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Electric Insights Quarterly

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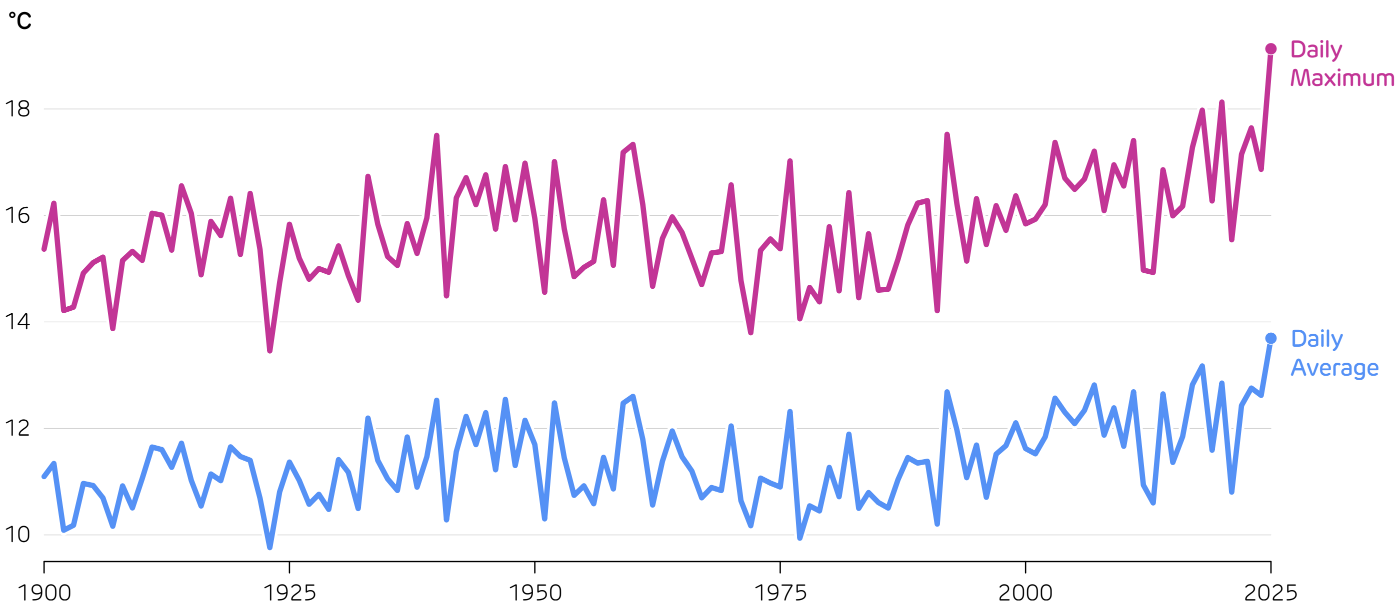
1. Introduction

The UK's energy politics moved fast this quarter. Ministers ruled out a move to zonal power prices, which would have seen wholesale prices vary around the country based on regional supply and demand. Instead, they opted to accelerate planning and grid build-out, with major implications for where projects go and who pays for them. The government also agreed to go forwards with a 44.9% stake in the Sizewell C nuclear project, the biggest domestic clean-power investment in a generation. Scotland also approved Berwick Bank, which, at 4.1 GW, will be one of the world's largest offshore wind farms. Looking abroad, China began building the Yarlung Tsangpo hydropower mega-project, which will have similar output to Britain's entire electricity consumption.

This quarter, we look at how Britain's power system is gearing up to run on zero fossil fuels. NESO's 2025 target of being able to operate without emissions is edging closer, backed by new frequency response and voltage services that let the system lean on renewables, storage, and demand response. Next, we look at how the rapid rise of solar power has turned Economy 7 on its head. The legacy tariff, which offers discount electricity overnight, is out of sync with 2025 Britain: power prices are now lower in the daytime than overnight as solar power has surged by 40% in just a year.

The UK saw its hottest and driest spring on record, with heat waves punctuating June and July. Extreme heat is a power system issue, not just a weather headline. Article 4 explores how heatwaves push up electricity demand, reduce generator and transmission output, as well as what it will take to maintain reliability as our summers intensify. Finally, Article 5 looks at the global liquified natural gas (LNG) market: how it overtook pipeline gas as the biggest source of world trade, and Britain's role as a gateway between the US and Europe. With the potential sale of the Isle of Grain terminal, this position in the global LNG supply chain may evolve.

Central England temperatures during the second quarter (April-June) of each year since 1900.



2. Getting to zero fossil fuel electricity

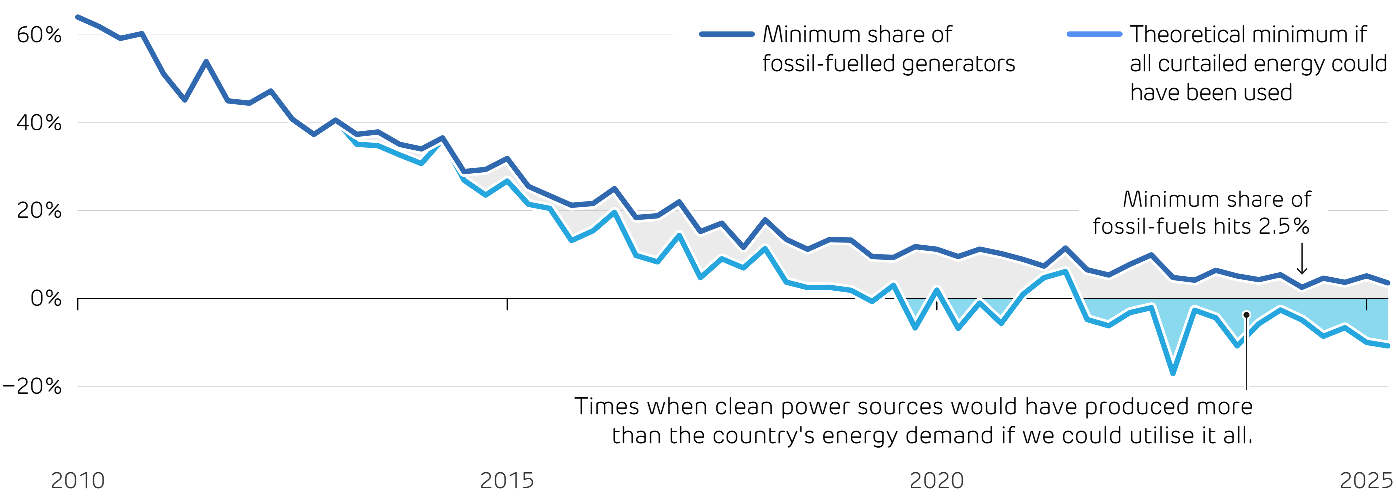
Back in 2016, Britain had its first ever zero-coal hour. Then, 8 years later, the last coal-fired power station shut forever. However, we are still heavily reliant on fossil fuels. Gas has been burnt to provide electricity every hour of every day since the 1980s. Phasing out gas is the next step on the road to clean power, and a major milestone may be just around the corner. Since 2019, NESO has been preparing the electricity system to be capable of running with zero fossil fuels when there is sufficient renewable output for short periods by 2025.

