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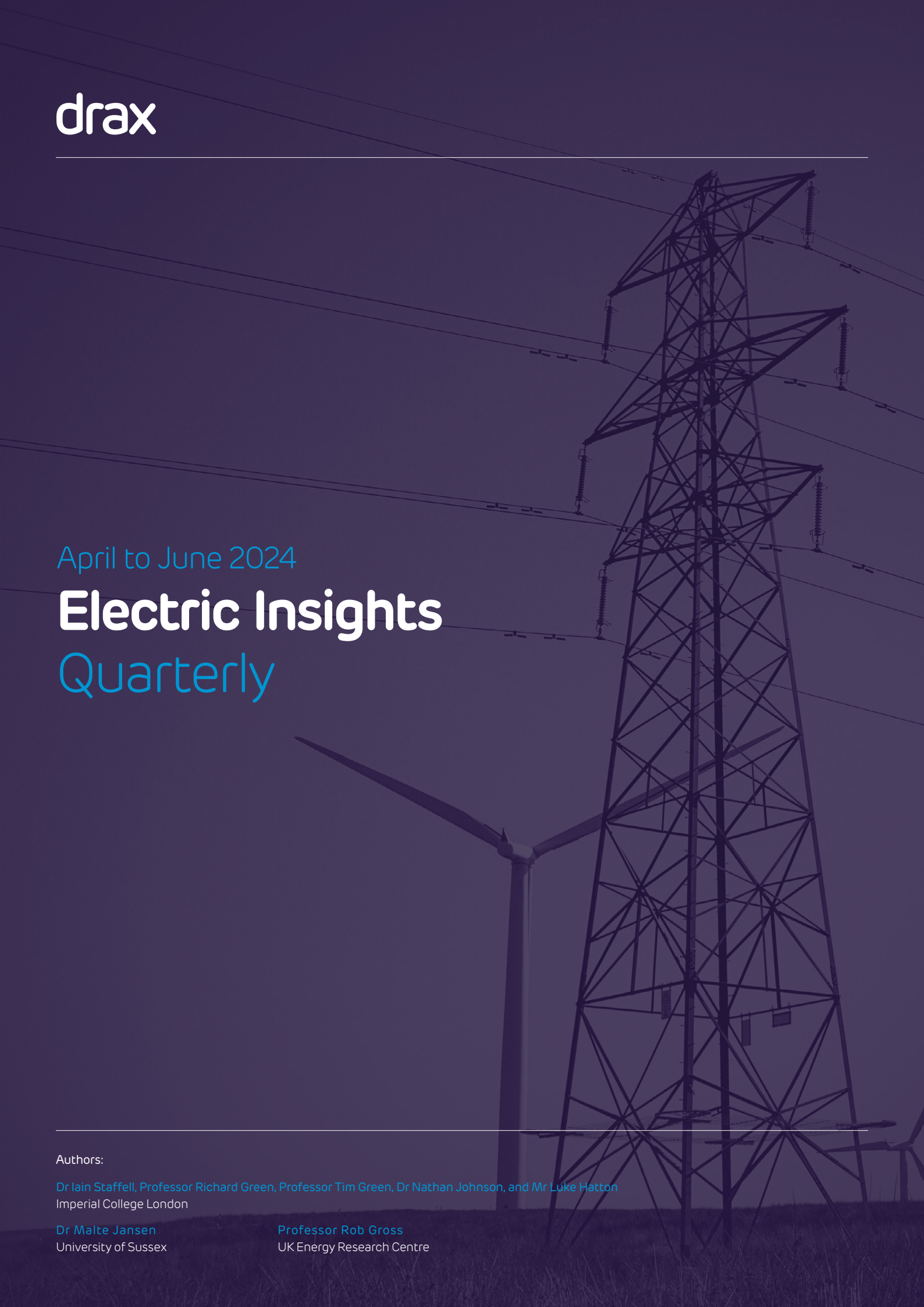

April to June 2024

Electric Insights Quarterly

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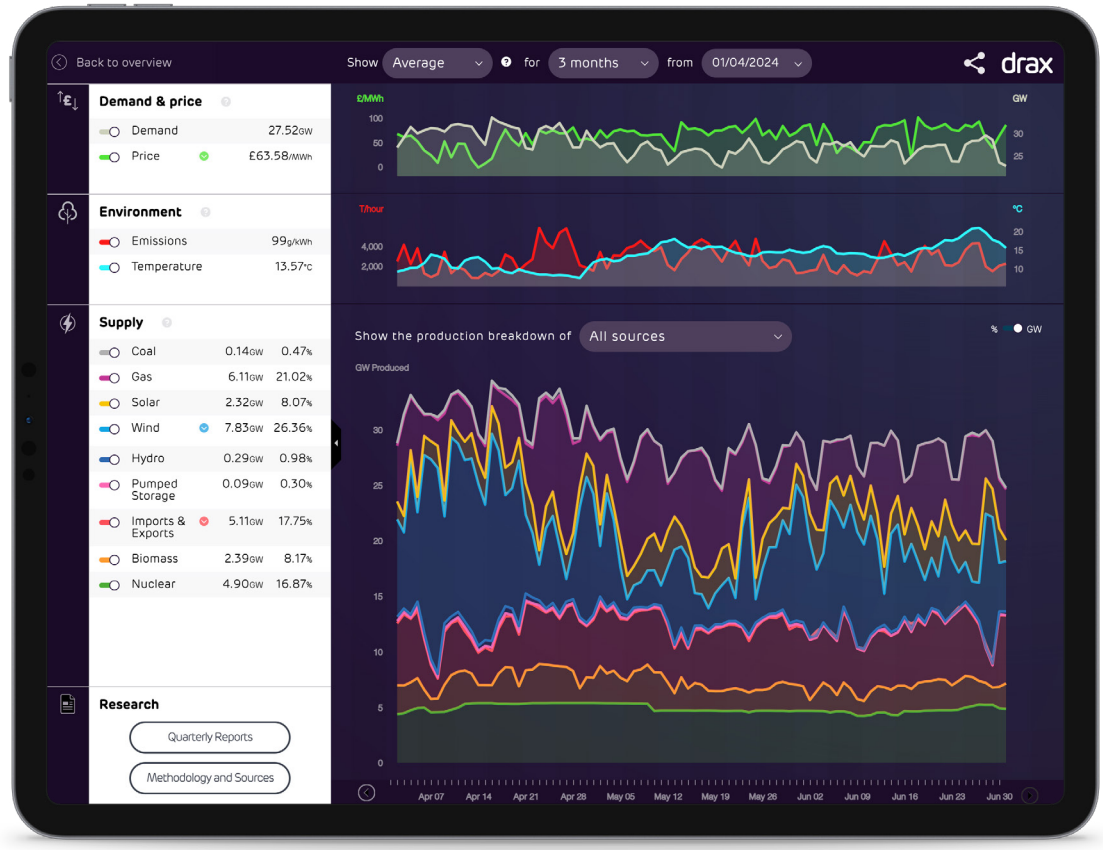


Contents

Electric Insights was established by Drax to help inform and enlighten the debate on Britain's electricity. Since 2016 it has been delivered independently by a team of academics at Imperial College London using data courtesy of Elexon, National Grid and Sheffield Solar.

