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Energy Developments in the United Kingdom

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Key Takeaways

- Energy transition is well engaged in the United Kingdom (UK), with coal phased out, offshore wind poised to replace gas, but also eased by the industrial decline of the country.
- The UK has a strong profile to become a European leader on offshore wind and Carbon Capture Usage and Storage (CCUS), provided conditions are improved and that cooperation with the European Union (EU) is fostered.
- The UK has reduced its GHG emissions by half since 1990 and shows similar renewable energy share in the power sector as the EU. Yet, EU's and UK's Emissions Trading System (ETS) are increasingly diverging on price and future Carbon Border Adjustment Mechanism (CBAM) schemes may complicate energy relations.
- A stronger UK-EU relationship would help to overcome challenges and to deliver the promises of the energy transition, energy security and industrial competitiveness.

Introduction

The United Kingdom (UK) has traditionally been an example for its neighbours and the world in developing ambitious, innovative and effective energy policies. Beyond its natural local resources (firstly coal, then oil and gas, windy coastlines), it enjoys the presence of big companies, innovative financiers, astute legislators, lawyers and commodity traders, who have set up the highest standards whether in terms of regulatory schemes or financial tools, such as, just to quote one, the Contract for Difference used to derisk private investment.

As the Labour government led by Keir Starmer seeks to reset its relations with the European Union (EU), damaged by Brexit, and the EU seeks partners on defense and upholding multilateralism in increasingly fraught geopolitics, this isa good moment to take stock of the energy developments taking place in the UK, while accounting for existing challenges. Indeed, Brexit so far has not been delivering on its promise of a brighter future outside the EU, with the UK's gross domestic product (GDP) not looking better than the EU's over the last five years. However, economic growth was a surprising 0,7% in Q1 2025 and the UK signed a first trade deal with the United States (US) in May 2025.

Table 1. Real GDP growth – UK and EU, 2019-2024

Time period	2019	2020	2021	2022	2023	2024
United Kingdom	1,6	-10,3	8,6	4,8	0,4	1,1
European Union (27 countries from 01/02/2020)	1,9	-5,6	6,3	3,5	0,4	1,0

Source: "Quarterly Real GDP Growth – G20 Countries", OECD Data Explorer, available at : https://data-explorer.oecd.org.

Besides Brexit, other difficulties are looming. Offshore oil and gas production, which has underpinned domestic energy security and supported strong economic activity and quality jobs, is on the decline (2.8 million barrels per day in 2000 to 0.8 million barrels in 2024 for oil) and BP's difficulties in reinventing itself into a clean energy actor has energy security implications, given the interest from foreign actors to acquire its assets. In that context, the UK decision to bet on a clean power system by 2030, mostly based on wind, solar, nuclear and carbon capture and storage (CCS)[1] is of particular interest. To note is that the country's own production still covers around 60% of its oil demand and 50% of its gas demand.[2]

1. "Clean Power 2030 Action Plan", UK Government, December 2024, available at: www.gov.uk.
2. "Oil and Gas in the UK", UK|EITI, available at: www.ukeiti.org/oil-gas.

A decarbonisation-oriented energy landscape tested by shocks and changes

Strong governance focused primarily on decarbonisation

A dense network of governmental and non-governmental organisations looks after the UK's energy security of supply, sustainability and competitiveness, with the Department of Energy Security and Net Zero (DESNZ) overseeing the implementation of governmental policies.

As recalled by the International Energy Agency (IEA) in November 2023,[3] the UK has been the first major economy to legally establish a net zero target in 2019 and an early mover in setting legally binding carbon budgets and carbon pricing as well as creating an independent body, the Climate Change Committee, with statutory authority to track the government's progress toward its climate targets.

The UK security of supply has proved resilient during the 2022 crisis when Russia invaded Ukraine, and the UK stopped importing Russian gas. The gas market remained well supplied, and the electricity supply was balanced without notable difficulty, albeit with severe consequences on prices and strong impacts on both retailers and customers, as will be discussed below.