Running with zero fossil fuels has been a multi-year project because it is technically much more difficult than phasing out a single fuel (coal). The grid relies on inertia, a service that absorbs fluctuations in supply and demand, like shock absorbers. Inertia is essential for keeping the lights on, but is only produced by conventional power stations – coal and gas, plus nuclear, biomass and hydro. The grid must also balance output from variable renewables using dispatchable power – options that are available instantly to meet demand. This means gas and other sources will remain essential for managing peaks in demand and shortfalls in wind and solar power for years to come.

Since 2020, NESO has introduced new tools to keep the grid stable without fossil fuels for short periods of time, such as the Dynamic Containment service for rapid frequency control, better voltage management, and systems to restart the network using clean power. It also trialled new ways for homes and businesses to offer flexibility, tested market changes to encourage low-carbon solutions, and ran the Demand Flexibility Service to reward shifting electricity use.

To date, the grid has never operated with less than 6 GW of conventional generation, and gas alone has never fallen below 0.74 GW. Turning off all gas plants, even briefly, will be moving the power system into new territory, and so must be handled carefully. The minimum fossil fuel generation fell steadily through the 2010s. In 2010 it had never gone below 12.5 GW, but by 2018 it was reaching below 2.5 GW. After that, progress stymied, as we started hitting the current limits of operability.

The minimum hourly share of Britain's electricity generation from fossil fuels each quarter since 2010, and how much lower this could have been if all curtailed wind energy could have been used.

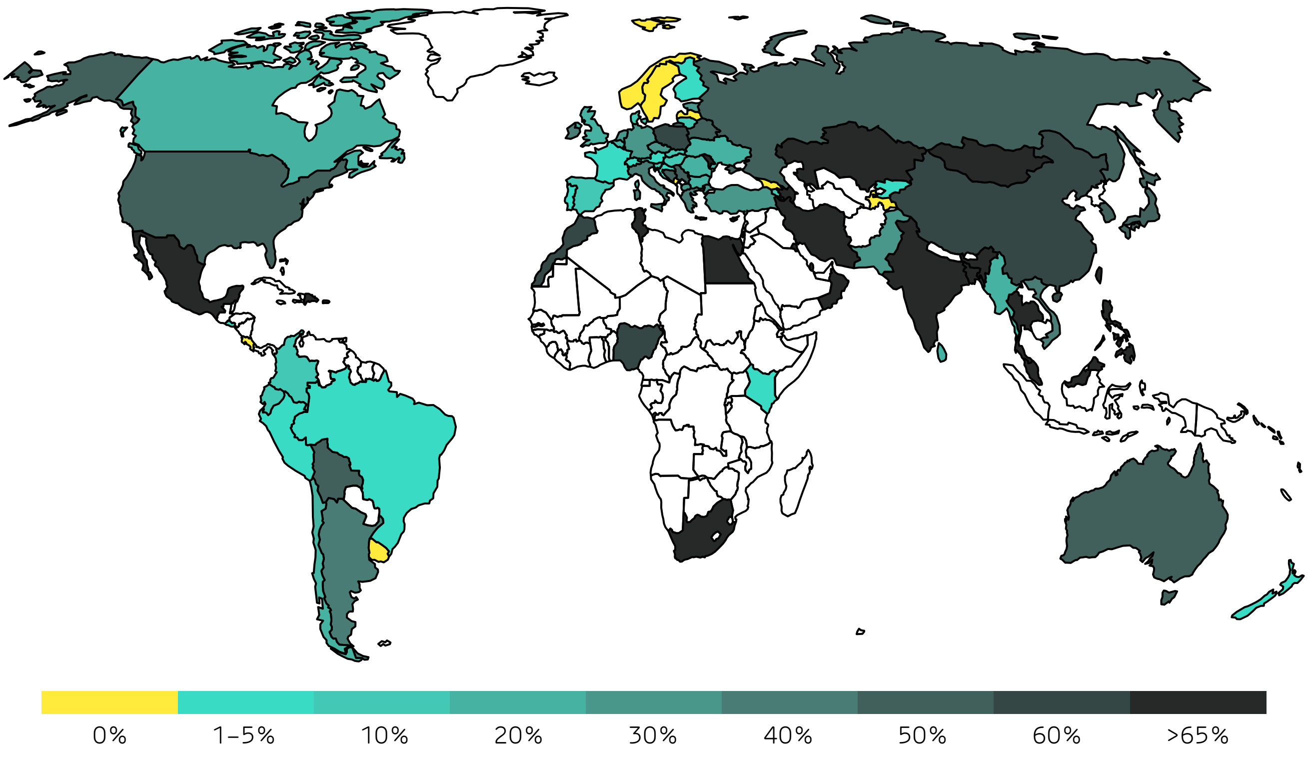


Around this time, curtailment of wind power picked up sharply, as the grid could no longer handle peak output. Wind farms have to be shut off, and generators elsewhere in the country (usually gas) turned on to replace their output. If that curtailed electricity could instead have been used, Britain could have theoretically reached zero need for fossil fuels back in 2019, and renewables plus nuclear could have supplied all the country's demand for over 250 hours last year.

Britain is not alone in moving away from fossil fuels. Worldwide, seven countries have so far managed to run their electricity systems with no fossil fuels for at least a month, including Sweden, Tajikistan, and Costa Rica. Some large countries have managed to get below 10% fossil, including France (due to high nuclear share) and Brazil (extensive hydropower). Britain's best so far is 22%, ahead of 30% in Germany, 50% in the US, Japan and South Korea, and 56% in China.

