Department for Business, Energy & Industrial Strategy

Energy Trends

UK, July to September 2022

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 2021, primary energy basis

(mtoe basis)	Production	Imports	Exports	Demand
Total energy	**0%**	**+23%**	**+28%**	**+3.7%**
Coal	**-44%**	**+34%**	**-43%**	**-10%**
Primary oil	**-16%**	**+5.9%**	**-21%**	**-0.7%**
Petroleum products	**+0.3%**	**+37%**	**+7.3%**	**+8.9%**
Gas	**+17%**	**+58%**	**+369%**	**+4.0%**
Electricity	**+12%**	**-71%**	**+771%**	**+12%**

Energy production was stable on the same quarter last year, but the picture differs by fuel. A planned maintenance programme meant that **oil production was down 16 per cent** and **2022 is on course to be a record low for both oil and coal**. But all other fuels are up: **natural gas has recovered** to pre-pandemic levels, nuclear is up on last year despite plant closures, and **all renewable technologies are also up**, including a 29 per cent increase in wind, solar & hydro on last year.

Trade in energy has been affected by lower indigenous production of oil and by international factors. **Exports of crude oil have dropped to a record low**, but **exports of electricity to France have reached a record high** to help make good a shortfall caused by maintenance on the French nuclear fleet. **Exports of gas are also at a record high** as the UK continues to operate as a land-bridge for imports of Liquified Natural Gas (LNG) into Europe.

Fuel imports from Russia continue to drop. The UK last imported Russian LNG in March 2022, and imports of oil in the third quarter have reduced to 0.4 per cent of all oil from 10.2 per cent last year. Imports of Russian coal also dropped.

Final energy consumption in the third quarter of was up 4.1 per cent from last year, largely because of increased consumption of transport fuels. Domestic consumption fell which could reflect people spending more time outside the home following the ending of Covid-19 restrictions, but energy prices may also be a factor. Industrial consumption fell (reflecting the fall in manufacturing output) but service sector consumption was similar to last year.

Renewable generation grew 18 per cent on the same period last year due to both increases in capacity (**wind generation grew by a record 2.8 GW**) and more favourable weather conditions. Fossil fuel generation accounted for a 46.6 per cent share over the quarter (up 0.5 percentage points on last year), with renewables at 36.3 per cent (up 1.1 percentage points). Low carbon's share fell by 0.5 percentage points from 50.8 per cent to 50.3 per cent.

Section 1: UK total energy

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Key headlines

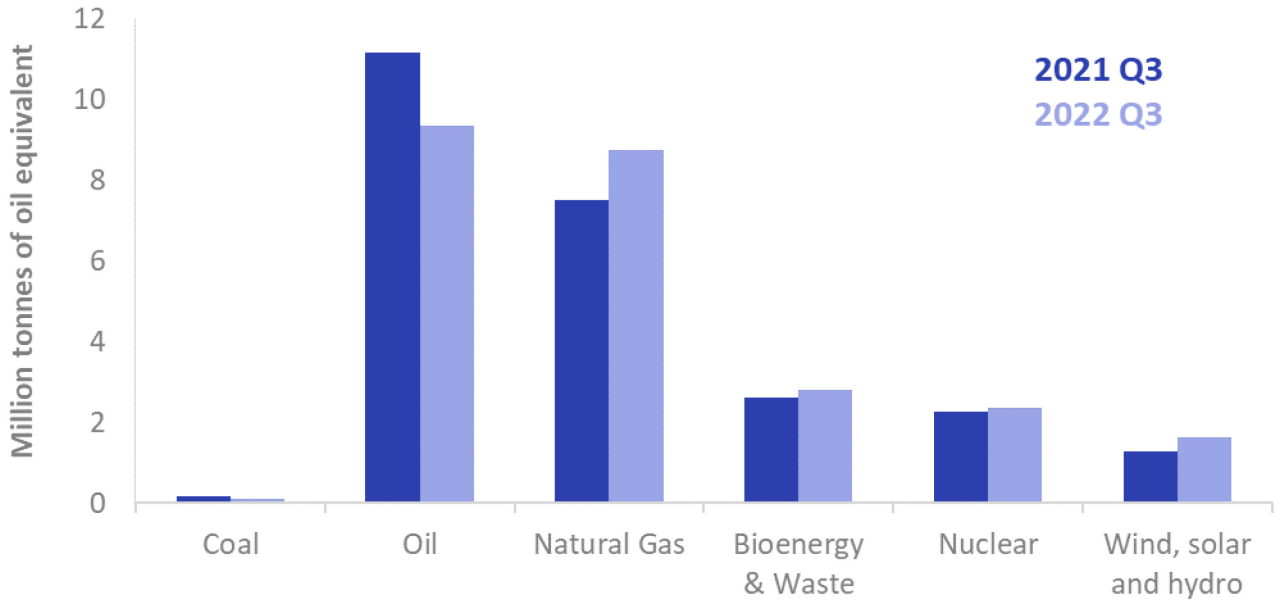
In the third quarter of 2022 **total production was 25.0 million tonnes of oil equivalent, largely unchanged** compared to the third quarter of 2021. Oil production fell markedly on last year and is notably below pre-pandemic levels, whilst gas output increased and has recovered to pre-pandemic levels. Favourable weather conditions saw an increase in the output of renewable technologies.

Total primary energy consumption for energy uses rose by 4.0 per cent, with gas used for power generation in the UK increasing to support the export of electricity to France. When adjusted to take account of weather differences, primary energy consumption rose by 1.5 per cent on the same period last year.

Total final energy consumption (excluding non-energy use) was 4.1 per cent higher compared to the third quarter of 2021. Transport consumption rose by 15 per cent as international travel restrictions were eased, but industrial consumption fell by 5.9 per cent and consumption from other final users (mainly from the service sector) fell by just 0.1 per cent. Domestic consumption fell by 9.5 per cent with average temperatures warmer than a year earlier, though the impact of increased energy prices is likely to have led to reduced demand. On a seasonally and temperature adjusted basis, final energy consumption fell by 0.8 per cent, with falls in all sectors except transport which rose by 14 per cent.

Consumption levels have continued to recover in 2022, but both industrial and transport consumption are below pre-pandemic totals. Whilst road fuels have recovered, demand for aviation fuel remains low.

Chart 1.1 UK production (Energy Trends Table 1.1)

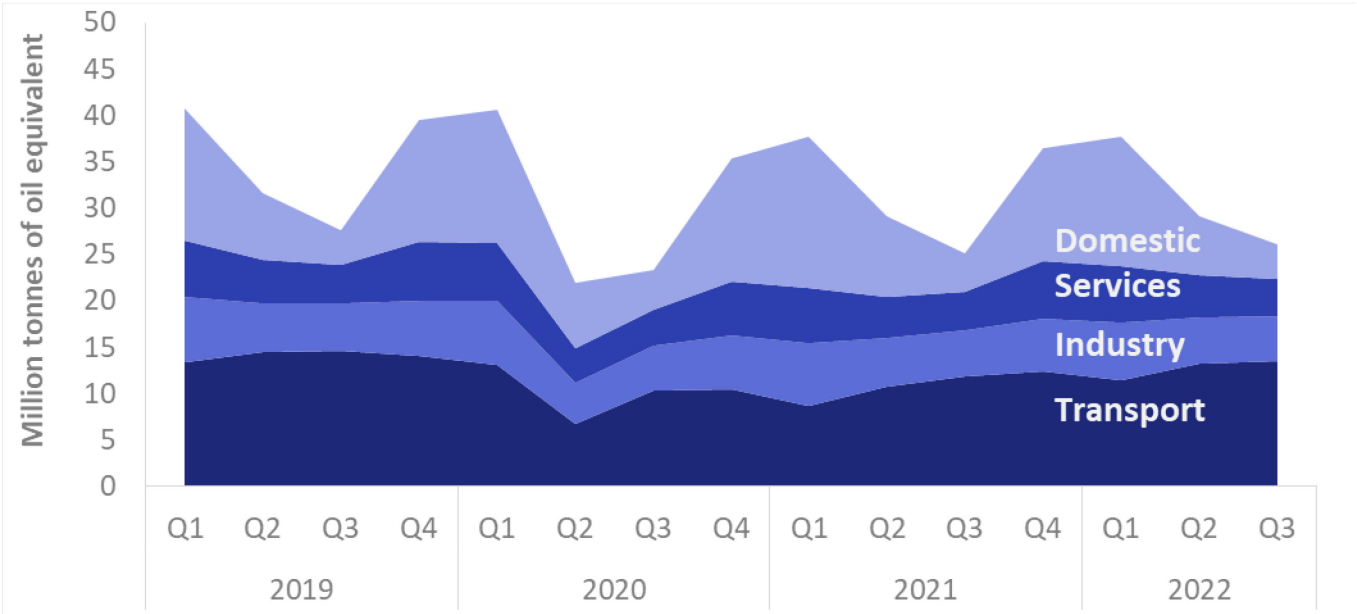


In the third quarter of 2022 **total production was 25.0 million tonnes of oil equivalent, broadly unchanged** compared to the third quarter of 2021. Oil production fell 16 per cent due to planned maintenance, with output down over 30 per cent compared to pre-pandemic levels. Conversely gas production rose 16 per cent with output now similar to Quarter 3 of 2019. Wind, solar and hydro output rose due to more favourable weather conditions for all renewable technologies, as well as increased wind and solar capacity.

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

In the third quarter of 2022 **total inland consumption (which includes fuel use by consumers alongside fuel used for electricity generation and other transformation)** was 175.6 million tonnes of oil equivalent, 1.5 per cent higher than in the third quarter of 2021, on a seasonally adjusted and annualised rate that removes the impact of temperature on demand. Petroleum consumption has increased (notably for aviation fuel), with gas consumption also increasing to help fuel power generation to support electricity export volumes to France.

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



In the third quarter of 2022 **total final energy consumption (excluding non-energy use) was 4.1 per cent higher** than in the third quarter of 2021. Transport consumption rose by 15 per cent, as international travel recovered following the lockdown restrictions imposed during the pandemic. Industrial sector energy consumption fell by 5.9 per cent and service sector consumption fell by just 0.1 per cent. Domestic consumption fell by 9.5 per cent on an unadjusted basis but was down 13 per cent once the warmer average temperatures of this year were accounted for. Except for industrial and transport demand, which remains relatively muted due to low demand for aviation fuel in particular, consumption levels are close to the average levels pre-pandemic.

Section 2: Coal and derived gases

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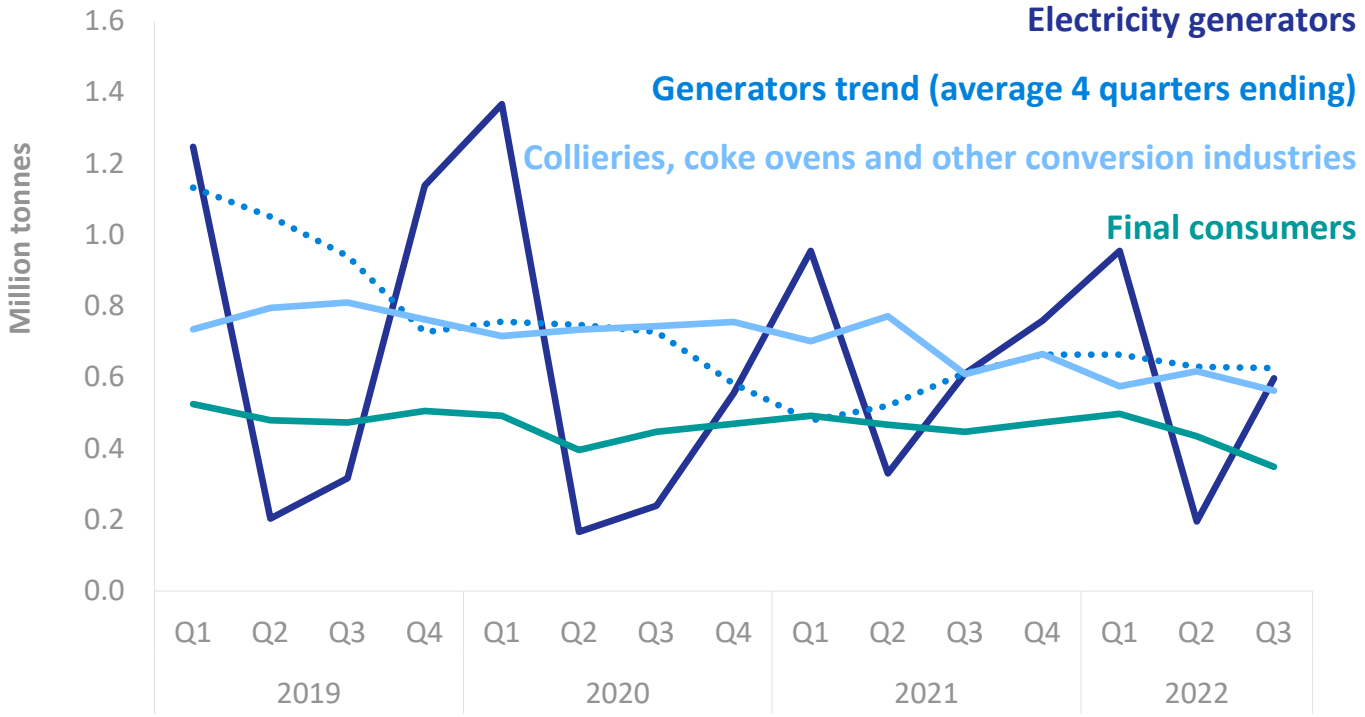
Key headlines

In the third quarter of 2022, demand for coal by electricity generators fell 2.3 per cent. Production favoured gas, nuclear energy and renewables. With the Drax coal units mothballed at the end of March 2021, just three coal plants remain operational in the UK, with coal use for electricity generation expected to cease completely by October 2024. (Chart 2.1)

Overall coal production **for the third quarter of 2022 fell to a new record low of 139 thousand tonnes,** down 44 per cent on the third quarter of 2021. Demand for coal remains low due to declining demand from electricity generators, and UK production over the last year has been further affected by mine closures.