The UK security of supply has proved resilient during the 2022 crisis

As regards carbon pricing, the UK now has its own Emissions Trading System (ETS), created in May 2021 to replace the EU ETS, after it left the EU. The UK ETS has consistently been much lower than the EU ETS due in part to a UK decision to allow a greater number of free allowances for the sectors which are hardest to decarbonise. Besides, the UK is drafting its own Carbon Border Adjustment Mechanism (CBAM), following in the footsteps of the EU.

Energy transition on its way, but so is deindustrialization

Total inland primary consumption (temperature corrected) reached 166.1 million toe in 2024[4] compared to 221.6 in 1990, while GDP grew by close to 80% over the period. Oil has retained a steady 37% of the energy mix, while coal dropped from 31.3 to 1.5%, gas increased from 31.3 to 37.2%, and primary electricity (nuclear, hydro, wind and solar) rose from 8.3 to 10.7%.

3. "United Kingdom 2024", *Report*, IEA, available at: www.iea.org.
4. On a seasonally adjusted and annualised rate that removes the impact of temperature on demand.

Primary oil production fell to 30.7 million tonnes in 2024 (down by 9.1%), the lowest level since North Sea production was established in the 1970s. Subsequently, exports fell to a record low of 26.3 million tonnes while imports reached a record high of 45.9 million tonnes.[5]

Gas production at 29.3 Mtoe (provisional) was down 11% in 2024 compared to 2023 but remained equivalent to half of demand, which fell to the lowest level since the early 1990s, due to a substantial drop in demand for electricity generation.[6]

Oil and gas extraction now represents less than 1% of the UK Gross Added Value, far from its peak of nearly 7% in the early 1980s, and the UK is now a net importer of energy (around 40%).

On the other hand, the proportion of UK energy supplied from low-carbon sources has steadily risen from 2010 onwards to reach 20.7% in 2023; total greenhouse gas emissions were 52.7% lower in 2023 than they were in 1990, which is way beyond the EU average (roughly -37%).

As a result, energy and carbon ratios to GDP have strongly fallen (see Table 2), and the UK sees itself halfway on its path to net zero.

Table 2. Energy and carbon ratios, 1990 to 2023

	1990	2000	2010	2020	2021	2022	2023
Primary energy consumption*	100	108.4	95.4	75.5	77.0	77.4	74.8
Carbon dioxide emissions	100	93.7	83.6	52.9	55.8	53.7	50.2
GDP	100	128.1	148.4	158.1	171.9	179.3	179.5
Energy ratio	**100**	**84.6**	**64.3**	**47.7**	**44.8**	**43.2**	**41.7**
Carbon ratio	**100**	**73.2**	**56.3**	**33.4**	**32.5**	**29.9**	**27.9**

* Temperature corrected primary energy consumption.

Source: "UK Energy in Brief 2024", Department of Energy Security and Net Zero, July 2024.

The downward trends are due to several factors, with improvements in energy efficiency, the coal phase down and the decline in the relative importance of energy-intensive industries affecting both ratios.[7]

Total electricity demand in 2024 increased slightly for the first time since 2021, to 318.7 terawatt hours (TWh) –up 0.6% from 2023–, as domestic consumption and consumption by other final users, including commercial use, increased for the first time since 2020 and 2021, respectively. Household consumption rose by 3.5% to 95.8 TWh, while consumption by other final users, including commercial use, rose by 2.0% to 81.0 TWh. Conversely, industrial consumption fell by 0.6% to 85.7 TWh, the lowest level since the mid-1980s. Despite a slight increase in total demand, total electricity generation

5. "Energy Trends: UK Total Energy", UK Government, June 2013 [Updated April 2025], available at: www.gov.uk.
6. Ibid.
7. "UK Energy in Brief 2024", Department of Energy Security and Net Zero, July 2024, available at: https://gov.uk.

fell 2.6% to 284.9 TWh in 2024, reaching the lowest level since 1983. This was due to a 40% rise in net imports to a record 33.4 TWh, due to favourable price differentials across the interconnectors.