1. Introduction

The general election on 4 July brought in a new government, and with it changes across all areas of policy. Energy and climate change featured prominently in the Labour manifesto, with "making Britain a clean energy superpower" one of their five core missions. This includes committing more money to renewables, planning reforms to get infrastructure built faster, and creating a new state-run energy company. This issue of Electric Insights explores what these changes mean for Britain's electricity sector.

The Government's boost to renewables comes just as they hit a major milestone. Since April, wind has been the country's largest source of electricity on an annual basis, overtaking gas. This means 2024 is likely to be the first ever year when a fossil fuel was not the largest source of power, and would make Britain only the sixth country in the world to be primarily powered by wind.

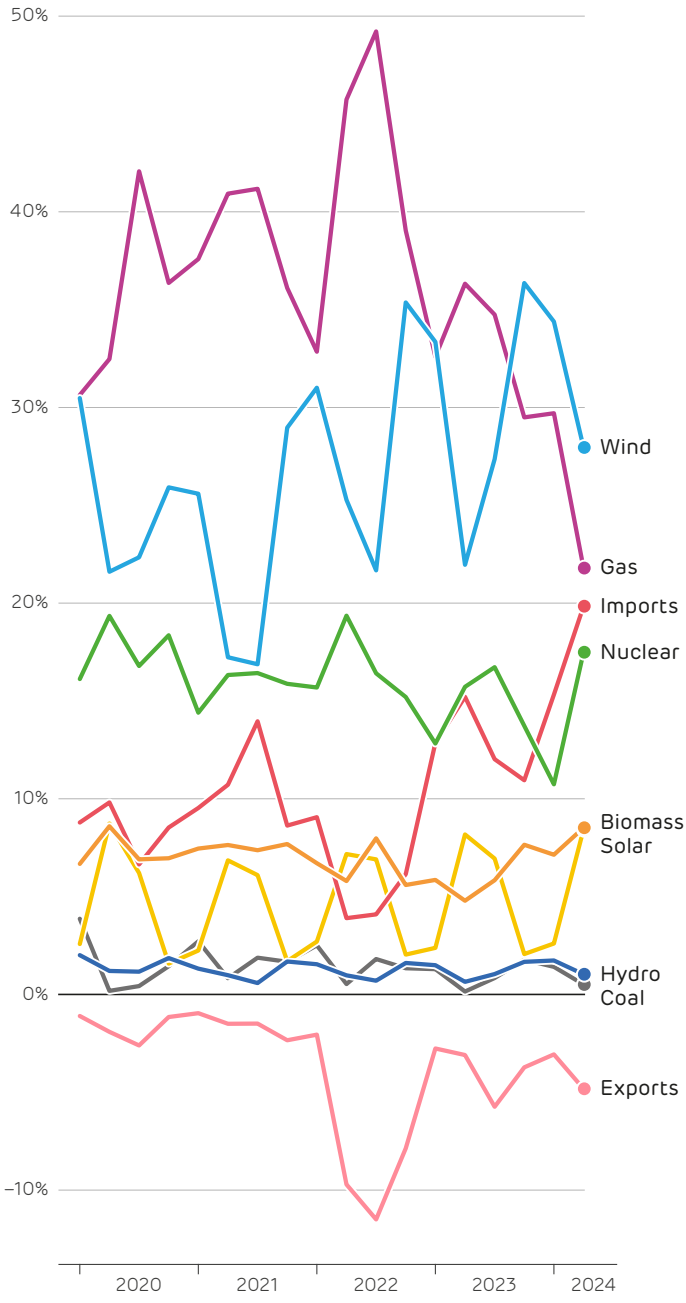
The energy price crisis has faded from the news headlines, but its effects are still being felt throughout the economy. Some aspects are beginning to improve though: household energy bills fell by 25% over the last year (meaning negative inflation). However, Ofgem's price cap is set to increase 10% in October, and longer-term effects on commodity prices and interest rate rises mean that renewable energy could remain more expensive for years to come.

One way that electricity prices have come down is that Britain's 9 GW of interconnectors are now importing cheaper power from abroad, whereas last year we were exporting to help France overcome capacity shortages. Over the last quarter, Britain imported a record 20% of its electricity demand, coming close to overtaking gas in the generation mix.

Gas-fired power generation fell sharply to its lowest level in over 15 years. Just 13 TWh of electricity came from gas over the quarter, 25% less than the previous minimum on record. Britain's solar PV panels produced more than 10 GW for the first time ever, and fossil fuels fell to a record low of supplying less than 1 GW for the first time ever. These changes signal that National Grid is getting closer to its 2025 ambition of being capable of running with zero carbon emissions.

Altogether, the increase in renewables, clean imports and nuclear meant that the electricity produced last quarter was cleaner than ever. Carbon emissions reached averaged below 90 g/kWh in April – a sign of positive things to come.

Share of Britain's electricity generation during each quarter since 2020.



