Department for Energy Security & Net Zero

Energy Trends

UK, July to September 2023

About this release

Information on energy production, trade, and consumption in the UK for total energy and by specific fuels.

In this release

Data tables

Additional data are available online as part of the Energy Trends series:

Total energy
Coal and derived gases
Oil and oil products
Gas
Electricity
Renewables

This publication is based on a snapshot of survey data from energy suppliers. New data are incorporated in line with the revisions policy.

Percentage change from Quarter 3 2022, primary energy basis

(Mtoe basis)	Production	Imports	Exports	Demand
Total energy	**-7.6%**	**-15%**	**-23%**	**-5.3%**
Coal	**+8.0%**	**-66%**	**+6.1%**	**-29%**
Primary oil	**-10%**	**+0.6%**	**+2.4%**	**-3.5%**
Petroleum products	**-4.0%**	**+0.8%**	**-12%**	**+1.2%**
Gas	**-13%**	**-46%**	**-57%**	**-20%**
Electricity	**+5.4%**	**+187%**	**-55%**	**+5.4%**

Total energy production for the third quarter of 2023 was down 8 per cent on the same period last year. Oil production dropped 10 per cent to a new record quarterly low, and gas production fell by 13 per cent. Energy production from renewable assets increased with wind, solar and hydro output up by 17 per cent.

Renewable electricity generation grew 7 per cent on the same period last year due to increases in capacity (up 5 per cent) and more favourable weather conditions. As a share of total generation, **renewable generation increased to 44.5 per cent, outpacing fossil fuel's share for the fourth consecutive quarter**.

Fossil fuel electricity generation decreased, down 31 per cent largely to near a new record low because of stronger renewable generation and higher net imports from France. These imports contrast with last year where the UK was a net exporter of electricity. The fossil fuel share of generation decreased nearly 10 percentage points to 37.0 per cent.

Final energy consumption by households fell 6 per cent on the same period last year to a record quarterly low. Whilst the warmest September in our records will have contributed to lower demand, high energy and other prices also played a part. Consumption by industrial users fell 2 per cent and other final users (including commercial, public and agriculture) fell by 5 per cent. Transport consumption rose by 3 per cent but remains down 7 per cent on pre-pandemic levels.

Net import dependency increased slightly, up from 36.3 per cent to 37.8 per cent, similar to the annual figures from 2021 and 2022. With European gas storage nearing capacity, the UK imported less gas for export through the pipeline infrastructure to Europe. In contrast to last year, the UK was also a net importer of electricity due to favourable pricing differentials through the interconnectors this summer.

Section 1: UK total energy

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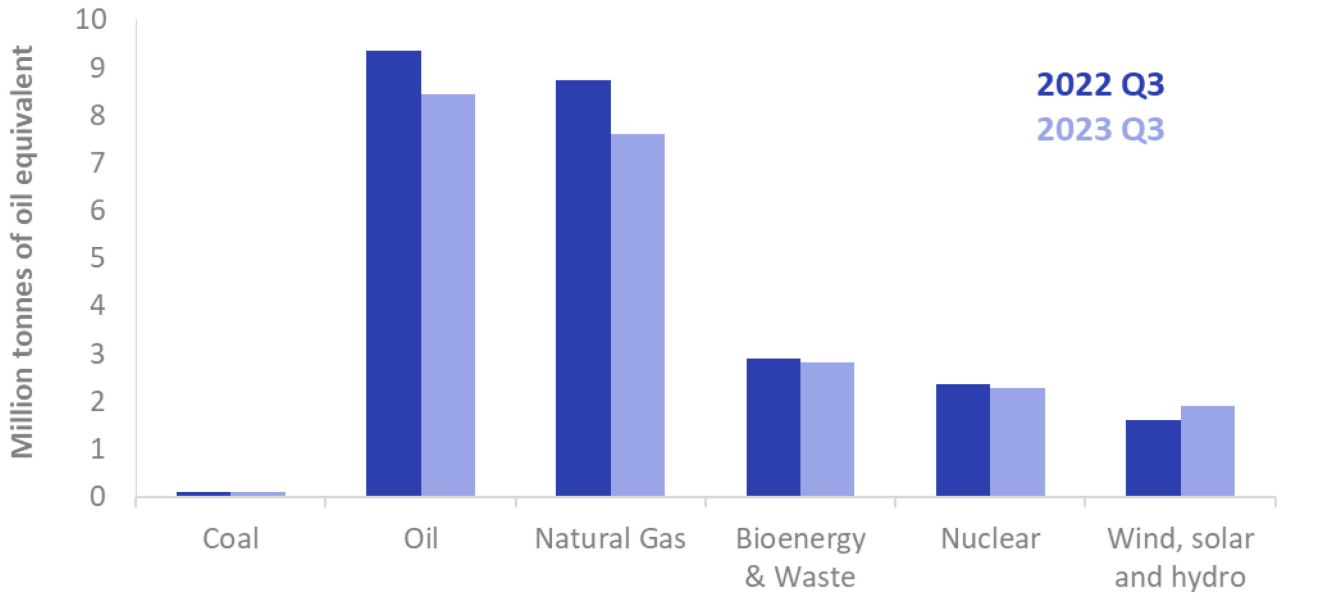
Key headlines

In the third quarter of 2023 **total production was 23.2 million tonnes of oil equivalent, 8 per cent lower** compared to the third quarter of 2022. Oil and gas production fell markedly on last year, and oil production is at a record low and notably below pre-pandemic levels. Favourable weather conditions saw an increase in the output of renewable (wind and hydro) technologies.

Total primary energy consumption for energy uses fell by 5.0 per cent, with reduced demand from electricity generators and higher energy and other prices reducing gas consumption. When adjusted to take account of weather differences, primary energy consumption fell by 4.8 per cent on the same period last year.

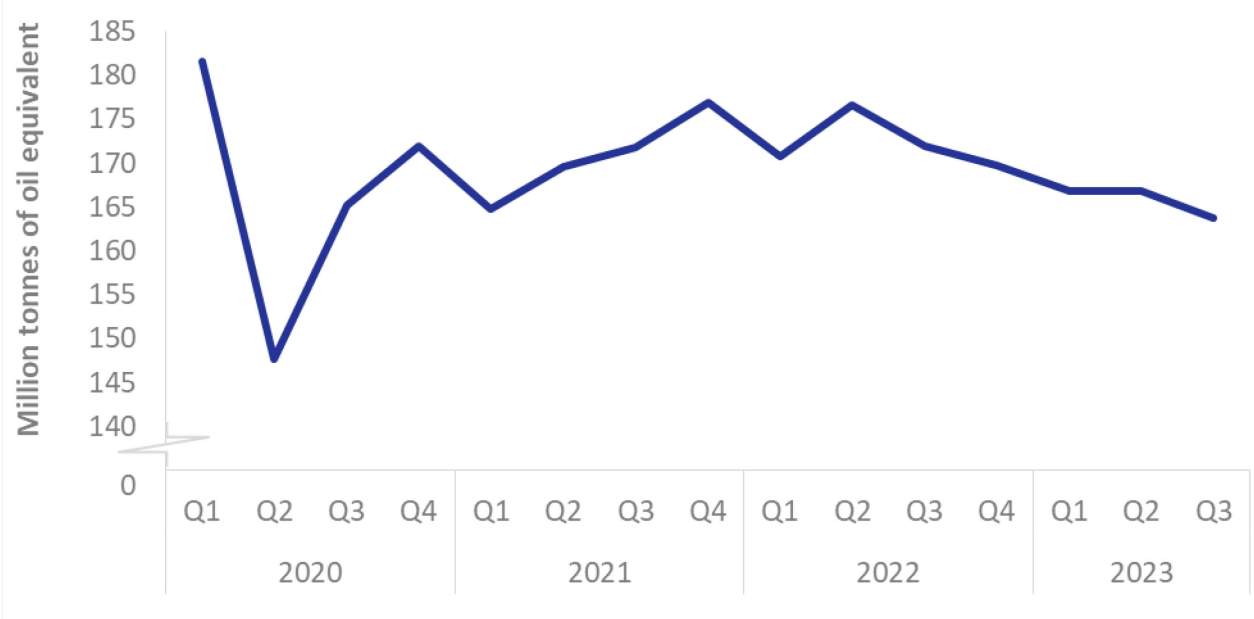
Total final energy consumption (excluding non-energy use) was 0.4 per cent lower compared to the third quarter of 2022. Transport consumption rose by 3.3 per cent, but other final users (mainly from the service sector) consumption fell by 5.1 per cent and industrial consumption fell by 2.3 per cent. Domestic consumption fell by 6.3 per cent to a record low with a notably warm September and the impact of increased energy and other prices likely drivers behind reduced demand. On a seasonally and temperature adjusted basis, final energy consumption fell by 1.6 per cent, with falls in all sectors except transport which rose by 1.9 per cent.

Chart 1.1 UK production (Energy Trends Table 1.1)



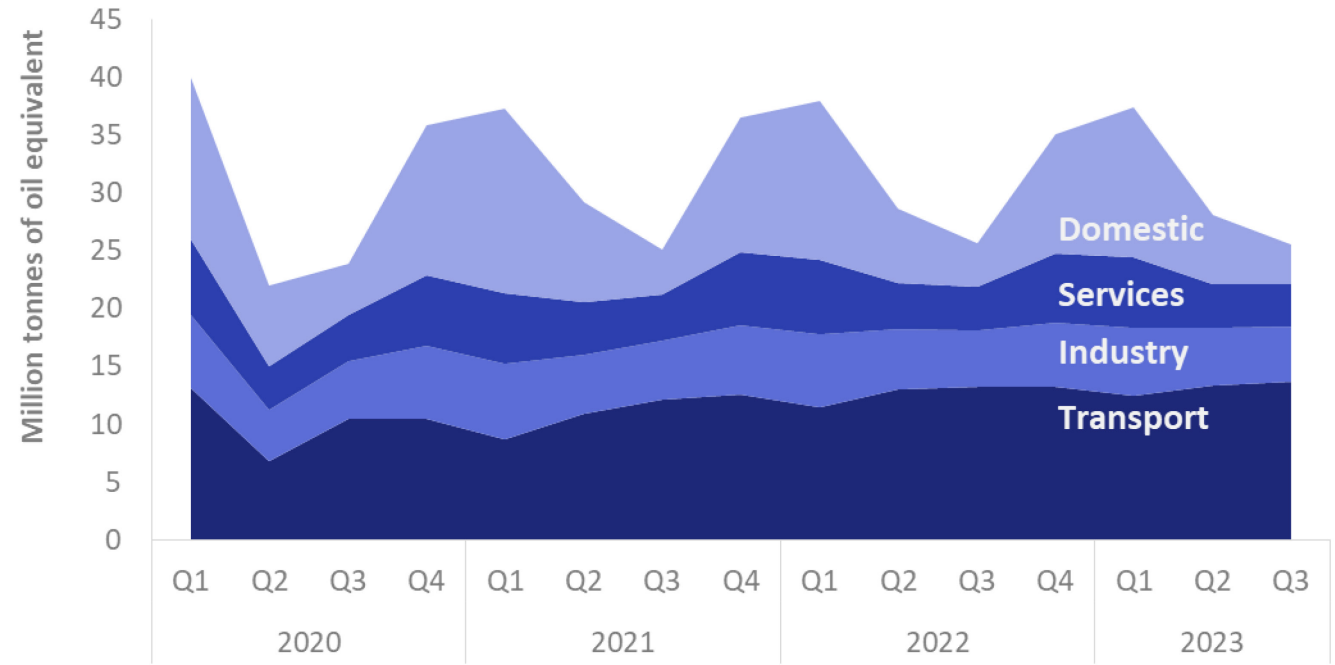
In the third quarter of 2023 **total production was 23.2 million tonnes of oil equivalent, 8 per cent lower** than in the third quarter of 2022. Oil production fell by 10 per cent to the lowest quarterly total this century, with output down nearly 40 per cent compared to pre-pandemic levels, whilst gas production fell by 13 per cent. Nuclear production fell by 3.4 per cent due to outages. Wind, solar and hydro output rose by 17 per cent due to increased output from both offshore and onshore wind due to increased capacity and higher wind speeds, hydro due to increased rainfall levels, but reduced output from solar due to fewer sun hours.

Chart 1.2 Total inland consumption (primary fuel input basis) (Energy Trends Table 1.2)



In the third quarter of 2023 total inland consumption over the last year (including not only fuel used by consumers, but for electricity generation and other transformation) was 163.7 million tonnes of oil equivalent, 4.8 per cent lower than in the third quarter of 2022. (Chart 1.2 is on a seasonally adjusted and annualised rate that removes the impact of temperature on demand.)

Chart 1.3 Final energy consumption by user (Energy Trends Table 1.3)



In the third quarter of 2023 **total final energy consumption (excluding non-energy use) was 0.4 per cent lower** than in the third quarter of 2022. Transport consumption rose by 3.3 per cent, but domestic consumption fell by 6.3 per cent. Service sector consumption fell by 5.1 per cent and industrial sector energy consumption fell by 2.3 per cent. The falls in consumption levels can be attributed in part to the impact of higher energy and other prices, resulting in domestic and industrial consumption levels being the lowest recorded for the third quarter of the year this century.

Section 2: Coal and derived gases

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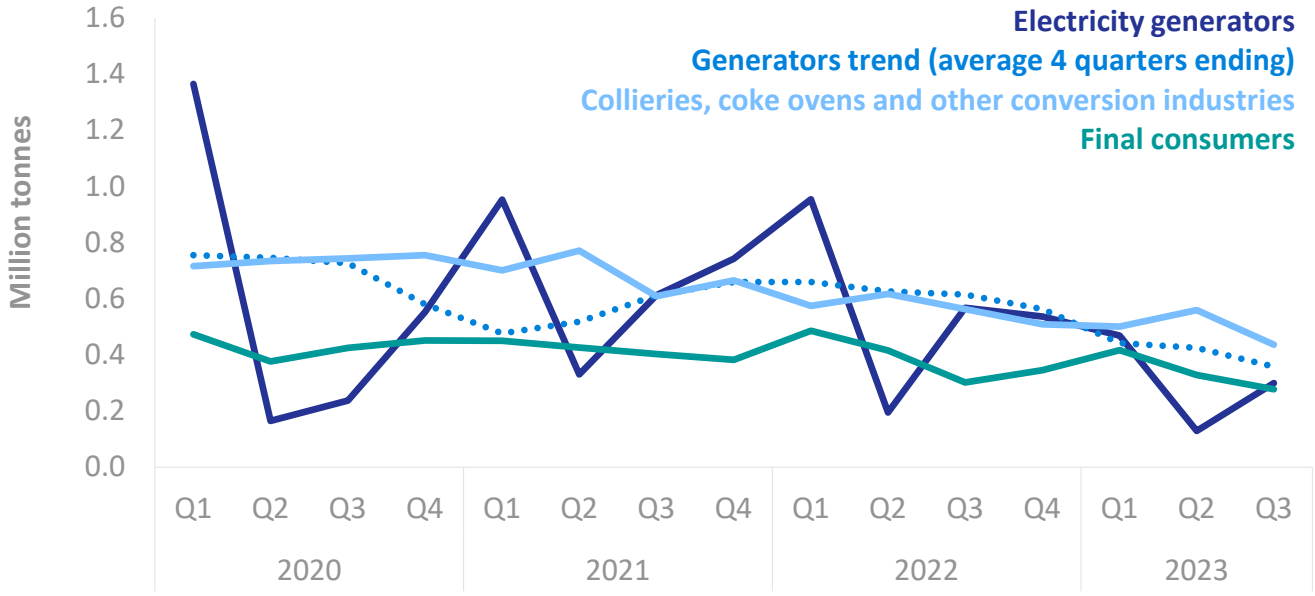
Key headlines

In the third quarter of 2023, UK coal demand fell 29 per cent to a record low of 1 million tonnes. Coal demand for electricity generation fell to 300 thousand tonnes (down 47 per cent compared to Quarter 3 2022) (Chart 2.1).

Overall coal production rose slightly to 144 thousand tonnes, up 3.5 per cent on the third quarter of 2022, due to natural variation in mining conditions. Production remains over 30 per cent down on last year in the year-to-date and coal production remains at historically low levels as a result of mine closures in recent years and falling demand for coal for electricity generation.

Coal imports fell to 565 thousand tonnes during the quarter, the lowest since the 1970s and 68 per cent down on the same period last year. The USA was the largest supplier of coal into the UK at 31 per cent of total imports. This was followed by the EU (16 per cent) and Colombia (15 per cent). (Chart 2.3)

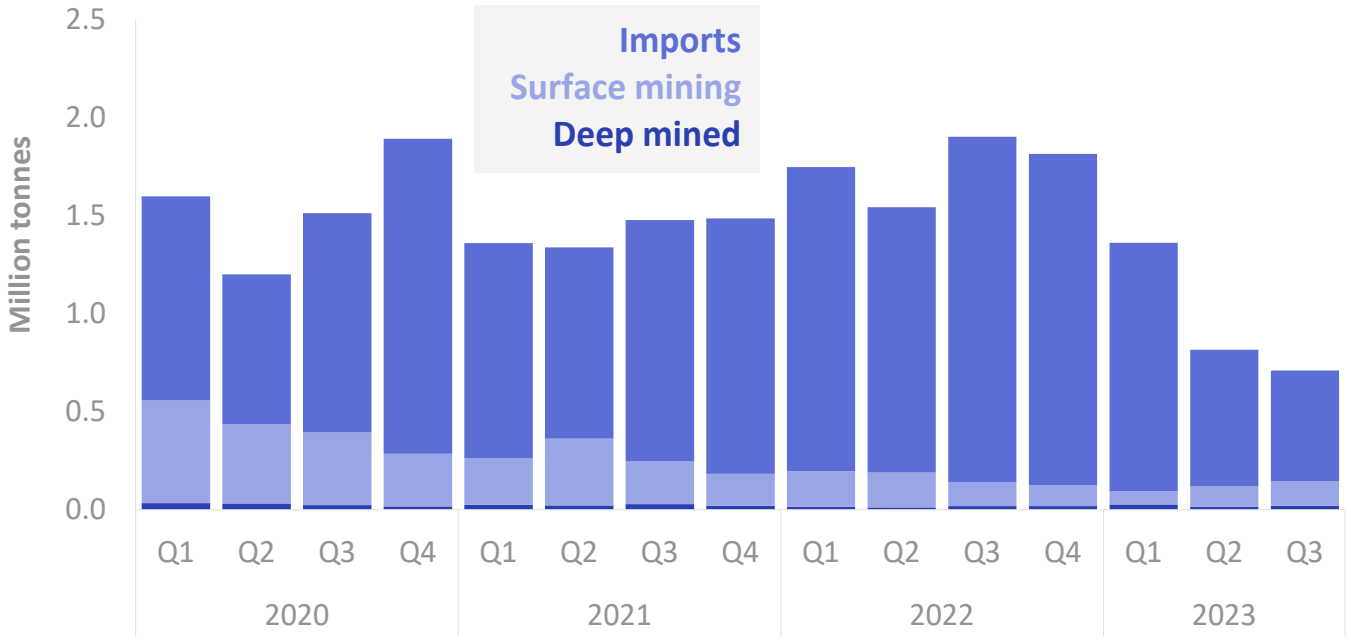
Chart 2.1 Coal Consumption (Energy Trends Table 2.1)



Demand for coal-fired generation is seasonal, peaking in winter when conditions are cold and dark. In recent years these peaks have declined as coal-fired generation became less competitive economically and gas and renewable sources displaced it.

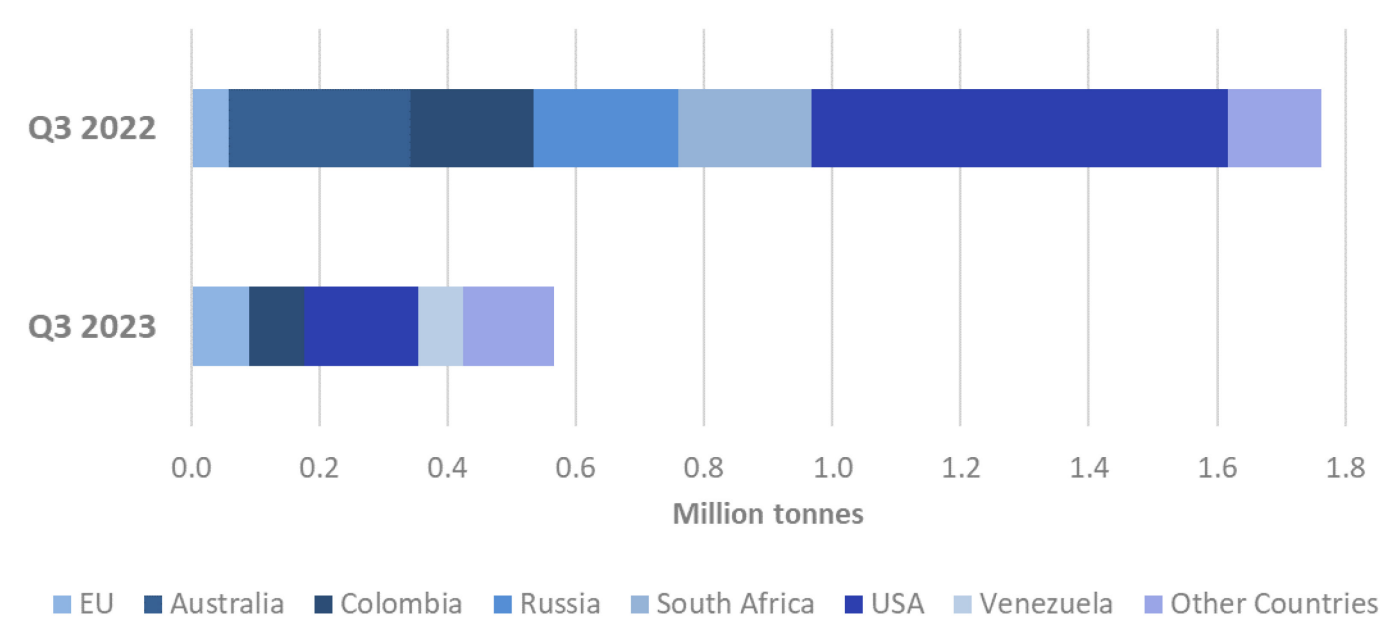
Coal demand for coal-fired electricity generation fell from 567 thousand tonnes in Quarter 3 2022 to 300 thousand tonnes in Quarter 3 2023. As coal use is being phased out, electricity generation favours gas, nuclear and renewables and, more recently, imported electricity. During this period overall electricity demand fell, but offshore wind increased substantially up 26 per cent to 9.7 TWh. (see Energy Trends 5.4 for information on generation). Following the closures of West Burton and Drax power plants earlier this year, only two coal fired power plants remained in service, Ratcliffe-on-Soar and Kilroot power station, with the latter closing on the 30th of September. The government remains committed to ending coal use for electricity generation by October 2024.