Renewable generation rose to a record 144.7 TWh in 2024, also achieving a record share of 50.8% of total UK generation, similar to EU levels. This is the first year when the renewables' share of generation has exceeded 50%. With 84.1 TWh, wind is the major renewable contributor (29.5% of total generation), coming very close to gas (30.3%). The decrease in gas reflected the displacement of UK gas-based power production because of strong renewable generation and high imports, while the decrease in coal was due to the closure of the last coal-powered station in 2024.

Nuclear capacity has been stabilised at around 6 gigawatts (GW) with five units in operation, which will be progressively retired. It is intended to retain a 10% share in the coming years with the construction of the 3.2 GW Hinkley C plant by EDF, making up for the decommissioning of old units, and possibly also another pair of large reactors at Sizewell, later also complemented by small modular reactors.

Electricity interconnectors, which transport electricity between two (or more) countries, enable the UK to import and export electricity depending on price signals from the connected markets, transporting electricity from the lower-priced market to the higher-priced market. At the end of 2024, the UK had 9.8 GW of interconnector capacity across nine interconnectors, with a further two interconnectors (1.9 GW of capacity) in construction.[8]

Interconnectors play a key role in bringing security and flexibility to the electricity systems

Interconnectors operate in two directions, for imports or exports of electricity, and play a key role in bringing security and flexibility to the electricity systems of both sides of the pond. They would also allow the UK to export future increased offshore wind generation.

Strong impact of the energy crisis of 2022-2023 on retailers and consumers

The UK gas and electricity retail sector has suffered from the market events caused first by the COVID-19 pandemic, then by the Russian invasion of Ukraine.[9] Several small players have disappeared, leaving hundreds of thousands of consumers without a supplier. Larger players such as Shell Energy have withdrawn. Well-established retailers such as British Gas have lost shares, mainly to the profit of Octopus Energy, a newcomer now respectively #1 and #2 in the domestic electricity and gas markets.

Until 2021, the UK supply market had not shown notable price divergences with

8. "Ofgem Annual Report and Accounts 2023-24", Ofgem, 2025, available at: www.ofgem.gov.uk.
9. More details available at: www.ofgem.gov.uk.

other major EU markets. The 2022 crisis, however, saw the UK electricity prices peak higher than average, due to the still large share of gas-fired generation and its role as marginal-price maker.

This situation pushed the British government to deploy massive financial efforts in 2022 and 2023 to soften the burden for households and small businesses and to introduce an Electricity Generator Levy to cap the exceptional profits made by infra-marginal electricity producers.

New initiatives to speed up the energy transition

The Clean Power 2030 Action Plan

The current Labour government, formed after the 2024 general elections, has put clean power "as a broader goal, key to a growing economy, national security and improved standards of living"[10] and launched its Clean Power 2030 Action Plan. According to the Plan, 95% of the UK's total electricity generation should come from clean sources in 2030, instead of 65% in 2023, while the existing 35 GW fleet of gas power stations will be retained to ensure security of supply. This transition means a huge jump in the installation of wind and solar capacities and of flexibility sources, all of them in record time.

Multiplying by three the offshore wind (from 14.8 to 43-50 GW) and solar capacities (from 16.6 to 45-47 GW) by 2030, and by two the onshore wind (from 14.2 to 27-29 GW) requires a conjunction of resolute efforts. Efforts are made to drastically improve the speed and the efficiency of planning and permitting processes, and the allocation of the Contracts for Difference (CfD) that enable financing. The grid and flexibility challenges are also mounting dramatically, with stress in the past months related to concerns over availability of generation in case of low wind and high demand, and now for the next summer, in cases of high solar generation and low demand. All available flexibility sources are to be boosted up to 2030, with battery electricity storage systems (BESS) and customer-led flexibility expected to make the biggest contribution by 2030. The UK has been a leader in Europe in installing BESS, with about 5 GW installed at the end of 2024 and an estimated 23 to 27 GW needed in 2030 by the National Energy System Operator (NESO).[11]

10. "Clean Power 2030 Action Plan", UK Government, available at: www.gov.uk.
11. The National Energy System Operator has responsibility for planning Britain's electricity and gas networks and operating the electricity system.