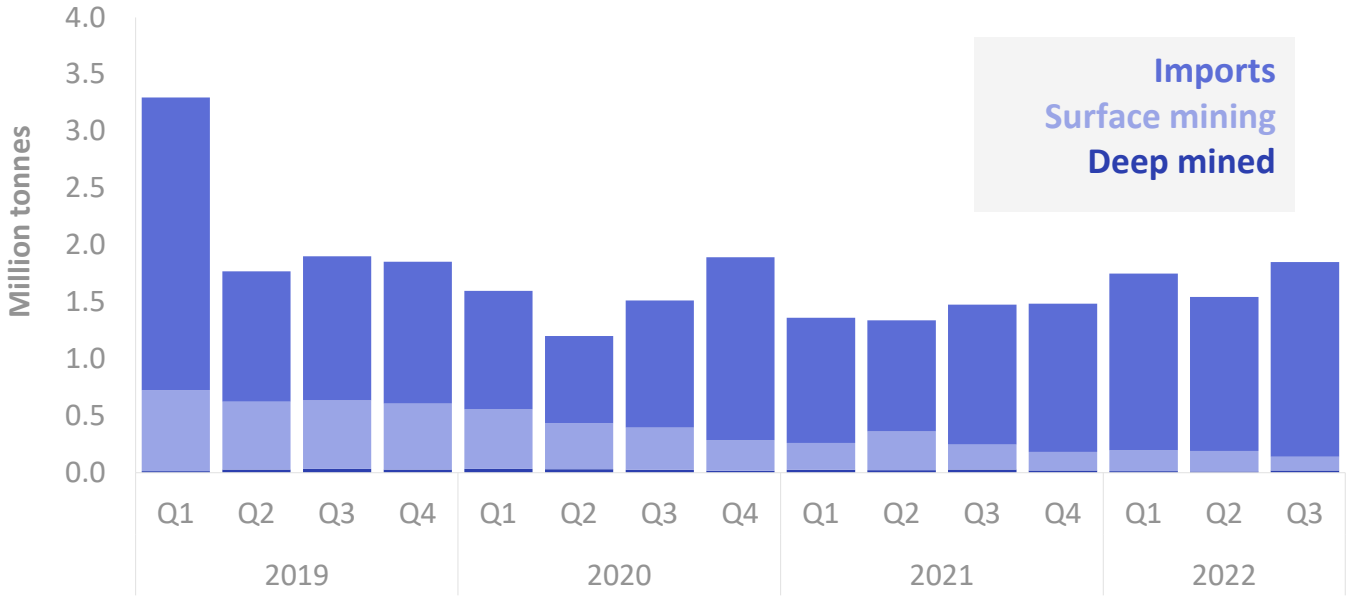
In Quarter 3 2022, **coal imports rose to 1.7 million tonnes**, 39 per cent up on last year. The USA (38 per cent), Australia (17 per cent), South Africa (12 per cent) and Colombia (11 per cent) accounted for 78 per cent of total coal imports. Russia provided 10 per cent of coal imports, down from 40 per cent in the same period last year mirroring the decreasing reliance on Russian energy seen for oil and gas. (Chart 2.3)

Chart 2.1 Coal Consumption (Energy Trends Table 2.1)



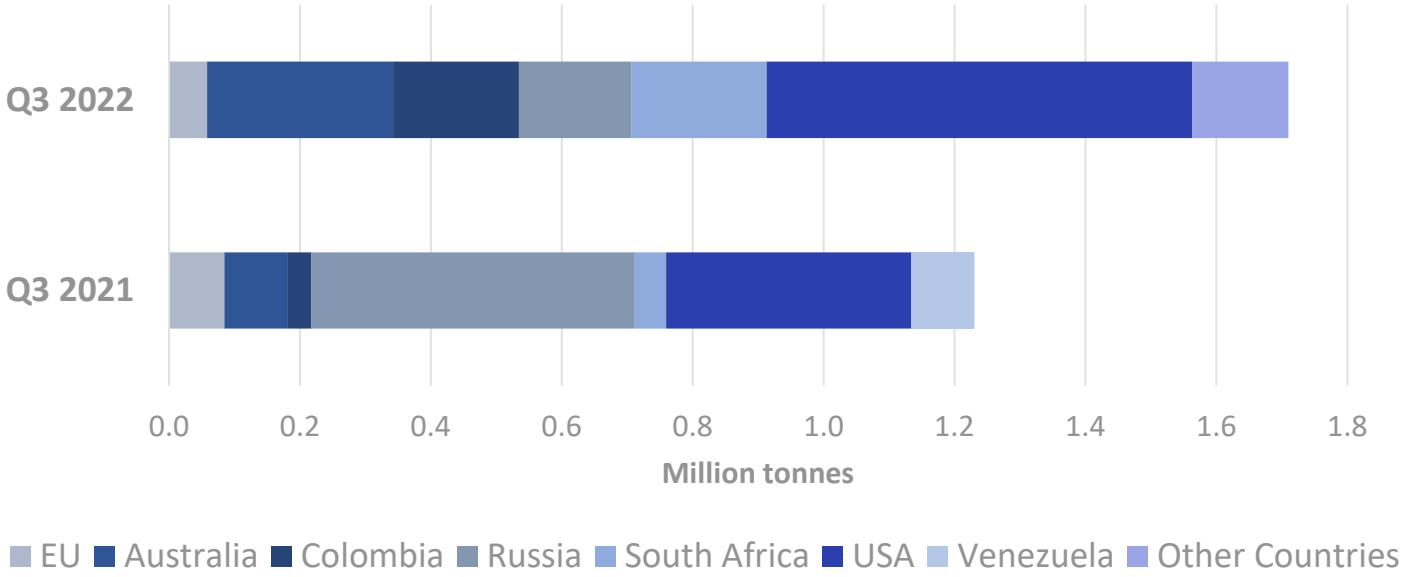
In the most recent quarter, coal demand for coal-fired electricity generation fell from 611 tonnes in Quarter 3 2021 to 597 thousand tonnes in Quarter 3 2022. Production favoured gas, nuclear energy and renewables during this period (see Energy Trends 5.4). Drax coal units were mothballed at the end of March 2021 but will remain available if needed over this coming winter. Four coal plants remain operational in the UK, with coal use for electricity generation expected to cease completely by October 2024. Demand for coal-fired generation is seasonal, peaking in winter when conditions are cold and dark; these peaks have declined as coal-fired generation became less competitive economically and gas and renewable sources displaced it.

Chart 2.2 Coal Supply (Energy Trends Table 2.1)



Domestic coal production has fallen steadily because of coal mine closures and a pattern of generally reduced demand over time, particularly for generation. With reduced production, imports filled the gap in demand, rising from 1.2 million tonnes in the third quarter of 2021 to 1.7 million tonnes in the third quarter of 2022. Set against historic imports however, current volumes are low: imports peaked at 13.3 million tonnes in the second quarter of 2013.

Chart 2.3 Coal Imports (Energy Trends Table 2.4)



In Quarter 3 2022 the USA (38 per cent), Australia (17 per cent), South Africa (12 per cent) and Colombia (11 per cent) accounted for 78 per cent of total coal imports. Russia provided 10 per cent of coal imports, down from 40 per cent in the same period last year. This mirrors the decreasing reliance on Russian energy seen for oil and gas. The UK banned coal imports from Russia from 10th August 2022.

Section 3: Oil and oil products

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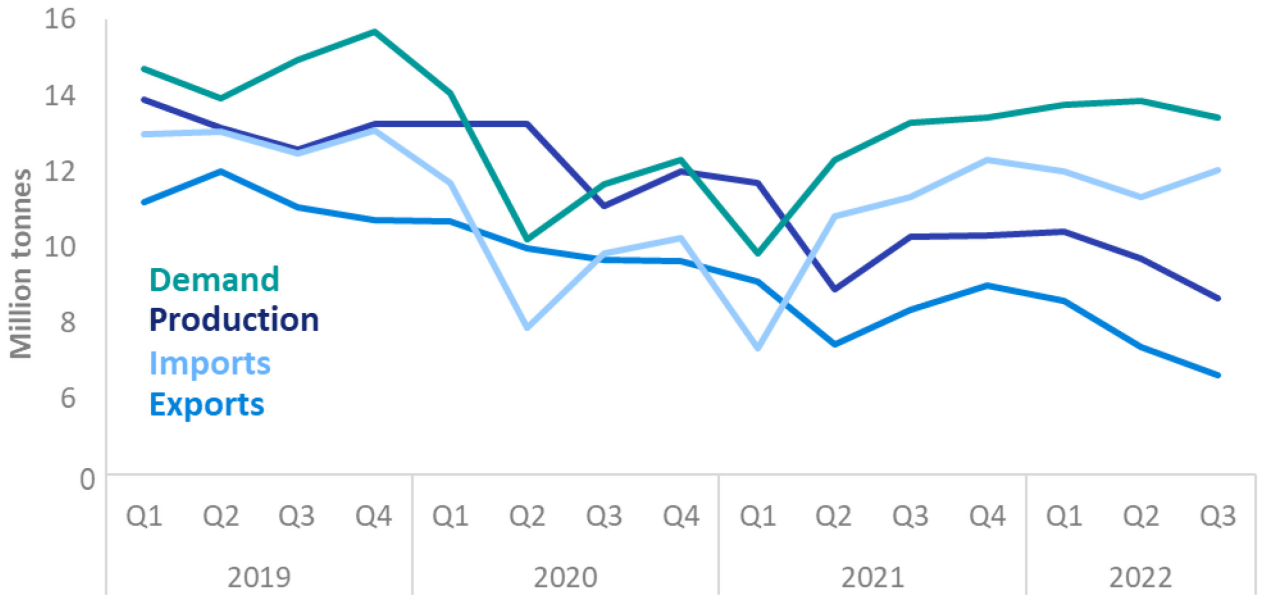
Key headlines

Planned maintenance meant that production of crude oil and NGLs was down 16 per cent in quarter 3 2022 compared to the same period in the previous year. Production remains low compared to pre-pandemic levels, down 31 per cent on Quarter 3 2019 close to a record low. Exports fell by 21 per cent to a new record low.

Demand for petroleum products increased by 9 per cent in quarter 3 2022. This increased demand was met through imports, up 37 per cent on the same period last year. With Russian imports falling significantly on the same period last year, imports arrived via a diverse number of sources including the Netherlands and Belgium. Imports of jet fuel form the Gulf and India have also increased in line with increased demand.

Increased demand was driven by the transport sector including demand for jet fuel more than doubling compared to the same period last year. Despite this demand for jet fuel remains around 20 per cent lower than before the pandemic, whilst demand for road fuels has recovered.

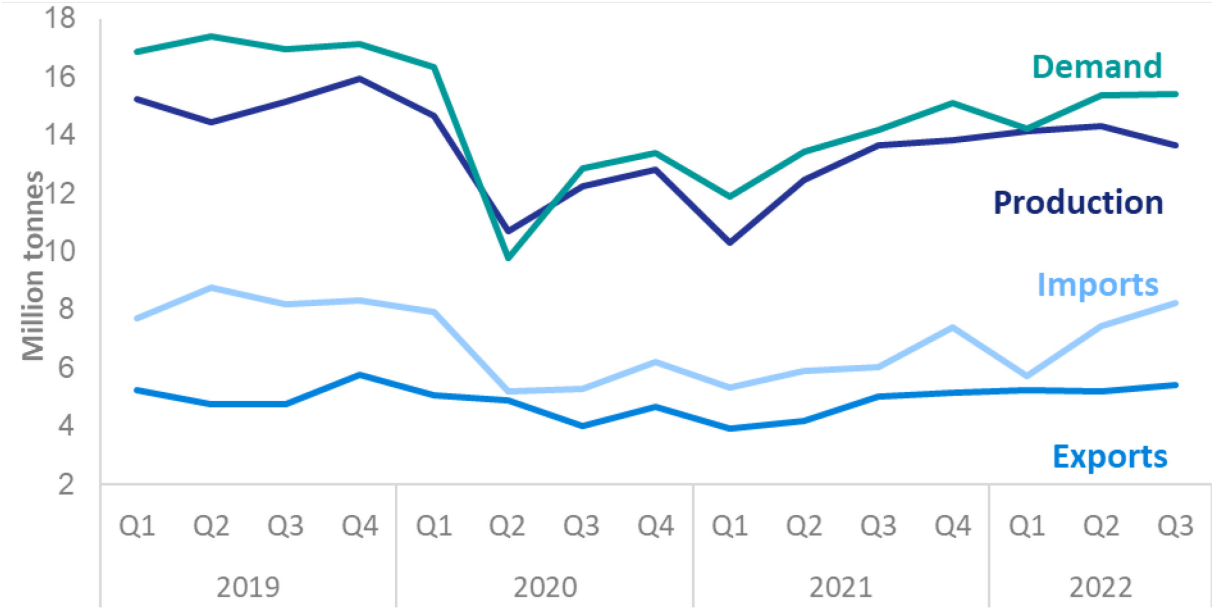
Chart 3.1 Production and trade of crude oil and NGLs (Energy Trends Table 3.1)



In Quarter 3 2022, a planned maintenance programme meant that production of primary oils fell 16 per cent compared to the same period in the previous year. This was a near record low, with only the second quarter of 2014 being lower. Production remains down compared to pre-pandemic levels, by 31 per cent compared to quarter 3 2019. Demand for primary oils was broadly stable compared to the same period in 2021 and remains down compared to pre-pandemic levels.

Exports of primary oils fell to a quarterly record low and were down 21 per cent compared to the same period in the previous year. Imports increased by 6.1 per cent and consequently, net imports, at 5.4 million tonnes, were almost double those seen in the same period last year. However, net imports have previously exceeded 8 million tonnes.