Chart 2.2 Coal Supply (Energy Trends Table 2.1)



Domestic coal production has fallen steadily because of mine closures and reduced demand. Imports filled the gap but have gradually fallen from the peak of 13.4 million tonnes in the second quarter of 2013 as overall demand dropped. In the third quarter of 2023, imports of coal were 0.6 million tonnes.

Chart 2.3 Coal Imports (Energy Trends Table 2.4)



As coal's place in the UK's generation mix has diminished, imports have decreased significantly. In the third quarter of 2012, the UK imported 11.1 million tonnes of coal, falling to 1.8 million tonnes in the third quarter of 2022. In the third quarter of 2023 this fell to 0.6 million tonnes, the lowest since the 1970s. This comprised 0.2 million tonnes of steam coal (38 per cent of imports), 0.3 million tonnes of coking coal (59 per cent of imports) and 0.01 million tonnes of anthracite (2 per cent of imports).

In Quarter 3 2023 the largest provider was the USA (31 per cent). This was followed by the European Union (16 per cent) and Colombia (15 per cent). The UK banned Russian coal imports in August 2022. This reflects a decreasing reliance on Russian energy in line with that seen for both oil and gas.

Section 3: Oil and oil products

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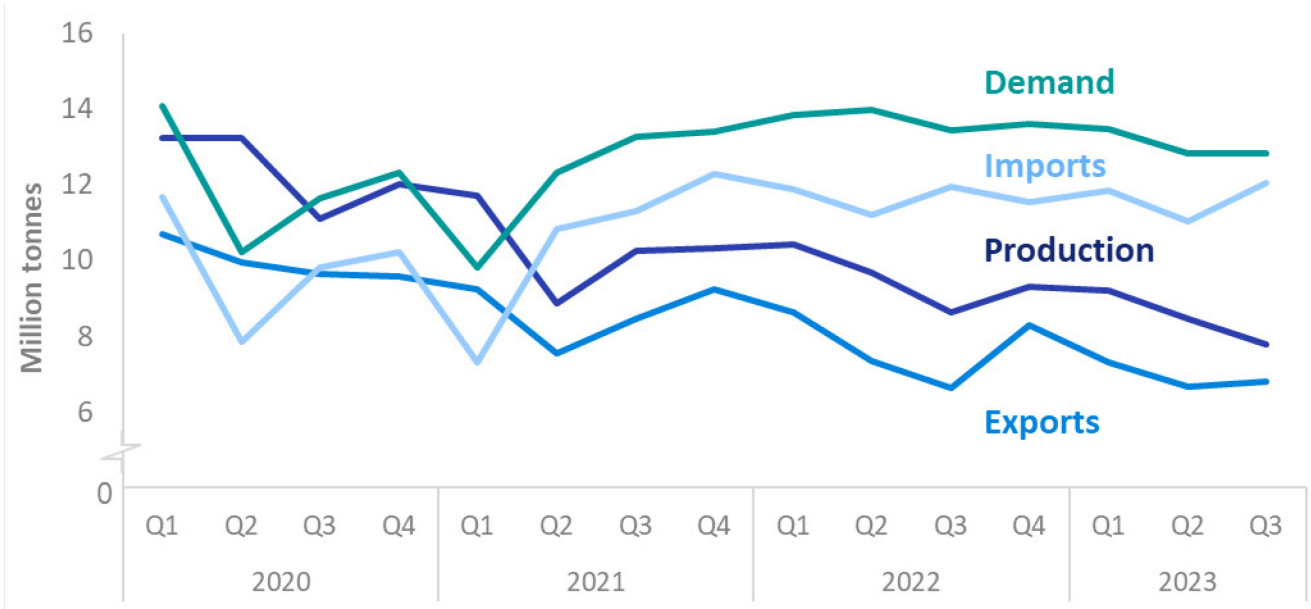
Key headlines

In Quarter 3 2023, production of crude oil and natural gas liquids fell to the lowest quarterly level since production peaked in 1999 due to planned maintenance and longer-term reports of reduced investment. Production remains low compared to pre-pandemic levels, down 38 per cent on Quarter 3 2019.

Production and exports of petroleum products were down 4.5 per cent and 13 per cent, respectively, in Quarter 3 2022 compared to the same period the previous year. Imports have remained relatively stable over the past few quarters. With no imports being sourced from Russia, oil originated from a diverse range of countries, mainly the Netherlands and United States.

Demand for transport fuels increased by 3.1 per cent with a 3.4 per cent drop in production of petrol, diesel, and jet fuel. Supply was met with an 8.9 per cent decrease in exports of petrol, diesel, and jet fuel.

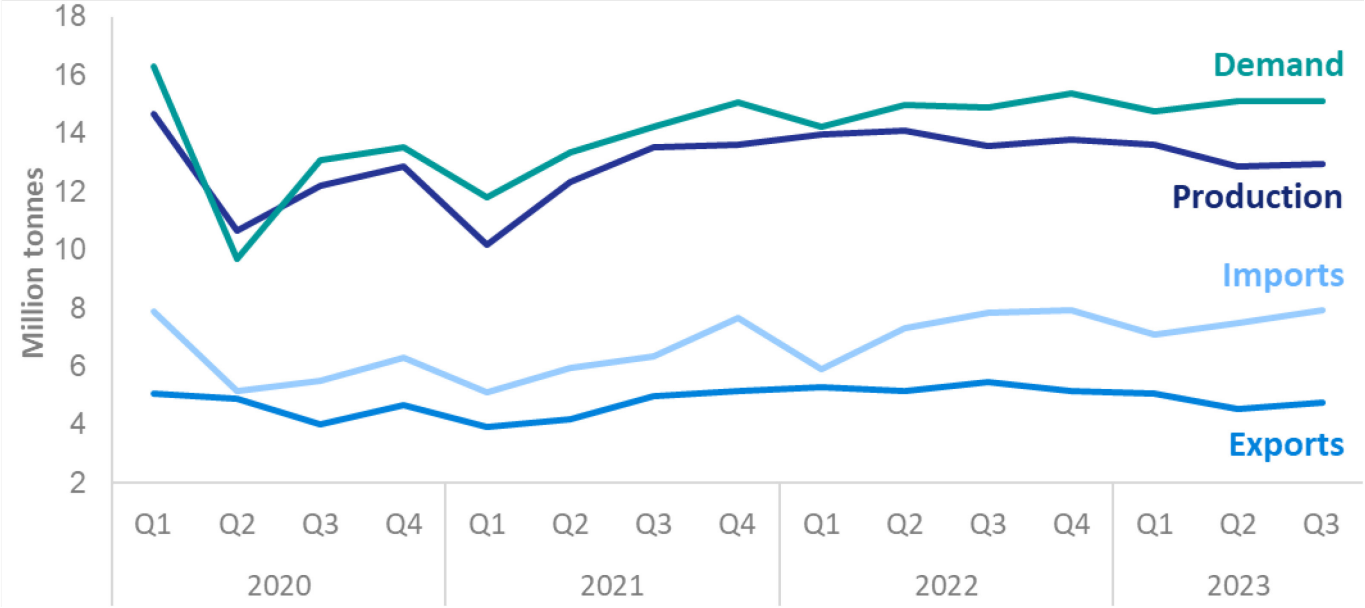
Chart 3.1 Production and trade of crude oil and NGLs (Energy Trends Table 3.1)



In Quarter 3 2023, indigenous production of crude oil and Natural Gas Liquids (NGLs) fell to the lowest quarterly level since production peaked in 1999. Production has been trending downwards in both the longer term and since 2019 following reports of reduced investment in the mature North Sea basin. In this context September and August respectively recorded the second and third lowest ever monthly production of crude oils because of maintenance at several larger assets. The UK produced 7.8 million tonnes of primary oils in Quarter 3 2023, down 9.6 per cent compared to the same period in 2022. Production compared to pre-pandemic levels was also low, down 38 per cent from Quarter 3 2019.

Imports and exports of primary oils remained stable in Quarter 3 2023 compared to the same period in the previous year. Exports of crude oil and natural gas liquids were at a near record low of 6.1 million tonnes. Net imports were relatively stable on the same period in 2022 at 5.2 million tonnes. Refinery demand was down 4.5 per cent on Quarter 3 2022.

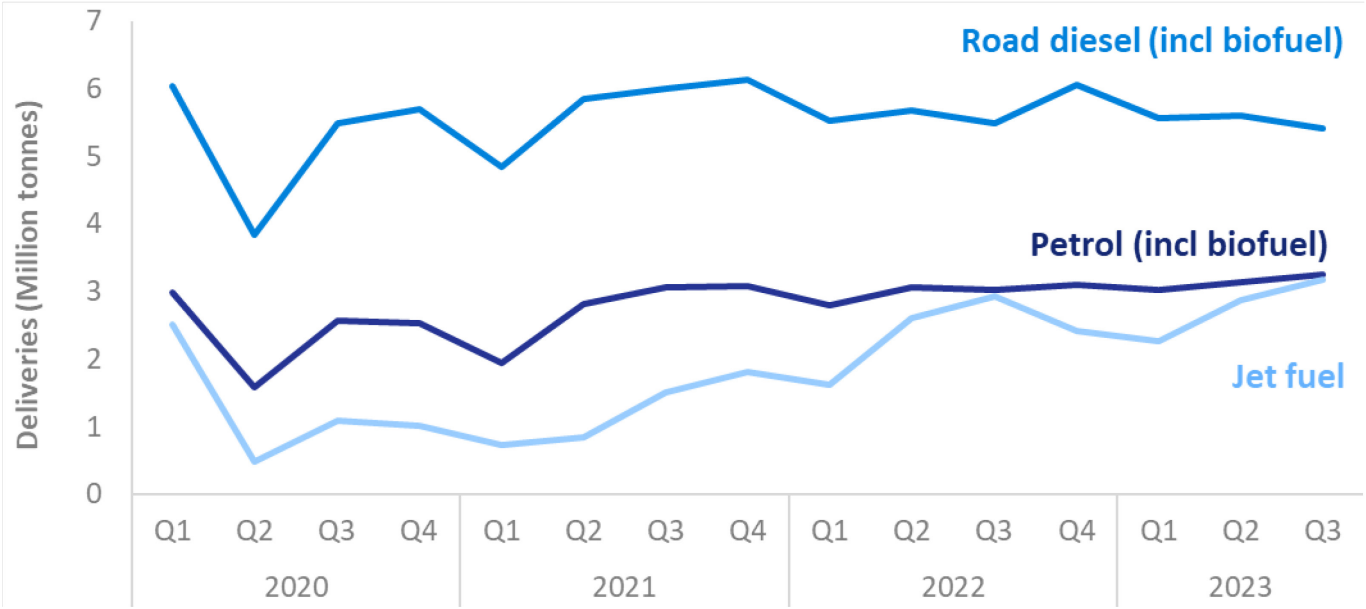
Chart 3.2 Production and trade of petroleum products (Energy Trends Table 3.2)



In Quarter 3 2023, production and exports of petroleum products were down 4.5 per cent and 13 per cent, respectively, compared to the same period in the previous year. Demand and imports remained relatively stable on Quarter 3 2022. The UK was a net importer of petroleum products by 3.2 million tonnes. Demand remains 11 per cent below pre-pandemic levels, with transport still 9.0 per cent lower than in Quarter 3 2019.

Imports of petroleum products originated from a large variety of countries, but the top three sources in Quarter 3 2023 were the Netherlands, the United States, and Kuwait. This is similar to the same period in 2022, except that Belgium was the second largest source of imports instead of the United States. There were no cargoes from Russia; due to sanctions the last cargo imported from Russia was received in November 2022.

Chart 3.3 Deliveries of transport fuels (Energy Trends Table 3.4 and 3.5)



In Quarter 3 2023, supply of key petroleum products remained stable (up 1.4 per cent) compared to the same period in 2022. Excluding biofuels, demand for road diesel was down by 2.4 per cent and was offset by an increase of 7.3 per cent in demand for petrol. Sales of bioethanol dropped by 1.0 per cent but biodiesel increased by 1.0 per cent. Gas diesel oil production was down by 11 per cent following maintenance, meaning demand was met by a near halving of exports.

Demand for jet fuel increased by 8.0 per cent compared to the same period in 2022, but indigenous production fell by 4.1 percent. This increase in demand was met with a 26 per cent increase in imports compared to Quarter 3 2022. Demand for aviation fuel is recovering because of increased demand for international travel. Final consumption of petroleum products remained stable on Quarter 3 2022, with decreases in the domestic and non-energy use sectors met by an increase of 3.1 per cent in the transport sector.

Section 4: Gas

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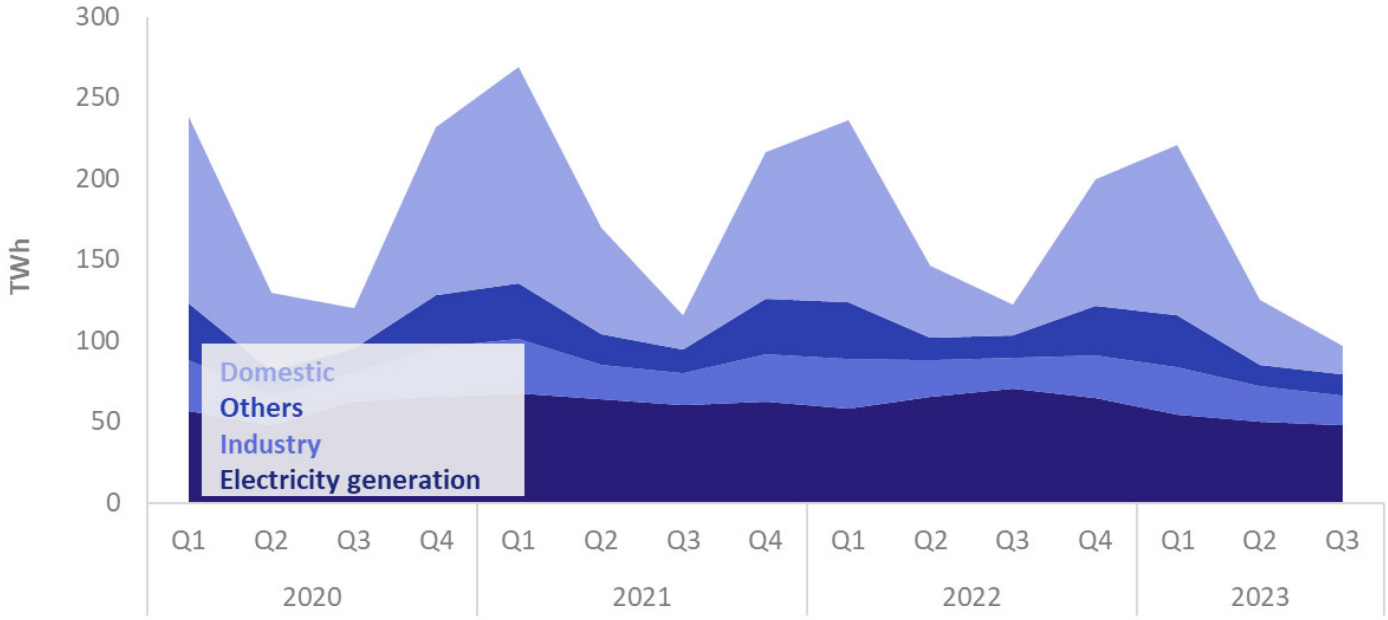
Key headlines

In Quarter 3 2023 gas demand reached a record low falling by one-fifth compared with the same period in the previous year. This was mainly driven by lower demand for electricity generation (a result of higher electricity imports over the quarter) but also lower consumption by final users. Consumption of gas by final consumers reached a record low overall and in the domestic and other final users' sectors. Given broadly similar temperatures, the fall in final consumption is likely a result of increased energy and other costs.

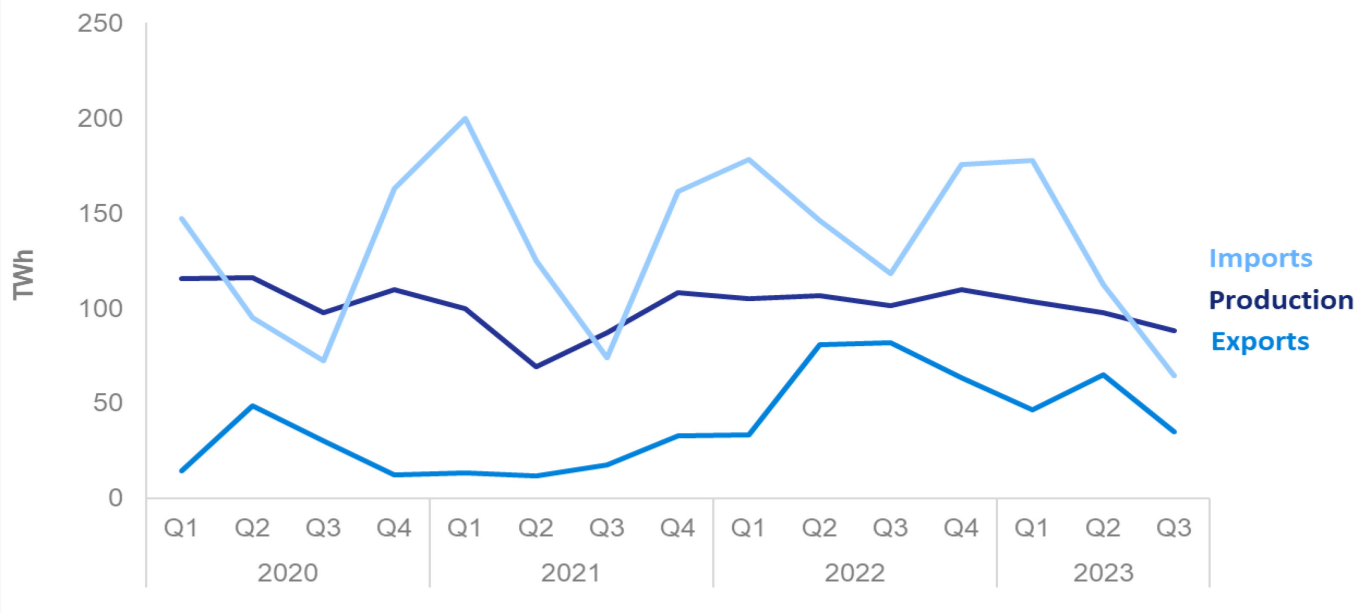
Imports and exports were down 46 and 57 per cent respectively compared to Quarter 3 2023 following record highs in 2022 when the UK supported European efforts to move away from Russian gas. The drop reflects decreases in both pipeline and Liquified Natural Gas (LNG) imports, including the three largest import sources Norway, Qatar and the US.

Chart 4.1 Demand for natural gas (Energy Trends Table 4.1)



Demand for natural gas reached a record low in Quarter 3 2023 at 113 TWh and down 20 per cent compared with Quarter 3 2022. This was largely due to a substantial fall in gas demand for UK electricity generation, down 32 per cent compared to the same period in 2022 as a result of increased imports of electricity (see Energy Trends Chapter 5 for more information). Final consumption was down 6.2 per cent also a record low, reflecting reduced demand for gas across all sectors. Demand by other final users (which is largely made up of commercial and public administration) was down 8.6 per cent compared to the same period in the previous year. Domestic (household) demand also dropped, by 7.8 per cent. Whilst temperatures for the quarter were broadly similar to last year, September was the warmest on record which likely impacted demand somewhat in addition to increased energy and other costs as temperatures (see Energy Trends Table 7.1). Demand from industry also fell, down 3.2 per cent in the same period.

Chart 4.2 Production and trade of natural gas (Energy Trends Table 4.2)



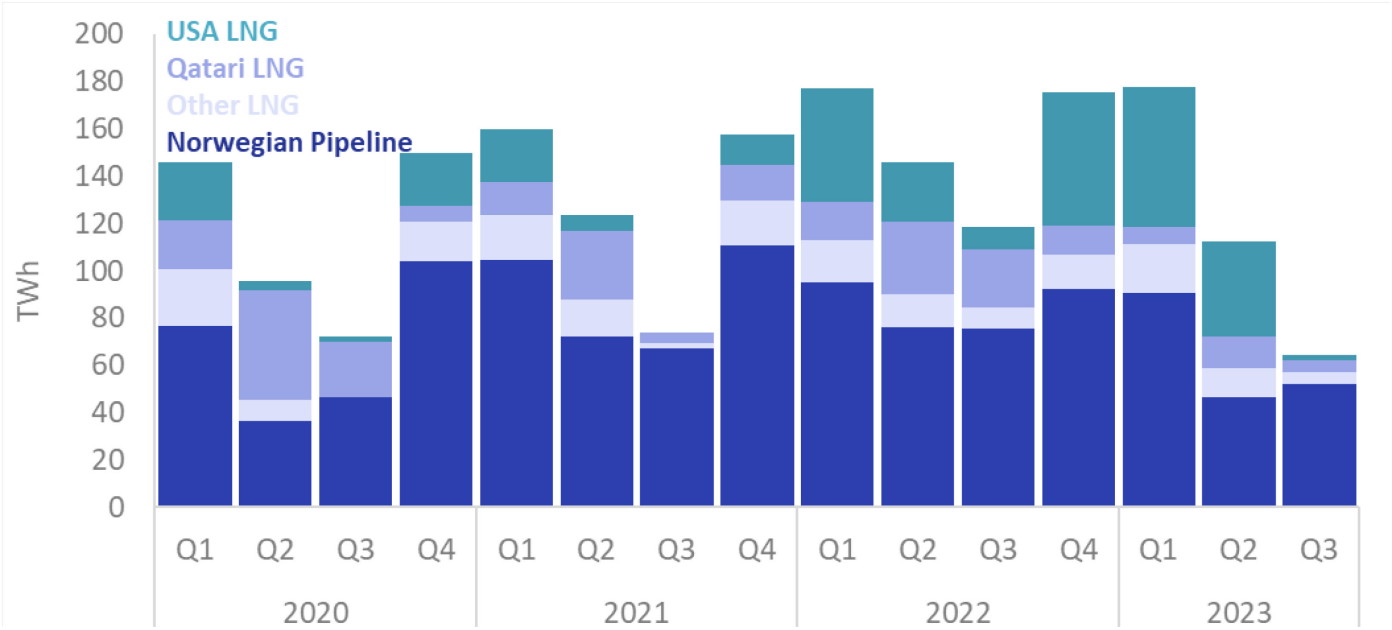
Exports of natural gas totalled 35 TWh in Quarter 3 2023, a 57 per cent decrease compared with the same period last year following consistently high exports throughout 2022 as the UK supported European efforts to move away from Russian gas. Reduced exports this year can also be attributed to lower demand in Europe due to reduced demand from final consumers[1] and as gas storage neared capacity ahead of winter. Despite this, exports in Quarter 3 2023 were still 14 per cent higher than average levels in the 5-year period between 2017-2021.

Imports were down 46 per cent compared to record highs in 2022 which facilitated the high exports. Imports were also down compared to the same period in 2021 (13 per cent) as demand fell more sharply than production less imports were required to make up supply.