2. The new government's plans for the electricity sector

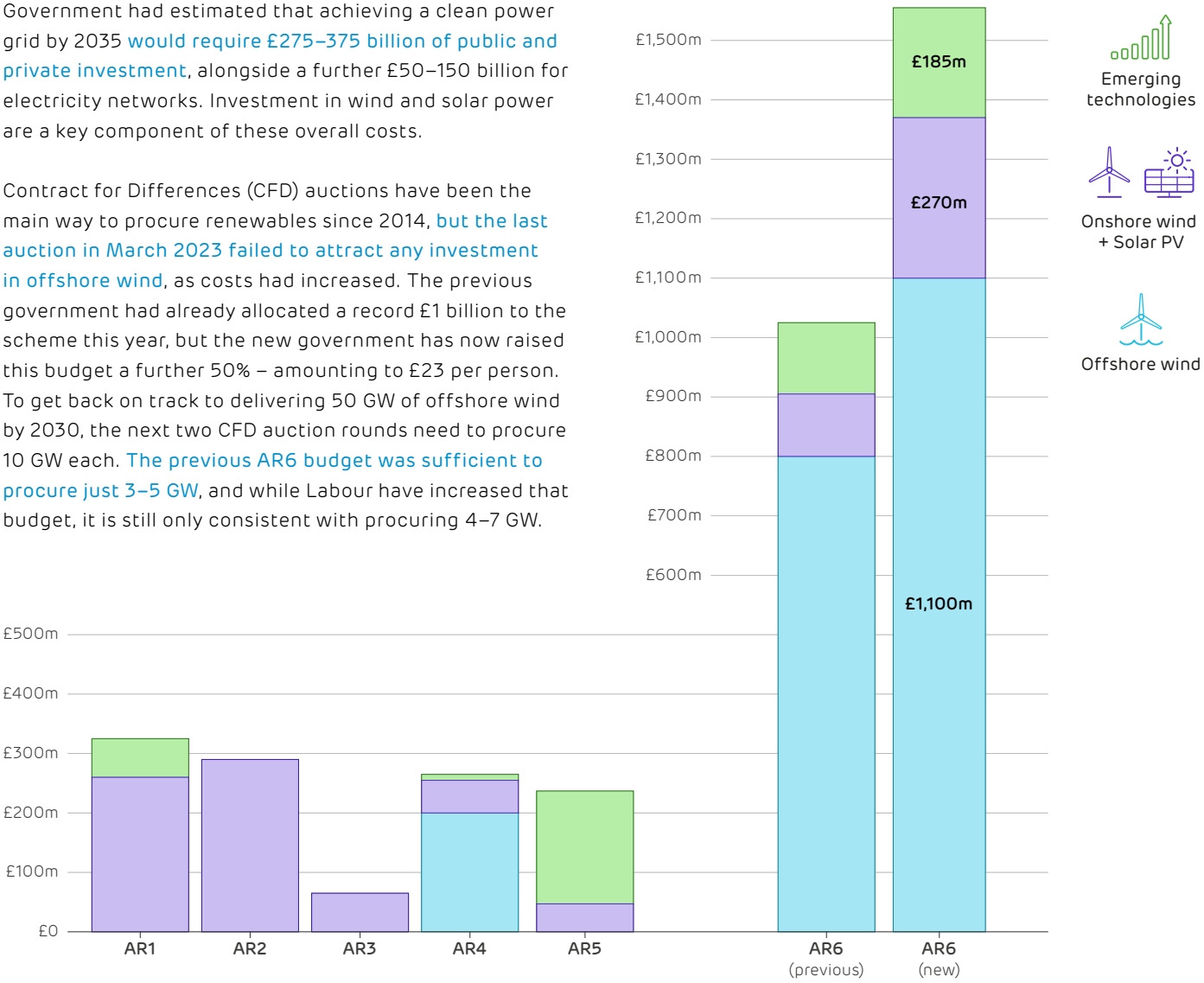
The last two years of Conservative governance saw a change in focus for UK energy policy, with boosted targets for renewables followed by rollbacks on key net-zero policies. The new Labour Government's manifesto set out an ambitious plan to put energy security and climate change at the top of the political agenda. It promised to decarbonise electricity by 2030, gain energy independence from foreign powers, and setup a state-owned company: Great British Energy. After their first months in power, we reflect on what these promises and recent announcements mean for the electricity sector.

Increased funding for renewables

While we know the date of their clean power target, Labour are yet to release estimates of the investment required to meet their goal of decarbonising electricity by 2030. It is likely to be a substantial sum, as the previous Conservative Government had estimated that achieving a clean power grid by 2035 would require £275–375 billion of public and private investment, alongside a further £50–150 billion for electricity networks. Investment in wind and solar power are a key component of these overall costs.

Contract for Differences (CFD) auctions have been the main way to procure renewables since 2014, but the last auction in March 2023 failed to attract any investment in offshore wind, as costs had increased. The previous government had already allocated a record £1 billion to the scheme this year, but the new government has now raised this budget a further 50% – amounting to £23 per person. To get back on track to delivering 50 GW of offshore wind by 2030, the next two CFD auction rounds need to procure 10 GW each. The previous AR6 budget was sufficient to procure just 3–5 GW, and while Labour have increased that budget, it is still only consistent with procuring 4–7 GW.

The budget allocated to CFD auction rounds from AR1 in 2014 to AR6 in 2024. Emerging technologies include floating offshore wind, tidal power and geothermal.



Revised planning rules

Moving the target for zero-carbon electricity from 2035 to 2030 is ambitious. In just over five years we must replace the one-third of electricity still supplied by fossil fuels. The pathway for achieving this is reasonably clear though: the Climate Change Committee provide roadmaps with rapid growth of wind and solar power, backed up by energy storage and clean flexible generation: gas with CCS, biomass and hydrogen. The question is less what to do, and more how to deliver. Enacting these changes quickly requires massive financing, overcoming technical changes in managing the power system, and above all an overhaul of planning regulations which have stifled renewables for years.

Planning reforms have been at the forefront of recent government announcements. At the end of July, the government laid out their proposed reforms to the National Planning Policy Framework (NPPF) and the 2008 Planning Act. Just four days after the general election, the government lifted the de-facto ban of onshore wind. The NPPF applied community 'tests' which were so restrictive that in 2023, not a single planning application for an onshore wind farm was submitted in England.

The government are also preparing to ease the procedural constraints for large solar and wind projects. The 2008 Planning Act prevents local councils from approving Nationally Significant Infrastructure Projects (NSIPs) over 50 MW, leading to a backlog of a dozen large-scale wind and solar projects that only the Secretary of State has the power to approve. Many solar farms therefore limit their capacity to 49.9 MW to avoid the cost and delays of planning regulations (e.g. Larks Green and Nuneham). Eight days after the general election, Ed Miliband sent a clear signal to developers of the change in heart, giving consent to 1.35 GW of new solar farms in Lincolnshire and Cambridgeshire, enough to power 400,000 homes. As part of their planning consultation, the government proposed that local authorities should be allowed the final say over larger onshore wind and solar farms, up to 100 and 150 MW respectively.