Getting to even short periods of zero-carbon electricity will require more than just new technology. It will mean upgrading the grid to handle higher peaks in renewables, expanding storage, and making full use of flexibility from homes, businesses, and industry. It will also take faster connections for clean energy projects and investment in backup solutions that don't rely on fossil fuels.

The lowest monthly-average share of fossil fuels in national electricity mixes.



3. Power prices turned upside down

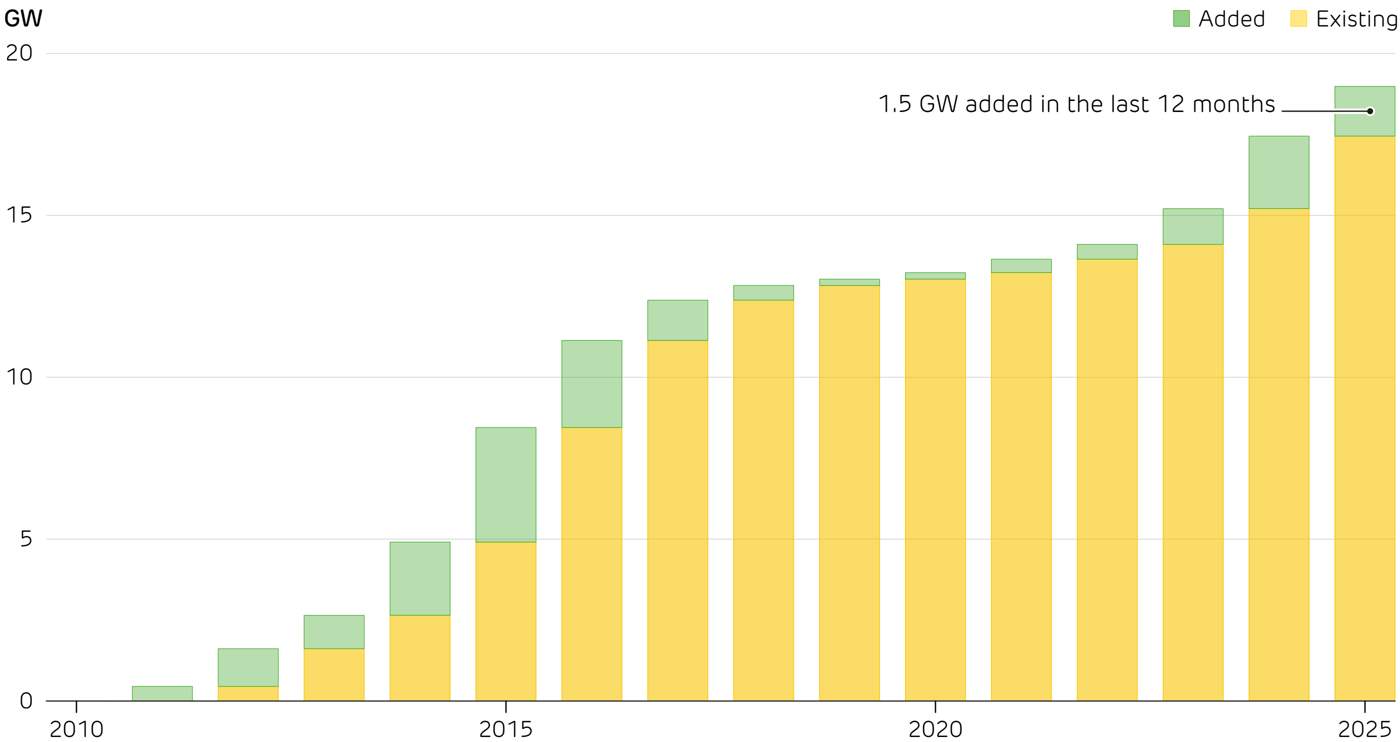
Ever since Britain had an electricity market, power prices have followed demand. High during the day when people are working, low overnight when they sleep. This summer, that logic has turned on its head, as supply of renewable electricity becomes a bigger factor than demand.

The Economy 7 tariff was introduced back in 1978, giving households lower prices for power consumed overnight. This encouraged people to shift their consumption, especially with night storage heaters, to make sure there was sufficient demand to keep the expanding new fleet of nuclear reactors running 24/7.

Fast forward to 2025 and this pricing pattern has turned on its head. Over the second quarter, daytime power prices were lower than those overnight for the first time ever. The rapid rise in solar PV over the last two years means the grid is being flooded with clean power on sunny afternoons, helped by the sunniest Spring on record with 40% more sunshine hours than average.

Solar pushes down the need for conventional generation during daylight hours, and with it, power prices. The boom is set to continue as small-scale solar costs tumble and English housebuilders must legally install solar panels on new homes by 2027. The UK's latest solar roadmap seeks to more than double installed capacity to over 45 GW by 2030.

Britain's solar PV capacity, with new installs each year.