Indigenous production continued to fall, down 13 per cent compared in Quarter 3 2023 compared to Quarter 3 2022 following reports of lowered investment in recent years.

[1] Eurostat

Chart 4.3 Trade in natural gas (Energy Trends Table 4.4)



Pipeline and LNG imports were down in Quarter 3 2023, compared to the same period last year. Pipeline imports, which all came from Norway, dropped by almost one-third compared with Quarter 3 2022, mainly due to Norwegian summer maintenance. Norway remained the largest imports source accounting for 70 per cent of total imports in Quarter 3 2023.

Imports of LNG decreased by almost three-quarters compared to the same period last year, which saw record highs. Imports of LNG from Qatar and the US were down by 80 and 77 per cent respectively. Peruvian imports dropped to zero, after previously totalling 13 per cent of LNG imports in the same period last year. 2022 saw record high LNG imports as UK regasification infrastructure meant it could operate as a 'land-bridge' exporting to Europe to support efforts to move away from Russian gas. In Quarter 3 2023 European storage began to reach capacity ahead of winter which alongside lower demand by final consumers in Europe (similar to that seen in the UK), imports of LNG returned to more typical levels for the time of year.

Section 5: Electricity

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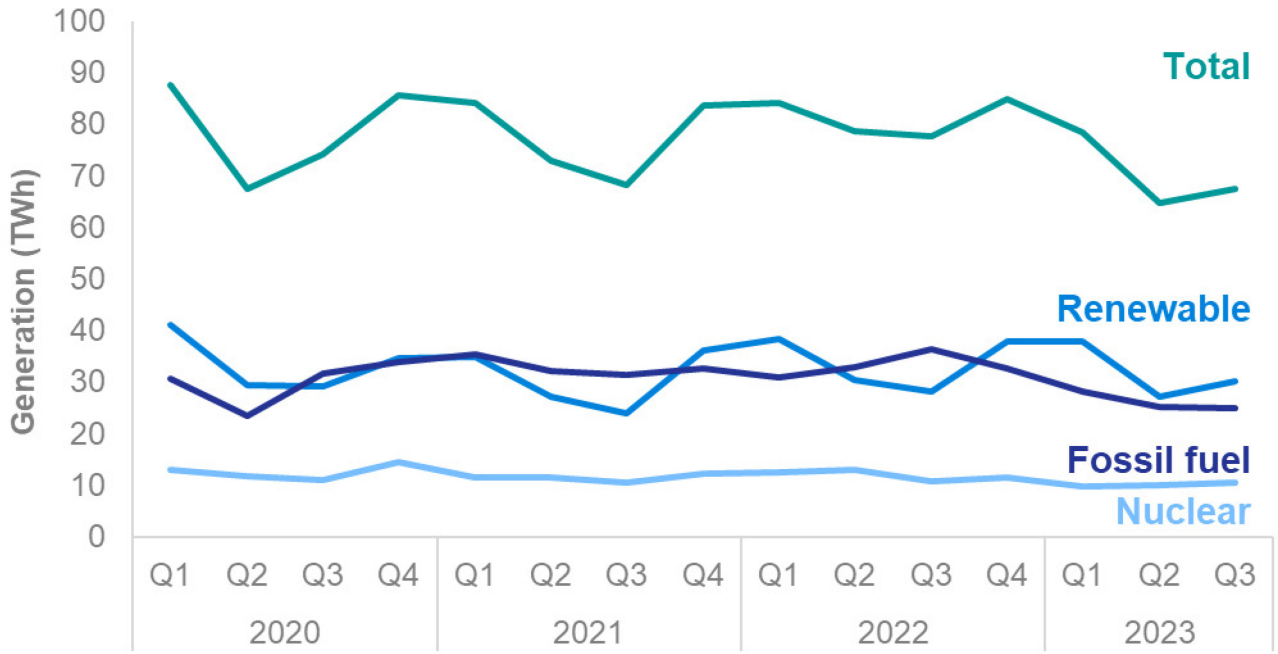
Key headlines

Electricity demand was 71.5 TWh in Quarter 3 2023, the lowest value on the published data series and a decrease of 1.9 per cent compared to the same period in 2022. **Electricity generation also decreased substantially, down 13 per cent to 67.5 TWh.** The difference was accounted for by net imports of 3.9 TWh, in contrast to Quarter 3 2022 when the UK was a net exporter of electricity.

Low carbon sources generated 60.1 per cent of the total in Quarter 3 2023, a 9.9 percentage point increase. This reflects higher renewable generation, up 6.8 per cent compared to the same period in 2022 at 30.1 TWh, driven by a large increase in generation from wind. Nuclear generation decreased by 2.9 per cent to 10.5 TWh in Quarter 3 2023 with outages at all but one nuclear plant during the quarter. **Fossil fuels generated 25.0 TWh in Quarter 3 2023, the third lowest quarterly value on the published data series** and 31 per cent lower than the same period the previous year.

Total consumption of electricity was 60.4 TWh in Quarter 3 2023. This was the lowest value on the published data series and a 3.4 per cent decrease compared to Quarter 3 of 2022. **Domestic consumption was also the lowest value on the published data series** as consumer costs remain high and September 2023 was unusually warm. Electricity consumed by the industrial sector decreased by 2.5 per cent compared to Quarter 3 2022, while consumption by other final users decreased by 4.3 per cent in Quarter 3 2023.

Chart 5.1 Electricity generated, by fuel type (Energy Trends Table 5.1)



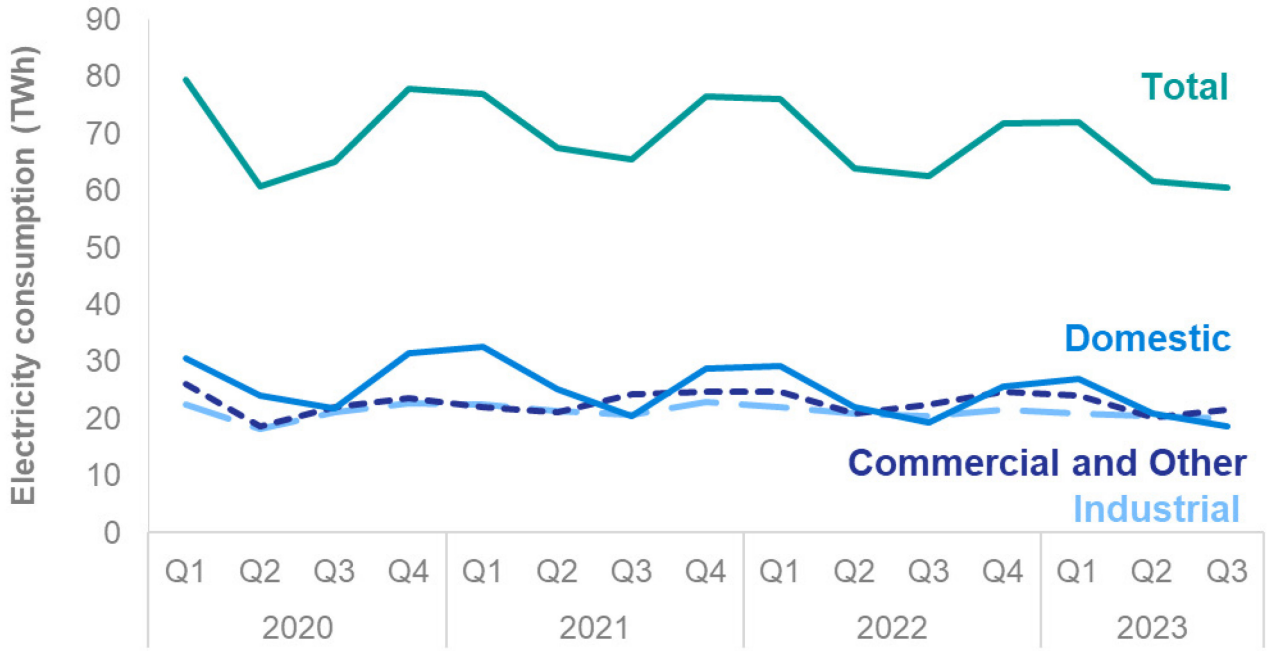
Quarter 3 of 2023 saw total electricity generation of 67.5 TWh, the third lowest quarterly value on the published data series and a 13 per cent decrease compared to Quarter 3 2022. Lower generation reflects lower demand for electricity within the UK but also changing patterns in electricity trade with other countries. In 2022, electricity exports reached record levels because of reduced nuclear output in France. In contrast, the UK was a net importer of electricity in Quarter 3 2023, reducing the need for UK-based generation.

Renewable electricity generation was 30.1 TWh in Quarter 3 2023, 6.8 per cent higher than the same period in 2022. This was driven by a large increase in generation from wind, up 23 per cent to 16.5 TWh, with increased capacity and higher average wind speeds. There was also a large percentage increase for hydro generation, up 37 per cent to 1.1 TWh. Other renewable technologies saw decreased generation, including a 15 per cent decrease for bioenergy, down to 7.9 TWh as outages continued at key bioenergy sites.

Low carbon sources generated 60.1 per cent of the total in Quarter 3 2023, a 9.9 percentage point increase. This reflects the higher renewable generation as nuclear generation decreased by 2.9 per cent to 10.5 TWh in Quarter 3 2023 with outages at all but one nuclear plant during the quarter.

Fossil fuels generated 25.0 TWh in Quarter 3 2023, the third lowest quarterly value on the published data series. This was a 31 per cent decrease compared to Quarter 3 2023 with lower demand for electricity and a greater proportion of demand met by net imports. Gas remained the fuel with the highest generation at 23.6 TWh, 31 per cent lower than in Quarter 3 2022 and equivalent to 35.0 per cent of generation. Coal generation was 0.7 TWh, 52 per cent lower than the same period in 2022 and representing a 1.0 per cent share of total generation. The closure of Kilroot in September 2023 left just one coal plant operating in the UK.

Chart 5.2 Electricity consumption by sector (Energy Trends Table 5.2)



Total consumption of electricity was 60.4 TWh in Quarter 3 2023. This was the lowest value on the published data series and a 3.4 per cent decrease compared to Quarter 3 of 2022. This is in line with the ongoing effects of increased consumer costs, including higher electricity prices, as well as weather conditions that were cooler in July and August, when heating tends to be minimal, but warmer in September.

Domestic consumption decreased 3.6 per cent compared to Quarter 3 2022 to the lowest value on the published data series. This reflects the warmer weather in September reducing the demand for electricity for heating as well as the continued pressure of relatively high energy and other prices restricting consumption.

Industrial consumption and consumption by other users also decreased in Quarter 3 2023. Electricity consumed by the industrial sector decreased by 2.5 per cent compared to Quarter 3 2022. Consumption by other final users (including the commercial sector) decreased by 4.3 per cent in Quarter 3 2023 compared to the same period in 2022, with the warmer temperatures in September reducing demand for heating.

Section 6: Renewables

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Key headlines

Renewable electricity generation was 30.1 TWh in Quarter 3 2023, 6.8 per cent higher than 2022 and a record for the third quarter of a year. Most of the increase was in wind generation driven by higher wind speeds and new onshore and offshore capacity. Solar PV generation was down slightly on 2022 with new capacity being offset by shorter average sunlight hours.

Over the last year, 2.9 GW of new renewable capacity has been added, a 5.4 per cent increase. The largest contribution to new capacity was in solar PV, which at 1.1 GW, is the highest for almost six years and continues to be driven by small scale installations. New capacity in offshore and onshore wind accounted for most of the remaining new capacity at 0.9 GW and 0.8 GW respectively.

Renewables' share of electricity generation was 44.5 per cent in Quarter 3 2023, up 8.2 percentage points on last year due to a combination of the increase in renewable generation and a fall in total generation (see section 5). The share of renewables has now outstripped fossil fuels' share for four consecutive quarters.

Chart 6.1 Change in renewable generation and capacity between Q3 2022 and Q3 2023 (Energy Trends Table 6.1)

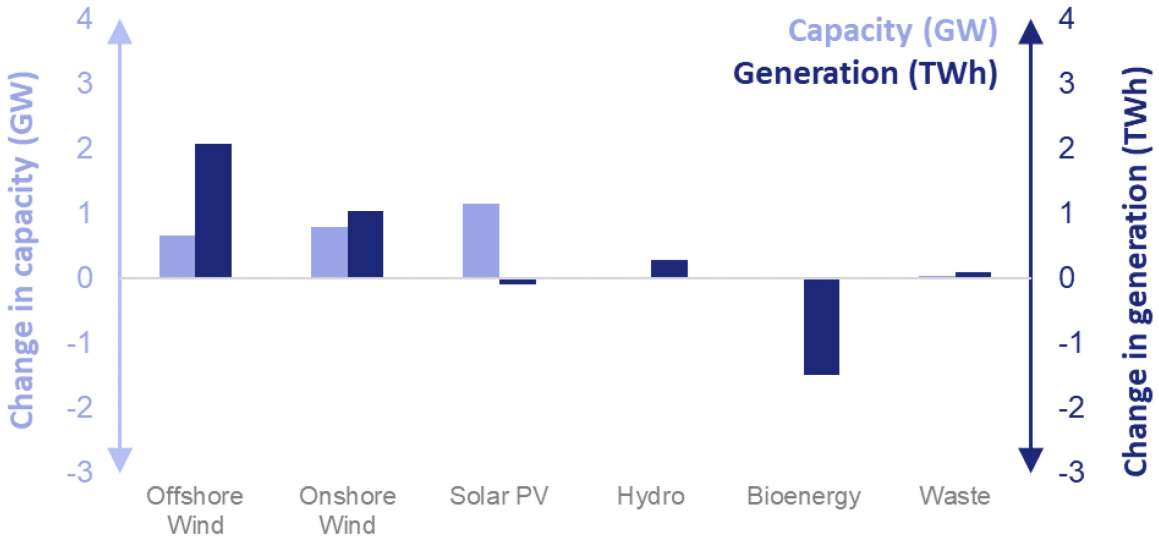


Chart 6.1 highlights the relatively higher generation growth in onshore and offshore wind compared to capacity growth, driven by the highest wind speeds for a third quarter since 2016. This has resulted in record wind generation for the third quarter. Conversely for solar PV, despite the largest increase in new capacity in absolute terms since Quarter 1 2017, lower sun hours supressed generation resulting in a small decrease. Bioenergy capacity is largely unchanged, but generation is down due to continuing outages at one major plant and a new outage at another. Indeed, since reaching a record high in Quarter 4 2021, generation from plant biomass has fallen by 39 per cent.

Chart 6.2 Added capacity during the year for the leading technologies (Energy Trends Table 6.1)

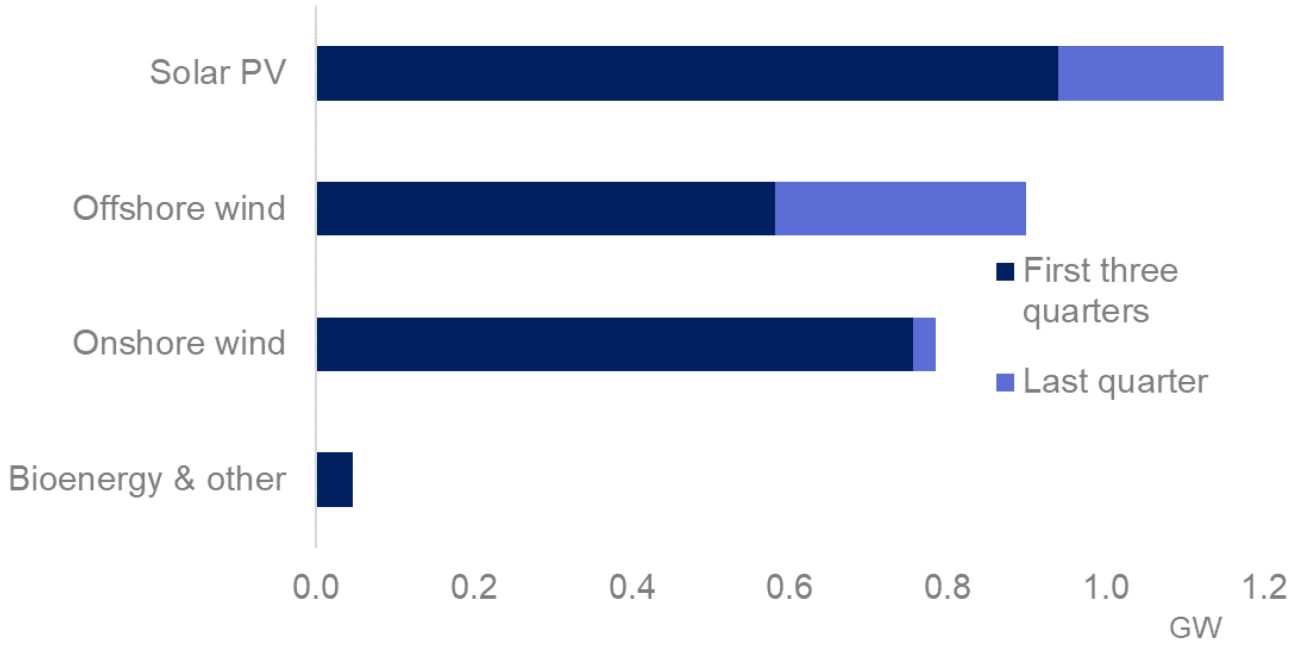
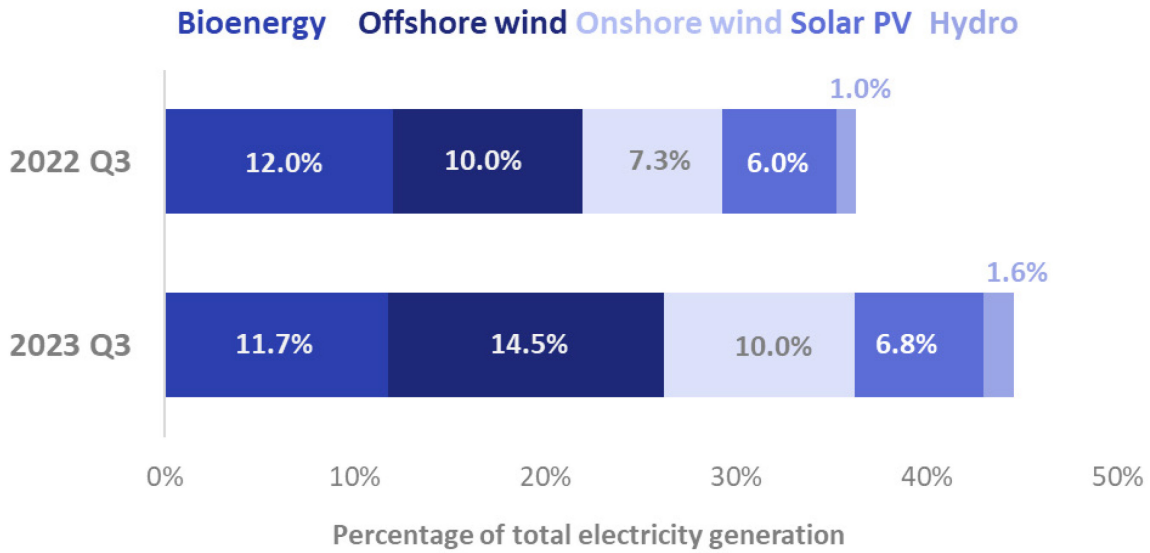


Chart 6.2 displays capacity added in the last 12 months, with the most recent quarter (July to September) shaded in light blue. It shows that new solar PV capacity added in Quarter 3 2023 was only marginally lower than the average for the three preceding quarters as it continues its recent strong growth in small scale installations; just over three quarters of this new capacity was accounted for by installations of 50 kW or less (for more details see the solar deployment tables here (opens in a new window)). Over a third of the new offshore wind capacity added during the year occurred during the latest quarter as Seagreen Offshore Wind Farm expanded its capacity by 316 MW. Other notable new capacity in the latest quarter includes two new sites, Ockendon Landfill Solar Farm (38 MW) and Greengairs East (onshore wind, 36 MW).

Chart 6.3 Renewables' share of electricity generation – Q3 2022 and Q3 2023 (Energy Trends Table 6.1



In Quarter 3 2023, renewables' share of generation was 44.5 per cent, 8.2 percentage points up on Quarter 3 2022 and higher than fossil fuels' share for the fourth consecutive quarter (see Chart 5.1).

Data tables and special articles

Data in this release

Data are collected by DESNZ through surveys of energy suppliers. This publication highlights key stories in energy in the UK for the specified period. Additional data are available in the quarterly and monthly statistical tables for each fuel and total energy. The tables are generally in commodity balance format, showing the flow from the sources of supply through to final use.

Special articles

Special articles that explore current topics of interest are available alongside this summary report. Included in this publication are:

Diversity and security of gas supply in Europe, 2022

Electricity generation and supply in Scotland, Wales, Northern Ireland and England, 2018 to 2022

Feed-in Tariff load factor analysis: 2022/23

Statistical tables*

Data tables available as part of the Energy Trends series:

Total energy
Solid fuels and derived gases
Oil and oil products
Gas
Electricity
Renewables

The full range of special articles is available here: https://www.gov.uk/government/collections/energy-trends-articles

Additional sources of information

Index of Production, published by the Office for National Statistics:
https://www.ons.gov.uk/economy/economicoutputandproductivity/output/bulletins/indexofproduction/previousReleases

Index of Services, published by the Office for National Statistics:
https://www.ons.gov.uk/economy/economicoutputandproductivity/output/bulletins/indexofservices/previousReleases

Detailed annual Digest of UK Energy Statistics:
https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Tables showing foreign trade flows of energy:
https://www.gov.uk/government/statistics/dukes-foreign-trade-statistics

Weather tables produced by DESNZ using Met Office data:
https://www.gov.uk/government/collections/weather-statistics

Information on Energy Prices:
https://www.gov.uk/government/collections/quarterly-energy-prices

*Hyperlinks will open the most recently published table. If you require a previously published version of a table, please contact DESNZ at: kevin.harris@energysecurity.gov.uk

Technical information

Methodology and revisions

More detailed notes on the methodology used to compile the figures and data sources are available on the collection pages for each fuel. The figures have not been adjusted for temperature or seasonal factors except where noted.