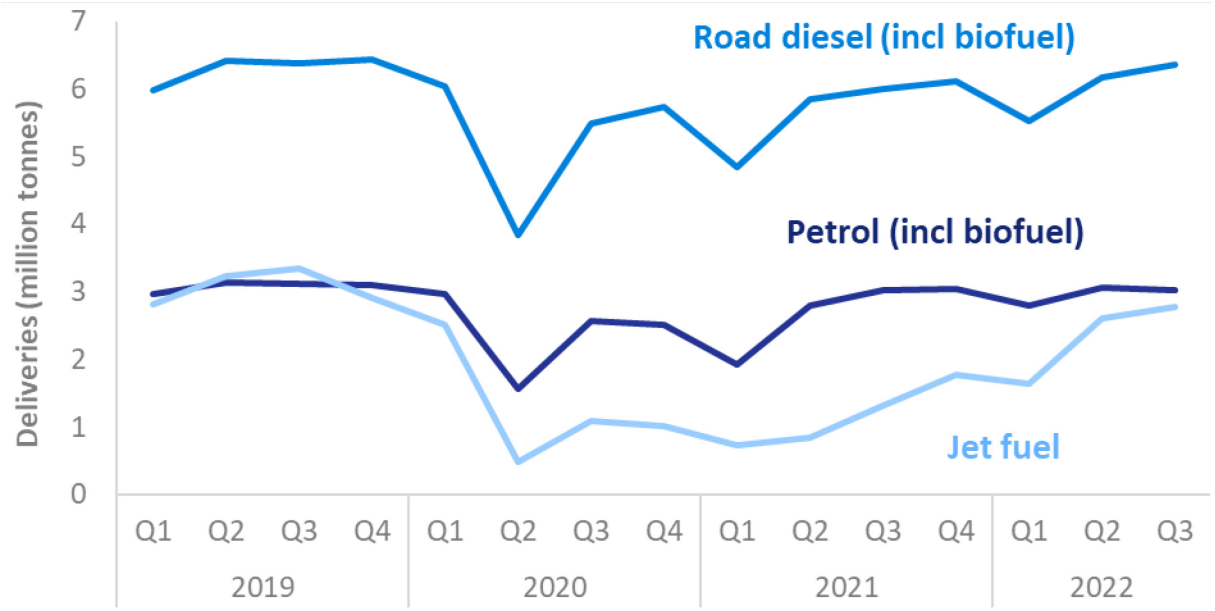
Chart 3.2 Production and trade of petroleum products (Energy Trends Table 3.2)



In Quarter 3 2022, demand for petroleum products increased by 8.9 per cent compared to the same period in the previous year. This was largely driven by increased demand in the transport sector (see Chart 3.3). Increased demand was largely met through imports which increased 37 per cent on last year. Exports were also up, 7.9 per cent, in the same period. The UK was a net importer of products by 2.8 million tonnes.

Imports of petroleum products originate from a large number of countries. In Quarter 3 2022, the top three import sources for petroleum products were the Netherlands, Belgium and Kuwait. This is different from the top three import sources in the same period in 2021 as imports from Russia significantly declined following the invasion of Ukraine and subsequent sanctions announcements. In Quarter 3 2022, Russian imports of oil accounted for 0.4 per cent of imports, down on 10.2 per cent for the same period in 2021.

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



In Quarter 3 2022, demand for jet fuel more than doubled compared to the same period in the previous year, as international travel continued to increase following the lifting of travel restrictions due Covid-19. Jet fuel demand remains around a fifth lower than pre-pandemic levels. Increased demand was met through production and imports both of which more than doubled compared to the same period in 2021.

In road fuels, diesel demand continued to increase, up 5.2 per cent in Quarter 3 2022 compared to the same quarter in 2021. Conversely demand for petrol fell 3.9 per cent in the same period. Production of both petrol and diesel fell due to refinery maintenance which led to increased imports up by a third and a fifth, respectively. The UK remains a net exporter of petrol with the majority of exports going to mainland Europe and the US.

Section 4: Gas

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Key headlines

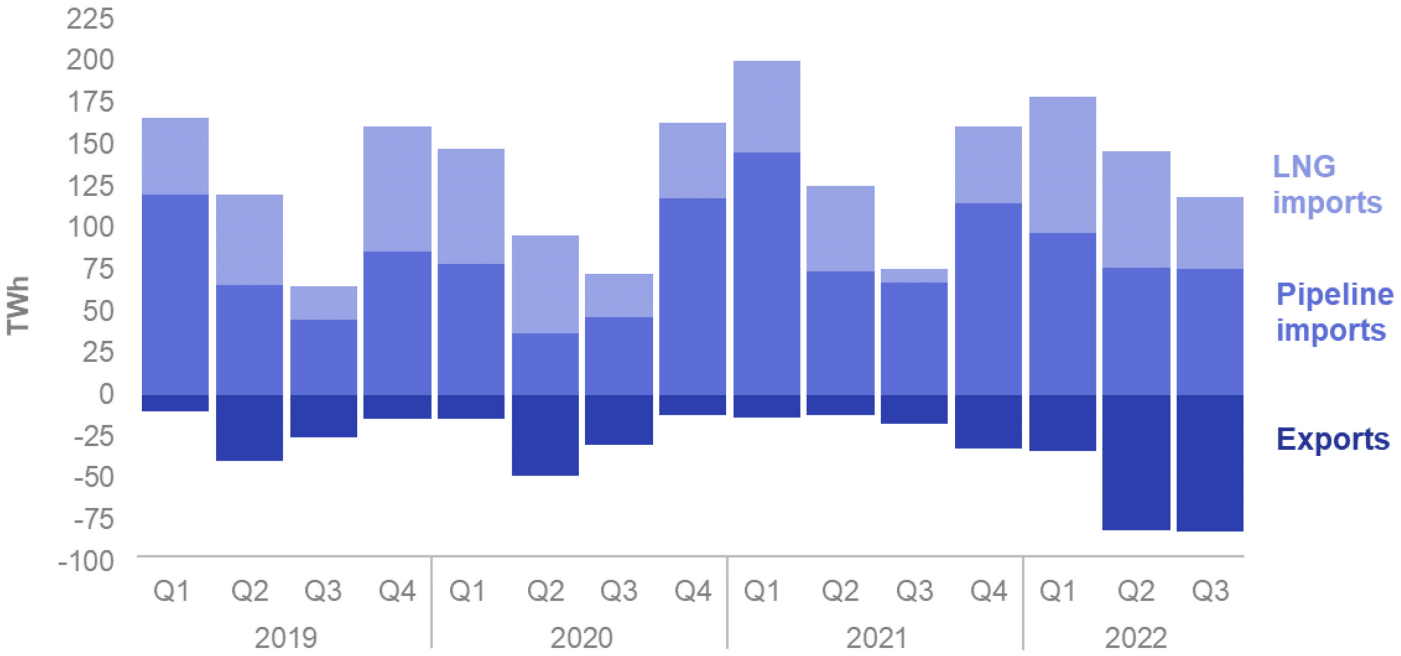
In Quarter 3 2022, exports reached a record high as the UK supported European efforts to move away from Russian gas. Low domestic demand meant that the UK acted as a land-bridge for increased global exports to European markets, utilising interconnectors between the UK, Belgium and the Netherlands.

Liquefied Natural Gas (LNG) imports were almost six times higher than in Quarter 3 2021, as the UK's substantial regasification infrastructure was used to increase supply to European markets. This included a sharp rise in imports from the USA and Peru.

Production increased by 17 per cent compared with a significant low in the same period the previous year. In 2021, production was muted due to extensive scheduled maintenance on key North Sea infrastructure, and the increase this quarter brings production back to pre-pandemic levels.

Demand for natural gas increased by 4.0 per cent in comparison with Quarter 3 2021. This was primarily driven by a 15 per cent increase in gas use for electricity generation. Domestic gas consumption fell by 12 per cent, following warmer average temperatures during the summer months.

Chart 4.1 Trade in natural gas (Energy Trends Table 4.3)



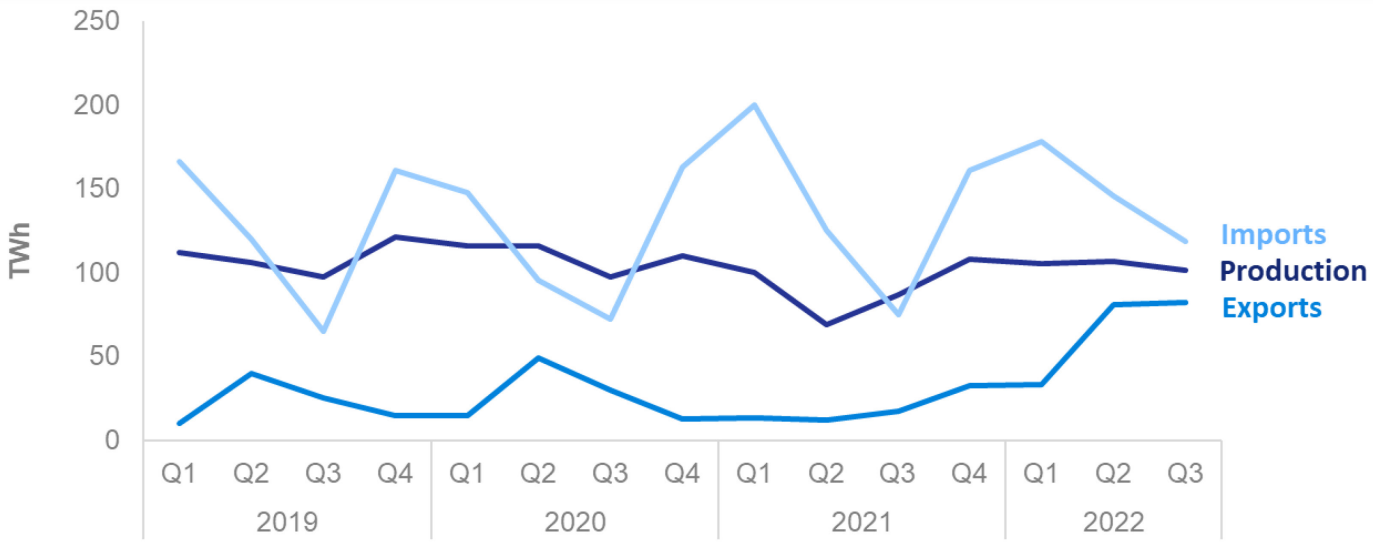
In Quarter 3 2022 gas exports reached a record high of 82 TWh, higher than total annual exports in 2021. The UK supported European efforts to move away from Russian gas, utilising substantial LNG regasification infrastructure and interconnectors with mainland Europe. Exports were over four times that seen in Quarter 3 2021 and 29 per cent higher than the previous record in Quarter 2 2003. Exports to Belgium and the Netherlands during the quarter were substantially higher than many annual totals from previous years.

Imports increased by 58 per cent, largely the result of increased imports of LNG. Pipeline imports were sourced entirely from Norway, as Belgian and Dutch interconnectors have been solely used for exports since April 2022.

LNG imports were almost six times higher than the previous year as the UK operated as a land-bridge for European markets. Qatar remained the largest source of LNG to the UK, accounting for 57 per cent of total

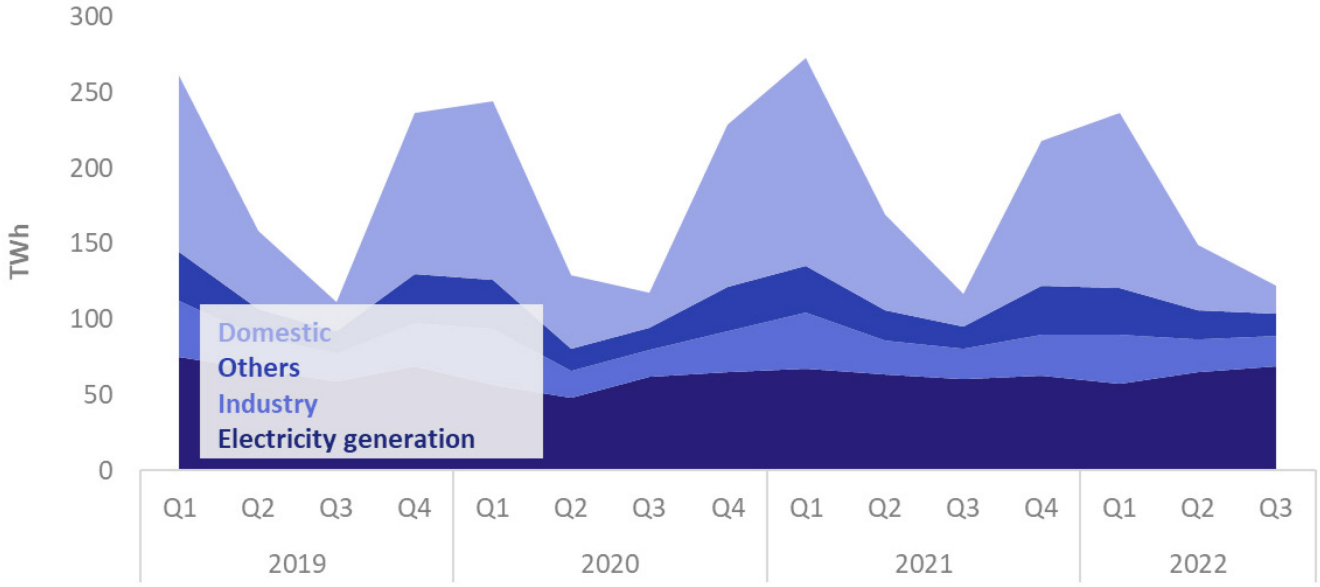
LNG imports. This was followed by imports from the USA, which increased tenfold to reach a share of 21 per cent. The UK also received imports from Peru; the UK has historically received relatively little LNG from Peru but imports this quarter reached 13 per cent of total LNG imports. The UK did not receive any imports of LNG from Russia in Quarter 3 2022, with the last cargo arriving in March 2022.

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



Gross gas production increased by 17 per cent in Quarter 3 2022, compared with lows in the previous year. Production across 2021 fell as the North Sea infrastructure underwent extensive maintenance, but production this quarter is similar to pre-pandemic levels.

Chart 4.3 Demand for natural gas (Energy Trends Table 4.1)



Demand for natural gas was 141 TWh in Quarter 3 2022, up 4.0 per cent when compared with Quarter 3 2021. This was largely the result of increased gas use for electricity generation. **Gas used for electricity generation increased by 15 per cent**, reaching its highest level since Quarter 1 2018. This was a result of increased overall electricity generation to meet demand for exports to France due to maintenance on the French nuclear fleet.