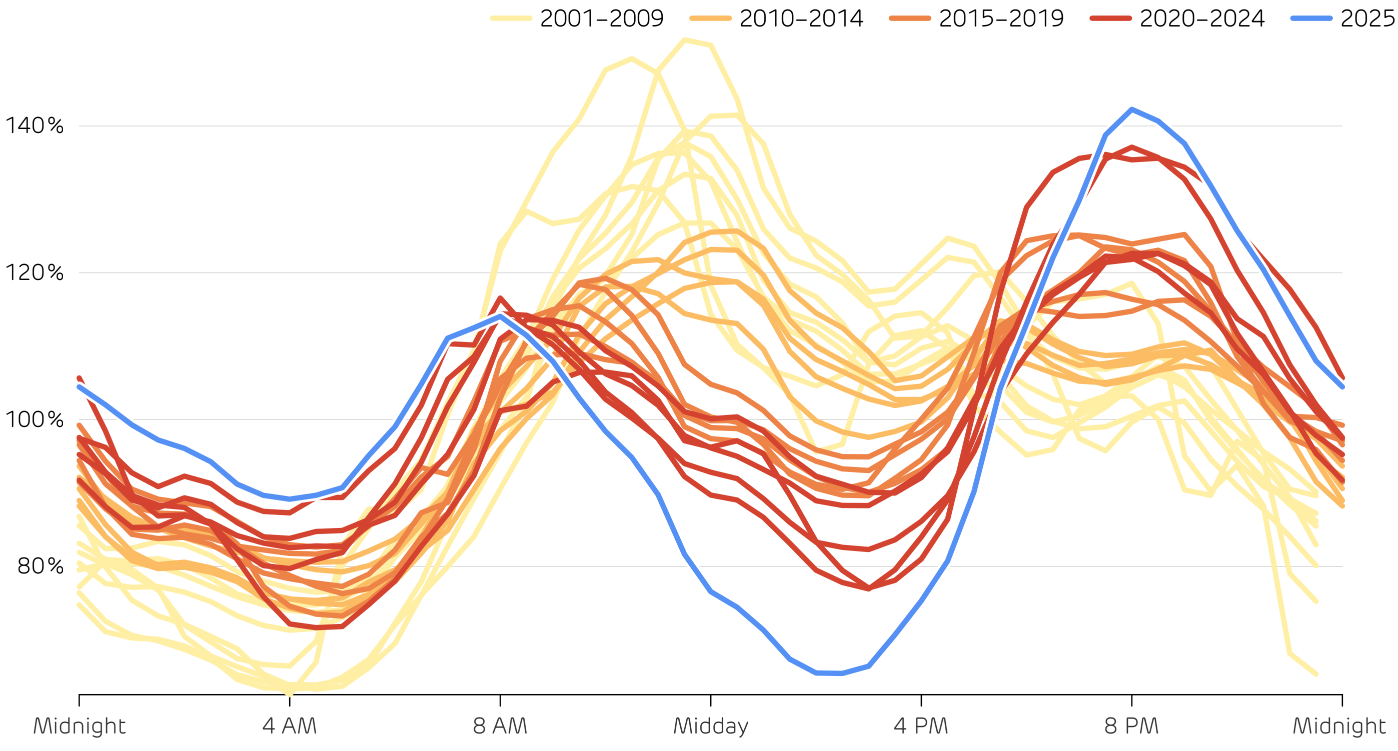


Prices are not just going down, becoming more prone to spikes. Prices during the evening peak, once the sun is setting, are growing relative to average prices. Back in 2010, a mid-merit power station could expect to turn on at 7 am and run through till 10 pm when demand started falling. Now, a contingent of stations need to turn on at 7, and then either shut down or dial back their output to minimum at 9 am once the sun is rising. Then they must ramp back up for just a couple of hours in the late evening.

Just as a gym membership becomes worse value for money if you only go twice a year, power stations must charge more if they operate less frequently. Fewer running hours mean that capital costs, insurance, and other fixed expenses need to be repaid from less output, while start-ups and running at minimum load are less efficient and so require more fuel, and induce more costly wear and tear.

California gives us a glimpse into the future. Their operator coined the term "duck curve" over a decade ago to describe declining midday demand and prices. Now the duck has flown the nest, as a huge build-out of batteries charges up on midday sunshine to fill the morning and evening peaks. In many sunny regions, falling energy storage costs mean it is now possible to achieve nearly 90% continuous year-round solar power generation for around £75/MWh. If Britain is to tame its own duck curve, it will need rapid deployment of storage to soak up cheap midday solar and release it when it's really needed.

The average daily profile of Britain's wholesale power prices during the second quarter of each year from 2001 through to 2025, shown relative to the average price in the quarter.



4. What do heat waves do to the power system

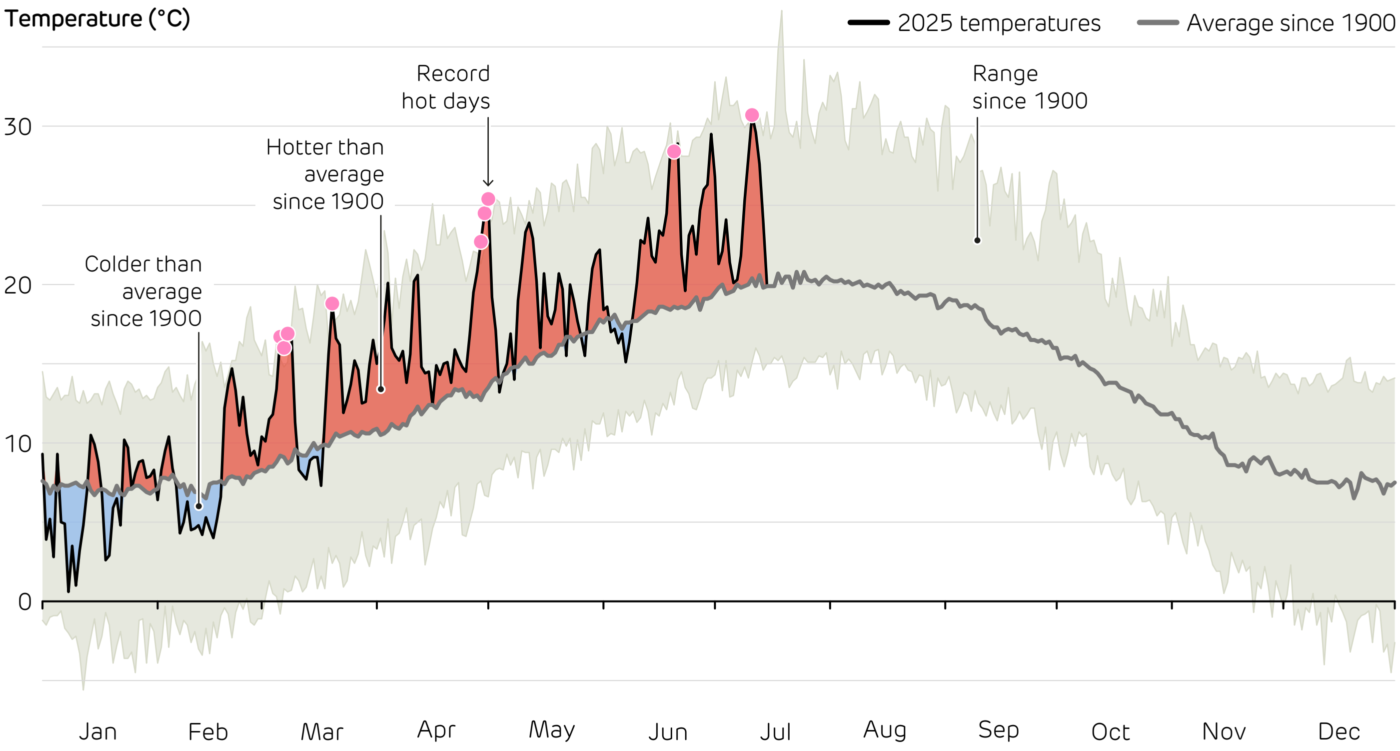
The UK, Western Europe, Japan and parts of China saw their warmest June on record in 2025. Rising temperatures place growing strain on both public health and power systems. Across the world, 500,000 heat-related deaths occur each year, with 1,300 excess deaths in the UK alone last summer. The heat also lowers people's productivity, with hot days (above 28°C) costing the UK economy an average of £1.2 billion per year.