Percentage changes relate to the corresponding period a year ago. They are calculated from unrounded figures. They are shown as (+) or (-) when the percentage change is very large. Quarterly figures relate to calendar quarters. All figures relate to the United Kingdom unless otherwise indicated. Further information on Oil and Gas is available from the North Sea Transition Authority at https://www.nstauthority.co.uk/

Table of conversion factors

To	ktoe	TJ	GWh	million therms	To	toe	GJ	kWh	therms
From	Multiply by				**From**	Multiply by			
ktoe	1	41.868	11.63	0.39683	**toe**	1	41.868	11,630	396.83
TJ	0.023885	1	0.27778	0.0094778	**GJ**	0.023885	1	277.78	9.4778
GWh	0.085985	3.6	1	0.034121	**kWh**	0.000085985	0.0036	1	0.034121
million therms	2.52	105.51	29.307	1	**therms**	0.00252	0.105510	29.307	1

ktoe = thousand tonne of oil equivalent toe = tonne of oil equivalent

Sector breakdowns

Categories for final users are defined by Standard Industrial Classification 2007:

Fuel producers	05-07, 09, 19, 24.46, 35
Final consumers	
Iron and steel	24 (excluding 24.4, 24.53 and 24.54)
Other industry	08, 10-18, 20-23, 24.4 (excluding 24.46), 24.53, 24.54, 25-33, 36-39, 41-43
Transport	49-51 (part*)
Other final users	
Agriculture	01-03
Commercial	45-47, 49-51 (part*), 52-53, 55-56, 58-66, 68-75, 77-82
Public administration	84-88
Other services	90-99
Domestic	Not covered

* Note – transport sector includes only energy used for motion/traction purposes. Other energy used by transport companies is classified to the commercial sector.

Revisions policy

Figures for the latest periods are provisional and are liable to subsequent revision. The DESNZ statistical revisions policy sets out the revisions policy for these statistics, which has been developed in accordance with the UK Statistics Authority Code of Practice for Statistics.

Glossary

Tonne of Oil Equivalent

A common unit of measurement which enables different fuels to be compared and aggregated, and equal to 41.868 gigajoules. Usually expressed in Trends as ktoe (Thousand tonnes of oil equivalent) or Mtoe (Million tonnes of oil equivalent).

Indigenous production

The extraction or capture of primary fuels: for oil this includes production from the UK Continental Shelf, both onshore and offshore. Production by fuel is shown in Table 1.1. As with all data in Tables 1.1 to 1.3, these data are presented in either Million tonnes of oil equivalent or Thousand tonnes of oil equivalent. Various conventions are involved in the presentation of these data (e.g. for nuclear production the energy input is the heat content of the steam leaving the reactor) and these conventions are detailed in the Table notes and methodology documents (see link at end of glossary).

Primary supply

Primary supply is the sum of production, other sources, imports (+), exports (-), stock change, marine bunkers and transfers. A breakdown of supply by fuel is shown in Table 1.3.

Primary demand

Primary demand is the sum of the transformation, energy industry use, losses and final energy consumption by the industry sectors including non-energy use. A breakdown of demand by fuel is shown in Table 1.3.

Primary inland energy consumption

The sum of primary supply less non-energy use (Table 1.2).

Final energy consumption

Energy consumption by final user, i.e., which is not being used for transformation into other forms of energy. Final energy consumption is shown by sector and for individual fuels in Table 1.3.

Non-energy use

Includes fuel used for chemical feedstock, solvents, lubricants, and road making material, see Table 3.2.

Imports

Goods entering the UK, e.g. via pipeline from Norway or LNG cargoes from Qatar and the US for gas (Table 4.3) and interconnectors for electricity from The Netherlands (Table 5.6).

Exports

Goods leaving the UK, e.g. via LNG regassification cargoes to Europe for gas (Table 4.3) and interconnectors for electricity to France (Table 5.6).

Transformation

Transformation covers those activities that transform fuels into a form which is better suited for specific uses. Most of the transformation activities correspond to particular energy industries whose main business is to manufacture the product associated with them. Certain activities involve transformation to make products that are only partly used for energy needs (e.g. coke and oven coke) or are by-products of other manufacturing processes (e.g. coke oven and blast furnace gases). A breakdown of transformation by fuel is shown in Table 1.3.

Seasonally and temperature adjustment

The temperature corrected series of total inland fuel consumption, Table 1.2 indicates what annual consumption might have been if the average temperature during the year had been the same as the average for the years 1991 to 2020. Table 1.3 shows seasonal and temperature adjusted final consumption.

Primary oil

Crude oil, natural gas liquids and feedstocks. (Table 3.1)

Petroleum products

Motor spirit, diesel, gas oil, aviation turbine fuel, fuel oils, petroleum gases, burning oil and other products. (Table 3.4)

Transport fuels

Motor spirit and diesel for road and aviation turbine fuel for aviation. (Table 3.4)

Electricity generation

Electricity generation represents the quantities of fuels burned for the generation of electricity. The activity is divided into two parts, covering the Major Power Producers such as those generating electricity for sale, as their main business activity, and autogenerators such as those generating electricity for their own needs but who may also sell surplus quantities (Table 5.1).

Fossil fuels

Coal, oil and natural gas. The percentage share of electricity generation by fossil fuels is shown in Table 5.1.

Renewables

Renewable energy includes solar power, wind, wave, tidal, hydroelectricity, and bioenergy. Solid biomass includes wood and wood pellets, straw, short rotation coppice, and the biodegradable component of wastes (the non-biodegradable component is shown as a memo item in Table 6.1). Liquid biofuels include bio diesel and bioethanol, along with new and emerging fuels such as bio LPG (liquified petroleum gas). Biogases include landfill gas, sewage gas, and anaerobic digestion. The percentage share of electricity generation by renewables is shown in Table 5.1.

Low carbon

Nuclear and renewables. The percentage share of electricity generation by low carbon sources is shown in Table 5.1.

Additional information

A more detailed glossary is available in The Digest of United Kingdom Energy Statistics (DUKES), Annex B, whilst the energy balance methodology note provides background detail on the compilation of an energy balance, as well as an explanation of each of the key energy balance flows. Notes in individual Energy Trends tables provide further detail.

Related publications

Recent publications of interest

Smart Meters
Statistics on the roll-out of Smart Meters in Great Britain, covering meters operating and meters installed: www.gov.uk/government/collections/smart-meters-statistics

Household Energy Efficiency
Statistics on the Energy Company Obligation (ECO), Green Deal and homes insulated. Monthly updates of ECO measures and quarterly updates of in-depth ECO statistics, carbon savings and the Green Deal schemes: www.gov.uk/government/collections/household-energy-efficiency-national-statistics

Renewable Heat Incentive
Statistics on deployment data for the domestic and non-domestic Renewable Heat Incentive (RHI) to support the uptake of renewable heat: www.gov.uk/government/collections/renewable-heat-incentive-statistics

Energy Consumption in the United Kingdom (ECUK)
Detailed data on end use estimates of energy in the UK: www.gov.uk/government/collections/energy-consumption-in-the-uk

Sub-national total final energy consumption
Findings of the sub–national energy consumption analysis in the UK for all fuels, for the period covering 1 January to 31 December, with gas consumption covering the annual period from mid-May: www.gov.uk/government/collections/total-final-energy-consumption-at-sub-national-level

Sub-national electricity consumption
Electricity consumption by consuming sector for Great Britain and devolved administration areas. Data are based on the aggregation of Meter Point Administration Number readings as part of DESNZ's annual meter point electricity data exercise: www.gov.uk/government/collections/sub-national-electricity-consumption-data.

Sub-national gas consumption
Gas consumption by consuming sector for Great Britain, and devolved administration areas. Data are based on the aggregation of Meter Point Reference Number readings throughout Great Britain as part of DESNZ's annual meter point gas data exercise. Data are subject to a weather correction factor to enable comparison of gas use over time: www.gov.uk/government/collections/sub-national-gas-consumption-data.

Sub-national road transport consumption
Road transport fuels consumption in the UK at regional and local authority level. Data is modelled and provided to DESNZ by Ricardo Energy & Environment, with estimates based on where the fuel is consumed, rather than where it is purchased.
www.gov.uk/government/collections/road-transport-consumption-at-regional-and-local-level

Sub-national consumption of residual fuels
Non-gas, non-electricity and non-road transport fuels consumption in the UK. Includes coal, petroleum, solid fuels, and bioenergy not for generation or road use: www.gov.uk/government/collections/sub-national-consumption-of-other-fuels

Further information

National Statistics

National Statistics are accredited official statistics. Accredited official statistics are called National Statistics in the Statistics and Registration Service Act 2007.

These accredited official statistics were independently reviewed by the Office for Statistics Regulation (OSR) in June 2014. They comply with the standards of trustworthiness, quality and value in the Code of Practice for Statistics and should be labelled 'accredited official statistics'.

Our statistical practice is regulated by the Office for Statistics Regulation.

OSR sets the standards of trustworthiness, quality and value in the Code of Practice for Statistics that all producers of official statistics should adhere to.

You are welcome to contact us by emailing energy.stats@energysecurity.gov.uk with any comments about how we meet these standards.

Alternatively, you can contact OSR by emailing regulation@statistics.gov.uk or via the OSR website.

Pre-release

Some ministers and officials receive access to these statistics up to 24 hours before release. Details of the arrangements for doing this and a list of the ministers and officials that receive pre-release access to these statistics can be found in the DESNZ statement of compliance with the Pre-Release Access to Official Statistics Order 2008.

User engagement

Users are encouraged to provide comments and feedback on how these statistics are used and how well they meet user needs. Comments on any issues relating to this statistical release are welcomed.

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Diversity and security of gas supply in Europe, 2022

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Key headlines

The Russian invasion of Ukraine and subsequent sanctions announcements saw significant shifts in European gas trade patterns in 2022. This included a substantial increase in European imports of Liquified Natural Gas (LNG) which made up 22 per cent of gross supply in 2022 compared to 13 per cent in 2021.

Imports of LNG from the US to Europe and the UK tripled with imports of LNG over double those of the second largest source, Qatar. Increased imports of LNG to the UK saw regasification infrastructure utilised to support European efforts to move away from Russian gas. As a result, the UK saw record high imports and exports in 2022.

Demand for natural gas fell as a result of warm temperatures, high costs and policies targeted at reducing natural gas consumption in light of Russia-Ukraine. Demand in the UK fell less than on the continent, down 8 per cent compared to 12 per cent for Europe, the result of record high temperatures, costs and record renewable output.

Indigenous production of natural gas in Norway fell on 2021 but remained substantial as Norway continues to be one of the largest producers of gas globally and the largest producer of natural gas in Europe. Indigenous production in the UK was up in 2022 compared to 2021 which saw record lows due to maintenance.

Background

In Europe and the UK, demand for natural gas is met through indigenous production and imports. In 2022, indigenous production was equivalent to 43 and 54 per cent of demand in Europe and the UK respectively. The remainder was met through imports, which arrive via pipeline or as shipments of Liquefied Natural Gas (LNG).

This article assesses the diversity and security of gas supply in Europe and the UK. Data for Europe used in this article were sourced from the International Energy Agency (IEA), and as such only reflect IEA member states. Whilst this includes the majority of Europe, Andorra, Kosovo, Liechtenstein, Monaco, San Marino, and Vatican City are not included. Cyprus, Iceland, and Montenegro are not included as they did not produce or consume natural gas in 2022. In this analysis Russia is not considered part of Europe.

Methods

This article uses three indicators to analyse the diversity and security of natural gas supply.

Self-sufficiency reflects a country's ability to meet natural gas demand through indigenous production alone. This is calculated by dividing the volume of indigenous production by demand. Countries with a self-sufficiency score of 0 did not product natural gas; countries with a score greater than 0 and less than 1 meet some demand through imports; countries with a score of 1 produced as much gas as was used; and countries with a score greater than 1 produced more gas than was used. A high self-sufficiency score means natural gas supply is likely to be more secure.

Diversity index measures the number of import sources for a given country, weighted by each source country's reported political stability[1]. This means that a country with many import sources of high political stability will have a high diversity index. Conversely, a country with few import sources of low political stability

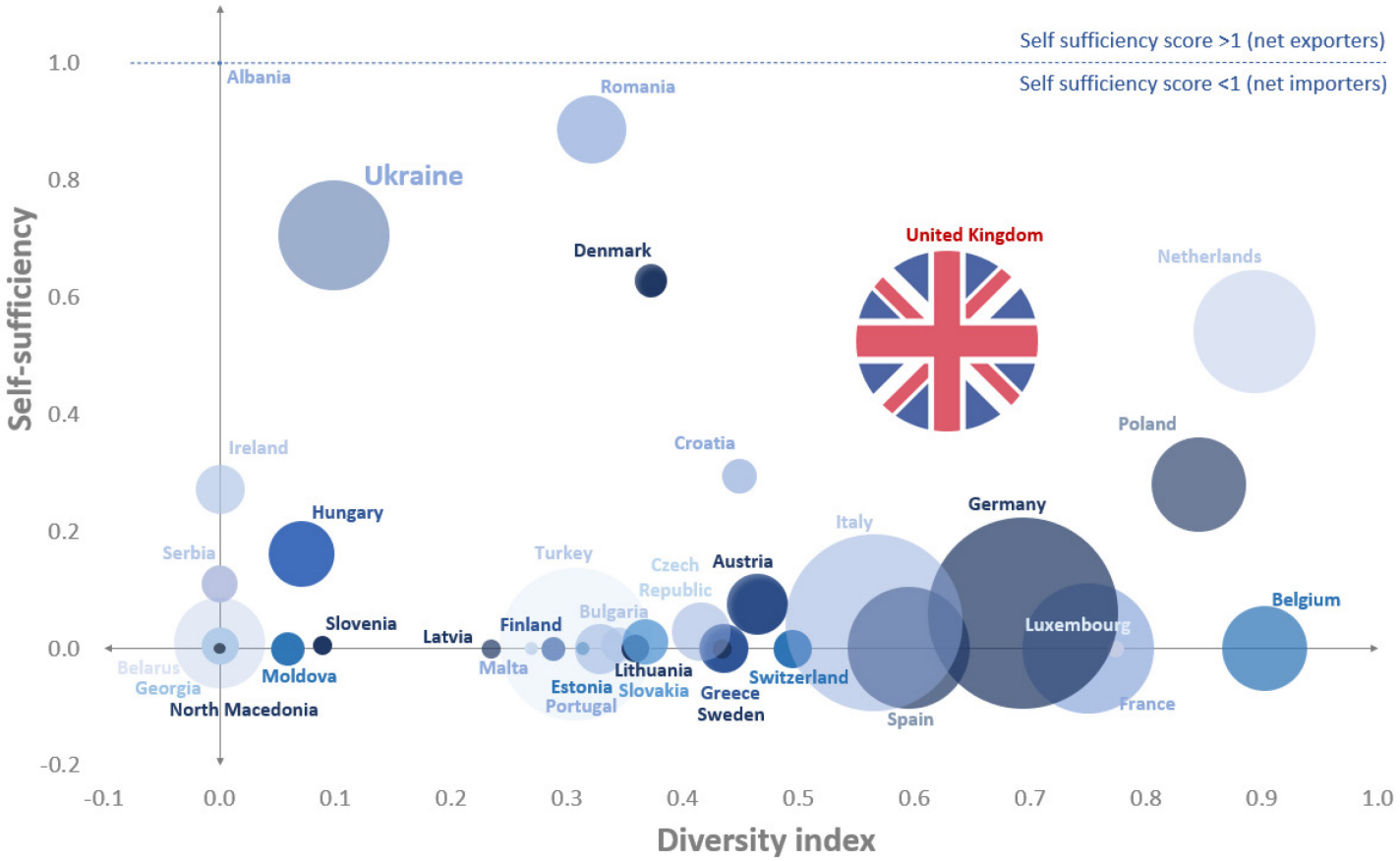
[1] Data sourced from World Bank governance indicators. See Appendix 1 for underlying data and Appendix 2 for method.

will have a low diversity index. In general, a diverse source of imports means gas supply is more secure. This is further improved if the source countries are politically stable.

Supply index calculates the sum of a country's self-sufficiency score and diversity index score. This is a simple indication of security of supply. A supply index of 0 indicates that a country has no indigenous production and only one import source.

Security and diversity of gas supply in UK and Europe

Chart 1: Self-sufficiency and diversity index for European countries, 2022



Norway has a diversity index of 0.54 and a self-sufficiency of 18.34 so has been excluded from the graph as it is substantially larger than the other countries, see Appendix 1 for underlying data

Chart 1 shows the relationship between a country's self-sufficiency score and diversity index. The size of each bubble equates to the natural gas demand in each European country.

Self-sufficiency

Norway and Albania met their demand for natural gas with indigenous production alone in 2022, making them self-sufficient. Norway is the largest producer of natural gas in Europe, and in the top 10 globally; in 2022, Norway produced more than 18 times more natural gas than it consumed, accounting for 55 per cent of total European natural gas production. Other European countries are not large producers of natural gas which is reflected by an average self-sufficiency score of 0.15 for European countries (excluding Norway). This means on average just 15 per cent of gas demand is met by indigenous production. Of European countries who consume natural gas Albania is the smallest, producing the same amount that it consumed in 2022.

The UK had a self-sufficiency score of 0.54 meaning it produced the equivalent to just over half the gas it consumed in 2022. In the UK, indigenous production has been equivalent to around half of demand for over a decade, reaching 54 per cent in 2022 due to notably low demand, and up on 2021 when production reached a record low due to planned maintenance of North Sea infrastructure including the Forties Pipeline System (FPS).

Of the 39 countries included in this analysis, 13 had a self-sufficiency score of 0 meaning they didn't produce any gas and were reliant on imports to meet supply.

Diversity

Most countries use imports to meet demand. In 2022, the average diversity index of European countries was 0.35. The proximity of Western European countries to the sea facilitates shipments of LNG from a wider range of countries than would be possible with pipelines alone, which contributes to their tendency to have higher diversity indexes. In contrast, Poland rose from seventh to fourth place in 2022 as a result of importing record high volumes of LNG in response to Russia's invasion of Ukraine; the US accounted for the majority of these imports, but Poland also imported from an additional 8 countries in 2022 compared with 2021.

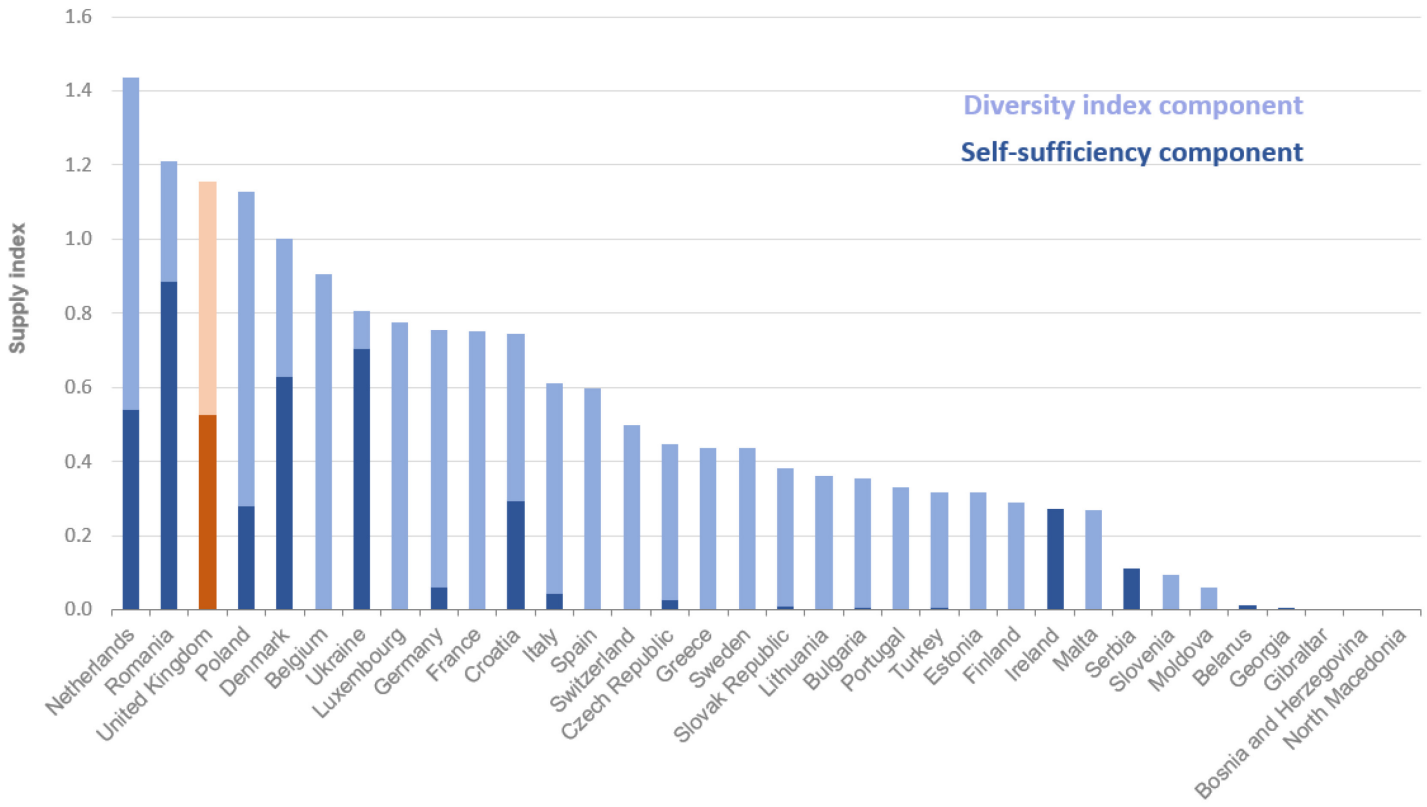
In 2022, the UK's diversity score was 0.63 reflecting a large number of import sources some of which are very politically stable.

Demand

Germany was the largest consumer of natural gas in Europe, consuming 80 bcm in 2022. This was followed by the UK (72 bcm), Italy (69 bcm) and Turkey (51 bcm). In 2022, these four countries accounted for half of total European natural gas demand. Demand for natural gas decreased throughout Europe in 2022, down 12 per cent on 2021. Declines were seen in 85 per cent of European countries as a result of warmer temperatures but also higher gas and other prices and new policies aimed at reducing gas consumption in light of Russia-Ukraine. UK gas demand decreased by 7.9 per cent in 2022 compared with 2021, due to the warmest year on record, higher prices impacting consumer behaviour, and record renewable output.

Some large consumers of natural gas sit in the bottom right quadrant of Chart 1 reflecting a high diversity index but low self-sufficiency relative to demand.

Chart 2: Supply index for European countries, 2022



Norway has a supply index of 18.9 so has been excluded from this graph as it is substantially larger than the other countries, see Appendix 1 for underlying data

Chart 2 shows the supply index for European countries in 2022. The self-sufficiency score and diversity index have been stacked, indicating the relative contribution of these components to the security of supply ranking.

Supply index

In 2022, Norway had the highest supply index of European countries at 18.9. This is significantly higher than the median score of 0.43 due significant indigenous production. The average European supply index is 0.97 which falls to 0.50 when excluding Norway, reflecting most countries' reliance on imports to meet demand. Thirteen countries produced no natural gas, so their supply index equalled their diversity index. Of these countries, Bosnia and Herzegovina, Gibraltar and North Macedonia had only one import source, resulting in a supply index of zero.

With a supply index of 1.15, the UK had the fourth highest European supply index, behind Norway, the Netherlands and Romania. The UK is Europe's second largest producer of natural gas; however it is substantially smaller than Norway, producing 71 per cent less gas than Norway in 2022.

