied natural gas. Liquefied natural gas costs include not only the base cost of gas but also the cost of liquefaction, transport and re-gasification. This is best illustrated by the differential between UK and US gas prices. Northern European countries used to have access to pipeline gas from Russia prior to the 2022 invasion of Ukraine. Since then, the UK and EU have been progressively weaning themselves off Russian gas, and the spot market price for gas in the UK and Northern Europe is closely aligned with the international liquefied natural gas price. Turkey, with its continued use of Russian pipeline gas, benefits from lower gas prices. India has limited domestic gas supplies and gives preferential prices to households and certain industries.

6.2 Coal

Coal is internationally traded and tends to be valued based on energy content. The price of coal per unit of energy tends to be lower than liquefied natural gas but higher than pipeline gas. However, domestically supplied coal in countries such as India, China and the USA can undercut the international price, and hence may have a lower cost per unit of energy than domestic gas.

As coal is no longer used for electricity generation in the UK, and specialist coal is used for industrial processes, no cost analysis has been carried out for coal, and it is assumed that the limited amount of coal used by industry would cost the same in other countries.

6.3 Oil products

Oil products are also traded internationally, with prices of crude oil varying more as a result of their quality and characteristics than energy content. Sweet, light oil, with low sulphur and low viscosity, tends to command higher prices than heavy, sour oil due to the ease of refining.

Very little oil is used for generation in the UK, and the consumption by industry is small. Again, it is assumed that the oil used by industry would cost approximately the same at other countries' prices.

7. Expenditure of UK industry on energy

The primary objective of this report is to compare the price paid for energy by UK industry with its international competitors. In this section we establish the cost paid by UK industry for different forms of energy. We then calculate how much less UK industry would pay if it was charged at the rates paid by competitors in the comparator countries.

7.1 UK industry expenditure on energy

Data is available from the Department for Energy Security and Net Zero on expenditure of UK industry on energy.[7] An extract from this is provided in Table 7.1.

Table 7.1: Expenditure by UK industry on different forms of energy, 2020 to 2024

	Coal and solid fuels	Natural gas	Electricity	Petroleum products	Heat and other fuels	Total
Year	£bn pa	£bn pa	£bn pa	£bn pa	£bn pa	£bn pa
2020	0.46	1.41	6.89	0.90	0.49	10.14
2021	0.53	2.44	8.91	1.06	0.75	13.71
2022	1.01	4.36	12.66	0.86	1.31	20.18
2023	0.85	4.06	13.50	0.47	1.20	20.07
2024	0.31	3.26	11.66	0.38	0.98	16.58

Source: Department for Energy and Net Zero, Digest of UK Energy Statistics. Table 1.1.6.

From Table 7.1 it can be seen that in 2024, 90 per cent of the energy expenditure was incurred on electricity and gas. As coal and petroleum products tend to be procured at international prices, and heat is dependent on neighbouring heat producers, only the electricity and gas expenditure is relevant for comparison with competitor countries.

7.2 Ratio of international electricity prices to the UK

Based on the data presented in Table 5.1 and Table 6.1, the ratio of electricity and gas prices to UK prices for 2024 have been calculated and are shown in Table 7.2.

Table 7.2: Ratio of international electricity and gas prices for industry to UK (2024)

Country	Electricity	Gas
UK	1.00	1.00
China	0.17	0.86
United States	0.25	0.19
Japan	0.37	0.84
Germany	0.58	0.88

7 See: Department for Energy Security and Net Zero's Digest of UK Energy Statistics, Table 1.1.6. The latest version of Table 1.1.6 covers expenditure up to 2024. An update is due on 31st July 2026, which should include expenditure up to 2025.

Country	Electricity	Gas
India	0.30	0.37
South Korea	0.43	0.96
Italy	0.57	0.74
France	0.50	0.62
Spain	0.40	0.67
Turkey	0.27	0.43

Source: Authors' analysis.

This table highlights the stark differential between the costs, especially for electricity, but also for gas in some countries.

7.3 Saving to UK industry if charged at other countries' prices

Using the gas and electricity price ratios in Table 7.2, the expenditure of UK industry on energy if charged at the competitor countries' rates is calculated and presented in Table 7.3.

Table 7.3: Annual energy cost to industry if charged at other countries' prices (2024)

	Coal and solid fuels	Natural gas	Electricity	Petroleum products	Heat and other fuels	Total
Country	£ billion	£ billion	£ billion	£ billion	£ billion	£ billion
UK	0.31	3.26	11.66	0.38	0.98	16.58
China	0.31	2.79	1.97	0.38	0.98	6.42
United States	0.31	0.63	2.88	0.38	0.98	5.17
Japan	0.31	2.73	4.32	0.38	0.98	8.71
Germany	0.31	2.87	6.79	0.38	0.98	11.32
India	0.31	1.20	3.54	0.38	0.98	6.41
South Korea	0.31	3.14	4.98	0.38	0.98	9.77
Italy	0.31	2.41	6.69	0.38	0.98	10.76
France	0.31	2.02	5.84	0.38	0.98	9.53
Spain	0.31	2.17	4.71	0.38	0.98	8.54
Turkey	0.31	1.41	3.17	0.38	0.98	6.24

Source: Authors' analysis.

Analysing the data in Table 7.3, the percentage of UK industry's costs, and the savings that would be achieved if they were charged at the other countries' electricity and gas prices, are shown in Table 7.4 and illustrated in Figure 7.1.