Domestic demand dropped by 12 per cent in comparison with last year, despite marginally colder temperatures across the quarter as a whole. The year-on-year decrease could reflect changes in behaviour as more normal working patterns resumed and people spent more time outside the home following the ending of Covid-19 restrictions. It may also include reductions in consumption as gas prices increased. Demand by industrial and other final users (such as commercial use) dropped by 4.0 and 1.3 per cent respectively in Quarter 3 2022 in comparison with the previous year.

Section 5: Electricity

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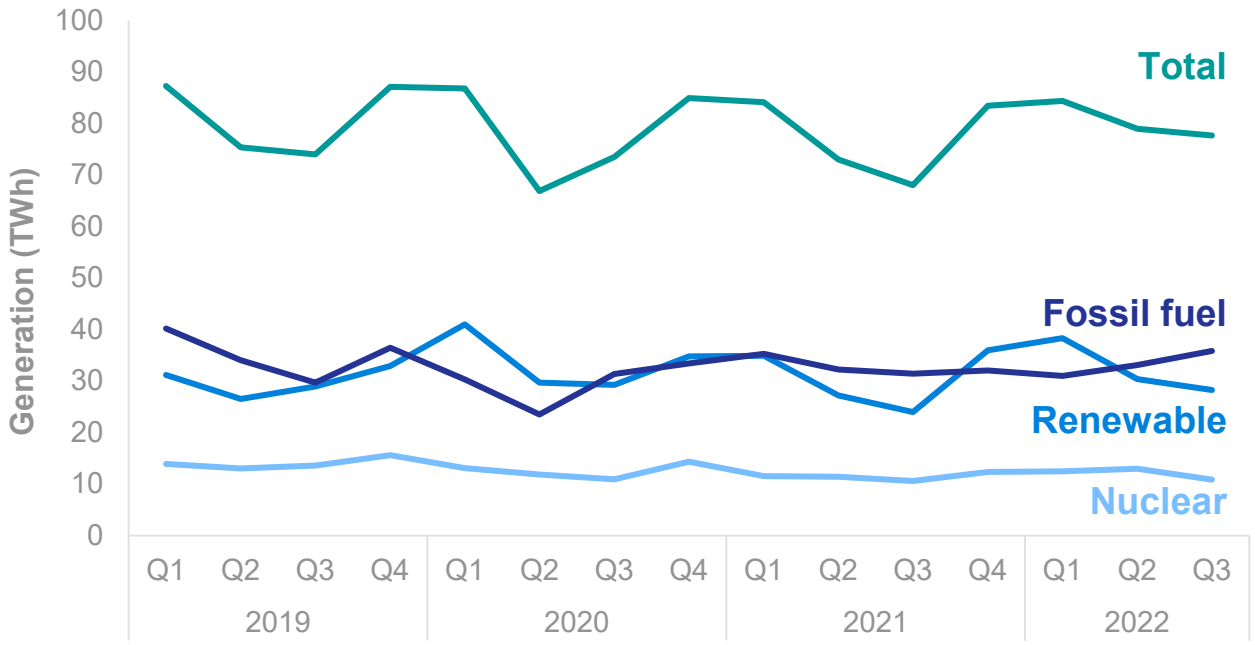
Key headlines

Electricity generation increased substantially in Quarter 3 of 2022, up 14 per cent to 77.7 TWh. In contrast, electricity demand decreased by 3.9 per cent over the same period. The increased generation was driven by high demand for electricity exports which were more than eight times higher than Quarter 3 2021.

Low carbon sources generated 50.3 per cent of the total in Quarter 3 2022, down 0.5 percentage points on the previous year, as the growth in renewable and low carbon generation was outpaced by the growth in gas use**.** Renewable electricity generation increased by 18 per cent to 28.2 TWh while nuclear generation increased 2.4 per cent. Fossil fuels generated 36.2 TWh in Quarter 3 2022, a generation share of 46.6 per cent, higher than renewable's share and an increase of 16% on last year.

Domestic and industrial demand decreased in Quarter 3 2022 while demand from commercial users increased. Domestic electricity consumption decreased by 7.1 per cent with the end of Covid-19 restrictions increasing time spent away from home. Electricity consumed by the industrial sector was down 7.8 per cent while consumption by other final users (including commercial users) increased by 0.9 per cent.

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



Quarter 3 of 2022 saw total electricity generation of 77.7 TWh, which was a 14 per cent increase compared to Quarter 3 2021. This was in sharp contrast to the 3.9 per cent decrease in total demand over the same period. The increased generation was driven by high demand for electricity exports which were more than eight times higher than Quarter 3 2021 at a record 7.4 TWh. The rise in exports is in line with greater demand for electricity in France as a result of reduced nuclear output there.

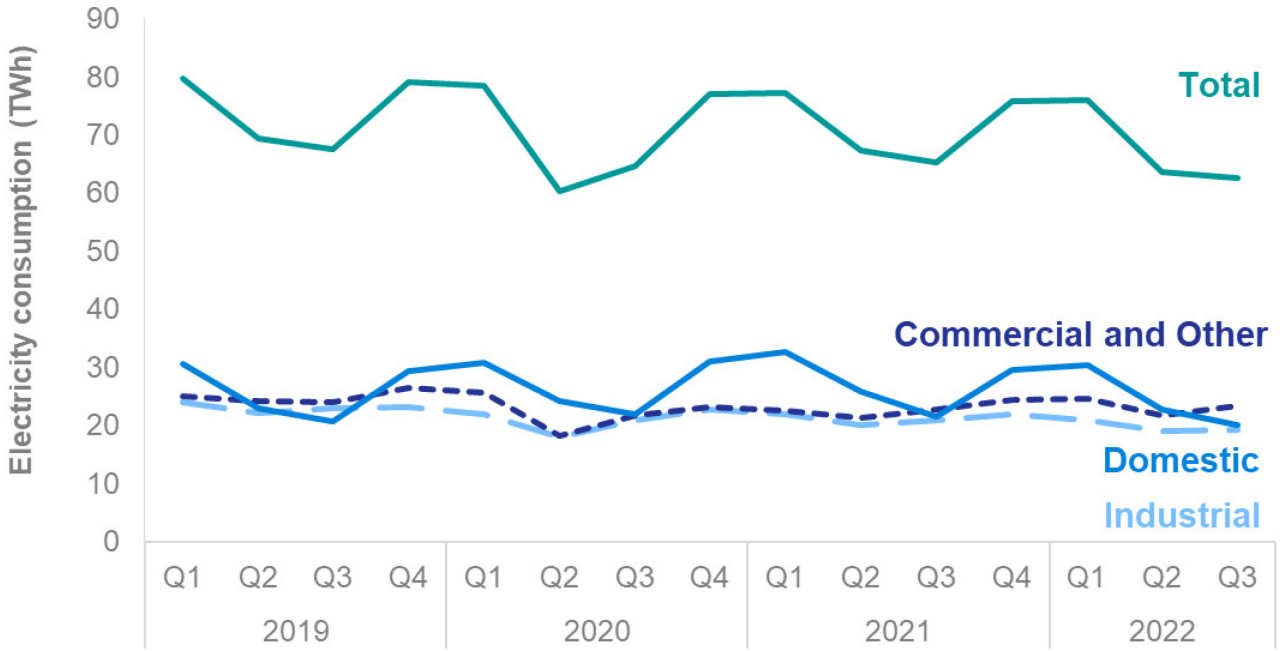
Renewable electricity generation was 28.2 TWh in Quarter 3 2022, 18 per cent higher than the same period in 2021. This marked a return to more normal levels after unusually low generation in Quarter 3 2021. There were increases for all renewable technologies with a particularly large increase for wind generation, up 33 per cent to 13.5 TWh. Average wind speeds increased, though were still below the long-term average. This

was offset by a record increase in offshore wind capacity over the year. The summer heatwave during Quarter 3 2022 saw solar generation increase 20 per cent to 4.8 TWh and hydro increase by 9 per cent to 0.7 TWh.

Low carbon sources generated 50.3 per cent of the total in Quarter 3 2022, down 0.5 percentage points on the previous year as fossil fuel generation increased. Nuclear generation increased by 2.4 per cent to 10.9 TWh in Quarter 3 2022, despite lower overall operational nuclear capacity, following the closure of Hunterston B in January 2022 and Hinkley Point B starting defueling in August 2022. The increased generation reflects the remaining nuclear sites operating at higher utilisation.

Fossil fuels generated 36.2 TWh in Quarter 3 2022, substantially higher than renewable sources. This was a 16 per cent increase compared to Quarter 3 2021 and was needed to meet UK demand as well as the increased demand for electricity exports. Gas remained the fuel with the highest generation at 34.3 TWh, 17 per cent higher than in Quarter 3 2021 and equivalent to 44.2 per cent of generation. Coal generation was 1.5 TWh, similar to the same period in 2021 and representing a 1.9 per cent share of total generation.

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



Total consumption of electricity was 62.4 TWh in Quarter 3 2022. This was a 4.5 per cent decrease compared to Quarter 3 of 2021 and the second lowest quarterly value on the published data series, with only Quarter 2 2022 being lower. Formal Covid-19 restrictions ended in July 2021, so these will have limited effect on the year-on-year comparison, though consumption continued to show the effect of changes in consumer behaviour. Year on year comparisons were also affected by the additional bank holiday for the funeral of Queen Elizabeth II in September.

Domestic consumption decreased 7.1 per cent compared to Quarter 3 2021. The year-on-year decrease could reflect changes in behaviour as more normal working patterns resumed and people spent more time outside the home following the ending of Covid-19 restrictions. It may also include reductions in consumption as electricity prices increased.

Industrial consumption also decreased in Quarter 3 2022 while there was an increase for commercial users. Electricity consumed by the industrial sector decreased by 7.8 per cent compared to Quarter 3 2021, broadly mirroring the trends shown in the manufacturing Index of Production. Consumption by other final users (including the commercial sector) increased by 0.9 per cent in Quarter 3 2022 compared to the same period in 2021. This reflects the end to formal Covid-19 restrictions and return to more normal patterns of behaviour and may also reflect increased consumption for cooling during the unusually warm weather in July and August.

Section 6: Renewables

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Key headlines

Renewable electricity generation was 28.2 TWh in Quarter 3 2022, 18 per cent higher than 2021, although last year had been the lowest third quarter since 2017 due to unfavourable weather conditions and some onshore wind outages. Most of the increase was in wind generation driven by higher wind speeds and new offshore wind capacity. **Solar PV generation was a record for Quarter 3**, driven by longer sunlight hours during the summer's heatwave.

Over the last year, 3.4 GW in new renewable capacity has been added, a 6.9 per cent increase. Most of the new capacity was in offshore wind (2.8 GW), continuing strong year-on-year growth that began in the first quarter of 2022 (with the third quarter showing a growth of 25 per cent on the same period last year).

Renewables' share of electricity generation was 36.3 per cent in Quarter 3 2022, up 1.1 per cent on last year. On a technology basis, wind generation was 17.3 per cent of total generation, and bioenergy was 11.9 per cent.

Chart 6.1 Change in renewable generation and capacity between Q3 2021 and Q3 2022 (Energy Trends table 6.1)

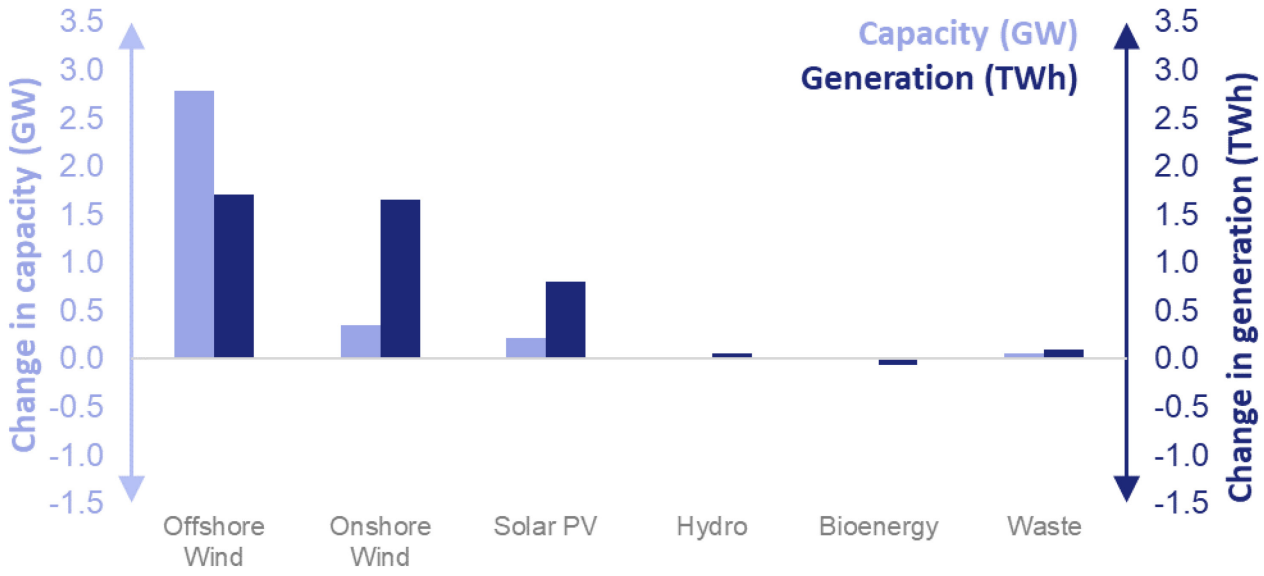
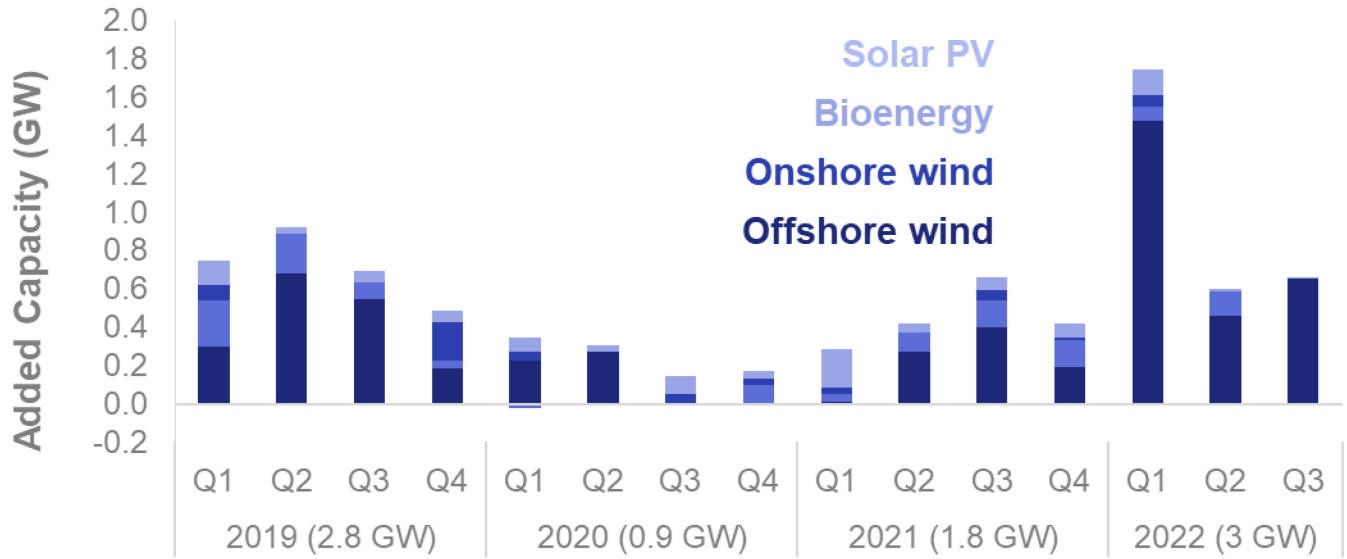