During the 2022 energy crisis, the UK government has put up for review the electricity market design to address the issue of marginal pricing (whereby volatile gas prices fix the price of overall electricity supply due to being the last source of supply to meet demand) and the need to find a more effective pricing system reflective of the growing share of renewables, but also to incentivize low-carbon flexibility, including demand-response, and improve grid management. Deciding on the pricing system is a crucial aspect to be worked out in order to respond to the difference between the spatial distribution of clean generation areas – mostly in the North, and demand areas, mostly in the South, the choice remaining to be made between a zonal pricing (dividing UK into zones that have each their own electricity price) and enhanced national pricing (with changes in terms of improving interconnectors management, further developing the grid, as well as flexibility means). The ongoing Review of Electricity Market Arrangements must be quickly finalised to bring visibility to investors, given that the NESO estimates that Clean Power 2030 will require an average annual investment of £40 billion, a huge increase from the average £11 billion spent during the 2020-2024 period.

Deciding on the pricing system is a crucial aspect to be worked out

According to the NESO, the resulting increase in total system costs would be equivalent to around GBP 10/MWh, which could be globally compensated at the consumer level by positive factors such as reduced infra-marginal rents and falling legacy policy costs.

The British government also strives to mobilise some more innovative policies:

- A bold move is made in support of Carbon Capture Usage and Storage (CCUS) via funds or schemes such as the Dispatchable Power Agreements (DPA), ensuring that Power CCUS plays a valuable mid-merit role, dispatching behind renewables, but ahead of unabated gas generation. Measures are designed to insert CCUS in the frame of Capacity Market agreements that are key for the existence of dispatchable peak assets. CCUS fits well with the North Sea offshore storage capacities and oil and gas companies' skills and motivation[12] in developing these technologies. CCUS is also planned to benefit the hard-to-abate industries such as steel, chemicals, cement and waste incineration. In October 2024, the UK government announced £21.7 billion of funding for carbon capture projects located in the East Coast Cluster and the HyNet cluster. The funding is to be allocated over 25 years for projects located in Teesside (Northeast) and Merseyside (near Liverpool)[13] for storing 8.5 million tonnes per year (mtpa) of CO_2, out of a total ambition to store between 20 and 30 mtpa of

12. "Equinor, BP and TotalEnergies Reach FID on 4 Mt/year CCS Project in the UK", Enerdata, December 2024, available at: www.enerdata.net.
13. On April 24, 2025, energy company Eni finalised a major deal with the government, which will see them award around £2 billion in supply chain contracts for their Liverpool Bay Carbon Capture and Storage Project, spanning North Wales and the North West of England.

CO_2 by 2030, also in other clusters, which would make the UK a global leader. The commercial success of the CCUS is not fully guaranteed, and voices rise in the UK, asking not to bet inconsiderate amounts of public money on it.

- Hydrogen (H_2) production, whether "blue" (using natural gas + CCS) or "green" (electrolytic process using green electricity), is also entitled to receive billions of pounds of subsidies from the National Wealth Fund. The purpose is to use low-carbon H_2 for Hydrogen to Power generation (H2P) or for synthetic fuels. In December 2023, the government announced an initial 11 projects from the First Hydrogen Allocation Round (HAR1), totalling 124 MW of production capacity. Five of these projects have signed their contracts, including the Bradford Low Carbon project in Yorkshire and the Cromarty Hydrogen Project in northeast Scotland. A new wave of 27 hydrogen projects has been selected on April 7, 2025, for the next stage of the Second Hydrogen Allocation Round (HAR2).
- In complement to the other policies, a publicly-owned Scotland-headquartered company, Great British Energy, has been created with an initial funding of £8.3 billion over the Parliament to provide the British government with their own vehicle to foster energy transition investment. GBE' first announced moves will be to install solar panels on schools and hospitals roofs and to fund offshore wind supply chains.