A focus on energy security

Since Russia's invasion of Ukraine and the subsequent gas market crisis, the subject of energy independence has become increasingly important to British policymakers. The UK relies on foreign imports for much of its supply of fossil fuels. We import nearly half of the oil and gas we use, and almost all of the coal[1]. We also import one-sixth of our electricity[1], and building more interconnectors between Britain and the continent is part of the plan for handling more wind and solar power.

The government's Energy Independence Act pledges independence from foreign energy imports, but it does not yet specify whether this extends to electricity. A power system that trades extensively with its neighbours for stability and to lower costs could reasonably be considered 'independent' if the two-way trade is on a roughly equal footing. If four times more electricity is imported than exported (currently the case for Britain) then perhaps it would not.

Reducing imports will require new generating capacity, so a strong commitment to new renewables projects in the next CFD Auction will help. However, Britain also needs more capacity that can generate at times when the wind is not blowing nor the sun shining, so more energy storage plus flexible and controllable power generation is needed to reduce imports.

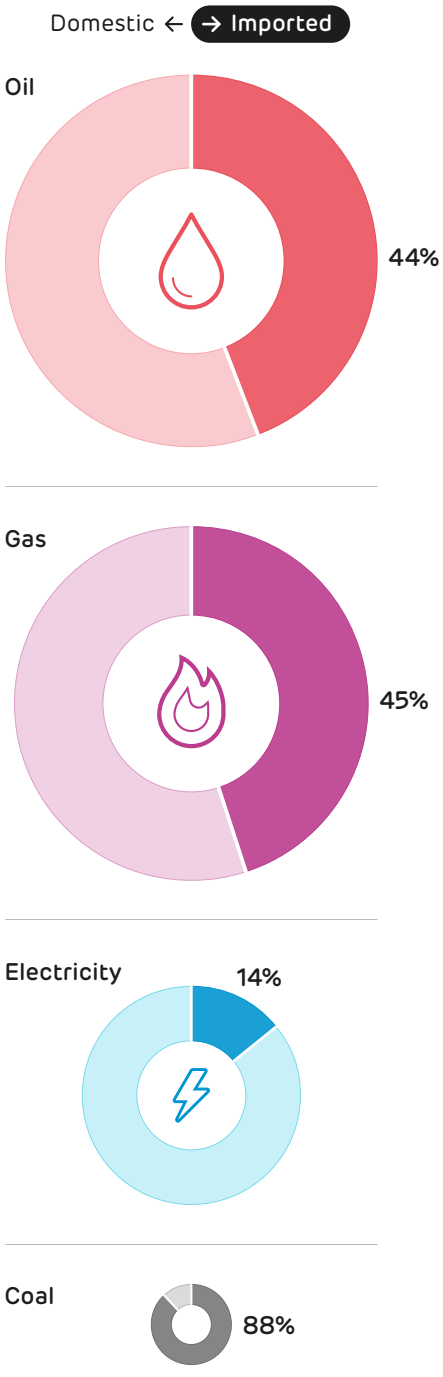
A new mode of delivery

On the 25 July, Great British Energy was founded, backed by £8.3 billion of new money over this Parliament. It will own, manage, and operate clean power projects, focusing on technologies where markets are less mature to crowd-in private investment. It is hoped this will enable faster buildout, support new technologies such as floating wind, hydrogen, and carbon capture, and invest in clean energy supply chains. Partnering with the Crown Estate, they plan to deliver up to 20–30 GW of extra offshore wind seabed leases by 2030, ensuring that the next round of leases has lower risk for developers.

Great British Energy will also explore opportunities to support energy projects in their early development stages (e.g., by securing planning consent or a grid connection) to accelerate delivery and its Local Power Plan aims to develop up to 8 GW of small- and medium-scale cleaner power, part-owned by local communities. The next few months will see its headquarters established, staff recruited, and stakeholder engagement begin, putting Great British Energy on a delivery footing.

While the dust may have only just settled on the results of the general election, the new government's earliest commitments signal a clear intent to put clean energy at the heart of policy moving forward.

Share of imports for the UK's main energy sources in 2023. Circles are sized by annual energy consumed.



1 These statistics are net imports (gross imports minus gross exports).

3. Wind becomes Britain's largest electricity source

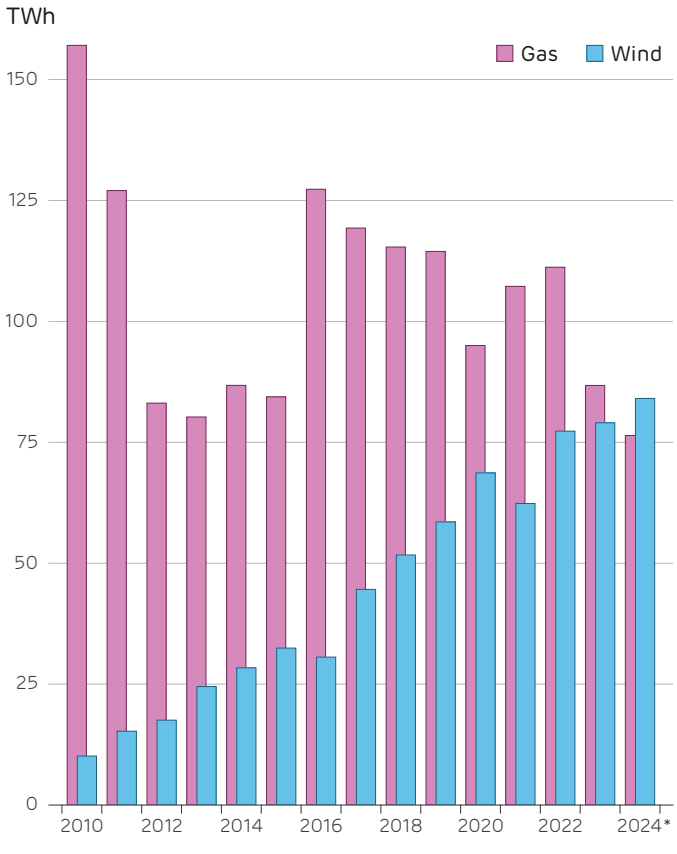
After a century of either coal or gas being our main source of electricity, wind power is now Britain's single largest source of electricity generation. Over the 12 months to April, Britain's wind farms produced 83 TWh of electricity, compared to 81 TWh from gas-fired power stations. Wind produced 32% of the country's demand, versus 31% from natural gas. It's important this is measured year-round, as this accounts properly for the intermittency of wind, which 'doesn't always blow'.