Alleviating heat stress requires that homes and businesses are cooled to a comfortable temperature. Across the UK, rising temperatures mean the need for cooling is rising by 3% per year. In London, this is growing by 5% per year, faster than anywhere in the world. This is leading to more households purchasing air conditioners (ACs), as people no longer want to tolerate stiflingly hot nights.

The number of homes with ACs in the UK rose from 3% to 20% between 2011 and 2023, with a huge leap following the UK's record-breaking 2022 heatwave. The Government are considering plans to extend the £7,500 grant for heat pumps to cover air-to-air systems, capable of both heating and cooling homes, which could further accelerate uptake. Each additional degree also means ACs must work harder to maintain the same indoor temperature, further increasing the amount of electricity consumed by a growing stock of ACs.

This problem is not unique to the UK. AC usage is rising across Europe, and with it summer peaks in electricity demand. In France, a country with relatively low ownership, the June heatwave saw peak electricity demand soar 25% above the typical off-season average.

Maximum daily temperatures in central England this year compared to the range of temperatures seen since 1900.



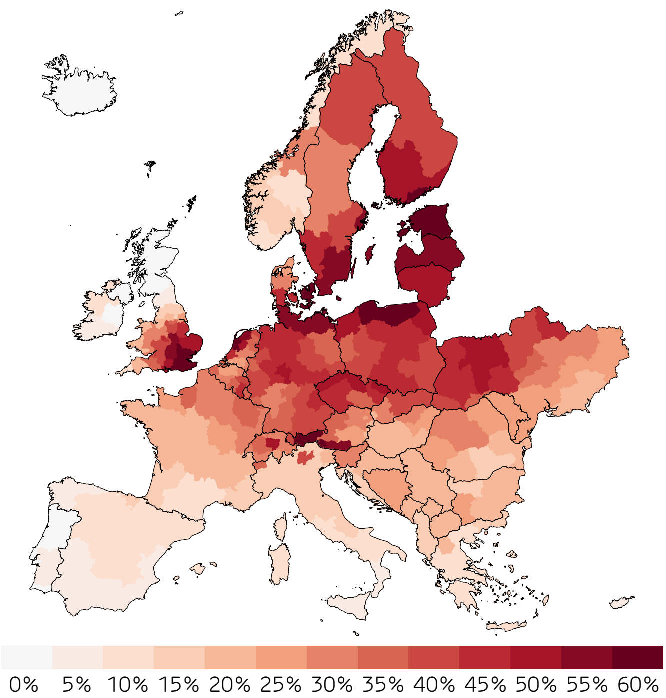
Thankfully, when it is hot and people need cooling the most, the sun is shining. Britain's solar panels produce 40% more electricity on days that reach above 25 °C compared to days that don't get above 20 °C. This means that when ACs are running flat out, they can tap into a cheap and low-carbon electricity, minimising the grid and emissions impacts.

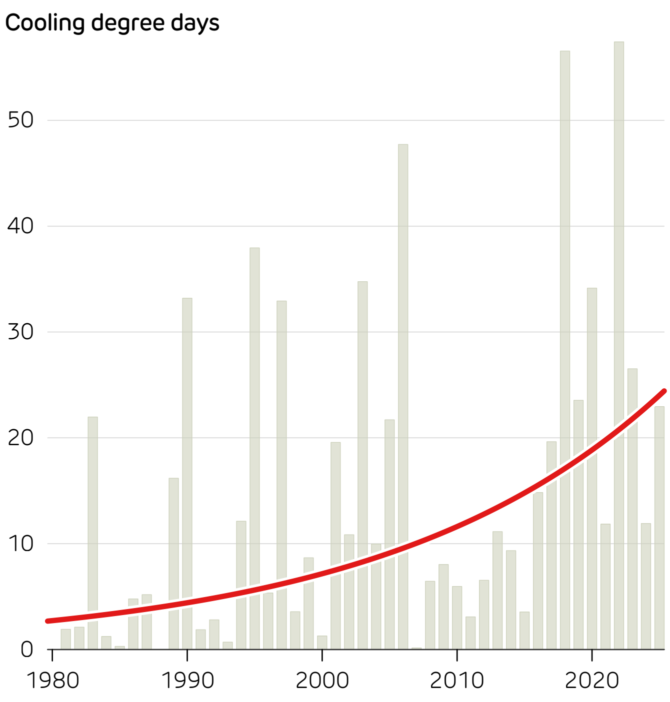
Rising temperatures still bring challenges for electricity supply. Transmission cables expand and sag in the heat, increasing the risk of faults and reducing the amount of power they can conduct by up to a tenth. Maintaining grid reliability as the UK warms will require improved cooling methods, upgrading to higher-capacity transmission and distribution cables, and updating asset ratings to reflect the impacts of climate change.

Power stations are also challenged by extreme heat. During June's Mediterranean heatwave, all but one of France's 18 nuclear reactors had to reduce output as river temperatures soared to 5°C above normal, meaning they could not be used for cooling. Overall, French nuclear output falls by more than 5 GW when daily-average temperatures rise above 24°C, despite elevated demand. Power stations also become less efficient on hot days as less efficient steam cooling reduces turbine output. Even solar panels are affected by the heat, as high temperatures reduce their efficiency in converting sunlight into power.

Britain must face the reality that it is now a hot country, with rising temperatures reshaping daily life and electricity use. Adapting to this new norm means building a robust electricity system capable of meeting growing summer demand and coping with extreme heat, all while reducing emissions.

Cooling degree days (CDD) measure the need for air conditioning by combining how hot it is and for how long.
Left: a map showing how rapidly annual CDDs are increasing per decade across Europe since 1980.
Right: the evolution of annual CDDs in London, where they are rising fastest in the world.