European gas supply

The majority of European natural gas imports arrive via pipeline as infrastructure is well-established. In 2022, imports by pipeline made up 69 and 55 per cent of total imports to Europe and the UK respectively. Pipeline infrastructure means it is often convenient to import gas from neighbouring countries. Countries can also import natural gas as shipments of LNG which is gas that has been cooled to a liquefied state, making it easier to store and transport. It can then be re-gasified at import terminals, before being transferred to the pipeline system. The UK has the second largest LNG regasification infrastructure in Europe, behind Spain, with three import terminals - Dragon, the Isle of Grain and South Hook[2].

Chart 3: Sources of European gross gas supply, 2022

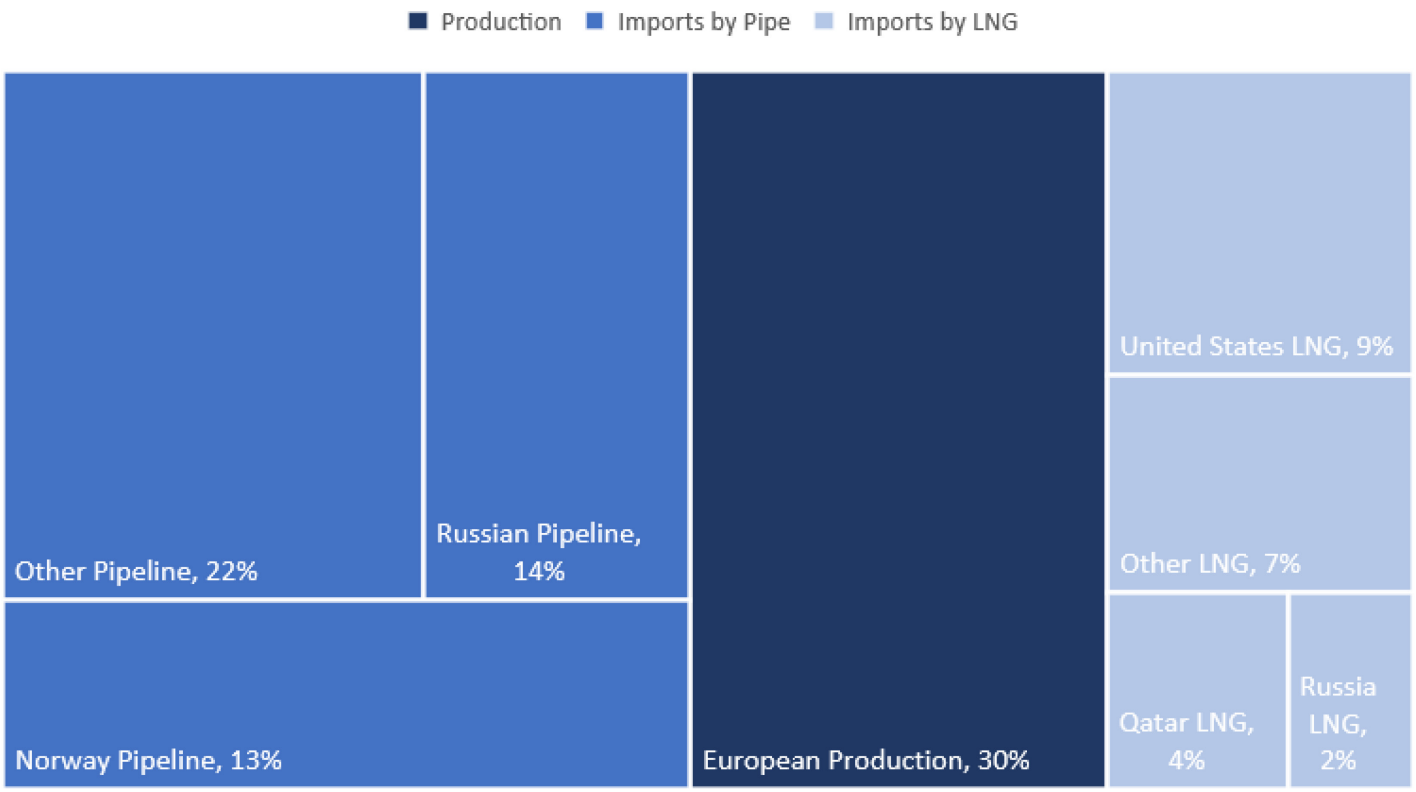


Chart 3 shows European gas supply sources in 2022, see Appendix 1 for a breakdown of other.

Following the Russian invasion of Ukraine in February 2022, many countries including all EU countries and the UK sanctioned Russian imports of natural gas. Whilst these sanctions did not come into effect until the end of

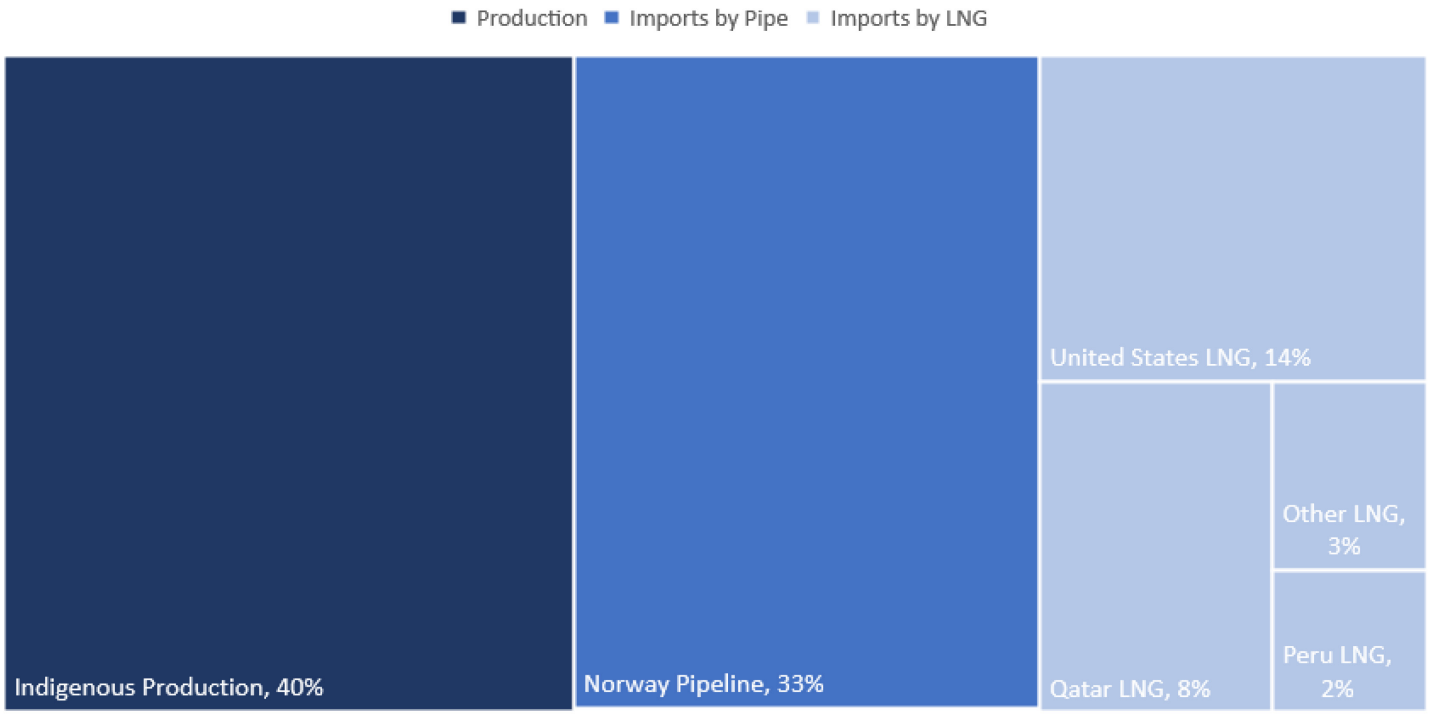
[2] For more information on LNG please see Supply of Liquified Natural Gas in the UK, this will be updated with data for 2023 in March 2024

the year, shifting trade patterns and industry self-sanctioning was observed from the Spring. Despite this, pipeline imports from Russia[3] remained the largest import source to European countries accounting for 14 per cent of gross supply, down from 24 per cent in 2021. The shortfall was made up by increased pipeline imports which increased by 20 per cent in 2022 compared to 2021; and increased imports of LNG which made up 22 per cent of gross supply in 2022 compared to 13 per cent in 2021.

In 2022, the US was the largest source of LNG imports to Europe making up 42 per cent of total LNG imports, compared to 27 per cent in 2021. Qatar was the second largest source of LNG, making up 16 per cent of the total, down from 23 per cent in 2021. This follows increased liquification capacity in the US and Qatar primarily focusing on long-term supplies to the Asian market. In total, European countries imported LNG from 34 different countries in 2022. Egypt, Angola and Norway joined the top ten LNG exporters to Europe in 2022.

Pipeline imports to Europe from the UK more than tripled in 2022 compared to 2021. UK LNG regasification infrastructure was utilised to support European efforts to move away from Russian gas, with imports of LNG to the UK increasing by 74 per cent in 2022. Once re-gasified, pipeline infrastructure meant these imports could be exported to the mainland allowing the UK to operate as a 'land bridge' for imports of LNG. 2022 also saw a large increase in pipeline imports from Azerbaijan to Europe, rising from the eighth largest pipeline import source to the fourth.

Chart 4: Sources of UK gross gas supply, 2022



Similar to Chart 3, Chart 4 shows gas supply sources for the UK in 2022.

In 2022, indigenous production in the UK increased by 16 per cent following record lows in 2021. Production was just below pre-pandemic levels, down 17 per cent compared to 2019.

The UK saw substantial shifts in trade patterns following Russia's illegal invasion of Ukraine. Exports tripled in 2022 compared to 2021, reaching a record high. Imports also reached a record high, up 10 per cent, and driven by a significant increase in imports of LNG, up 74 per cent in the same period. Norway remained the UK's largest import source, accounting for 33 per cent of gross supply. Norway accounted for more than 99 per cent of all pipeline imports to the UK in 2022 as Belgian and Dutch interconnectors were mainly used for exports.

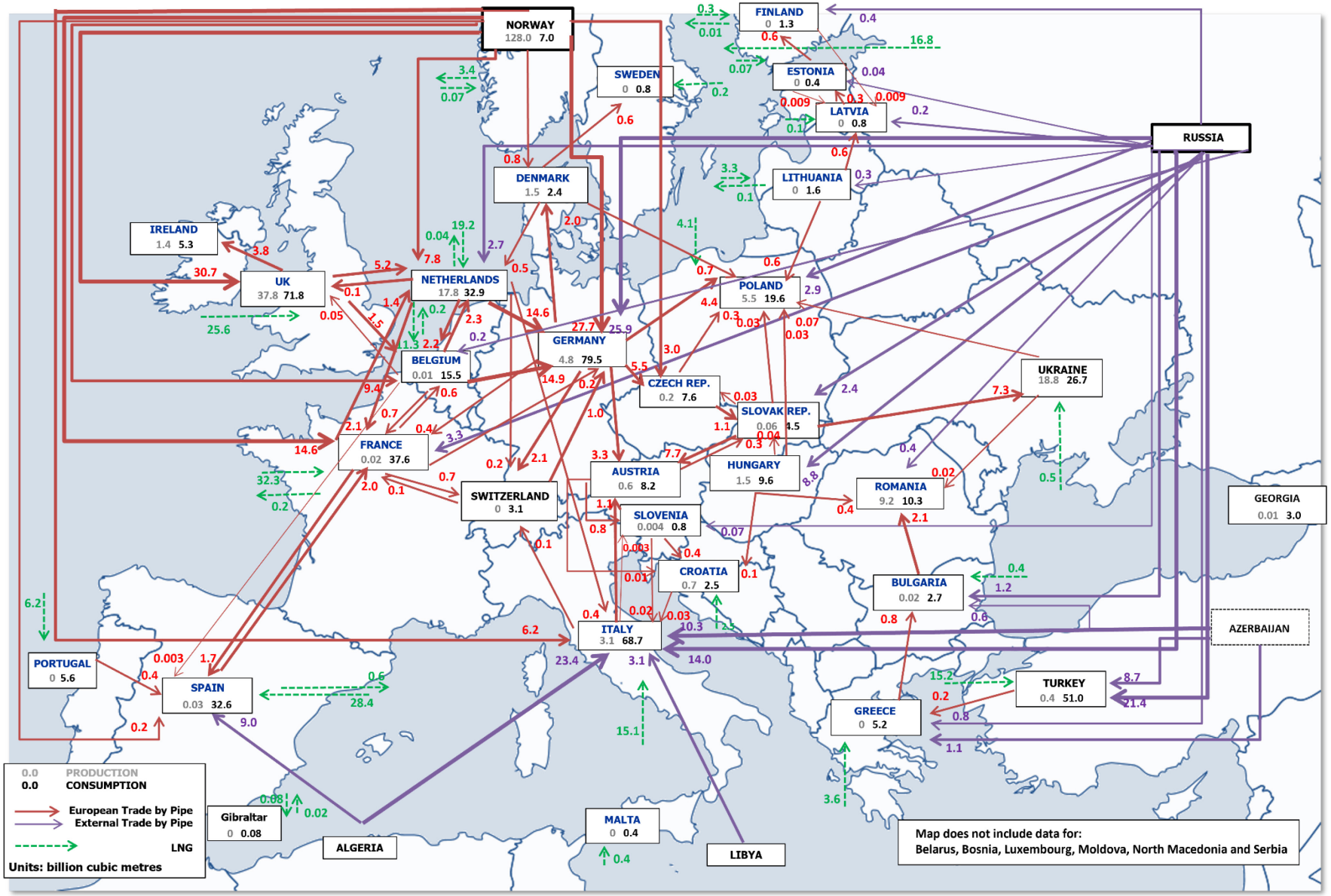
[3] Russia acts as a transit country for gas from Kazakhstan and Turkmenistan, so it should be noted that the origin of this gas is not necessarily all Russian.

Imports of LNG from the US tripled in 2022, accounting for 50 per cent of total LNG imports and making it the largest source of LNG to the UK for the first time, overtaking Qatar. LNG from the US has been increasing considerably since the first import in 2017. Recent provisional data up to October 2023 indicates that so far in 2023, US LNG imports have accounted for almost 60 per cent of total LNG imports (see Energy Trends Table 4.4 for further information). In 2022, Qatari LNG imports accounted for 30 per cent of total LNG imports and despite being the second largest source, this was the lowest proportion seen in over a decade. In total, the UK sourced LNG from 13 different countries in 2022, up from 8 in 2021.

Following sanction announcements and industry self-sanctioning, the last cargo of Russian LNG imported to the UK was received in March 2022, which made up 1.2 per cent of gross supply.

Map 1:

Map 1 illustrates the diversity of import supply, as well as the complexities of inter-EU gas trade.



Appendix 1: Underlying data for charts

Table 1: Underlying data for Chart 1 and Chart 2

Country	Self-sufficiency	Diversity index	Supply index	Demand (mcm)
Albania	1.00	0.00	1.00	49
Austria	0.08	0.46	0.54	8,175
Belarus	0.01	0.00	0.01	18,272
Belgium	0.00	0.90	0.90	15,539
Bosnia and Herzegovina	0.00	0.00	0.00	244
Bulgaria	0.01	0.34	0.35	2,747
Croatia	0.29	0.45	0.74	2,531
Czech Republic	0.03	0.42	0.44	7,604
Denmark	0.63	0.37	1.00	2,388
Estonia	0.00	0.31	0.31	353
Finland	0.00	0.29	0.29	1,294
France	0.00	0.75	0.75	37,578
Georgia	0.00	0.00	0.00	3,038
Germany	0.06	0.69	0.75	79,540
Gibraltar	0.00	0.00	0.00	82
Greece	0.00	0.44	0.44	5,171
Hungary	0.16	0.07	0.23	9,575
Ireland	0.27	0.00	0.27	5,286
Italy	0.05	0.57	0.61	68,737
Latvia	0.00	0.23	0.23	843
Lithuania	0.00	0.36	0.36	1,598
Luxembourg	0.00	0.77	0.77	593
Malta	0.00	0.27	0.27	384
Netherlands	0.54	0.89	1.44	32,929
Norway	18.34	0.54	18.88	6,984
Poland	0.28	0.85	1.13	19,569
Portugal	0.00	0.33	0.33	5,580
Republic of Moldova	0.00	0.06	0.06	2,482
Republic of North Macedonia	0.00	0.00	0.00	276
Turkey	0.01	0.31	0.31	51,041
Romania	0.89	0.32	1.21	10,353
Serbia	0.11	0.00	0.11	2,960
Slovak Republic	0.01	0.37	0.38	4,548
Slovenia	0.01	0.09	0.09	840
Spain	0.00	0.59	0.60	32,583
Sweden	0.00	0.43	0.43	775
Switzerland	0.00	0.49	0.49	3,134
Ukraine	0.71	0.10	0.81	26,662
United Kingdom	0.53	0.63	1.15	71,785
Average	**0.62**	**0.35**	**0.97**	**13,952**

Source: IEA (http://data.iea.org/)

Countries included in 'Other Pipeline' in Chart 3: Algeria, Azerbaijan, Netherlands, Belgium, Germany, Slovak Republic, United Kingdom, Iran, France, Libya, Ukraine, Bulgaria, Spain, Denmark, Czech Republic, Italy, Lithuania, Switzerland, Austria, Greece, Estonia, Hungary, Portugal, Slovenia, Latvia, Turkey, Croatia, Moldova, Finland, Romania.

Countries included in 'Other LNG' in Chart 3: Algeria, Nigeria, Egypt, Angola, Trinidad and Tobago, Norway, Peru, Equitorial Guinea, Cameroon, Oman, Spain, France, Australia, Indonesia, Lithuania, China, Chile, Mozambique, Netherlands, Gibraltar, Belgium, South Korea, Jamaica, Finland, Malaysia, Sweden, Estonia, Germany, Hungary, Italy.

Countries included in 'Other LNG' in Chart 4: Angola, Algeria, Nigeria, Russia, Norway, Trinidad and Tobago, Egypt, Spain, Chile, Oman.

Appendix 2: Methodology

Self-sufficiency

Data for natural gas was extracted from the IEA database. Self-sufficiency was determined from data on indigenous production and demand (indigenous production (mcm) ÷ demand (mcm)).

Diversity index

The diversity index used here is a product of a standard diversity index and an index for political stability. As a basic index for measuring diversity, we used the Shannon-Wiener diversity index:

$$\sum_{i=1}^{n} -x_i ln(x_i)$$

Where x is the proportion of total natural gas supply represented by the i^{th} source country and n represents the final source country. A value below 1 signifies a country that is dependent on a small range of import sources, a value above 1 represents a country with a wider range of import sources. The minimum value of zero denotes a country that has one imported fuel source or relies entirely on indigenous production (or a country with no imports). The Shannon-Wiener was chosen here because it places weight on the diversity of contributions from smaller countries and reduces the impact of larger nations.

Political stability was determined using data from the World Bank worldwide governance indicators. Specifically, the index reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism. These data were standardised between 0 and 1.

Source: World Bank http://info.worldbank.org/governance/wgi/index.aspx#home

Shannon-Wiener and political stability indices were multiplied and summed:

$$\sum_{i=1}^{n} -x_i ln(x_i) b_i$$

Where b is an index of political stability of producing country. This is called the SWNI (Shannon-Weiner-Neumann index), in line with previous work. Each SWNI index was normalised between 0 and 1, in order to have a standardised index. This was done by working out a maximum diversity score, by assuming maximum diversity was equivalent to importing products in line with proportional contributions of exporting countries (e.g. if a single country were responsible for exporting 50 per cent of all natural gas, and five other countries were responsible for 10 per cent each, we assumed maximum import diversity at a ratio of 5:1:1:1:1:1). This maximum diversity score then acted as our upper score of 1, with all other scores divided by this maximum to standardise the data.

Other sources of gas

Sometimes, due to a variety of reasons, countries may report an import of natural gas from a “Non-Specified/ Other” source country. Border Point Data was used to reallocate imports for Austria, Czech Republic, France, Ireland and Slovak Republic, which is available at www.iea.org/gtf/. This data is collected by the IEA and shows monthly gas flows in Europe.

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Electricity generation and supply in Scotland, Wales, Northern Ireland, and England, 2018 to 2022

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Introduction

This article examines the variation of electricity generation and consumption in the four nations of the United Kingdom. It updates and extends the previous version, published in December 2022. The UK data in this article is taken from chapters 5 and 6 of the Digest of United Kingdom Energy Statistics (DUKES) 2023; the definitions are thus identical to those in DUKES. The main text covers the latest five years of data and the corresponding timeseries (including latest revisions) for 2004 to 2022 can be found in the accompanying excel spreadsheet.

Key headlines

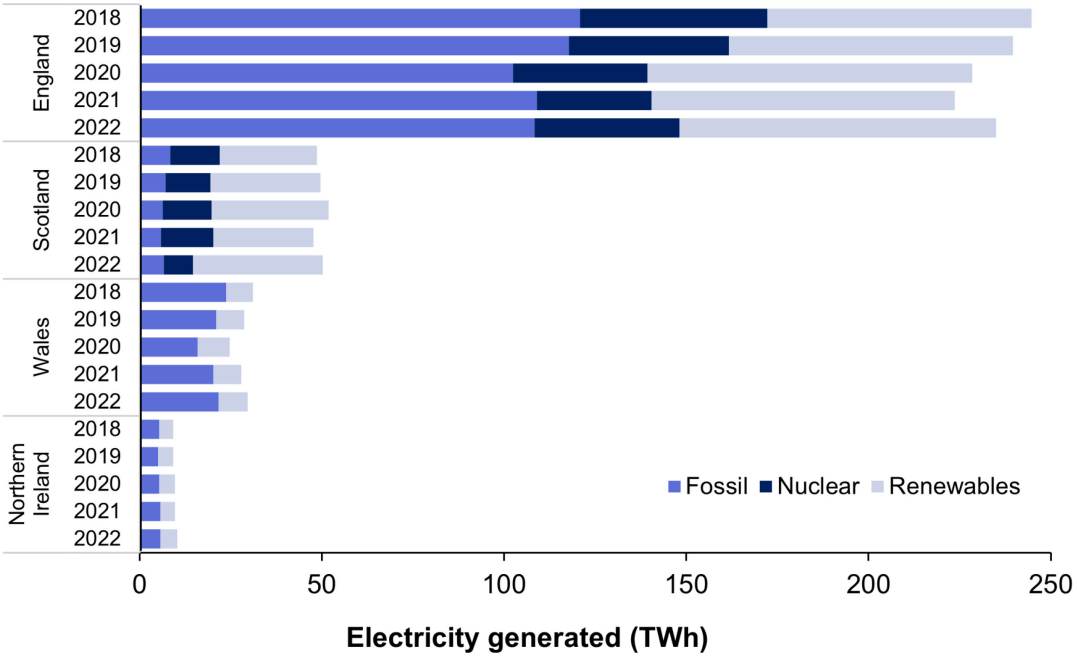
- UK total electricity generation in 2022 was 325 TWh, an increase of 5.3 per cent compared to 2021. This is the highest electricity generation since 2019. Total electricity demand was down 3.8 per cent from 2021 with the difference coming from higher than usual electricity exports.
- UK fossil fuel generation increased 0.9 per cent compared to 2021. Wales and Scotland both saw increases in fossil fuel generation, but their generation remained below 2020 levels. England saw a slight decrease in generation whereas Northern Ireland stayed the same.
- There were record levels of renewable generation with an increase from all four nations in 2022. Scotland has a higher proportion of capacity for these technologies and saw its renewable generation increase by 30 per cent.
- UK nuclear generation increased by 4.0 per cent compared to 2021 but remained at the second lowest level since 1996. Nuclear generation fell by 45 per cent in Scotland due to site closures and outages but rose by 27 per cent in England where fewer outages took place.
- The low carbon share of total UK generation stood at its second highest value on the time series at 56.2 per cent, with a 53.9 per cent share in England, 86.8 per cent in Scotland, 26.8 per cent in Wales, and 44.3 per cent in Northern Ireland.
- The UK exported record amounts of electricity to Europe in 2022, more than it received in imports. Net exports totalled 5.3 TWh, the majority to France to maintain their supply during nuclear outages, this was aided by a new interconnector between England and France.