Chart 6.1 compares changes in capacity and generation by technology for Quarter 3 in 2021 and 2022. Where capacity and generation trends conflict, it tends to indicate the dominance of weather effects. Most notable for this quarter is the divergence for onshore wind; with a modest increase in capacity, generation showed strong growth at 41 per cent, although generation in Quarter 3 2021 was unusually low due to outages. Offshore wind capacity grew by 25 per cent, and generation by 28 per cent. The unusually sunny conditions over the summer saw solar PV generation increase by 20% to a record for Quarter 3 (there was only a modest 1.6 per cent increase in new capacity[1]). Hydro generation also increased by 9.3 per cent, in line with an 8 per cent rise in average rainfall[2]. Bioenergy generation and capacity is largely unchanged since last year.

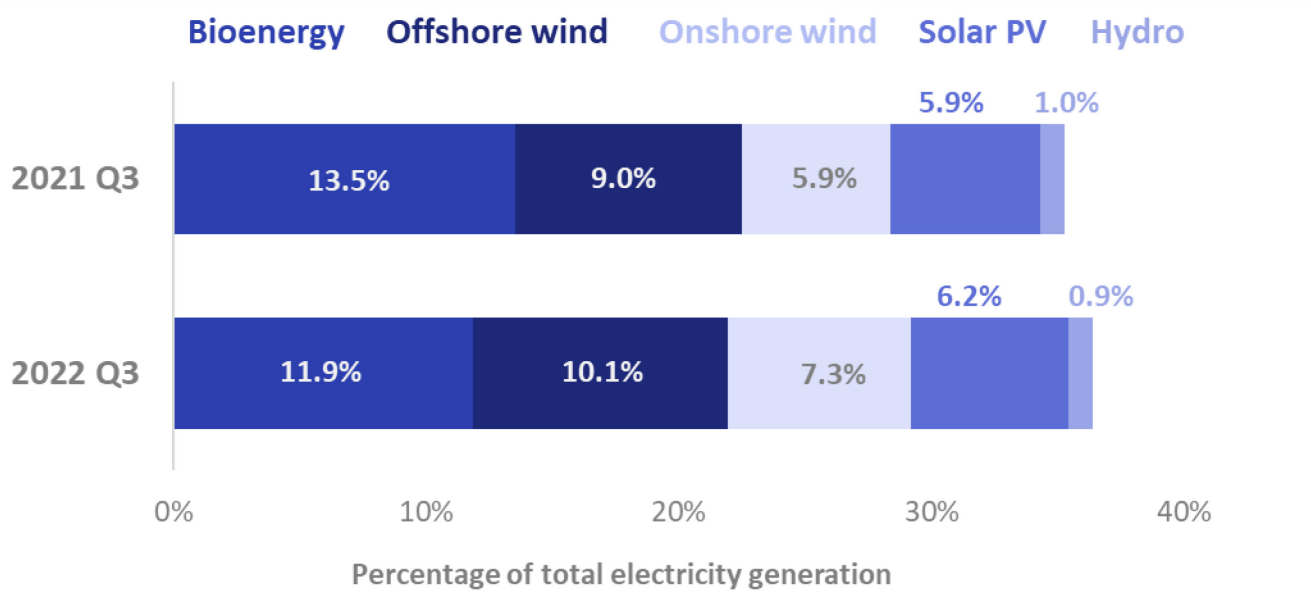
[1] The Feed in Tariff (FiT) scheme[2] closed March 2019. BEIS continues to monitor small scale generation using the Central FiTs Register, and Micro Generation Certification Scheme (MCS) registrations and the Renewable Energy Planning Database (REPD). Currently excluded are unsubsidised installations below 1MW not MCS registered. We are reviewing data sources to improve coverage.
[2] See technical information page for links to weather data.

Chart 6.2 Added capacity since 2019 for the leading technologies (Energy Trends table 6.1)



Offshore wind capacity year on year growth increased building further on very strong growth in Quarter 1 2022 (23 per cent) and is now at 25 per cent. Notable new capacity over the last year includes Moray East in Scotland (1.0 GW) and Hornsea 2 in England, the largest offshore wind farm to date (1.4 GW). Seagreen in Scotland came online in the most recent quarter (0.2 GW). Onshore wind saw a modest increase in capacity at 0.3 GW and solar PV at 0.2 GW. Since the end of 2021 and for the first time since the Feed-in Tariff closed to new entrants, there have been record numbers of new Solar PV installations every month, but the contribution to capacity remains modest owing to their small size.

Chart 6.3 Renewables' share of electricity generation – Q3 2021 and Q3 2022 (Energy Trends table 6.1



In Quarter 3 2022, renewables' share of generation was 36.3 per cent, 1.1 percentage points up on Quarter 3 2021 and lower than fossil fuels' share for the second consecutive quarter (see Chart 5.1).

Data tables and special articles

Data in this release

Data are collected by BEIS 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, 2021

Electricity generation and supply in Scotland, Wales, Northern Ireland and England, 2017 to 2021

Feed-in Tariff load factor analysis: 2021/22

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 published on 28 July 2022:
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 BEIS 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 published by BEIS, please contact Kevin Harris:
Tel: 0747 135 8194
e-mail: kevin.harris@beis.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	.39683	**toe**	1	41.868	11.63	396.83
TJ	.023885	1	.27778	.0094778	**GJ**	.023855	1	277.78	9.4778
GWh	.085985	3.6	1	.034121	**kWh**	.000085985	.003600	1	.034121
million therms	2.52	105.51	29.307	1	**therms**	.00252	.105510	29.307	1

toe = tonne of oil equivalent
ktoe = thousand 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
Other final users	
Agriculture	01-03
Commercial	45-47, 52-53, 55-56, 58-66, 68-75, 77-82
Public administration	84-88
Other services	90-99
Domestic	Not covered

Revisions policy

Figures for the latest periods are provisional and are liable to subsequent revision. The BEIS 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.

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 BEIS'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 BEIS'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 BEIS 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

This is a National Statistics publication. National Statistics status means that our statistics meet the highest standards of trustworthiness, quality, and public value, and it is our responsibility to maintain compliance with these standards.

The Office for Statistics Regulation confirmed continued designation of Energy Trends as National Statistics in 2018 following a compliance check. A full assessment against the Code of Practice was last conducted in June 2014.

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 BEIS 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.

This publication is available from: https://www.gov.uk/government/collections/energy-trends

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Diversity and security of gas supply in Europe, 2021

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Key headlines

Europe consumed 558 billion cubic metres (bcm) of natural gas in 2021.[1] Indigenous production within Europe could have met 40 per cent of demand in 2021, largely due to substantial production by Norway, one of the largest gas-producing countries in the world and by far the largest in Europe.

The UK is the second largest producer of natural gas in Europe and, in 2021, could have met 42 per cent of national demand with indigenous production. This was despite production a record low in 2021 due to substantial maintenance of key North Sea infrastructure. Imports from a diverse range of sources met the remainder of supply, leading the UK to rank fourth overall when considering the security of supply index presented in this article.

An extensive pipeline network provides the infrastructure for much of the gas trade across Europe. Additionally, in recent years Liquefied Natural Gas (LNG) has come to play an important role in balancing both UK and European gas markets. In 2021, the UK and Europe sourced LNG imports from more countries some of which are further afield, due to increased demand in Asia.

Background

Demand for natural gas is met through indigenous production and imports the sum of which is equal to gross supply. In 2021, indigenous production met 40 and 42 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). Pipeline imports made up 81 per cent of total European imports, compared to 19 per cent for LNG. For the UK, this was 72 per cent and 28 per cent respectively.

This article assesses the diversity and security of gas supply in Europe and the UK. The data used in this article were sourced from the International Energy Agency (IEA), and as such reflect IEA member state countries. This includes the majority of Europe. The European countries not included are Andorra, Kosovo, Liechtenstein, Monaco, San Marino, and Vatican City. Cyprus, Iceland, and Montenegro were excluded from this analysis as they did not produce or consume natural gas in 2021. Russia is not considered part of Europe for this analysis.

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. In general, high self-sufficiency means natural gas supply is secure.

Diversity index measures the number of import sources for a given country, weighted by each source country's political stability[2]. 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 will have a

[1] Europe wide data for 2022 are not yet available. Information on UK production and trade to October 2022 can be found in Energy Trends.

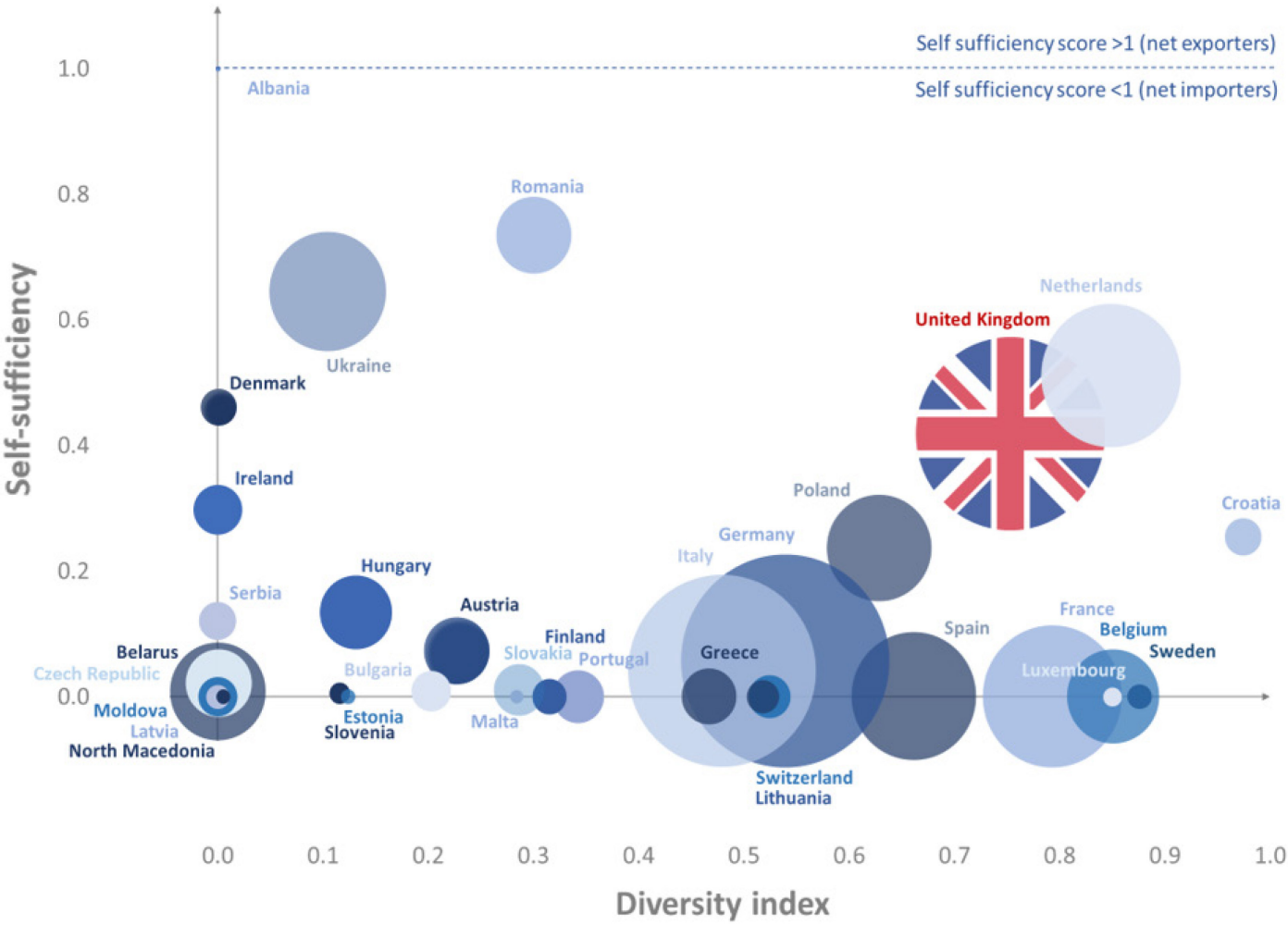
[2] Data sourced from World Bank governance indicators. See Appendix 1 for underlying data and Appendix 2 for method.