5. Global LNG trade

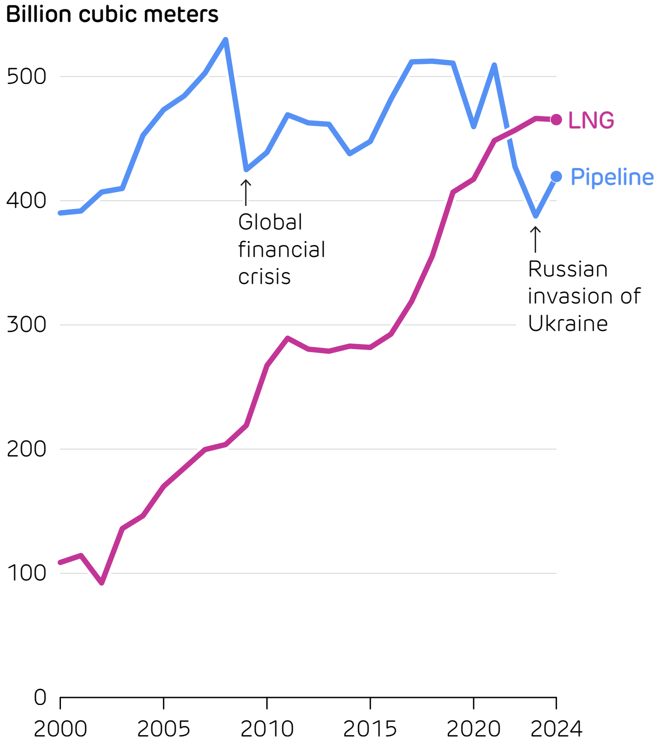
Natural gas heats eight in ten UK homes and provides one third of our electricity. Half of the gas we consume is imported, one-quarter of which arrives by ship in the form of liquefied natural gas (LNG), primarily from the US. The colossal $750 billion US–EU energy pledge will reshape global gas markets, with implications for UK energy prices and security of supply.

The UK's dependence on imported LNG is a relatively recent phenomenon. The first ever LNG shipment came from Algeria back in 1964, yet by 2005 it still formed just 3% of the UK's imports. Globally, LNG has now overtaken pipelines as the main form of trade, quadrupling from 140 to 550 bcm between 2000 and 2024. Qatar, Australia, and the US are the three major players in LNG trade. Qatar, home to the world's largest gas field, started exporting LNG in 1997 and became the world's largest source by 2010. Australia overtook Qatar in 2018, as exports from the Western Territory soared. It was not until 2016 that the first payload of LNG left the US, but export capacity has since increased twelve-fold (from 10 to 120 bcm), crowning it the world's largest supplier.

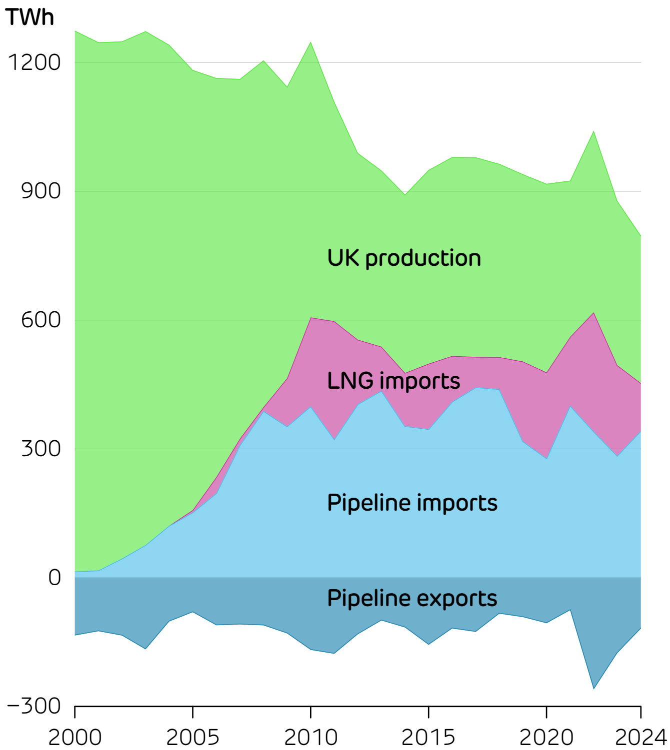
The growth of major LNG exporters has been driven by breakthroughs in production and transport technology. Floating LNG enables offshore gas extraction without the need for expensive pipelines, while giant Q-Max tankers cut shipping costs by carrying over 3.5 TWh of cargo per trip (enough to heat 300,000 UK homes for a year).

LNG importers are concentrated in Europe and Asia. Production in the US flows to both continents, while Australia and Qatar cater primarily to the burgeoning Asian markets. Russian and North Africa export smaller volumes, mostly to Europe. Russian gas continues to enter Europe as LNG via spot diversions, worth around €8 billion per year. Russia accounts for around one-third of all LNG imported to France (8 bcm) and Spain (7 bcm) and almost half that in Belgium (3 bcm).

Global trade in natural gas since 2000.



The UK's source of natural gas since 2000.