Wind has been the largest source for short periods of time, first producing more than any other source for a single hour back in November 2013. February 2020 was the first full month when wind output beat gas or coal. Taking the top spot for a full year signals a genuine shift in our primary source of electricity. This was down to both wind output growing and reliance on gas falling. Compared to 12 months ago, wind output increased 6% and gas output fell 25%.

The large fall in gas output is due to more electricity being imported from abroad, with imports resuming from France after their nuclear outages last year, plus increases from Norway and the new Viking link to Denmark. Wind output increased both because of stronger wind speeds, particularly during the storms of December 2023 and January 2024, and new capacity coming online. The 1 GW Seagreen wind farm off the coast of Scotland came fully online, and Dogger Bank A in the North Sea started generating its first power.

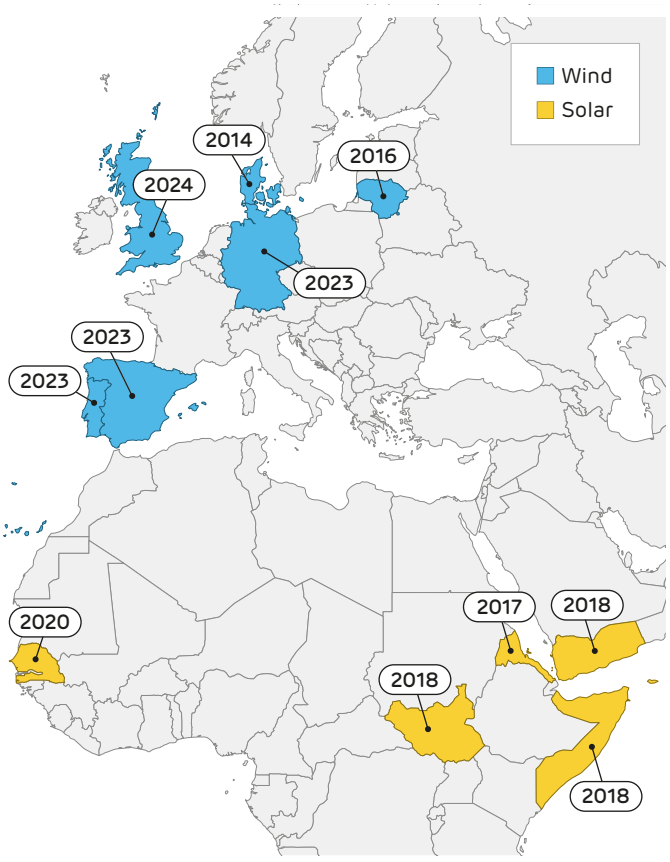
As of last year, there were ten countries in the world with either wind or solar power as their largest source of electricity. For solar power, these are all among the least developed countries in the Middle East and North Africa. For wind power, they are all coastal European countries. Britain is set to continue this trend at the end of the year, becoming only the sixth country in the world where wind farms are the top source of electricity.

The annual electricity generated from wind and natural gas in Britain since 2010.



*12 months from July 2023 to June 2024.

The countries where wind or solar PV are the largest sources of electricity, and their first year of achieving this. Only countries with population above 1 million are shown.



4. Energy prices and inflation

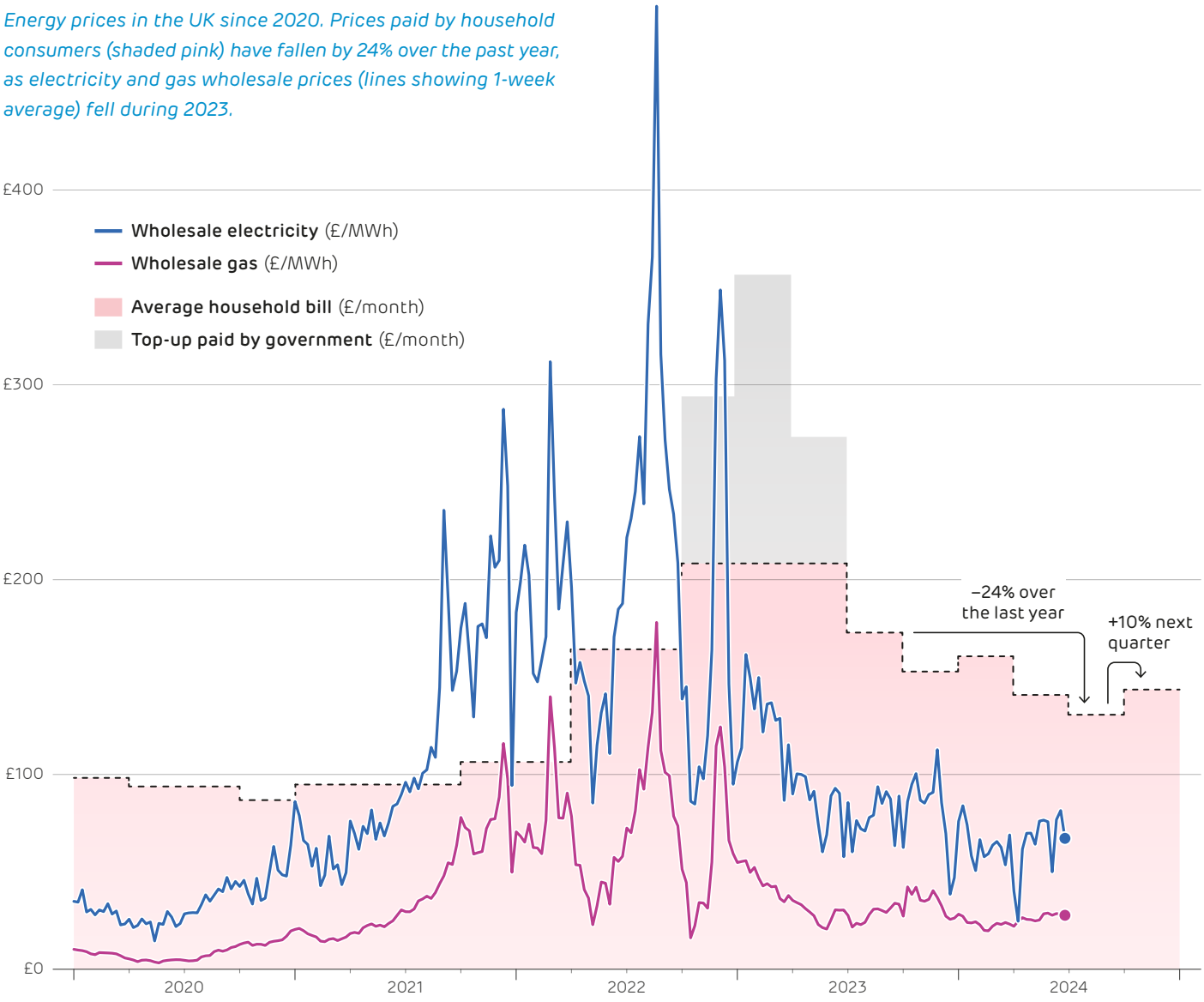
Everything is expensive these days. The UK has gone through a period of high inflation, in part driven by the energy crisis. Food bills, rents and mortgages have all gone up, but for different reasons. Similarly, there have been various pressures on electricity prices, some of which are short-term and are already going into reverse, while others are deeper-rooted and could take years to revert, if at all.