A favorable time for renewing the cooperation between the UK and the EU and its member states

The general feeling is that the moment has come to give a new boost to the UK-EU relationship in energy matters, as well as in other topics. Political leaders on both sides have expressed their willingness to work together to reinforce security, to fight the hybrid war led by Russia, to protect industries from unfair competition, and to build a common approach on the road to net-zero emissions. This could give the necessary political momentum to solve technical issues caused by the UK leaving the EU energy market,[14] which creates frictions to energy trading between the two blocs or even more importantly, potential future obstacles due to the implementation by each side of their own Carbon Emissions Adjustment Mechanism (CEAM).

Beyond these technicalities, there is much to gain in working together to enable the development of two sectors in particular, offshore wind and CCUS.

With respect to offshore wind energy, the UK represented a significant share in offshore wind installations in Europe in 2024: 1.18 GW out of 2.57 (i.e., 46%). The UK also has the largest offshore wind installed capacity in Europe, with 16 GW, out of 37 GW.

14. C. Born and J. Reland, "UK-EU Climate & Energy Relations", UK in a Changing Europe, September 2024, available at: https://ukandeu.ac.uk.

Currently, the key joint priority for the UK and the EU is harnessing the fabulous potential of the Northern Seas to build the "green powerhouse of Europe", with the objective of building hundreds of gigawatts of offshore wind farms and large transmission connectors that would bring competitive clean electricity to Europe. The North Seas Energy Cooperation (NSEC), currently featuring among its members Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and the European Commission, has been created to support and facilitate these projects. The UK has signed a Memorandum of Understanding[15] with the NSEC in December 2022, establishing a cooperation framework. The rapid expansion of offshore RES requires huge investments in both offshore and onshore infrastructure to transport the energy to the main demand centres. The total offshore wind capacity is, according to the goals of the Northern Seas countries, expected to be about 120 GW by 2030 (of which 58 GW in GB+NO), climbing to 333 GW by 2050.[16]

Yet, if the UK is second after China in terms of offshore wind operating capacities (about 16 GW installed), it has been struggling over the past few years to speed up its deployment and is off track for reaching its 2030 ambitions (45-50 GW of installed capacity). The fifth CfD auction in 2023 was a wake-up call: the government intended to award 5 GW of offshore wind, yet no bids were submitted as the maximum strike price was much too low (44 GBP/MWh), not considering the inflation and bottlenecks across the supply chains, which have also taken a toll on one of Vattenfall's Norfolk project (1.4 GW), ultimately sold to RWE. More recently, Ørsted announced on May 7 that it was cancelling its Hornsea 4 Project (2.7 GW), citing rising costs, supply chain disruptions, and the lack of investors' confidence, notably due to Donald Trump's measures against offshore wind in the US. If the UK government wants to keep such projects alive and meet its offshore wind ambitions, it needs to get right the auction pricing, but, equally important, to work with the EU on further developing the European wind equipment manufacturing capacity to overcome supply chain shortages and drive down installation costs, while boosting local employment and skills, and industrial resilience. This should be a key joint priority for the EU and the UK, especially as both sides are increasingly concerned by the penetration of Chinese actors on their markets. China represented in 2024 more than half of offshore wind additions and Chinese Original Equipment Manufacturers (OEMs), driven by the domestic market, made it to Top 3 in terms of share of installed wind turbines, pushing EU/US companies out (nevertheless, for the first time, Siemens Gamesa was leading installations in the offshore wind sector). Similar to the EU, the UK's wind sector is also facing the likelihood of a penetration of

UK needs to work with the EU on further developing the European wind equipment manufacturing capacity

15. "NSEC-UK Memorandum of Understanding", CIRCABC, December 2022, available at: https://circabc.europa.eu.
16. "TYNDP 2024 | Sea-Basin ONDP Report |TEN-E Offshore Priority Corridor: Northern Seas Offshore Grids", January 2024, available at: https://eepublicdownloads.blob.core.windows.net.