Generation, consumption, and trade

During 2022 the UK generated 325 TWh of electricity, an increase of 5.3 per cent on 2021 and the highest value since 2018. This is in contrast with a 4.5 per cent reduction in electricity consumption. The different trends between generation and consumption were a result of higher than usual electricity exports, mainly to France as a result of nuclear outages there.

Electricity consumption had been on a downward trend since 2016 though with a small year-on-year increase in 2021 with the lifting of Covid restrictions. The downward trend continued with 279 TWh consumed in 2022, the lowest value on the published data series. From 2021 to 2022, all four nations saw an increase in generation. Scotland increased by 5.3 per cent while England increased 5.1 per cent on 2021; Wales and Northern Ireland saw their generation increase by 6.5 and 6.7 per cent respectively with higher wind generation in all four countries. Scotland, Wales and Northern Ireland also had substantial increases in gas generation, where England saw a 0.5 per cent fall. Despite the rise in generation, 2022 saw UK generation down by 4.3 per cent from its peak in 2016. Chart 1 shows total electricity generation by country, between 2018 and 2022, with generation divided by fossil fuel, nuclear and renewable technologies.

Chart 1: Total electricity generation by country (all generating companies), 2018 to 2022.



Generation shares

Shares of electricity generated by nation remained almost identical to the previous year, with England having the largest share of electricity generation at 72.2 per cent, decreasing by 0.2 percentage points relative to 2021. Scotland accounted for the second largest share, at 15.5 per cent, the same as 2021. Wales and Northern Ireland increased their share by 0.1 percentage points to 9.1 per cent and 3.2 per cent respectively.

Fossil fuels

UK fossil fuel generation increased by 0.9 per cent between 2021 and 2022, though was 11 per cent below 2018 levels and a lower share of generation at 40.8 per cent, a reduction of 1.8 percentage points on 2021. The year-on-year increase in fossil fuel use reflects higher total generation including generation to meet demand for exports. Scotland experienced the largest year-on-year increase in fossil fuel generation, up 9.4 per cent, though from 2018 this was a 26 per cent decline. Wales similarly experienced a year-on-year rise of 8.8 per cent between 2021 and 2022, to 19.4 TWh, the highest fossil fuel generation since 2018. Northern Ireland's fossil fuel generation was the same as last year at 5.7 TWh, though Northern Ireland saw an 18 per cent decrease in coal generation, offset by a rise in gas generation. England is the only other country in the UK with coal generation, which fell 14 per cent compared to 2021. This means that coal generation accounted for just 1.7 per cent of total UK generation in 2022, down from a fifth in 2015, with plans for the remaining coal-fired power stations to be phased out by October 2024.

Nuclear

UK-wide nuclear generation increased by 4.0 per cent in 2021 to 47.7 TWh, though this was half the amount generated from nuclear at its peak in 1999. This represented a 14.7 per cent share of total generation. Much of the decline is the result of the UK's aging nuclear infrastructure requiring more frequent maintenance outages. Nuclear generation fell by 45 per cent in Scotland but rose by 27 per cent in England where fewer outages took place. 2022 also saw the decommissioning of Hunterston B in Scotland leaving only one site in Scotland and three in England. Since the closure of Wylfa in Wales in 2015, there has been no nuclear generation within Wales or Northern Ireland.

Renewables

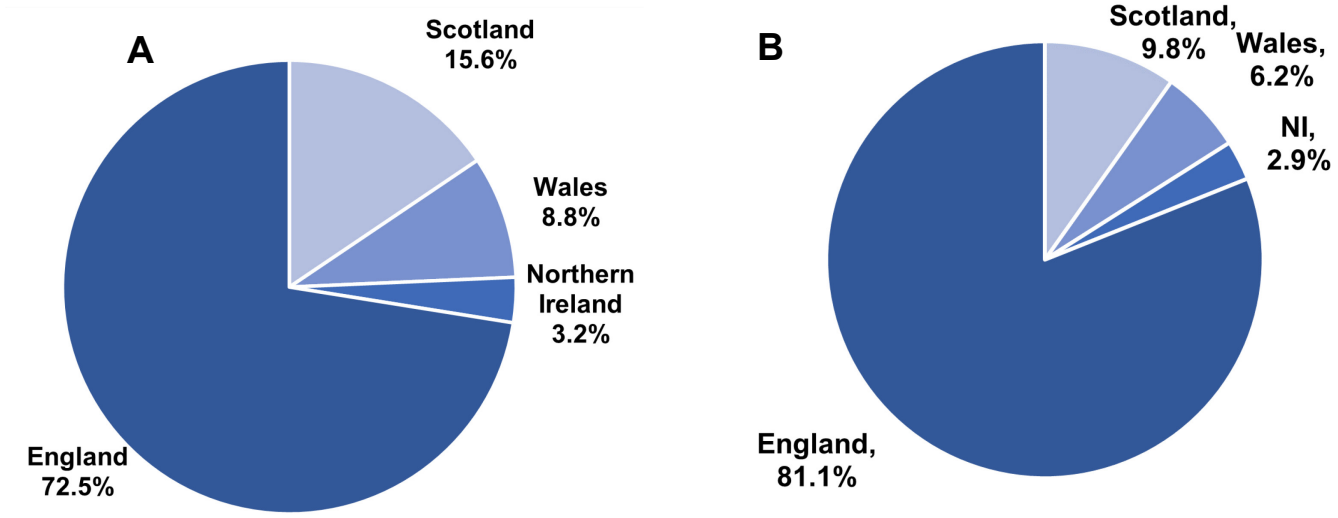
Renewable generation increased by 10 per cent for the UK in 2022, to 135 TWh, the highest value on the published data series. The renewable share of generation was 41.5 per cent, up 2.0 percentage points compared to 2021, and was greater than the share of generation from fossil fuels (40.8 per cent) for the second time. This was driven by increased wind generation, mainly resulting from increased capacity as although average wind speeds were higher than in 2021 they were still below the 10 year average. Weather conditions were also more favourable for hydro with greater rainfall than in 2021 and solar generators with

higher average daily sun hours. Scotland has a larger share of wind and hydro capacity so saw a greater increase in renewable generation as result of the improved weather conditions for these technologies.

Consumption

Shares of annual electricity consumption of the respective UK nations did not vary much from 2021 and have been relatively consistent across the reported data series. The overwhelming majority of consumption came from England (81.1 per cent), 9.8 per cent from Scotland, 6.2 per cent from Wales, and 2.9 per cent from Northern Ireland. This reflected minimal difference from the average across the previous extent of the time series (2004-2021), where average consumption shares were 81.8 per cent, 9.9 per cent, 5.7 per cent, and 2.6 per cent respectively. This also shows Scotland and Wales supply more than they consume whereas the reverse is true for England and Northern Ireland. Chart 2 shows shares of electricity supply and consumption in the UK by country in 2022.

Chart 2: Shares of electricity supply (A) and consumption (B) in the UK by country in 2022.



International exports and transfers

For the first time in more than forty years the UK was a net exporter of electricity, exporting more electricity than it imported. This was primarily due to nuclear outages in France reducing availability of electricity there. The UK transferred electricity to continental Europe via interconnectors with France, Netherlands, Belgium, and Norway and a new 1 GW interconnector with France was added in 2022. England was the largest exporter of electricity to Europe, transferring 5.1 TWh an increase of 120 per cent increase from last year, followed by Northern Ireland which transferred 0.8 TWh. Scotland transferred 19 TWh of electricity to England and Northern Ireland transferred 0.3 TWh to Scotland. A flow chart illustrating electricity generation, consumption and trade in the UK nations is provided in Appendix A.

Electricity generation by fuel

In recent years the closure of coal and gas fired power stations and an increase in the capacity of renewable generators has shifted the UK's mix of generation from fossil fuels to renewables. For the second time in the reported data series, renewable generation had a greater share than fossil fuels. Fossil fuel share has fallen from 44.9 per cent in 2018 to 40.8 per cent in 2022 whereas the renewable share has risen from 33.0 per cent in 2018 to 41.5 per cent in 2022. Even though the share of renewables was greater in 2020 more electricity was generated by renewables in 2022. Notably in Scotland, fossil fuel generation has decreased by 26 per cent since 2018, though increased 9.4 per cent compared to 2021. England saw its fossil fuel generation decrease 12 per cent since 2018, also driven by greatly reduced coal generation which was down 70 per cent since 2018. Northern Ireland was the only nation to have experienced an increase in fossil fuel generation since 2018, up 6.4 per cent.

Coal
The introduction of the Carbon Price Floor (CPF) in April 2013 resulted in the swift decline of coal generation, which accounted for 39.2 per cent of the UK generation mix in 2012, but was only 1.7 per cent in 2022, matching the record low in 2020. At the end of 2022, four coal plants remained in the UK, with Drax, West Burton and Kilroot closing in 2023. There was a decrease in coal generation in both England and Northern Ireland in 2022, down by 14 per cent and 18 per cent respectively.

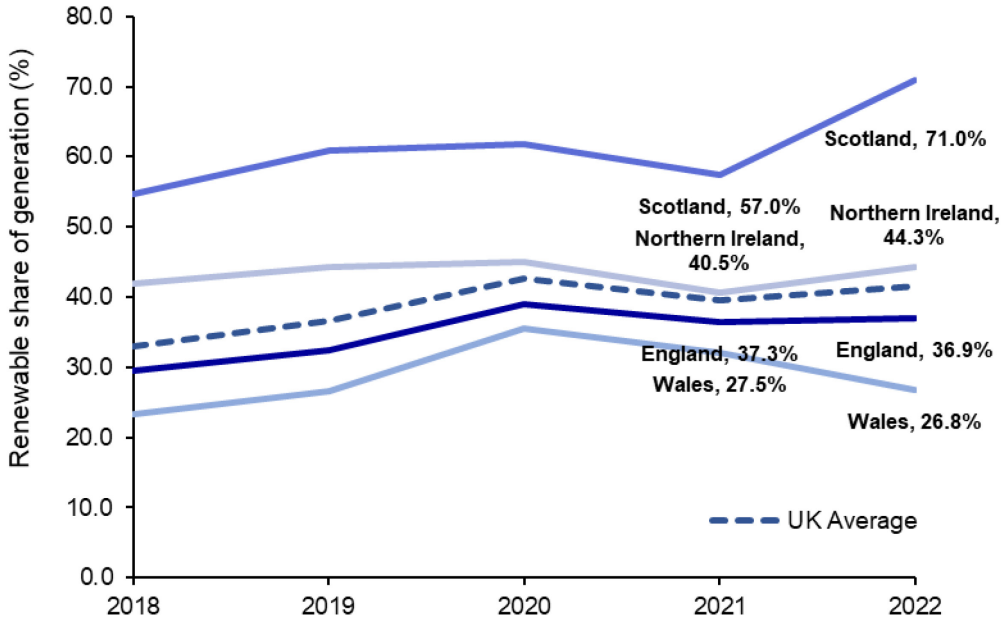
Gas
Gas largely replaced coal in the generation mix since the introduction of the CPF. UK gas generation increased 1.5 per cent to 125 TWh in 2022, remaining as the fuel with the highest generation. Despite this increase, gas generation was down 5.0 per cent since 2018. England had the highest level of gas generation with 95.8 TWh generated in 2022, this is a decrease of 4.6 per cent compared to 2021. The remaining UK nations all saw an increase in gas generation, in particular Scotland had an increase of 9.9 per cent. Despite the year-on-year increases, all nations apart from Northern Ireland have decreased gas generation since 2018, where 2018 had an unusually low value.

Nuclear
The UK's overall nuclear generation increased for the first time in five years, increasing by 4.0 per cent to 47.7 TWh. Despite the increase in generation, 2022 saw the closure of both Hinkley Point B in England and Hunterston B in Scotland. These site closures and outages at the remaining sites saw Scotland's nuclear generation decreased by 45 per cent whereas England saw an increase of 27 per cent. Even with the increase in overall generation all the UK's nuclear plants were on outage at times during the year, and both England and Scotland have decreased in generation since 2018, 23 per cent and 42 per cent respectively. Since the closure of Wylfa in 2015 there has been no nuclear generation in Wales.

Low carbon
There was an increase of 8.7 per cent in low carbon generation compared to 2021. This is due to greater nuclear and renewable generation, particularly the increased wind generation. Despite the low nuclear generation in Scotland, low carbon generation increased by 4.1 per cent in 2022. England, Northern Ireland and Wales all saw an increase in low carbon generation in part due to the more favourable weather conditions. They increased by 10 per cent, 16 per cent and 4.7 per cent respectively. These increases were also associated with an increase in the share of generation from low carbon sources, which was 56.2 per cent for the UK but with a wide variation across the 4 nations at 86.8 per cent of generation in Scotland, 44.3 per cent in Northern Ireland and 26.8 per cent in Wales. The share of generation from low carbon sources increased for the UK as a whole and in England and Northern Ireland but decreased in Scotland and Wales. The increase in share was particularly large for Northern Ireland, up by 3.7 percentage points.

Renewables
Renewable generators saw their share of generation increase to 41.5 per cent (up 2.0 percentage points on 2021) as capacity increased and weather conditions were more favourable for wind, solar and hydro generation. Installed capacity for renewables increased by 7.7 per cent, increasing wind capacity and allowing for increased generation. There was also increased rainfall in 2022 compared to 2021 resulting in a 4.5 per cent increase in hydro generation. Chart 3 shows the renewable share of total electricity generation in each UK country from 2018 to 2022, in comparison to the UK average.

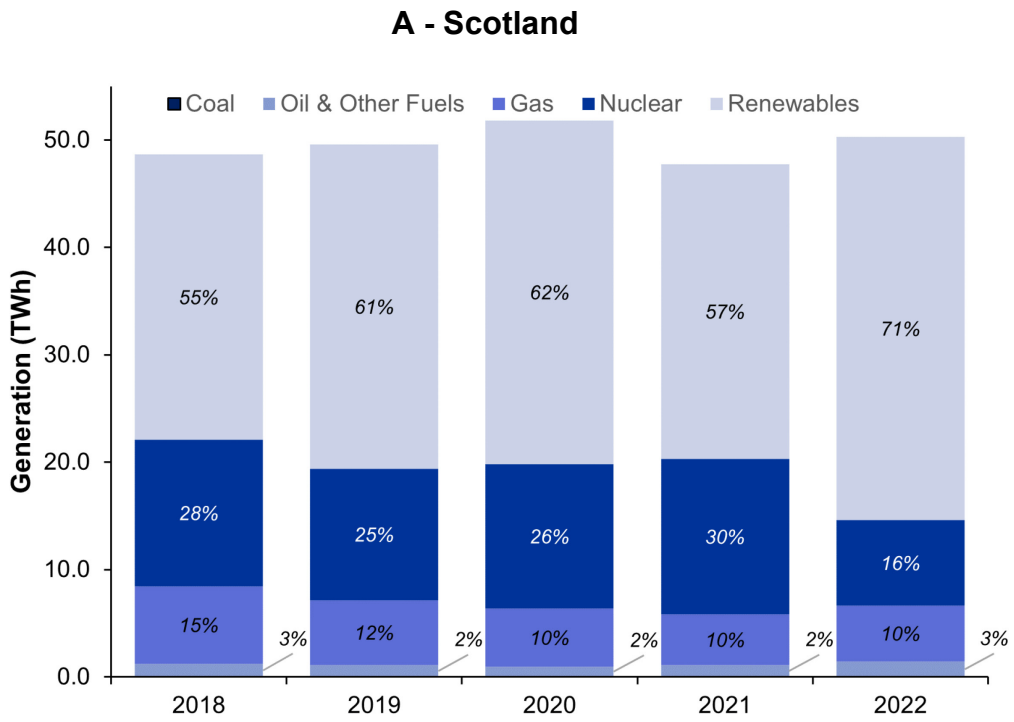
Chart 3: Renewable share of electricity generation by country, 2018 to 2022.



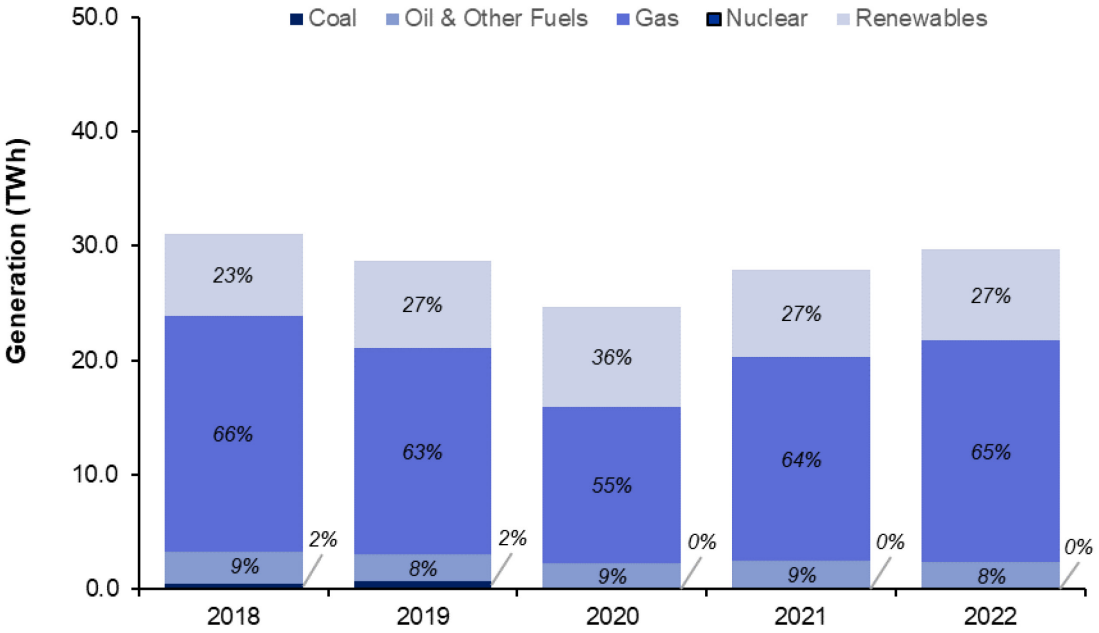
A map illustrating the distribution of Major Power Producers in Scotland, Wales, Northern Ireland and England is provided in Appendix B.

Chart 4 shows electricity generation by fuel (in all generating companies) in each UK country for the period 2018 to 2022. To illustrate the generation mix in each country, shares of electricity generated by fuel are shown as data labels.

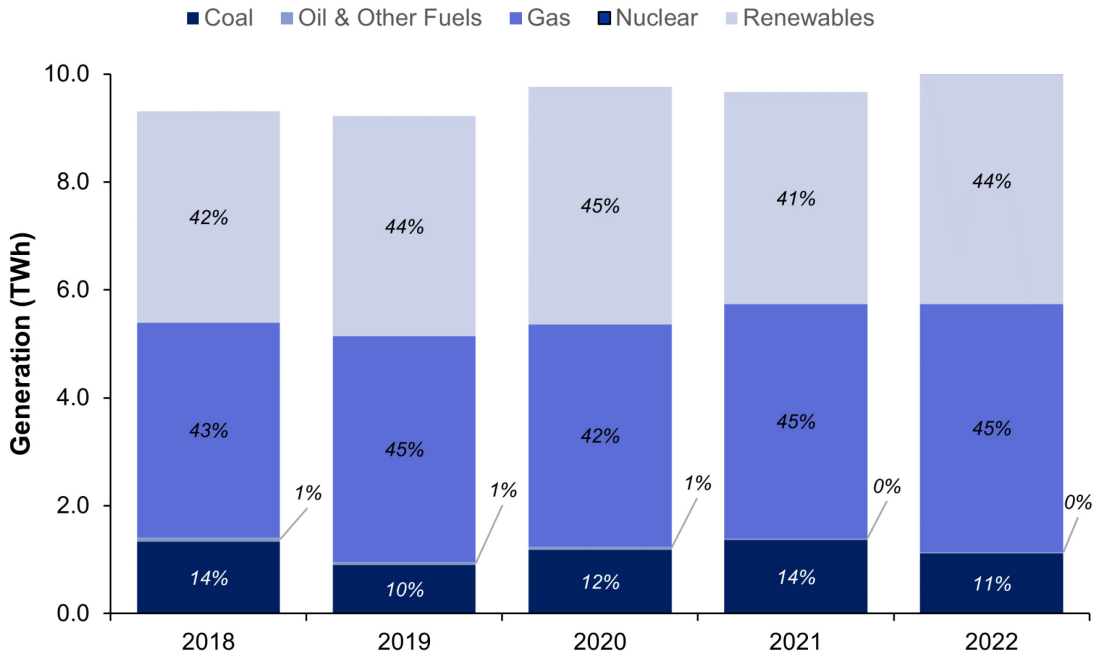
Chart 4: Electricity generation by fuel (with shares of electricity generated) in all generating companies, in Scotland (A), Wales (B), Northern Ireland (C) and England (D), 2018 to 2022.