In the short-term, electricity prices rose because of the cost of fossil fuels. Gas prices increased six-fold during 2021 as the world emerged from COVID and Moscow started restricting gas supplies to Europe. Then Russia's war in Ukraine sent markets into turmoil during 2022.

But over the last year, gas prices have fallen back towards normal levels as demand fell and supplies of LNG (liquid natural gas) from America and the Middle East filled the void. Household bills lag behind wholesale prices, not rising sharply until the end of 2022, but then staying high until the second half of 2023. This is because Ofgem sets its price cap based on the previous 6 months of wholesale prices, and so market shifts take time to reflect onto bills.

The average household bill has fallen by 24% over the last twelve months, from £2,074 to £1,568 per year; however, bills are set to rise again in October to £1,717, eating away at those savings.

Energy prices in the UK since 2020. Prices paid by household consumers (shaded pink) have fallen by 24% over the past year, as electricity and gas wholesale prices (lines showing 1-week average) fell during 2023.



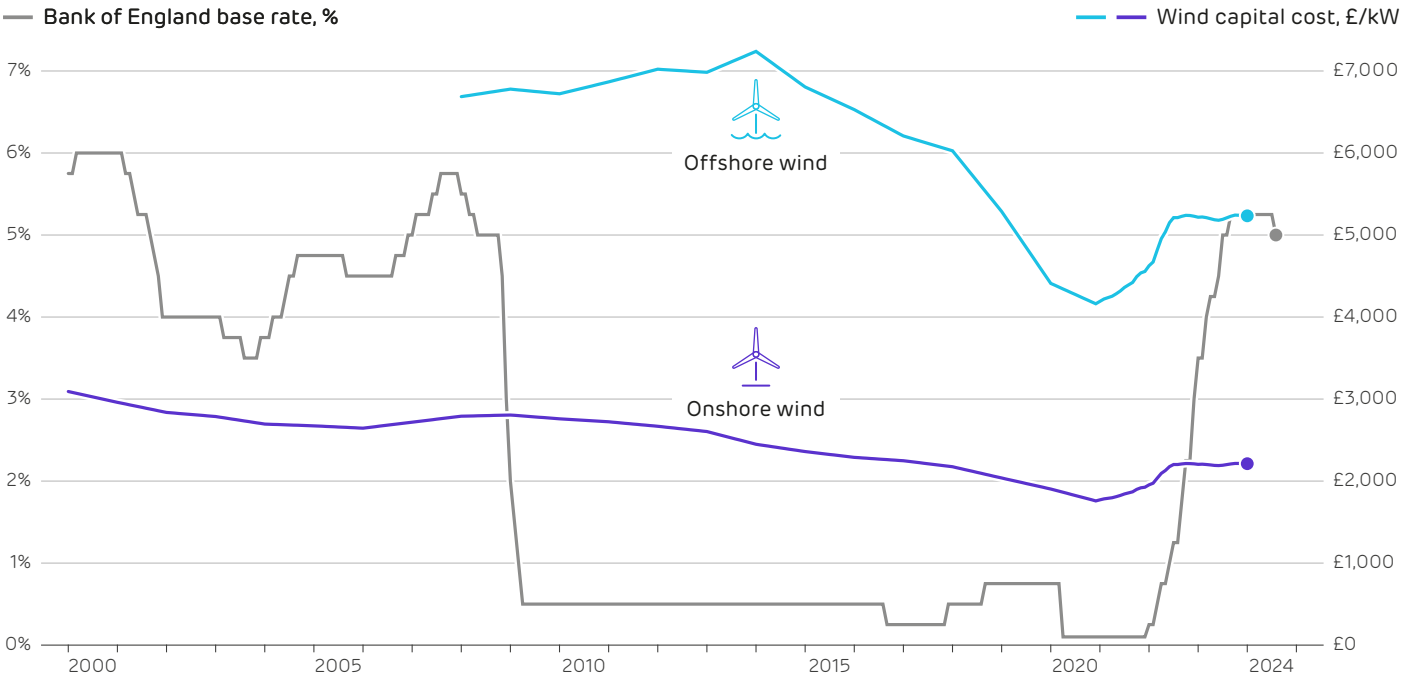
In the medium-term, high energy prices feed into the cost of other goods and services. The cost of commodities, everything from timber to tomatoes, rose sharply during the 2020s, with the CPI inflation rate peaking at 9.6% in October 2022. The average plate of fish and chips hit £9 nationwide, in part because of the cost of energy to run the fryers. The same factors affect the cost of building new power stations – especially seen with wind farms as the cost of concrete, steel and other energy-intensive materials hit record prices. The capital cost of wind turbines, solar panels and batteries all increased during 2022, and are only just starting to fall.

In the long-term, it is not so much capital cost, but the cost of capital that will push up the price of renewable energy. When buying a house or a car on finance, the borrowing rate drives the monthly repayments. In just the same way, the cost of financing wind or solar farms is the most influential driver on their cost of electricity – as they need no fuel to operate, and maintenance costs are small relative to upfront costs. The Bank of England increased interest rates 14 times between 2021 and 2023 in an effort to quell inflation, ending the decade of ultra-cheap borrowing after the 2009 global financial crisis. This increase in borrowing cost contributed to last year's CFD auction delivering no offshore wind capacity and recent wind farms projects being cancelled, as developers can no longer deliver projects for under £50/MWh.