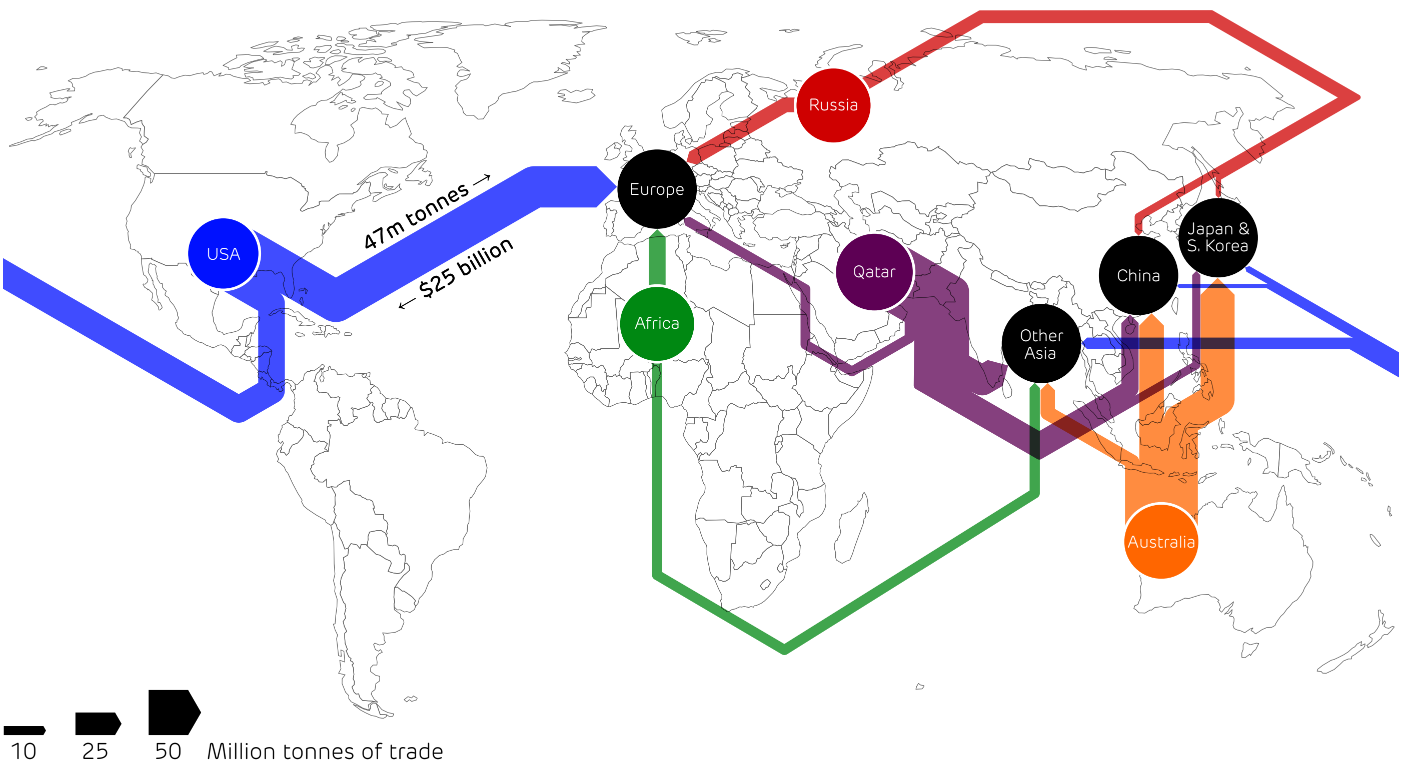


Britain today is both a major LNG importer and a gateway to the Continent. Last year, most shipments arrived from the US (68%), with smaller amounts from Qatar (7%), Trinidad and Tobago (6%) and Algeria (5%). The UK's three LNG terminals at South Hook (21 bcm/year), Isle of Grain (33 bcm/year), and Dragon LNG (8 bcm/year) could supply almost the entire UK's demand of around 700 TWh per year. Some of this capacity is used to sell gas on into Europe: LNG is re-gasified in Britain and exported to the Continent via pipeline when European prices outrun those at home.

The new US–EU energy pledge is huge on paper, but bumps up against physical market limits. Europe cannot purchase, and US supply-chains cannot produce, the target $250 billion per year of energy. Total US energy exports amounted to ~$300 billion in 2024, with the EU accounting for just $80 billion. Replacing all Russian oil and gas imports solely with US supplies would increase Europe's imports by around $70 billion over three years. That said, even a fraction of this volume would present a lucrative opportunity for Britain as one of Europe's gas trading hubs.

Rising imports of US LNG to Europe will re-shape global gas markets, with first news of the US–EU energy pledge supressing UK gas prices. However, tariffs on US energy could have the opposite effect, driving up European and, indirectly, UK prices. Since gas sets electricity prices ~90% of the time, LNG price shocks feed straight into wholesale electricity costs. The UK must watch global gas geopolitics as closely as renewable energy goals. While Britain works to decarbonise its grid, flexible gas remains essential for meeting demand, and affordable LNG is key to maintaining supply-chain flexibility.

The major flows of LNG around the world. Arrow width is proportional to the annual trade in 2024.



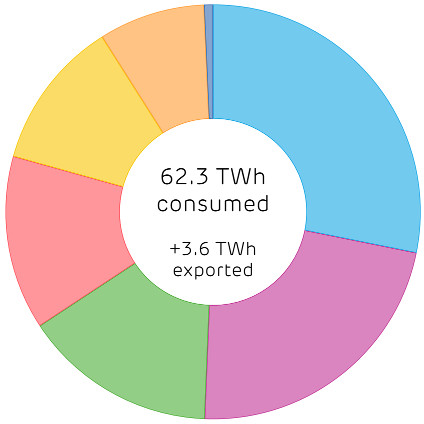
6. Capacity and production statistics

Britain saw its cleanest-ever quarter for electricity production. The average carbon intensity fell below 100 g/kWh for the first time in the three months to June. This marks a symbolic waypoint on the road to the government's Clean Power plan, which targets "well below" 50 g/kWh by 2030. Power sector emissions have now fallen to the point where they are now lower than those from UK aviation, a reversal that would have been unthinkable a decade ago.

Behind the headline, the grid mix shifted in familiar ways. Solar output continued its surge from last quarter, again being 40% higher than the same quarter last year. Biomass generation also rose 18% year-on-year, but nuclear output fell by 12% due to a heavy period of planned maintenance.

Britain's electricity demand continued to edge back upwards, recording its seventh quarter of successive growth. Demand last quarter was up 2% year-on-year, as the growing fleets of electric vehicles and heat pumps continue to add load. The upshot is that Britain is still managing to cut emissions within the power sector while it contributes ever more to decarbonising transport and heat.

Britain's electricity supply mix in the second quarter of 2025.