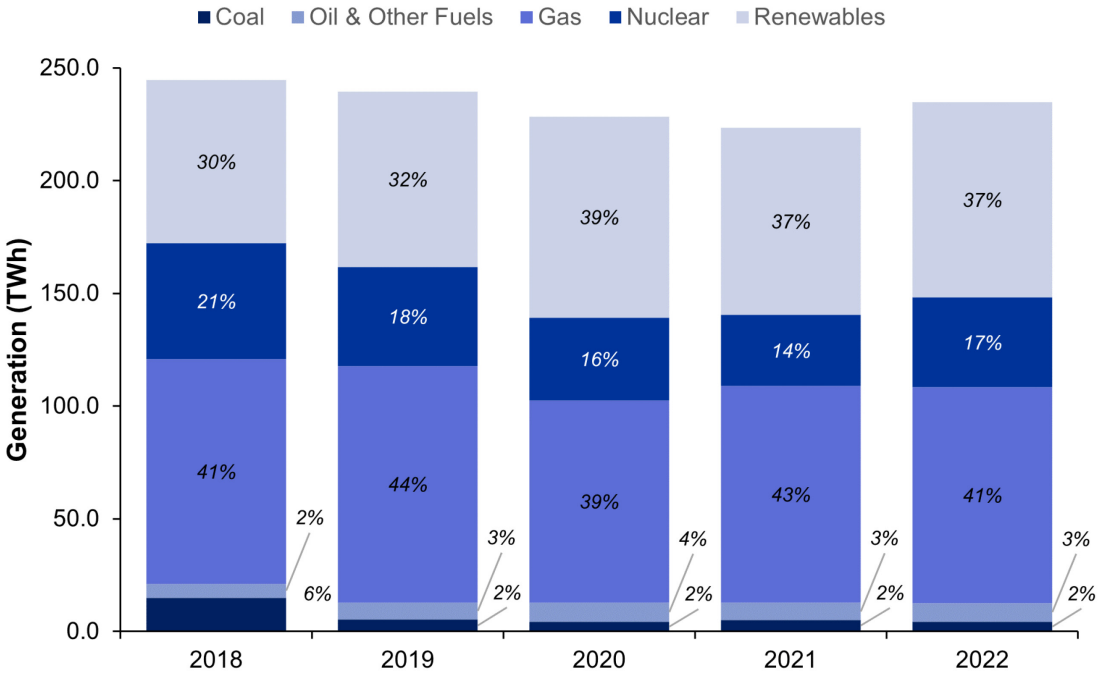
B - Wales



C – Northern Ireland



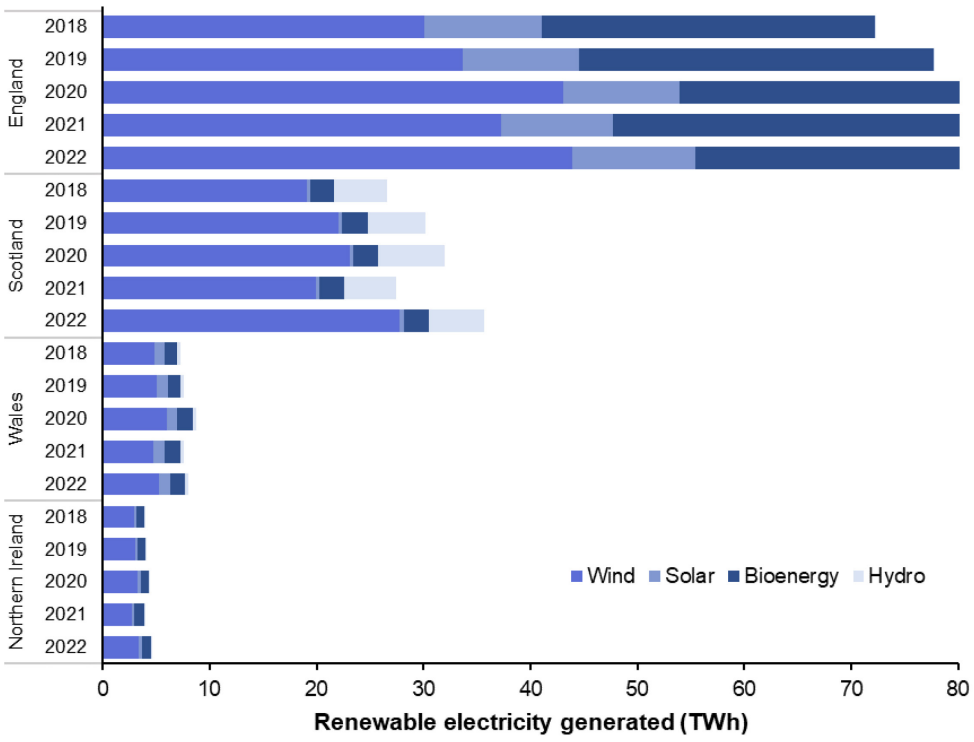
D – England



Low carbon and renewable electricity

Renewable electricity generation and capacity has increased dramatically in recent years, as the UK strives towards a cleaner future, working towards its goal to achieve net zero carbon emissions by 2050. In 2019, the UK became the first global economy to enshrine this commitment in law. Chart 5 shows electricity generation by renewable technology in each UK nation between 2018 and 2022.

Chart 5: Renewable electricity generation by technology, in each UK nation between 2018 and 2022.



Wind
Wind has the largest generation of the renewable technologies at 80.3 TWh in 2022, with UK wind generation increased 41 per cent from 2018 to 2022. Wind power accounted for 55.2 per cent of Scotland's generation in 2022, the greatest proportion of any nation and more than double the proportion of English and Welsh wind generation (18.7 per cent and 17.6 per cent respectively). Wind generation increased in all four nations in 2022 against 2021, this is due to higher average wind speeds and increased capacity than in 2021. Total wind capacity increased 12 per cent to 28.8 GW in 2022, notably including the completion of Moray East Offshore Windfarm in Scotland and Hornsea 2, located off the coast of Yorkshire, the largest offshore wind project in the world which totalled 1.3 GW of capacity. The UK is committed to increase its installed capacity for offshore wind generation to 40 GW by 2030, increasing overall wind capacity to over 50 GW, in line with the commitment to achieve net zero carbon emissions by 2050.

Bioenergy
Bioenergy was the second largest category of renewable generation in 2022, at 11.0 per cent of total generation. Since the conversion of coal units at Lynemouth and Drax to biomass in 2018, most bioenergy generation by major power producers takes place at these two sites, which are both in England. Bioenergy capacity was similar in 2021 and 2022, rising only 0.1 per cent to 8.2 GW. Bioenergy generation decreased in all four countries compared to 2021 but increased compared to 2018 with the largest increase in Northern Ireland (up 31 per cent), Wales (up 19 per cent), followed by Scotland (up 9.5 per cent) and England (up 0.3 per cent).

Solar
Solar generation increased in 2022 with increased capacity and more favourable weather conditions. Average daily sun hours were up 21 per cent against 2021, and up 13 per cent against the 20-year mean. Overall, this meant that UK solar generation increased 10.0 per cent in 2022, in part due to a 5.3 per cent capacity increase. All nations saw an increase in solar generation. Scotland had by far the greatest increase in generation (up 19 per cent) with England following with an increase of 10 per cent. Wales and Northern Ireland increased by 4.7 per cent and 4.8 per cent respectively.

Hydro
The vast majority of the UK's hydro generation assets are in Scotland. There were no changes in capacity but higher average monthly rainfall in 2022 (up 12 per cent) meant hydro generation increased 6.2 per cent in Scotland. In turn, UK hydro generation increased by 4.5 per cent as a whole in 2022.

Further Details
For further detailed renewable statistics on a sub-national and regional basis, please refer to the special feature article published in the September 2022 issue of Energy Trends. For weather data, weighted by location of renewable resources, refer to Energy Trends section 7: weather.

Note that previous versions of this article included reference to renewable generation under the Renewables Obligation (RO). This is no longer included since the RO closed to new generating capacity in March 2017, with a grace period ending in 2018. Since this date, the expansion of renewable capacity renders renewable generation under the RO less significant.

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Revisions

Previous versions of the data in this article remain available online for comparison at:

www.gov.uk/government/collections/energy-trends-articles

References

Digest of UK Energy Statistics 2022 (DUKES) – Electricity (Chapter 5):

https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Electricity Statistics: data sources and methodologies

https://www.gov.uk/government/publications/electricity-statistics-data-sources-and-methodologies

Electricity generation and supply article and accompanying data for Scotland, Wales, Northern Ireland and England, 2017 to 2021:

https://www.gov.uk/government/publications/energy-trends-december-2022-special-feature-articles

UK electricity generation and consumption (Energy Trends 5.1 to 5.6):

https://www.gov.uk/government/statistics/electricity-section-5-energy-trends

Renewable electricity generation and capacity (Energy Trends 6.1):

https://www.gov.uk/government/statistics/energy-trends-section-6-renewables

Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2022:

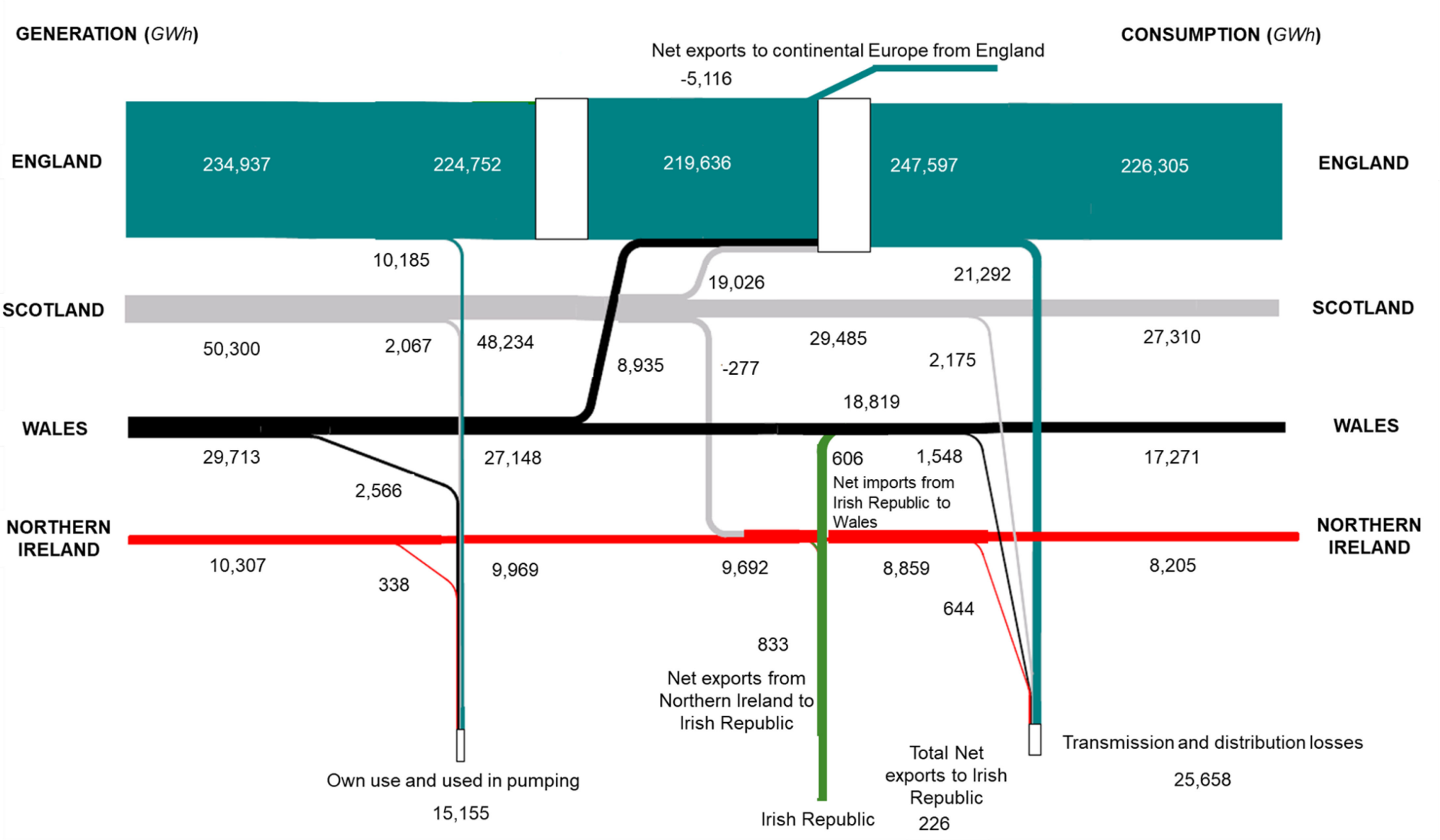
https://www.gov.uk/government/publications/energy-trends-september-2023-special-feature-articles

Energy Trends: weather

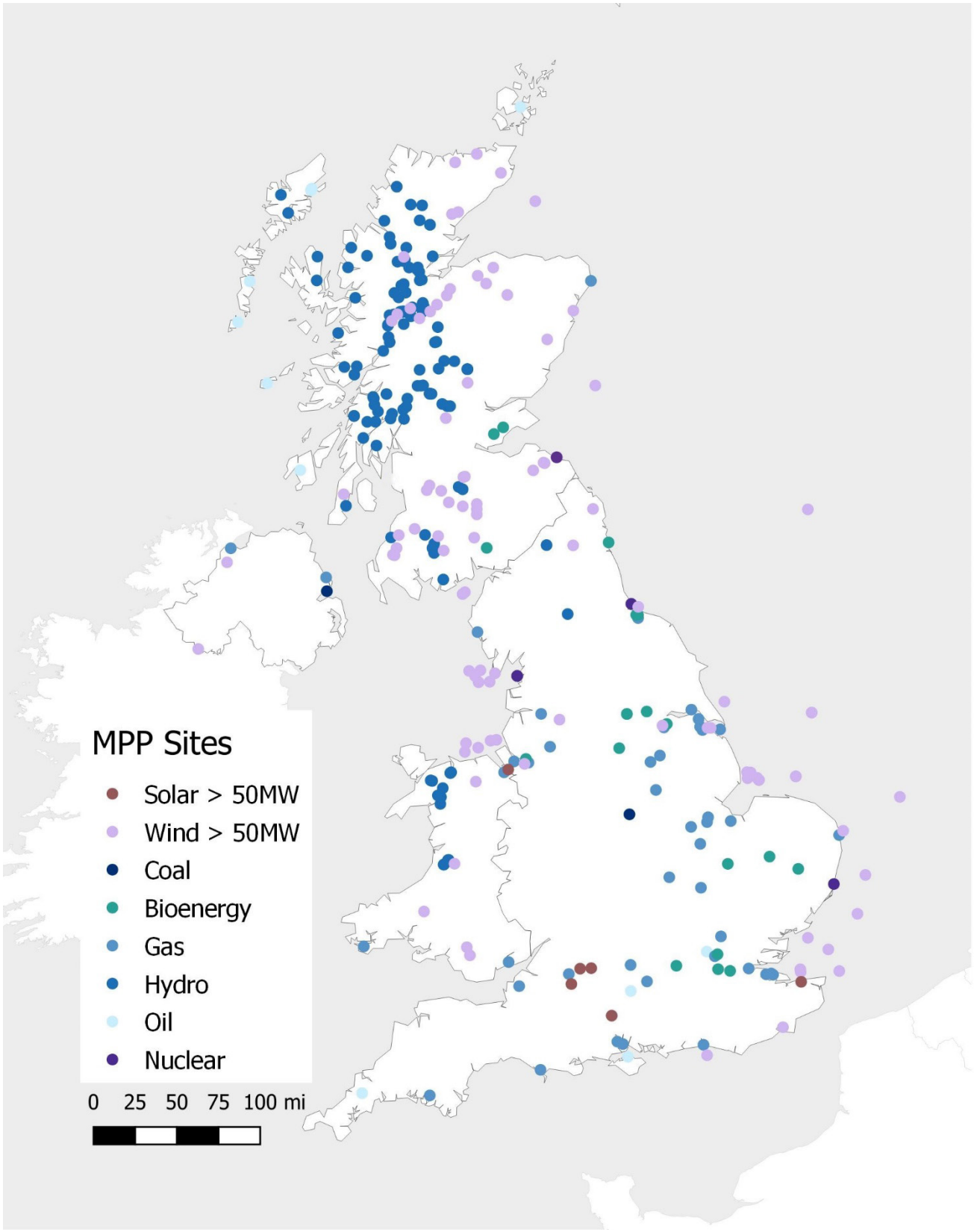
www.gov.uk/government/statistics/energy-trends-section-7-weather

Appendices

Appendix A: Electricity generation and consumption in Scotland, Wales, Northern Ireland and England



Appendix B: Distribution of Major Power Producers (MPPs) in the United Kingdom (as of May 2023)



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Feed-in Tariff load factor analysis 2022/23

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Key headlines

Median load factors for solar photovoltaic (PV) increased slightly to 10.5 per cent in 2022/23, while hydro remained steady at 34.8 per cent. Weather conditions were the main driver, with this financial year being marginally sunnier and wetter.

The median load factor for wind was 16.8 per cent in 2022/23, a 0.9 percentage points fall with respect to 2021/22 despite a small rise in average wind speed. However, the higher wind speeds are reflected by a higher weighted mean.

Quarterly figures for wind and hydro have been added for the first time. The load factors follow a seasonal pattern due to weather conditions, with high load factors for hydro and wind being associated with wetter, windier autumn and winter months, and solar PV load factors being higher in spring and summer months.

South West and East of England had the highest median load factor for solar PV, while **Scotland had the highest wind load factor** this year. Wind load factors exhibit greater regional variability than solar's.

This article analyses load factors of small-scale renewable electricity generation installations accredited under the Feed-in Tariff (FiT) scheme[1]. For each financial year since 2011/12 (the second year of the FiT scheme), we provide an update on national load factors for all technologies, as well as regional load factors for solar PV and Wind installations, and quarterly national load factors for solar PV, Wind and Hydro schemes. Detailed tables are available as an Excel workbook, at this link (opens in a new window).

Background

Load factors are a measure of the efficiency of electricity generation. A load factor is the amount of electricity generated by a system over a certain period expressed as a proportion of its maximum possible output.

The Feed-in Tariff scheme was launched in April 2010[2]. It is managed by Ofgem. It is a financial support scheme for eligible low-carbon electricity technologies, aimed at small-scale installations. The following technologies are supported:

- Solar photovoltaic (up to 5 MW capacity)
- Anaerobic digestion (up to 5 MW capacity)
- Hydro (up to 5 MW capacity)
- Wind (up to 5 MW capacity)
- Micro Combined Heat & Power (Micro CHP, up to 2 kW capacity)

Some generators receive financial support for generating electricity and some for exporting electricity, depending on the tariff which they are on. The generation tariff is based on the number of kilowatt hours (kWh) generated whereas the export tariff is based on electricity that is generated on site, not used, and exported back to the grid. The FIT scheme closed to new entrants at the end of March 2019, though a grace period was allowed to a small number of installations for a short period after. Accredited generators continue to receive support for 20 years from the date they were commissioned (10 years for micro-CHP, 25 years for solar PV commissioned prior to August 2012).

[1] The article published in December 2022 can be found at the following link (opens in a new window)
[2] More details here: www.ofgem.gov.uk/environmental-and-social-schemes/feed-tariffs-fit

Data cleansing

Table 1 shows how many installations were registered on the Central Feed-in Tariff Register at the start of FIT Year 13 and how many installations had valid meter readings; to be included in the analysis, each installation was required to have meter reading taken sufficiently close to April 1st, 2022, and a corresponding reading approximately one year later.

Of the 869,971 schemes registered for FiTs at the start of the financial year[3], 22 per cent were found to have sufficient meter readings for the annual analysis. Extreme load factor values were then excluded (as in previous years' analysis), accounting for around 4,000 (0.5 per cent) of installations. The column 'Valid load factor' in Table 1 indicates how many installations were included in the final annual analysis for each technology. Micro CHP statistics will no longer be included in this release, since the sample size approached zero within the past two years, likely a reflection of the end of FiT support for most schemes in this technology (see Introduction).

The headline coverage is always lower in the most recent survey wave, due to the absence of a final meter reading for many installations. In last year's publication we introduced a new method whereby closing readings for the previous year's analysis are added to the data set which increases the sample size for that year, making the results more robust. See the methodology annex in the December 2022 edition of this article[1] (link in note 1). Therefore we have revised the results for 2021/22 by supplementing the data with this year's data. This has added nearly 50,000 more installations with valid readings to the analysis.

Table 1: Installations included in analysis by technology – FIT Year 12

Technology	Commissioned by 31st March 2021	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	427	202	167	39%
Hydro	1,206	350	293	24%
Micro CHP	525	14	2	0%
Photovoltaic	860,252	189,774	186,068	22%
Wind	7,561	2,489	2,213	29%
All Technologies	**869,971**	**192,829**	**188,743**	**22%**

For this year's edition, we have revised the whole dataset back to FiT year 2 (2011/12) to ensure all figures are consistent with the current, more robust, methodology. This means that the sample size has increased for 2021/22 and for each year from 2011/12 to 2016/17. The data tables now also include full quarterly time series for wind and hydro load factors. Quarterly figures were only published for solar PV in previous editions of this report.

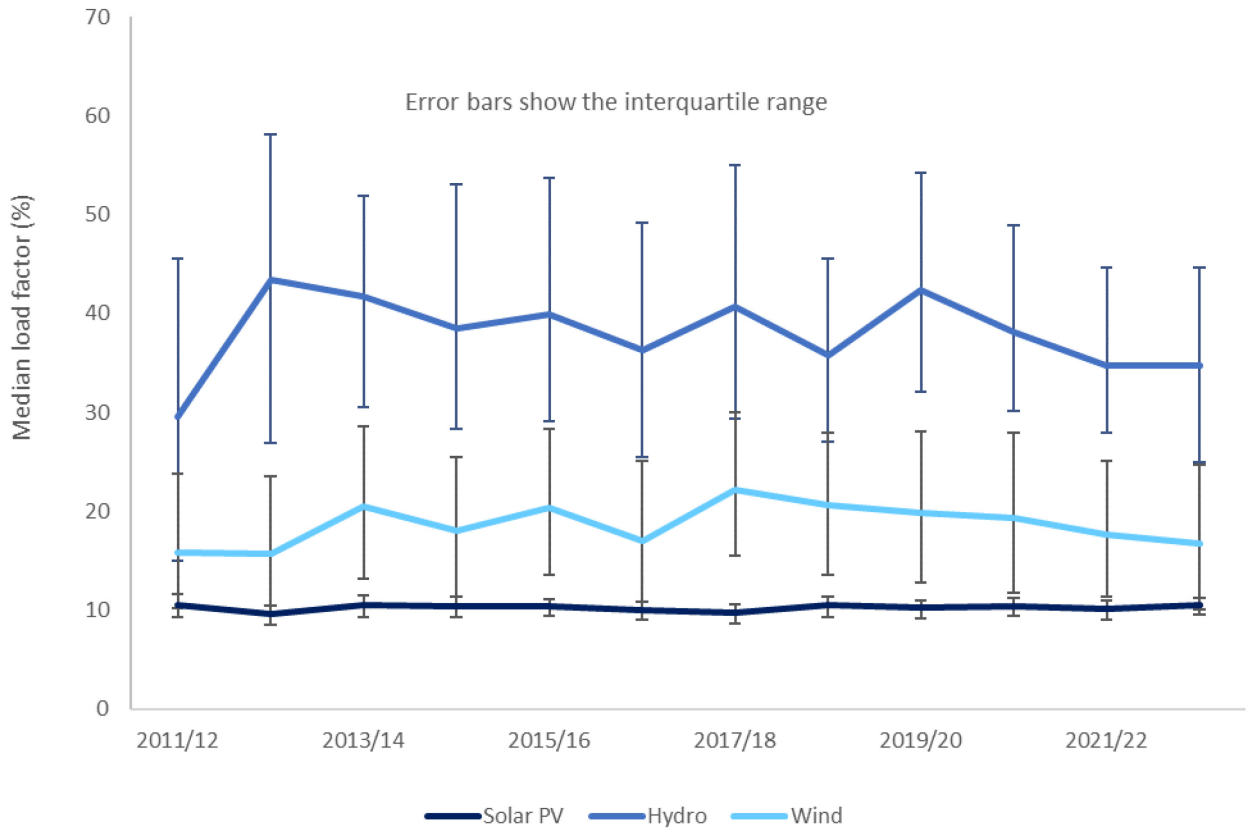
[3] Subject to further revision.