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, 2021



Norway has been excluded as it is substantially larger than the other countries and therefore distorts the graph, 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

In 2021, Norway and Albania were the only self-sufficient countries in Europe. Norway had a self-sufficiency score of 21.6, meaning it produced significantly more natural gas than it used. Historically Denmark has been self-sufficient however the closure of Tyra, the country's largest natural gas field, has led to lower production, and therefore a lower self-sufficiency score of 0.46. Reopening of Tyra has been delayed to 2023 due to manufacturing and supply chain disruptions. Romania, Ukraine, and the Netherlands met more than half of demand with indigenous production.

The UK had a self-sufficiency score of 0.42 in 2021, meaning that UK indigenous production met 42 per cent of demand. Previously UK production had sat at around 50 per cent of demand but this reached a record low in 2021, falling almost a fifth on the previous year. This was due to extensive maintenance on key North Sea

infrastructure including the Forties Pipeline System (FPS) which serves a significant proportion of UK continental shelf (UKCS) oil and gas infrastructure. Despite this, the UK remained the seventh most self-sufficient country in Europe.

16 countries had a self-sufficiency score of 0 as they didn't produce any natural gas in 2021 and were reliant on imports to meet supply.

Diversity

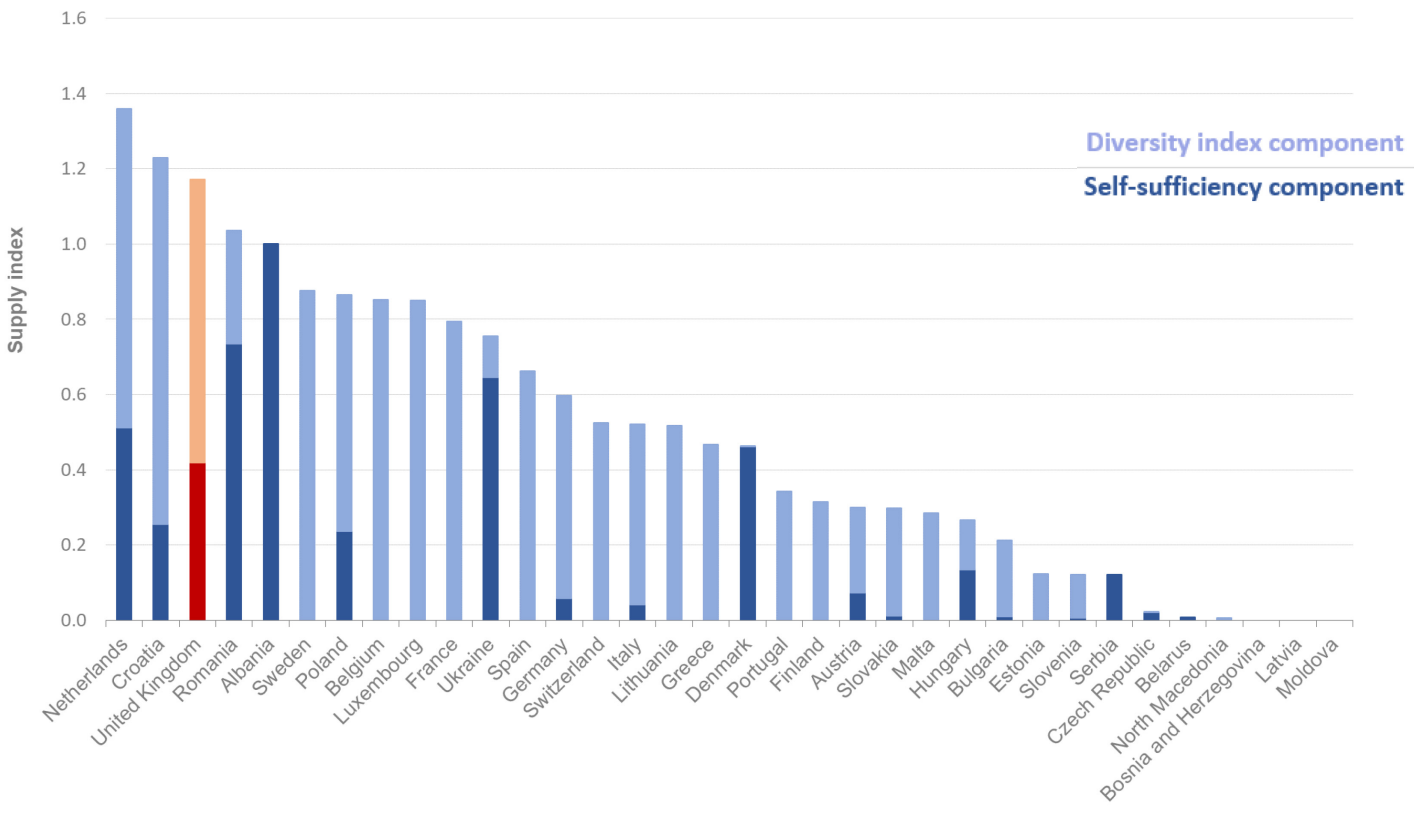
Counties use imports to meet demand. Western European countries tend to have higher diversity indexes. This is in part related to their proximity to the sea which facilitates shipments of LNG from a large number of countries in comparison to pipelines alone. All countries with a diversity index above the European average of 0.35 were in Western Europe, the highest being Croatia, Sweden, Belgium, Luxembourg, the Netherlands, France and the UK. Croatia had the highest diversity index of 0.99, importing gas from twelve countries in 2021. This followed the opening of Croatia's first LNG terminal, which saw a diversification of import sources.

The UK had a diversity index of 0.76, larger than the European average. The UK's high score was due to imports from multiple sources. Import sources to Europe and the UK will be discussed in greater detail later in this article.

Demand

Germany was the largest consumer of natural gas in Europe, consuming 94 bcm in 2021, followed by the UK at 78 bcm. Some large consumers appear in the bottom right quadrant of Chart 1, showing a high diversity index yet relatively lower self-sufficiency score. As self-sufficiency shows production in relation to demand, it is harder to be self-sufficient if a country consumes more natural gas. Albania consumed the least natural gas, and was self-sufficient, as it met demand exactly with indigenous production.

Chart 2: Supply index for European countries, 2021



Norway has been excluded from this graph, see Appendix 1 for underlying data

Chart 2 shows the supply index for European countries in 2021. 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

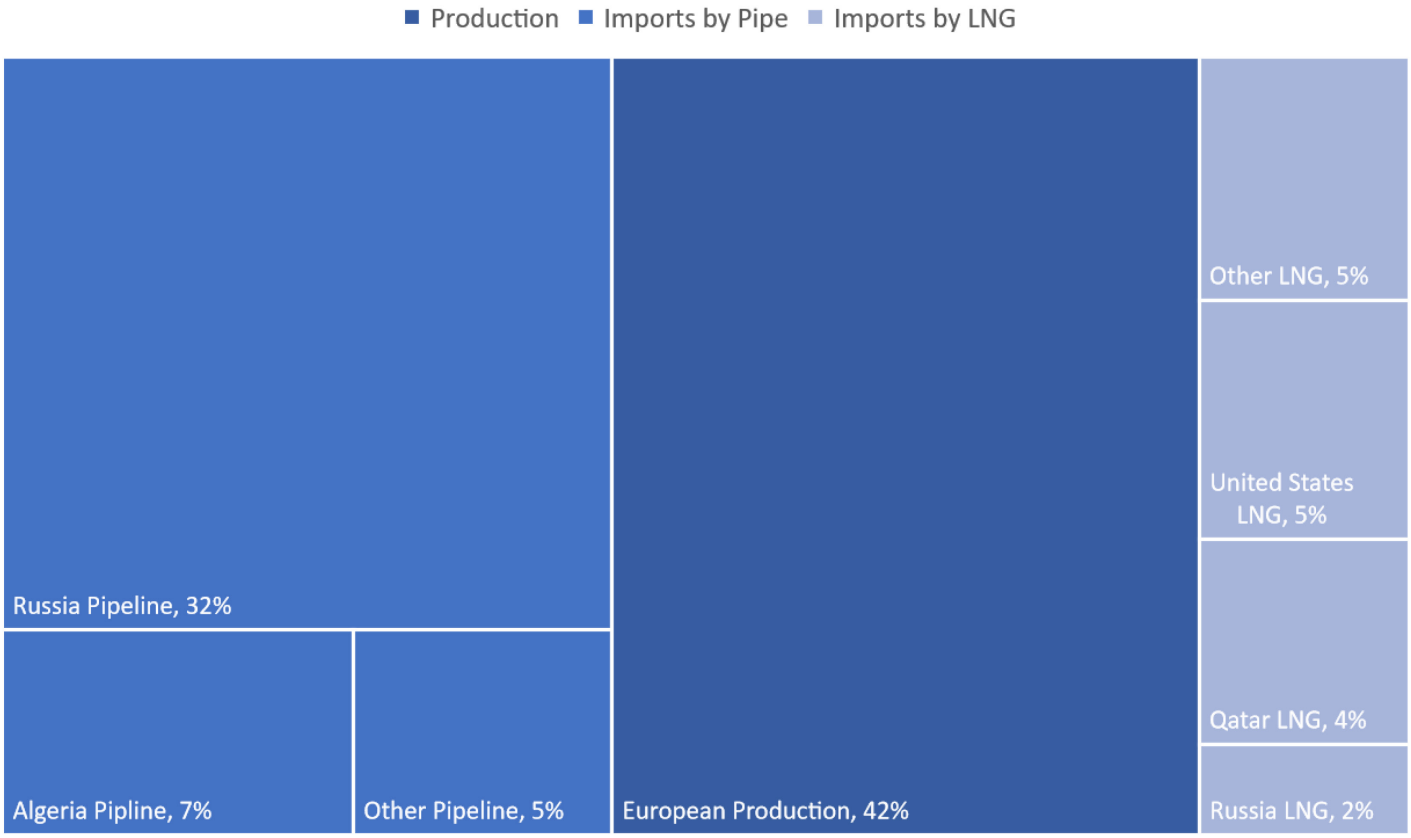
In 2021, most countries had a supply index between 0 and 1.5. The only country outside of this range was Norway, which had a supply index of 22.0, this was the result of its high self-sufficiency score. The average supply index across Europe was 1.09. However, when excluding Norway's score of 22.0, the average falls to 0.5. For most European countries, a diverse range of imports made a greater contribution to overall security of supply rather than indigenous production. Sixteen countries used imports alone to meet demand, with Bosnia and Herzegovina, Latvia, and Moldova meeting demand with only one import source - leading to a supply index of zero.

The UK ranked in fourth place with a supply index of 1.18, behind Norway, the Netherlands and Croatia. This reflects the UK's relatively high self-sufficiency and diversity index scores.

European gas supply

The majority of European and UK natural gas imports arrive via pipeline as infrastructure is well-established. In 2021, imports by pipe made up 81 per cent and 72 per cent of total imports respectively. Pipeline infrastructure means it is often convenient to import gas from neighbouring countries. Countries can also import natural gas as shipments of LNG. This is gas that has been cooled to a liquefied state, making it easier to store and transport. It can then be regasified at import terminals, before being transferred to the pipeline system. The UK has well-established LNG infrastructure, with three import terminals: the Isle of Grain, South Hook, and Dragon[3].

Chart 3: Sources of European gas supply, 2021



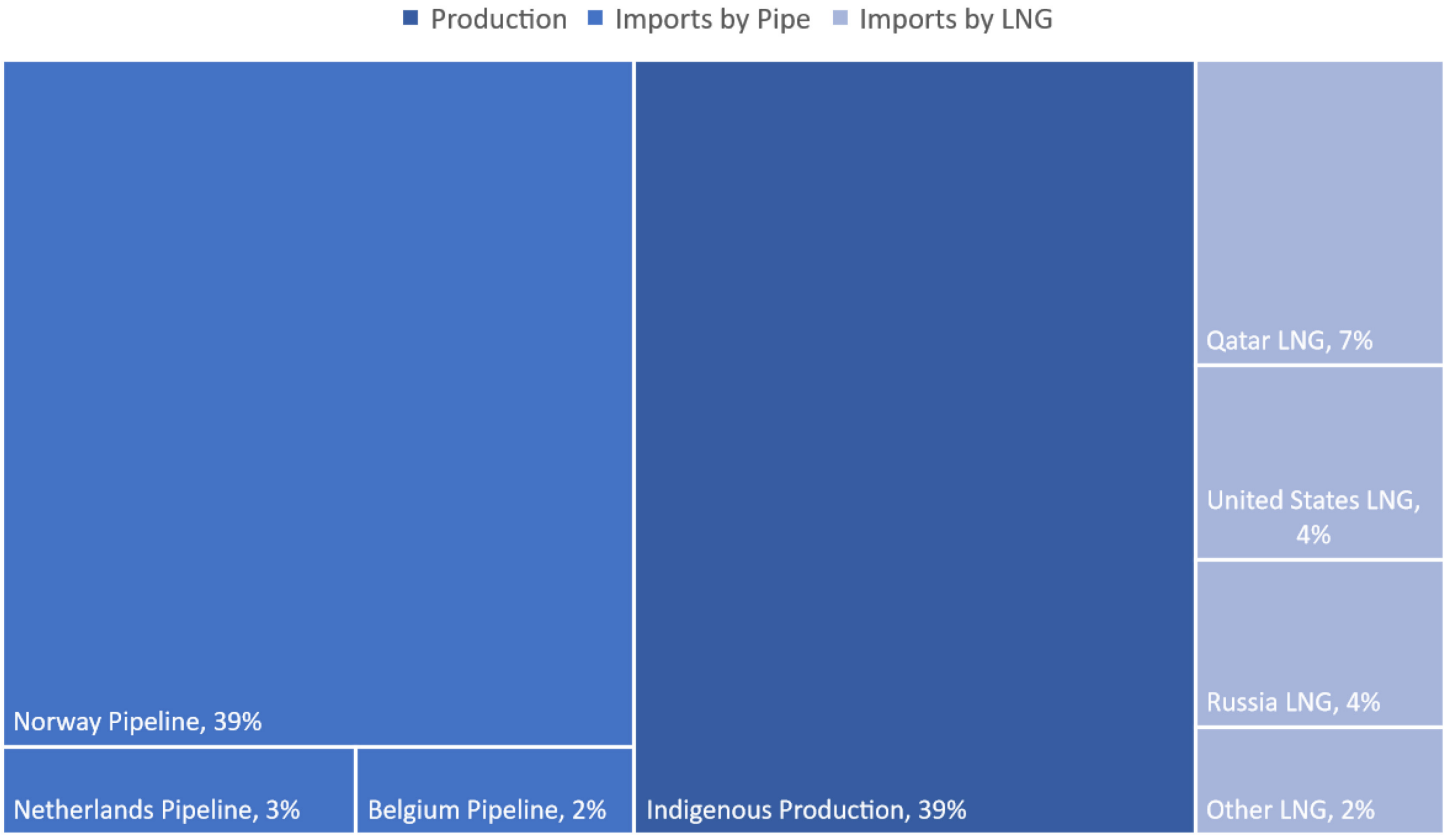
[3] For more information on LNG trends please see Supply of Liquified Natural Gas in the UK, this will be updated with data for 2022 in March 2023

Chart 3 shows gross European natural gas supply in 2021. Gross supply is equal to indigenous production plus imports; imports have been split into pipeline and LNG sources. Smaller quantities of gas imports have been grouped together as 'Other Pipeline' and 'Other LNG' (see Appendix 1 for the complete list).