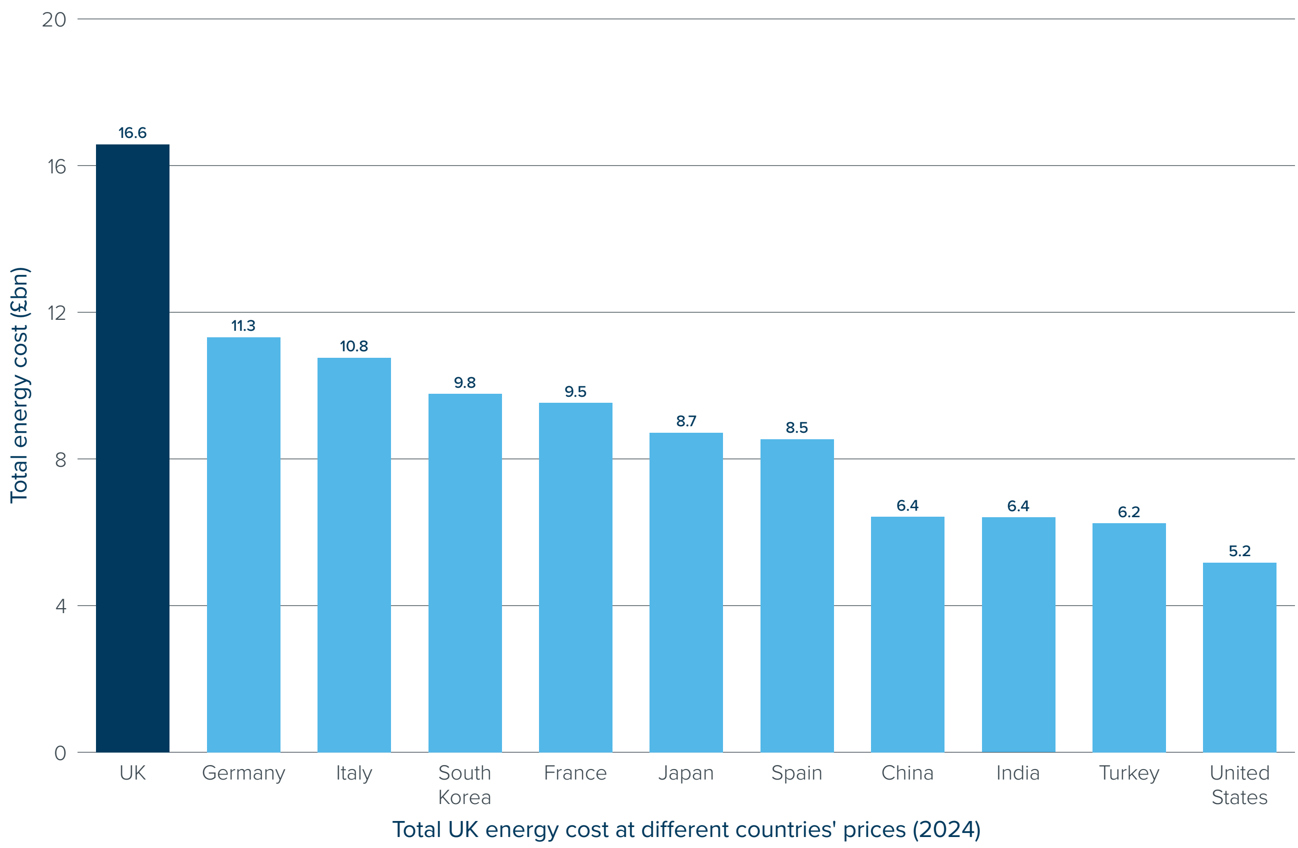
Table 7.4: Percentage and savings to UK industry if charged at other countries' prices (2024)

	Total cost	Percentage of UK cost	Saving
Country	£ billion	%	£ billion
UK	16.6	100	0
China	6.4	39	10.2
United States	5.2	31	11.4
Japan	8.7	53	7.9
Germany	11.3	68	5.3
India	6.4	39	10.2
South Korea	9.8	59	6.8
Italy	10.8	65	5.8
France	9.5	57	7.1
Spain	8.5	52	8.0
Turkey	6.2	38	10.3

Source: Authors' analysis.

The expenditure on energy by UK industry would reduce by 50 per cent if charged at the average electricity and gas prices of these competitor countries. In key competitors such as the United States, China and India, UK industry would save between 60 per cent and 70 per cent of its energy costs.

Figure 7.1: Energy cost to UK industry if charged at other countries prices (2024)



Source: Authors' analysis.

8. Analysis and comparison of policies

This analysis shows how much extra UK manufacturers pay for their energy compared with their main international competitors.

Not only the fact of the higher costs is relevant but its scale. To put it in context, the higher prices paid by UK manufacturers compared with what they would pay had they paid US prices is as much as five per cent of the entire manufacturing value added.

Another comparison is that the additional cost of energy compared with the US is equivalent to 8.5 per cent of the entire employment compensation (wages, and so forth, plus employers' contributions) in the sector.

Moreover this comparison does not include the higher costs of feedstock for the petrochemical and agri chemical sectors.

And it also excludes the indirect cost impact of higher energy prices through the entire supply chain raising the costs of all intermediate purchases.

An addition to costs on this scale is bound to have had an impact on the UK's deindustrialisation.

The next report in this series will analyse the extent to which the UK's deindustrialisation has been caused by high energy prices.

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