	Share of the mix
Wind	28.2%
Gas	22.5%
Nuclear	15.1%
Imports	13.6%
Solar	11.7%
Biomass	8.3%
Hydro	0.7%
Coal	0.0%

Installed capacity and electricity produced by each technology.[1 2]

	Installed Capacity (GW)		Energy Output (TWh)		Utilisation / Capacity Factor	
	2025 Q1	Annual change	2025 Q1	Annual change	Average	Maximum
Nuclear	6.4	~	9.0	+1.1 (+15%)	66%	80%
Biomass	3.8	~	5.4	+0.9 (+20%)	66%	93%
Hydro	1.2	~	1.0	-0.2 (-18%)	41%	98%
Wind	30.8	+1.5 (+5%)	22.2	-3.1 (-12%)	34%	73%
– of which Onshore	15.3	+0.8 (+5%)	9.1	-1.1 (-11%)	28%	58%
– of which Offshore	15.5	+0.7 (+5%)	13.0	-2.0 (-13%)	40%	72%
Solar	18.1	+1.0 (+7%)	2.7	+0.8 (+42%)	7%	68%
Gas	27.6	~	26.8	+5.0 (+23%)	45%	97%
Coal	0.0	-1.9 (-100%)				
Imports	9.7	+0.5 (+5%)	10.7	-0.6 (-5%)	52%	94%
Exports			2.4	+0.2 (+7%)	12%	57%
Storage discharge	3.1	~	0.5	-0.1 (-17%)	8%	100%
Storage recharge			0.6	-0.1 (-18%)	10%	100%

1 Other sources give different values because of the types of plant they consider. For example, BEIS Energy Trends records an additional 0.7 GW of hydro, 0.6 GW of biomass and 3 GW of waste-to-energy plants. These plants and their output are not visible to the electricity transmission system and so cannot be reported on here.

2 We include an estimate of the installed capacity of smaller storage devices which are not monitored by the electricity market operator.

7. Power system records

This quarter was defined by record-breaking solar output and the lowest ever carbon emissions. Solar power broke all hourly, daily, and monthly records. At 1 PM on 10 May, it supplied more than 40% of Britain's electricity demand for the first time. That month also saw both the cleanest day on record (averaging 28 grams of CO_2 per kWh of electricity consumed), and then the lowest ever instantaneous carbon intensity of just 6 g/kWh. June then extended the run of milestones, with solar power averaging more than 3.4 GW over the month, well above the previous record of 2.8 GW.

The tables below look over the past sixteen years (since 2009) and report the record output and share of electricity generation, plus sustained averages over a day, a month, and a calendar year. Cells highlighted in blue are records that were broken in the second quarter of 2025. Each number links to the date it occurred on the Electric Insights website, so these records can be explored visually.

	Wind – Maximum	
	Output (MW)	Share (%)
Instantaneous	22,545	72.1%
Daily average	21,687	61.2%
Month average	14,525	40.4%
Year average	9,414	29.6%

	Solar – Maximum	
	Output (MW)	Share (%)
Instantaneous	13,212	40.9%
Daily average	4,480	15.9%
Month average	3,415	11.5%
Year average	1,512	4.8%

	Biomass – Maximum	
	Output (MW)	Share (%)
Instantaneous	3,831	16.8%
Daily average	3,483	12.9%
Month average	2,926	8.8%
Year average	2,216	7.1%

	All Renewables – Maximum	
	Output (MW)	Share (%)
Instantaneous	31,169	81.8%
Daily average	3,788	14.5%
Month average	2,813	10.0%
Year average	1,512	4.8%

	Gross demand	
	Maximum (MW)	Minimum (MW)
Instantaneous	60,070	16,934
Daily average	49,203	23,297
Month average	45,003	26,081
Year average	37,736	29,910

	Demand (net of wind and solar)	
	Maximum (MW)	Minimum (MW)
Instantaneous	59,563	1,365
Daily average	48,823	6,292
Month average	43,767	15,229
Year average	36,579	19,389

Day ahead wholesale price	Maximum (£/MWh)	Minimum (£/MWh)
Instantaneous	1,983.66	-77.29
Daily average	666.90	-11.35
Month average	353.36	22.03
Year average	198.16	33.88

Carbon intensity	Maximum (g/kWh)	Minimum (g/kWh)
Instantaneous	704	6
Daily average	633	28
Month average	591	78
Year average	508	121

All low carbon – Maximum	Output (MW)	Share (%)
Instantaneous	39,126	97.0%
Daily average	30,599	90.1%
Month average	23,941	75.5%
Year average	20,058	63.1%

All low carbon – Minimum	Output (MW)	Share (%)
Instantaneous	3,395	8.3%
Daily average	5,007	10.8%
Month average	6,885	16.7%
Year average	8,412	21.6%

All fossil fuels – Maximum	Output (MW)	Share (%)
Instantaneous	49,307	88.0%
Daily average	43,085	86.4%
Month average	36,466	81.2%
Year average	29,709	76.3%

All fossil fuels – Minimum	Output (MW)	Share (%)
Instantaneous	887	2.4%
Daily average	1,990	6.2%
Month average	4,831	16.8%
Year average	8,474	26.6%

Nuclear – Maximum	Output (MW)	Share (%)
Instantaneous	9,342	42.8%
Daily average	9,320	32.0%
Month average	8,649	26.5%
Year average	7,604	22.0%

Nuclear – Minimum	Output (MW)	Share (%)
Instantaneous	2,065	5.0%
Daily average	2,238	5.9%
Month average	3,292	8.9%
Year average	4,368	13.7%

Coal – Maximum	Output (MW)	Share (%)
Instantaneous	26,044	61.4%
Daily average	24,589	52.0%
Month average	20,746	48.0%
Year average	15,628	42.0%

Coal – Minimum	Output (MW)	Share (%)
Instantaneous	0	0.0%
Daily average	0	0.0%
Month average	0	0.0%
Year average	179	0.6%

Gas – Maximum	Output (MW)	Share (%)
Instantaneous	27,339	73.4%
Daily average	24,906	64.5%
Month average	20,828	54.8%
Year average	17,930	46.0%

Gas – Minimum	Output (MW)	Share (%)
Instantaneous	738	1.8%
Daily average	1,874	5.9%
Month average	4,748	16.5%
Year average	8,276	24.6%

Imports – Maximum	Output (MW)	Share (%)
Instantaneous	8,055	35.9%
Daily average	7,299	27.0%
Month average	5,557	20.8%
Year average	4,990	15.7%

Exports – Maximum	Output (MW)	Share (%)
Instantaneous	-5,662	–27.0%
Daily average	-4,763	-14.1%
Month average	-3,098	-9.8%
Year average	–731	-5.8%

Pumped storage – Maximum[3]	Output (MW)	Share (%)
Instantaneous	2,660	7.9%
Daily average	409	1.3%

Pumped storage – Minimum[3]	Output (MW)	Share (%)
Instantaneous	–2,782	–12.2%
Daily average	–622	–4.5%

3 Note that Britain has no inter-seasonal electricity storage, so we only report on half-hourly and daily records. Elexon and National Grid only report the output of large pumped hydro storage plants. The operation of battery, flywheel and other storage sites is not publicly available.

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