When considering European countries together, pipeline imports from Russia were the largest single import source, accounting for 32 per cent of gross supply. Russian LNG made up an additional 2 per cent of Europe's gas supply. Six European countries imported gas from Russia alone due to their proximity and existing pipeline infrastructure. 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. Algeria was the second largest import source of natural gas to Europe accounting for 7 per cent of supply, followed by Azerbaijan, Libya, and Turkey.

In 2021, 27 per cent of LNG came from the US, overtaking Qatar at 23 per cent, who have historically been Europe's largest LNG source. The diversification of LNG imports can be observed due to increased demand from Asia in early 2021, with LNG imports from Nigeria, Algeria, Trinidad and Tobago, and Peru (classed within 'Other LNG') increasing considerably.

Chart 4: Sources of UK gas supply, 2021



Similar to Chart 3, Chart 4 shows indigenous production and imports for the UK in 2021.

UK gas production reached a record in 2021 following maintenance on key North Sea infrastructure. Production fell to 364 TWh, which was 47 TWh below the previous record low in 2013 and over 70 per cent lower than the peak in 2000. This was not the case across Europe, with European production remaining stable on the previous year.

UK natural gas imports increased by 17 per cent in comparison with the previous year to account for this low production. The largest import source was Norway due to shared infrastructure ion the North Sea, constituting 39 per cent of gross supply. The UK has two other pipeline import sources, the Netherlands and Belgium; all three import sources are deemed politically stable, meaning that the UK has a high diversity index.

Similar to European trends, UK imports of LNG fell by one fifth compared with high levels in 2020, as a cold winter in Asia increased demand. As a result, LNG imports diversified, as the UK imported LNG from 9 countries including Peru and Algeria (categorised under 'Other LNG' in Chart 4). Historically, a large proportion

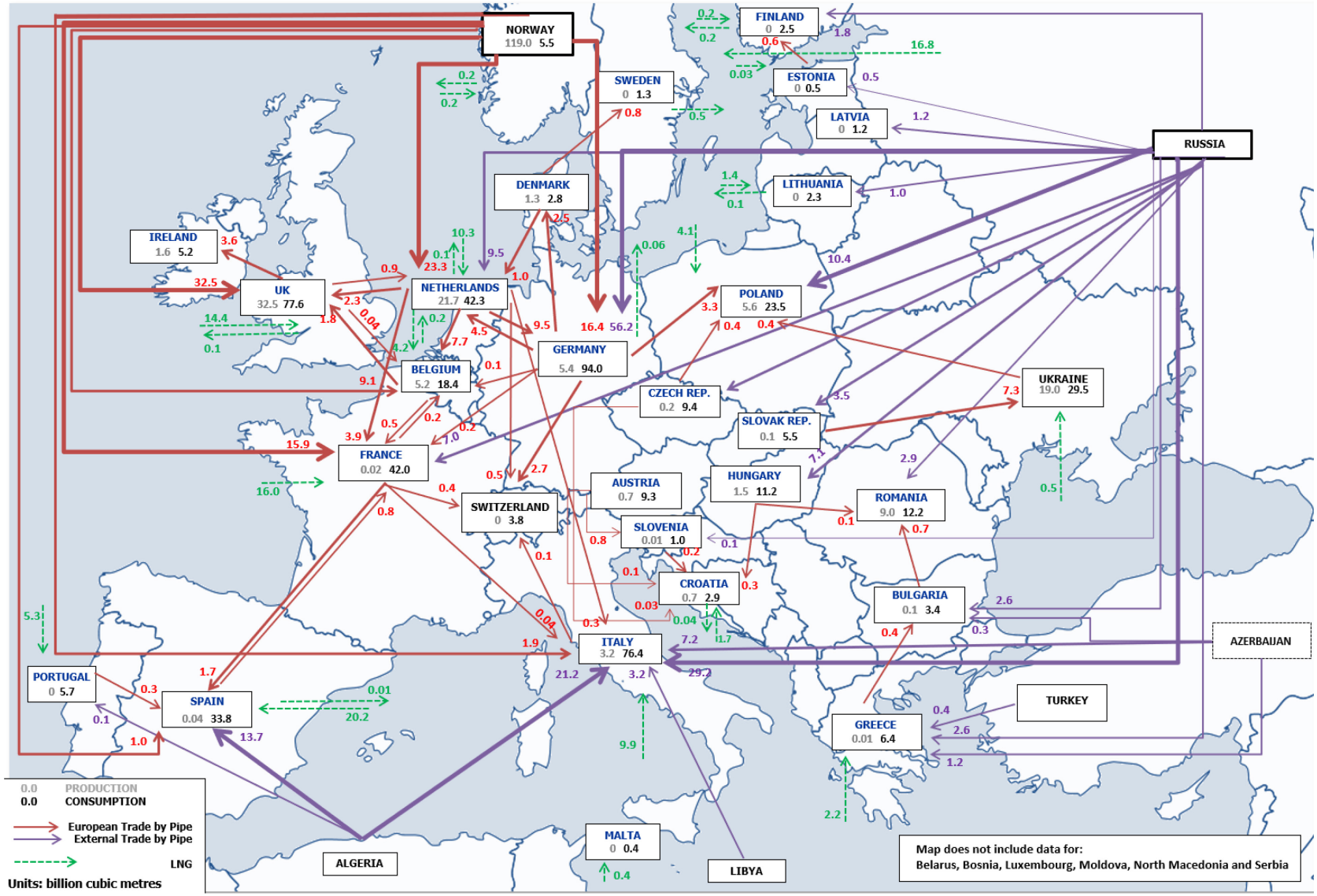
of LNG imports have been Qatari, peaking at 98 per cent in 2012. However, in 2021, Qatari imports accounted for just under 40 per cent of total LNG imports, the lowest in over a decade.

Imports of LNG from the US and Russia increased considerably since 2018, accounting for 7 and 6 per cent of total imports respectively in 2021. In 2022, following Russia's invasion of Ukraine, this has decreased significantly, the last cargo of LNG from Russia was received in March 2022. Sanctions on Russian gas will come into force on the 31 December 2022[4].

[4] For more recent data on Russian LNG imports see Energy Trends Table 4.4.

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	62
Austria	0.07	0.23	0.30	9333
Belarus	0.01	0.00	0.01	19966
Belgium	0.00	0.86	0.86	18367
Bosnia and Herzegovina	0.00	0.00	0.00	243
Bulgaria	0.01	0.21	0.21	3418
Croatia	0.25	0.99	1.24	2926
Czech Republic	0.02	0.00	0.02	9459
Denmark	0.46	0.00	0.46	2815
Estonia	0.00	0.13	0.13	456
Finland	0.00	0.32	0.32	2584
France	0.00	0.80	0.80	42004
Germany	0.06	0.55	0.60	94043
Greece	0.00	0.47	0.47	6446
Hungary	0.13	0.13	0.27	11247
Ireland	0.30	0.00	0.30	5214
Italy	0.04	0.49	0.53	76400
Latvia	0.00	0.00	0.00	1187
Lithuania	0.00	0.52	0.52	2269
Luxembourg	0.00	0.86	0.86	762
Malta	0.00	0.29	0.29	379
Netherlands	0.51	0.86	1.37	42333
Norway	21.56	0.41	21.97	5521
Poland	0.24	0.64	0.87	23542
Portugal	0.00	0.35	0.35	5725
Republic of Moldova	0.00	0.00	0.00	3262
Republic of North Macedonia	0.00	0.01	0.01	421
Romania	0.73	0.30	1.04	12262
Serbia	0.12	0.00	0.12	3007
Slovak Republic	0.01	0.29	0.30	5471
Slovenia	0.01	0.12	0.12	952
Spain	0.00	0.67	0.67	33820
Sweden	0.00	0.89	0.89	1301
Switzerland	0.00	0.53	0.53	3824
Ukraine	0.65	0.11	0.76	29504
United Kingdom	0.42	0.76	1.18	77626
Average	**0.74**	**0.35**	**1.09**	**14688**

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

Countries included in 'Other Pipeline' in Chart 3: Azerbaijan, Libya, Turkey, and non-specified sources.

Countries included in 'Other LNG' in Chart 3: Nigeria, Algeria, Trinidad, Peru, Equatorial Guinea, Egypt, Angola and non-specified sources

Countries included in 'Other LNG' in Chart 4: Peru, Algeria, Trinidad, France, Belgium, Nigeria

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, Hungary, Ireland, North Macedonia, Portugal, Slovakia and Ukraine, which is available at www.iea.org/gtf/. This data is collected by the IEA and shows monthly gas flows in Europe.

This publication is available from: www.gov.uk/government/collections/energy-trends

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Electricity generation and supply in Scotland, Wales, Northern Ireland, and England, 2017 to 2021

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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 2021. The UK data in this article is taken from chapters 5 and 6 of the Digest of United Kingdom Energy Statistics (DUKES) 2022; the definitions therefore match those in DUKES. The main text covers the latest five years of data and the corresponding timeseries (including latest revisions) for 2004 to 2021 can be found in the accompanying excel spreadsheet.

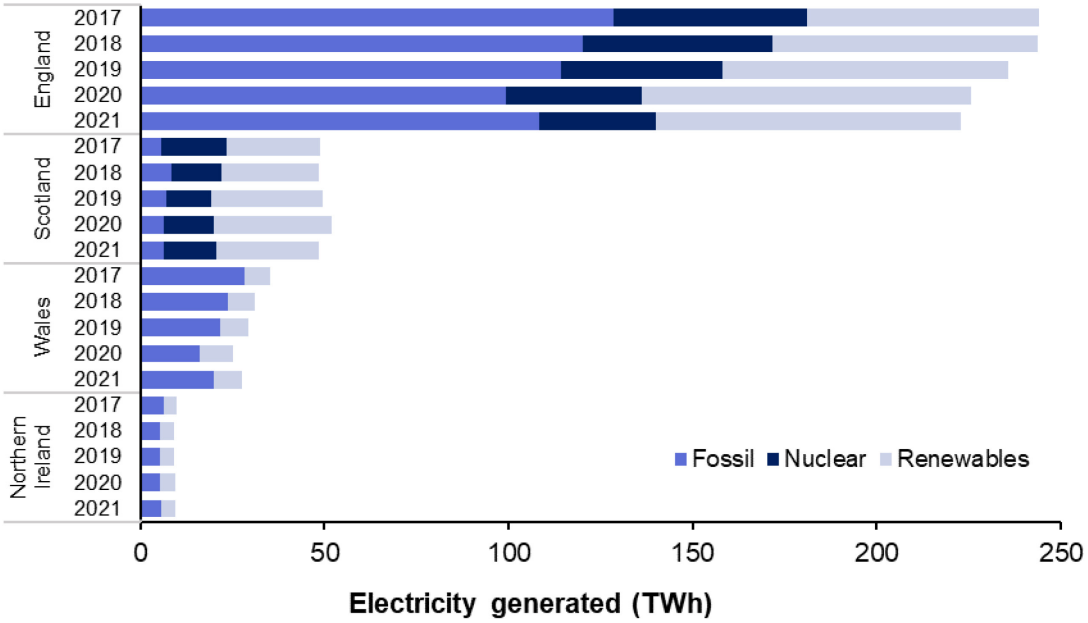
Key headlines

- UK total electricity generation in 2021 was 309 TWh, the lowest value in the published time series, and a decrease of 1.2 per cent compared to 2020. This continues the trend of electricity generation declining year on year. Electricity demand though was up 1.2 per cent from 2020, with record net imports accounting for the difference
- Shares of generation and demand by country remained similar to 2020, with England having the largest share. England's share of demand is larger than its generation share, so it continues to transfer electricity from Scotland and Wales, as well as import electricity from continental Europe.
- UK fossil fuel generation increased 11 per cent in 2021 as higher demand for electricity and lower renewable generation increased the need for fossil fuel generation. Wales and England both saw increases in fossil fuel generation, but these remained below 2019 levels. Northern Ireland was the only nation where fossil fuel generation increased compared to 2019 levels.
- Renewable generation fell in all four nations in 2021, though was from record levels in 2020. This was driven by less favourable weather conditions for wind, hydro and solar generation. As these technologies account for a higher proportion of Scotland's capacity, its renewable generation fell by 14 per cent.
- UK nuclear generation fell by 8.7 per cent compared to 2020, to the lowest level of nuclear generation in more than twenty years. Nuclear generation fell by 15 per cent in England but rose by 8.0 per cent in Scotland where fewer outages took place.
- Despite declines in renewable and nuclear generation, the low carbon share of total UK generation stood at its second highest value on the time series at 54.5 per cent, with a 51.4 per cent share in England, 86.9 per cent in Scotland, 27.5 per cent in Wales, and 40.8 per cent in Northern Ireland

Generation, consumption, and trade

During 2021 the UK generated 309 TWh of electricity, a decrease of 1.2 per cent on 2020 and the lowest value in the published time series. This contrasted with a 1.2 per cent increase in electricity demand, with record net imports accounting for the difference. Electricity demand had been on a downward trend since 2015, but increased in 2021 relative to 2020 with the lifting of Covid-19 restrictions. In total, 2021 saw UK generation down by 9.0 per cent from its peak in 2016. From 2020 to 2021, Wales was the only nation to experience a considerable rise in generation, an increase of 11 per cent on 2020, due to increased gas generation. Generation in Scotland, England, and Northern Ireland fell by 7.0 per cent,1.2 per cent, and 0.6 per cent respectively. Chart 1 shows total electricity generation by country, between 2017 and 2021, with generation divided by fossil fuel, nuclear and renewable technologies.