These are not UK-specific issues, inflationary pressures and high interest rates have contributed to rising electricity costs around the world. UK interest rates have started to fall as inflation moves back towards the 2% target. However, the 0.25% cut made in August is a drop in the ocean, and interest rates now stand at the range they were for much of the 1990s and 2000s. The average cost of electricity generation from wind (known as the 'levelised cost') has risen by 60% in the last three years due to movements in interest rates, exchange rates and turbine capital costs. In response, the administrative strike price for offshore wind in the latest round of CfD auctions has been raised sharply from £44/MWh to £73/MWh, accompanied by a record budget to ensure that it can attract viable bids.

So, although consumer bills are now catching up with falling wholesale prices, further decreases in energy bills may take longer to materialise.

The indicative average capital cost of onshore and offshore wind farms in the UK, based on IRENA and ONS data, and the Bank of England base rate as a measure of the cost of borrowing.



5. Britain imports one fifth of its electricity

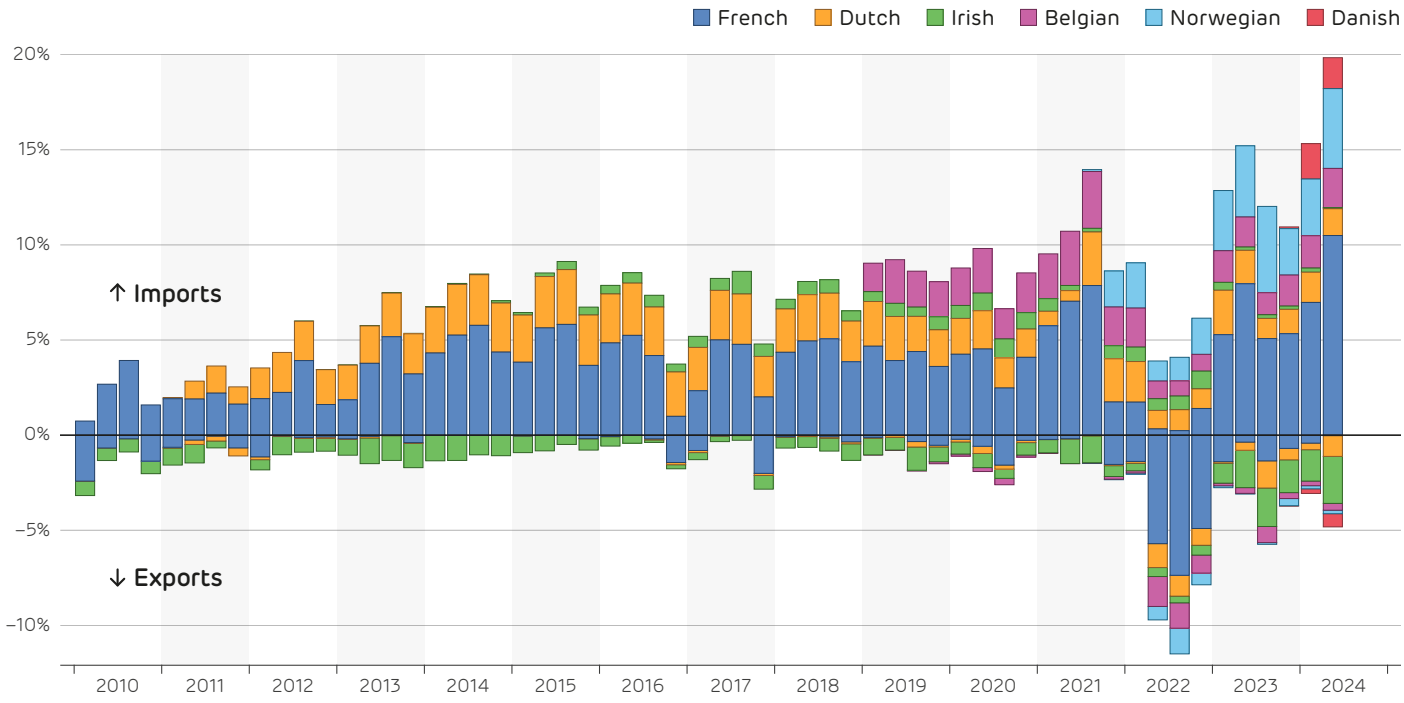
Electricity imports have reached record levels, with 19.8% of demand met by overseas sources over the three months to June. For the first time ever, more than a tenth of electricity came from France alone, and the cost of imported electricity rose to over £250 million per month. Overall, Britain imported 12.2 TWh last quarter, more than the country's nuclear output (10.7 TWh), and close to total production from fossil fuels (13.6 TWh). In comparison, exports were just 3 TWh.

For decades, Britain has imported more electricity than it exported, as neighbouring France has plentiful cheap nuclear power. In recent years, the stronger carbon price in the UK (specifically an £18 per tonne surcharge paid by power stations) made it more expensive to generate fossil-fuelled power here. However, the UK left the European carbon market after Brexit and launched its own. While the £18/t surcharge is still in place, Britain's market now trades at around £20/t lower than Europe's, bringing the cost of generating electricity from fossil fuels into line with the continent.

Much of Britain's conventional generation has retired in the last decade, with 18 GW of coal, 4 GW of nuclear, and 3 GW of gas power shutting down. Fewer generators means higher prices as there is less competition between suppliers, but capacity changes on the continent are also influencing electricity trade. Much of Europe now has excess power generation, as countries have rapidly expanded their solar PV capacity to reduce reliance on Russian gas. Germany and the Netherlands installed 28 and 14 GW over the last three years (compared to just 2 GW in Britain), so spring and summer are now characterised by negative prices across the continent, which Britain can import at low cost.

On the one hand, Britain's growing dependence on its neighbours for electricity goes against the government's push for energy independence. On the other hand, interconnectors help to balance out the variability of wind and solar power, and support the aim to rapidly decarbonise electricity. There is a key distinction to make between importing because we are unable to supply our own needs versus importing to lower the cost of electricity. We are doing the latter – so developing further interconnector capacity is not a vulnerability, it is a strength. It will be a vital part of making Britain a "clean energy superpower" as the government intends. Reaching their 2030 targets of 80 GW of wind and 50 GW of solar will leave the UK with more annual generation than demand, and having the infrastructure in place to export excess production benefits everyone.

Gross electricity imports and exports as a share of British electricity demand each quarter.