Chinese turbine OEMs. In March 2024, Mingyang and Opergy Group (a UK company specializing in renewable energy) signed a partnership. Mingyang has also emerged as the preferred manufacturer for the Green Volt project (jointly owned by Scottish Flotation Energy and Norwegian Vårgrønn), which aims to construct the first commercial-scale floating offshore wind farm in Europe (560 MW). But the UK government has shown reluctance to this turbine supply and will scrutinize the decision, especially after it recently stepped in to take operational control of British Steel, in the context of claims arguing that its Chinese owner, Jingye Group, intended to shut down the Scunthorpe plant to make the UK a dumping ground for Chinese steel. China has already expressed concerns that the UK-US trade agreement contains strict security provisions regarding certain technologies.

In a similar trend, the EU has been boosting its internal market defense toolbox through the enforcement of the Foreign Subsidies Regulation, allowing it to step up enquiries into unfair trade practices, as well as by applying non-price criteria in renewables auctions (cybersecurity, resilience, sustainability, etc.). Hence, for both parties, it makes sense not only to jointly harness the potential of wind energy in the North Sea, but to boost the resilience of their supply chains, maintain industrial leadership in wind manufacturing and align their economic security agenda.

CCUS is the second clean tech sector where the UK has taken a clear leadership role that could be of interest for continental European hard-to-abate industries. There again, working together between the EU and the UK could allow for overcoming the legal, technical and economic obstacles that arise on the path to export CO_2 from the EU to the UK and to establish the CO_2 hubs and chains toward the North Sea sublevels storage locations. Nevertheless, regulatory challenges need to be addressed, as currently, CO_2 captured in the EU/European Economic Area but stored outside this jurisdiction would not be recognised under the EU ETS as having been stored; hence, current projects primarily focus on CO_2 storage facilities in Norway. If linking the UK and EU ETS systems seems the most reasonable path forward given their similar decarbonisation ambitions and interconnections, other solutions may be envisaged in the short term to overcome this regulatory barrier, as part of an enhanced EU-UK energy cooperation.[17]

The presence of large energy multinational companies on both sides of the North Sea, such as French ENGIE and EDF, German RWE, Spanish Iberdrola, Italian ENI, and Anglo-Dutch Shell, will facilitate these developments, as is the case in the nuclear sector. EDF is the cornerstone of nuclear electricity production in the UK and is committed to delivering 3.2 GW Hinkley Point C, with Unit 1 scheduled for completion between 2029 and 2031.

17. T. Lockwood, “Carbon Dioxide without Borders: Connecting the UK and EU Can Create a More Resilient and Lower-cost CO_2 Storage Network”, Clean Air Task Force, August 23, 2024, available at: www.catf.us.

Conclusion

The UK government policies and action plans are a great showcase of the goals, challenges and solutions on the way to net zero. It is the shared interest of the UK and the EU to work more together to overcome those challenges and learn from each other's experience and take advantage of their respective strengths. Deepening their relationship would also enable them to be stronger in overcoming geopolitical headwinds and other challenges that were not covered in this paper, such as supply chain issues, skills needed, critical materials procurement, etc. Speed is of the essence on both sides of the pond to make citizens quickly feel the benefit of the energy transition, and to build more resilient and competitive supply chains.

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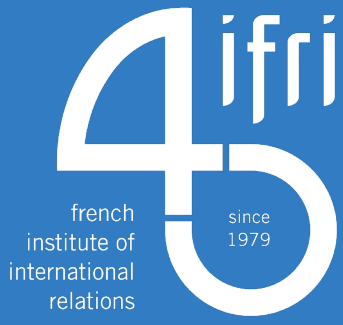

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