Results

Chart 1 below shows the annual load factors for the leading technologies (hydro, wind, and solar PV) over the FiT years. We present load factors on a line plot for each technology and year, displaying their median value and the interquartile ranges as a measure of dispersion around it.

The plot highlights the differences between the technologies: although primary renewables are all dependent on weather conditions, the distribution of load factors around their median repeats across the years and has a different spread for each technology. While load factors for solar PV are more concentrated, hydro and wind load factors exhibit a wider spread and a wider range of values can be observed. Changing sample sizes may also influence the distribution year on year; solar PV has the largest sample size each year.

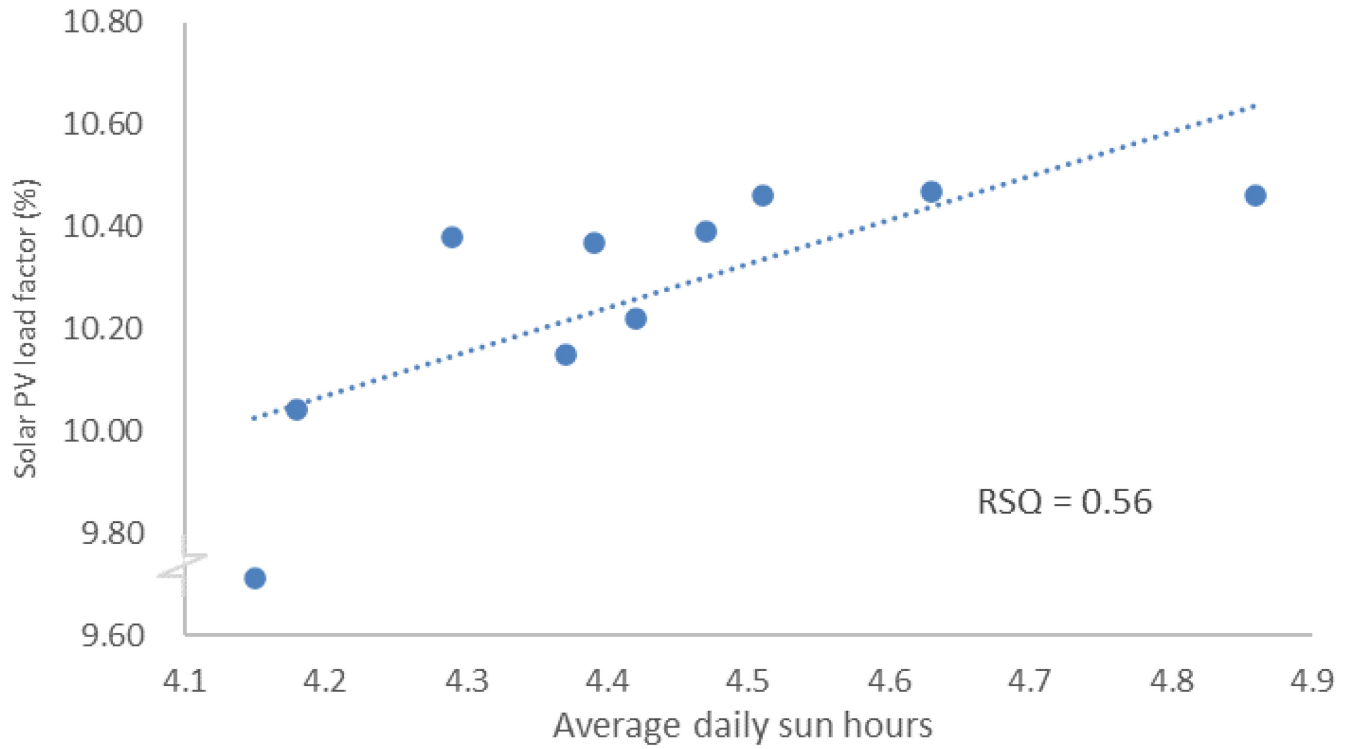
Chart 1: Hydro, Wind and Solar PV load factors, 2011/12-2022/23



The median load factor for solar PV in 2022/23 was 10.5 per cent, 0.3 percentage points higher than in 2021/22; this can be explained by the higher average sunlight hours reported for this period which were up by around 6 per cent on the year before. The weighted mean is systematically lower than the median, but the difference is small in relative terms; this suggests that the efficiency of solar PV installations is less dependent on their size than other technologies, although small scale installations (less than 50 kW) account for around two thirds of accredited capacity and may skew mean load factors towards the lower end.

The load factors for solar PV show a close relationship with average sunlight hours, with patterns repeating in the two series (see Chart 2 below). The clustered appearance of the boxplot indicates that Solar PV is not extremely sensitive to small changes in sunlight conditions, a feature also evident in the quarterly analysis.

Chart 2: Solar PV load factors and average sun hours, 2013/14-2022/23



In 2022/23, the median load factor for Wind was 16.8 per cent, decreasing by 0.9 percentage points since 2021/22. This is the lowest value reported since 2012/13, despite average wind speed increasing compared to last year. As in previous years, the weighted mean of the load factor for wind is notably higher than the median and tends to reflect trends in wind speed more accurately. The difference between the median and weighted mean generally reflects that larger wind farms are more efficient, and therefore skew the mean load factor towards higher values.

There is a relationship between annual wind speed and wind load factors, but it is weaker than the relationship between solar PV and sun hours. Load factors for wind vary more than those for solar PV throughout the year, with percentiles spreading further away from the median. It is also worth noting that in addition to being strongly seasonal, wind speeds can vary considerably by location and by height above the ground, making an accurate nationwide analysis more difficult to achieve.

The median load factor for hydro in 2022/23 was 34.8 per cent, a modest increase from 34.7 per cent the previous year and in line with an increase in average rainfall. Load factors for hydro tend to vary a lot within the sample, although the median value has remained stable over the years, broadly following average rainfall figures. With 2022/23 being a relatively dry year (rainfall was slightly below average), the current load factor appears particularly low when compared to wetter years, such as the 42.4 per cent measured in 2019/20.

Load factors for anaerobic digestion are highly variable due to a relatively small sample, however **the median load factor stands at 84.2 per cent in 2022/23**, which is consistent with the values observed in the past decade.

Quarterly load factors for primary renewables.

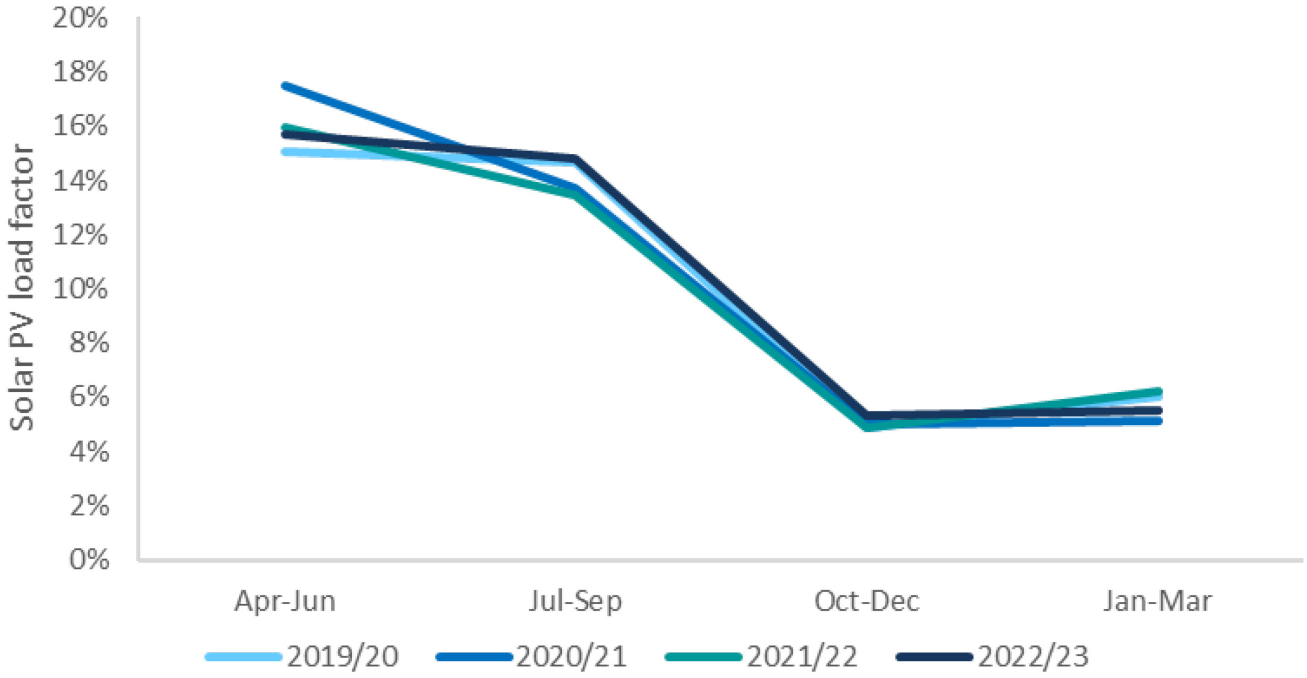
Primary renewables (hydro, solar PV, and wind) convert energy from natural elements and, as such, depend on their availability throughout the seasons. Therefore, their quarterly load factors have strong seasonal patterns.

Chart 3 below presents quarterly load factors for Solar PV within the last four years, plotted on the same axis. As expected, there is an association between sunnier seasons and higher load factors, with a nearly binary pattern between spring-summer and autumn-winter. Solar PV generation is boosted when the sun shines for longer, while it tends to wither in dimmer months.

In 2022/23, the spring quarter (April-June) had the highest load factor of the year (15.7 per cent), which has often been the case over the previous ten years. The sun’s irradiance is at its highest in June. The lowest load

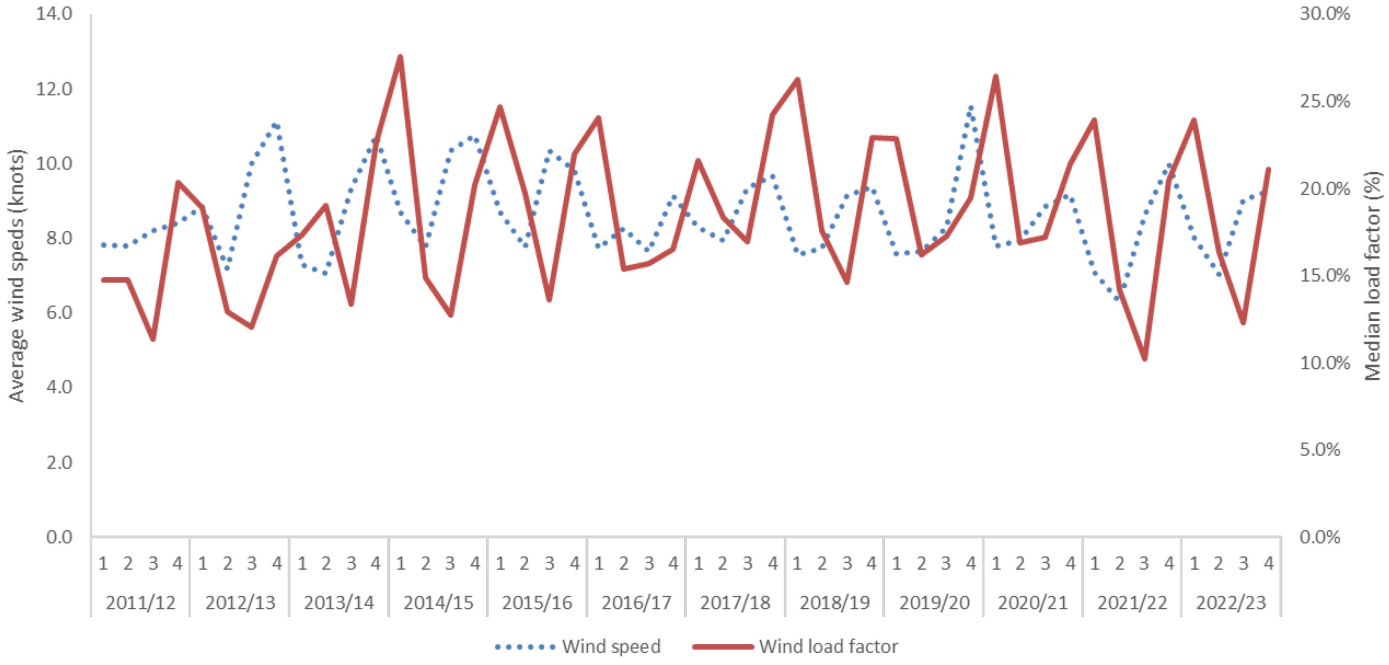
factor of 5.3 per cent was observed between October and December; this is nearly half a percentage point above the same period last year, following a slightly sunnier quarter this year.

Chart 3: Quarterly Solar PV load factors by FIT year



Wind load factors also follow a regular quarterly pattern. Chart 4 displays a line plot of wind load factors across the quarters since 2011 against average wind speed. Except for some discrepancies in the early years, load factors have mirrored wind speed quite closely, reaching their maximum during the winter months in most years.

Chart 4: Average wind load factors and wind speeds by quarter



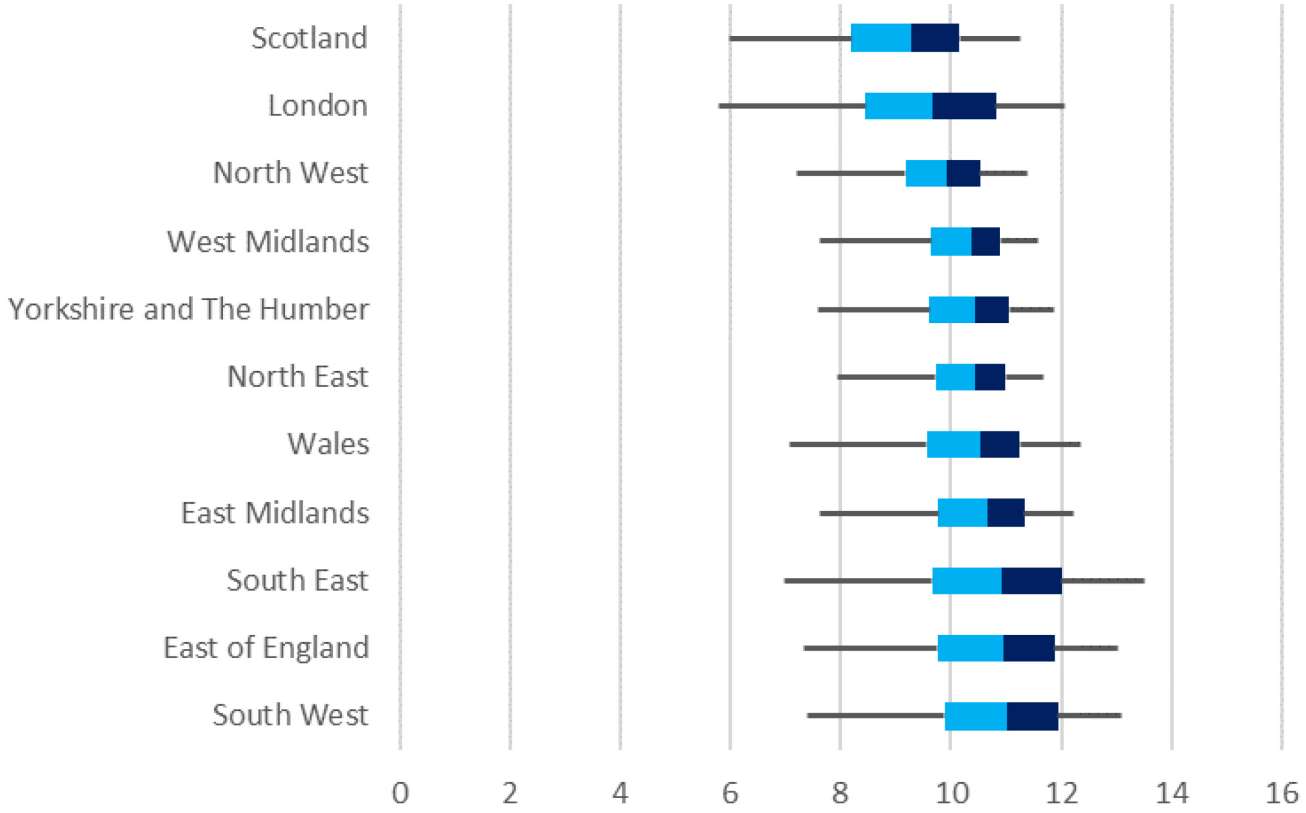
For hydro, wetter seasons are associated with higher load factors, though the relationship with rainfall is less precise than it is observed for wind and solar PV.

Regional Solar PV load factors

Chart 5 below displays the solar PV load factor for Scotland, Wales, and each region of England in Year 13. The median load factor varies across regions, but the load factors' distributions are similar from region to region.

In 2022/23, South West and East of England had the highest load factor at 11.0 per cent. Scotland had the lowest median load factor in 2022/23, with London and North West being the only other regions with a load factor below 10 per cent. London typically has one of the lowest regional load factors; this may be due to pollution, particles settling on the panels, or because panels are shaded by tall buildings nearby. When compared to 2021/22, median load factors increased in all regions except for modest decreases in North East and Scotland (0.2 and 0.1 percentage points respectively). London and East of England saw the largest increase in absolute terms (0.6 percentage points), likely a result of unusually low figures for last year.

Chart 5: Solar PV regional load factor for FiT Year 13 (2022/23).



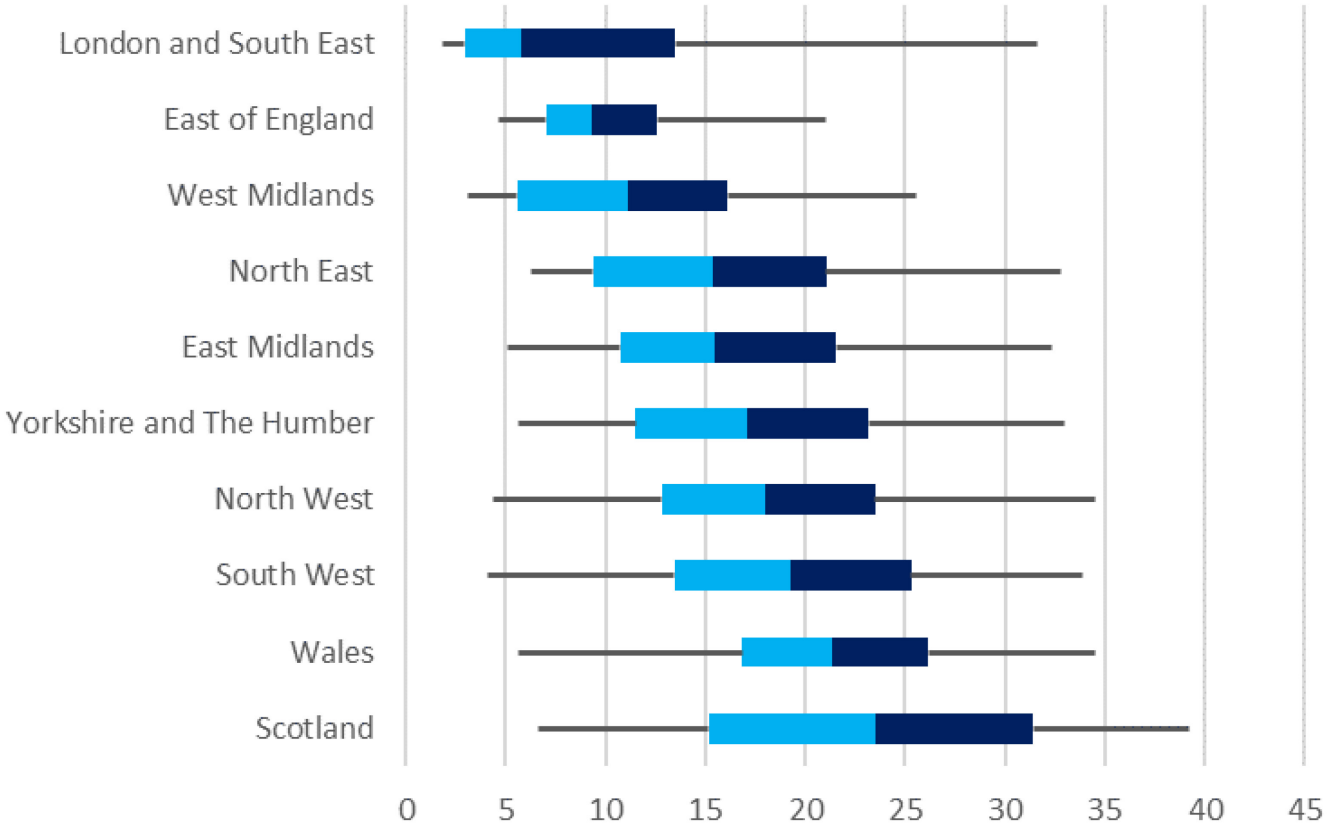
Regional Wind load factors

Chart 6 shows wind load factors in a box-and-whiskers plot for each region. Data from London and the South East are aggregated due to low number of installations with a valid load factor within these regions.

In the latest year, **Scotland had the highest Wind median load factor at 23.6 per cent**, followed by Wales and South West. When compared to last year, load factors have generally gone down in England, with the exception of North West and Yorkshire, but went up in Scotland and Wales (0.4 and 2.1 percentage points respectively).

Unlike solar PV, load factors for wind appear to follow different distributions across different regions, although the overall spreads are comparable. West-facing coastal regions tend to report higher load factors more frequently than inner and east-facing regions. This is likely due to prevailing winds coming from the South West. Moreover, apart from London and South East, regions with a lower median load factor are less likely to report extreme load factors. This suggests that wind load factors have a stronger geographic dependence than solar PV load factors.

Chart 6: Wind regional load factors for FITs year 13 (2022/23)



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