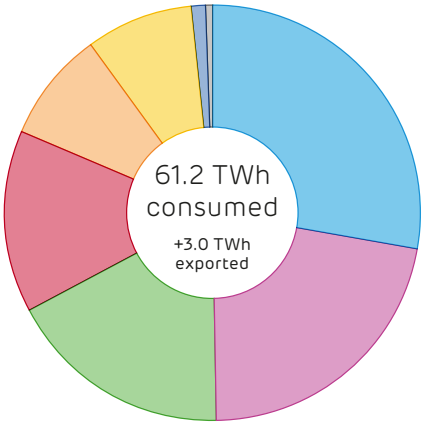


6. Capacity and production statistics

Gas power saw a shock slump in output, down 40% between the first and second quarters of this year. Gas produced just 13.3 TWh, which was not only the lowest quarterly output since records began in 2009, but also 25% lower than the previous minimum.

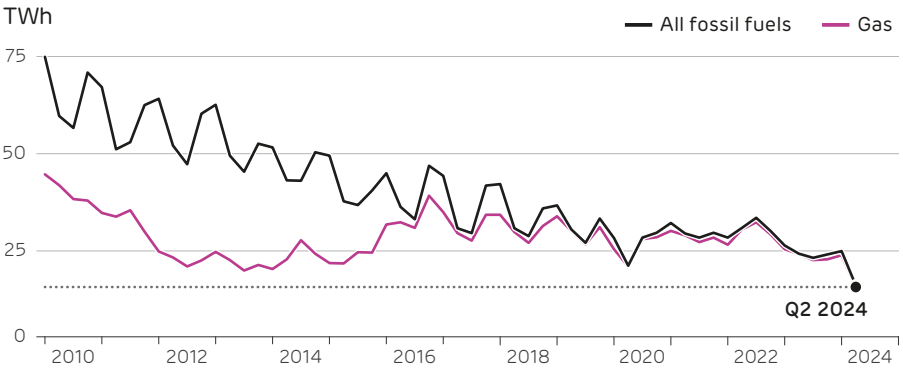
Wind power was the largest source of electricity for the third quarter running, producing more than all fossil fuels combined. Output from biomass, nuclear and solar all increased from the same period last year, as economic conditions improved, technical problems were resolved, and capacity grew, respectively. Biomass almost doubled its output from lows last year and nuclear power produced more than 10 TWh over a quarter for the first time since 2022.

Britain's electricity supply mix in the second quarter of 2024.



	Share of the mix
Wind	28.0%
Gas	21.8%
Nuclear	17.5%
Imports	14.2%
Biomass	8.5%
Solar	8.4%
Hydro	1.0%
Coal	0.5%

Gas and fossil fuel electricity generation since 2010.



Installed capacity and electricity produced by each technology. [2] [3]

	Installed Capacity (GW)		Energy Output (TWh)		Utilisation / Capacity Factor	
	2024 Q2	Annual change	2024 Q2	Annual change	Average	Maximum
Nuclear	6.4	~	10.7	+1.2 (+12%)	78%	85%
Biomass	3.8	~	5.2	+2.3 (+79%)	63%	100%
Hydro	1.2	~	0.6	+0.2 (+62%)	25%	81%
Wind	29.3	+1.2 (+4%)	17.1	+3.8 (+28%)	27%	72%
– of which Onshore	14.6	+0.4 (+3%)	7.2	+1.4 (+23%)	23%	55%
– of which Offshore	14.8	+0.8 (+5%)	9.9	+2.4 (+33%)	31%	66%
Solar	15.7	+0.6 (+4%)	5.2	+0.2 (+4%)	15%	68%
Gas	27.6	~	13.3	–8.7 (–40%)	22%	64%
Coal	1.8	~	0.3	+0.2 (+246%)	8%	52%
Imports	9.2	+0.8 (+10%)	12.2	+2.9 (+32%)	61%	96%
Exports			3.0	+1.1 (+57%)	15%	61%
Storage discharge	3.1	~	0.4	+0.2 (+100%)	6%	50%
Storage recharge			0.6	+0.3 (+113%)	8%	90%

2 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.
3 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

Britain's solar panels surpassed 10 GW of output for the first time. On 2 June, output hit 10.7 GW, boosted by June being relatively cool but with higher than average sunshine hours. The combined output of fossil fuels fell to a record low of 0.89 GW on 5 April, the first time they have produced less than 1 GW in a century. Fossil fuels produced less than one-fifth of electricity during April. Putting these together, the carbon intensity of electricity fell to a record low of 103 g/kWh averaged over the second quarter, going under 90 g/kWh in April. The share of all low carbon reached a new peak of 97%, with generation of 39 GW, up from the previous record of 35 GW.

The tables below look over the past fifteen years, back to 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 2024. 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	21,929	70.7%
Daily average	20,877	60.9%
Month average	14,525	40.4%
Year average	9,022	28.9%

Solar – Maximum

	Output (MW)	Share (%)
Instantaneous	10,700	35.1%
Daily average	3,788	14.5%
Month average	2,813	10.0%
Year average	1,397	4.5%

Biomass – Maximum

	Output (MW)	Share (%)
Instantaneous	3,831	16.8%
Daily average	3,316	12.9%
Month average	2,849	8.8%
Year average	2,216	7.1%

All Renewables – Maximum

	Output (MW)	Share (%)
Instantaneous	30,776	78.0%
Daily average	24,262	70.8%
Month average	18,334	51.0%
Year average	12,610	40.4%

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	2,717
Daily average	48,823	6,883
Month average	43,767	16,253
Year average	36,579	19,491

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	8
Daily average	633	31
Month average	591	89
Year average	508	148

All low carbon – Maximum

	Output (MW)	Share (%)
Instantaneous	39,126	97.0%
Daily average	30,599	90.1%
Month average	23,941	74.7%
Year average	18,451	59.2%

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	5,702	17.8%
Year average	10,234	32.8%

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	4,372	14.0%

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	315	1.0%

Gas – Maximum

	Output (MW)	Share (%)
Instantaneous	27,131	72.6%
Daily average	24,210	62.2%
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	5,406	16.9%
Year average	9,159	24.6%

Imports – Maximum

	Output (MW)	Share (%)
Instantaneous	8,055	34.4%
Daily average	7,299	27.0%
Month average	5,557	20.8%
Year average	3,792	12.2%

Exports – Maximum

	Output (MW)	Share (%)
Instantaneous	–5,662	–23.7%
Daily average	–4,763	–14.1%
Month average	–3,098	–9.8%
Year average	–731	–5.8%

Pumped storage – Maximum[4]

	Output (MW)	Share (%)
Instantaneous	2,660	7.9%
Daily average	409	1.2%

Pumped storage – Minimum[4]

	Output (MW)	Share (%)
Instantaneous	–2,782	–11.4%
Daily average	–622	–4.5%

4 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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