Chart 1: Total electricity generation by country (all generating companies), 2017 to 2021.



Generation Shares

Shares of electricity generated by nation remained broadly stable compared to the previous year, with England having the largest share of electricity generation at 72.2 per cent, decreasing by 0.1 percentage points relative to 2020. Scotland accounted for the second largest share, at 15.7 per cent, though down 0.9 percentage points against 2020. Wales increased its share by 1.0 percentage points to 9.0 per cent of generation, making it the only nation to have increased its share of generation. Northern Ireland, the nation with the lowest share, remained responsible for 3.1 per cent of total generation. Scotland's reduction in generation share reflects lower renewable generation as less favourable weather conditions for wind, solar and hydro reduced renewable generation, which make up a higher percentage of Scotland's generation (57.0 per cent of total generation compared to the rest of the UK at 39.6 per cent). Wales meanwhile experienced the opposite, with an increased generation share resulting from greater fossil fuel generation, particularly gas, which constituted 63.8 per cent of Welsh generation compared to the UK average of 39.9 per cent. England and Northern Ireland both maintained consistent shares of generation, as decreases in renewable generation were offset by increased generation from fossil fuels.

Fossil Fuels

UK fossil fuel generation increased by 11 per cent between 2020 and 2021, though remained 6.6 per cent below 2019 levels. As a share of generation fossil fuels stood at 42.6 per cent, up 4.6 percentage points on 2020 due to less favourable weather conditions for renewables. The year on year rise in fossil fuel use reflects lower renewable generation as well as increased demand as the UK emerged from Covid-19 lockdown restrictions, under which many businesses and industries had seen their activities severely limited. Wales experienced the largest year on year rise in fossil fuel generation, up 30.0 per cent, though compared to 2019 this was a 5.7 per cent decline. England similarly experienced a year on year rise of 9.6 per cent between 2020 and 2021, but was still 6.8 per cent lower than in 2019. Northern Ireland was the only nation to see a rise in fossil fuel generation since 2019, up 9.7 per cent (8.2 per cent greater than in 2020). Though much of the increase in fossil fuel generation in Northern Ireland was led by coal (up 39 per cent on 2019), in the UK as a whole coal generation fell 5.8 per cent compared to 2019. This means that coal generation accounted for just 2.1 per cent of total UK generation in 2021, down from a fifth in 2015.

Nuclear

UK-wide nuclear generation fell by 8.7 per cent in 2021 to 45.9 TWh, its lowest level since 2008, accounting for a 14.9 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 15 per cent in England but rose by 8.0 per cent in Scotland where fewer outages took place. 2021 also saw the decommissioning of Dungeness B in England, however the site had been unable to generate since 2018 so does not represent a

material reduction in capacity. Since the closure of Wylfa in Wales during 2015, there has been no nuclear generation within Wales or Northern Ireland.

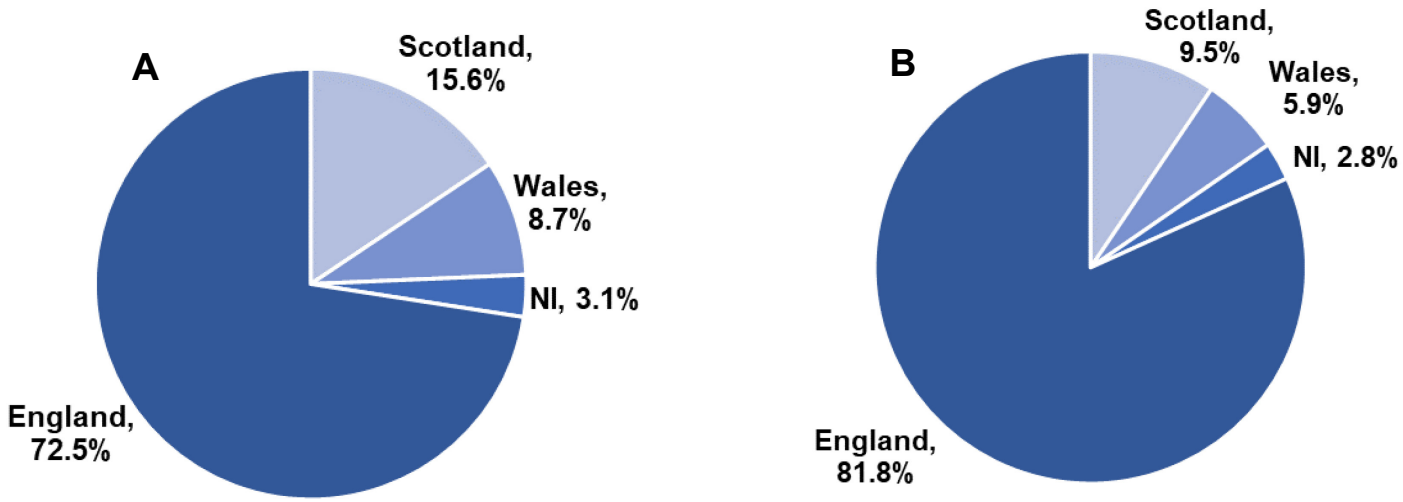
Renewables

Though renewable generation fell by 9.3 per cent for the UK in 2021, it is still the second highest year on record, at 122 TWh. The renewable share of generation was 39.6 per cent, down 3.6 percentage points compared to 2020, and was lower than the share of generation from fossil fuels (42.6 per cent), a contrast to the previous year. This was driven by decreased wind generation, because of unusually low average wind speeds across most of 2021. Weather conditions were also less favourable for hydro and solar generators. This impacted Scotland the most as it has a larger share of these technologies and so Scotland's renewable generation fell by 14 per cent.

Consumption

Despite the UK beginning its recovery from Covid-19, shares of annual electricity consumption of the respective UK nations did not vary much from 2020 (which itself did not significantly differ from 2019). The overwhelming majority of demand came from England (81.8 per cent), 9.5 per cent from Scotland, 5.9 per cent from Wales, and 2.8 per cent from Northern Ireland. This reflected minimal difference from the average across the previous extent of the time series (2004-2020), where average consumption shares were 81.8 per cent, 9.9 per cent, 5.7 per cent, and 2.6 per cent respectively. Chart 2 shows shares of electricity supply and demand in the UK by country in 2021.

Chart 2: Shares of electricity supply (A) and demand (B) in the UK by country in 2021.



Transfers

To offset the difference between England's electricity generation and demand, net positive transfers were received from Scotland and Wales, as well as from continental Europe via the France, Netherlands, Belgium, and Norway interconnectors (the Norway interconnector came online in October 2021). During 2021, these sources provided 20.0 per cent of England's total electricity consumption, up 2.7 percentage points from 2020. In 2021, Scotland exported 33 per cent of its generation in net transfers to England and Northern Ireland, down from the record level of 37 per cent in 2020.This was in line with lower generation in Scotland (due to lower renewable output), though Scotland's electricity demand also decreased (down 1.7 per cent). Wales exported 13 per cent of its generation in net transfers to England, up 10.2 percentage points from the 2020 value which was the lowest proportion in the time series. Total generation in Wales has fallen 35 per cent since its peak in the time series in 2016, predominantly due to the reduction of coal and gas fired-fired generation. 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 generation mix from fossil fuels towards renewables. Between 2017 and 2021 the fossil fuel share has fallen 5.0 percentage points to 42.6 per cent of UK total generation. Simultaneously, the renewable share has risen 10.4 percentage points to 39.6 per cent of UK total generation. Wales, England, and Northern Ireland all saw substantial decreases in fossil fuel generation, with the decrease largest for Wales at 30 per cent since 2017. Scotland was the only nation to have experienced an increase in fossil fuel generation over the period, with generation from fossil fuels up 15 per cent. Scotland does however remain the nation with the lowest fossil fuel generation share in the UK at 10.9 per cent.

Though for the UK as a whole the share of renewables did decline by 3.6 percentage points from 2020, 2021 still featured the second highest share for renewables on record.

Coal

The introduction of the Carbon Price Floor (CPF) in April 2013 has 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 2.1 per cent in 2021, up slightly from the record low of 1.8 per cent in 2021. Just four coal-fired power stations remain in the UK as the UK works towards net zero emissions by 2050. There were no further closures in 2021 following the closure of both Aberthaw B in Wales and Fiddler's Ferry in England in 2020. The closure of Aberthaw B ended over 125 years of coal generation in Wales, joining Scotland as the only two UK nations with no coal generation. This meant that the increase in coal generation came from England (18 per cent up on 2020) and Northern Ireland (20 per cent up on 2020). Northern Ireland still relies on coal for a 13.2 per cent share of its total generation. In England coal constitutes a 2.4 per cent share of generation.

Gas

Gas largely replaced coal in the generation mix since the introduction of the CPF, and since 2017 has fluctuated around an average of a 39.3 per cent share of generation. Overall, the share of UK gas generation rose to 39.9 per cent in 2021, up 4.2 percentage points since 2020. This was however a drop of 0.8 percentage points against 2019, as Covid-19 restrictions still in place in 2021 reduced the demand for electricity generation. That the share of gas generation was down versus 2019 is the result of an increased share of generation from renewables, up 2.7 percentage points on their 2019 share. Wales remains the UK nation most reliant on gas generation, with gas generation accounting for 63.8 per cent of the total, with an increase of 1.9 percentage points since 2019 making Wales the only UK nation to have increased its share of gas generation since then. England and Scotland both saw falls in the share of gas generation since 2019. Northern Ireland saw its share of gas generation stay the same.

Nuclear

The UK's overall nuclear generation fell for the fifth consecutive year, decreasing by 8.7 per cent since 2020, with much of the decline attributable to the UK's aging nuclear infrastructure requiring more frequent maintenance outages. This meant that 2021 saw the UK's nuclear generation at its lowest level in more than twenty years, as all of the UK's nuclear plants were on outage at times during the year. Between 2020 and 2021 nuclear generation fell by 15 per cent in England but rose by 8.0 per cent in Scotland. The rise in Scotland reflects fewer maintenance outages in 2021 than 2020, whilst England experienced more. Since the closure of Wylfa in 2015 there has been no nuclear generation in Wales.

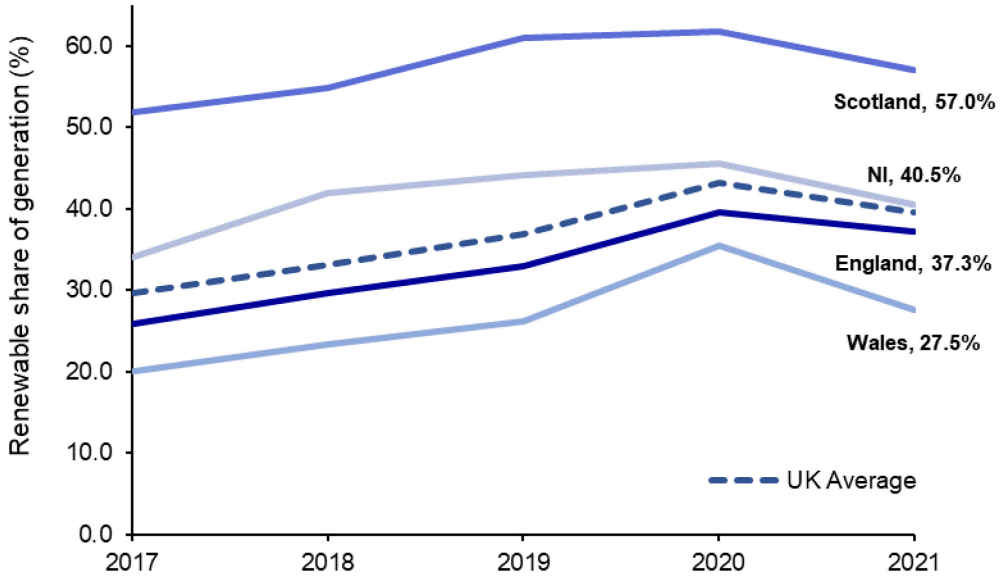
Low Carbon (nuclear and renewable)

Lower renewable generation compared to 2020 meant that the low carbon shares of generation fell in all UK nations from record highs set in 2020, representing an overall decline of 4.8 percentage points year on year. The low carbon share did improve against 2019 however, up 0.2 percentage points overall, meaning that in 2021 low carbon generation was at its second highest share in the time series. In 2021 the low carbon share of generation England stood at 51.4 per cent, 86.9 per cent in Scotland, 27.5 per cent in Wales, and 40.8 per cent in Northern Ireland. Wales and Northern Ireland both have lower low carbon generation shares since neither nation has nuclear capacity, as well as both nations having lower proportions of renewable capacity when compared to England and Scotland.

Renewables

Renewable generators saw their share of generation decrease to 39.6 per cent (down 3.6 percentage points on 2020) as the UK experienced less favourable weather conditions for renewable generation. Unusually low average wind speeds across most of 2021 meant that despite increased capacity wind generation fell 14 per cent. Weather conditions were also less favourable for hydro and solar generators, with lower-than-average rainfall leading to a 20 per cent decrease in hydro generation, and lower average sun hours meaning that solar generation fell by 5.9 per cent. This meant that all four nations experienced a decline in their shares of renewable generation, though Wales and England did both record their second highest shares on the time series. Scotland remains the UK leader for renewable generation. Chart 3 shows the renewable share of total electricity generation in each UK country from 2017 to 2021, in comparison to the UK average.

Chart 3: Renewable share of electricity generation by country, 2017 to 2021.

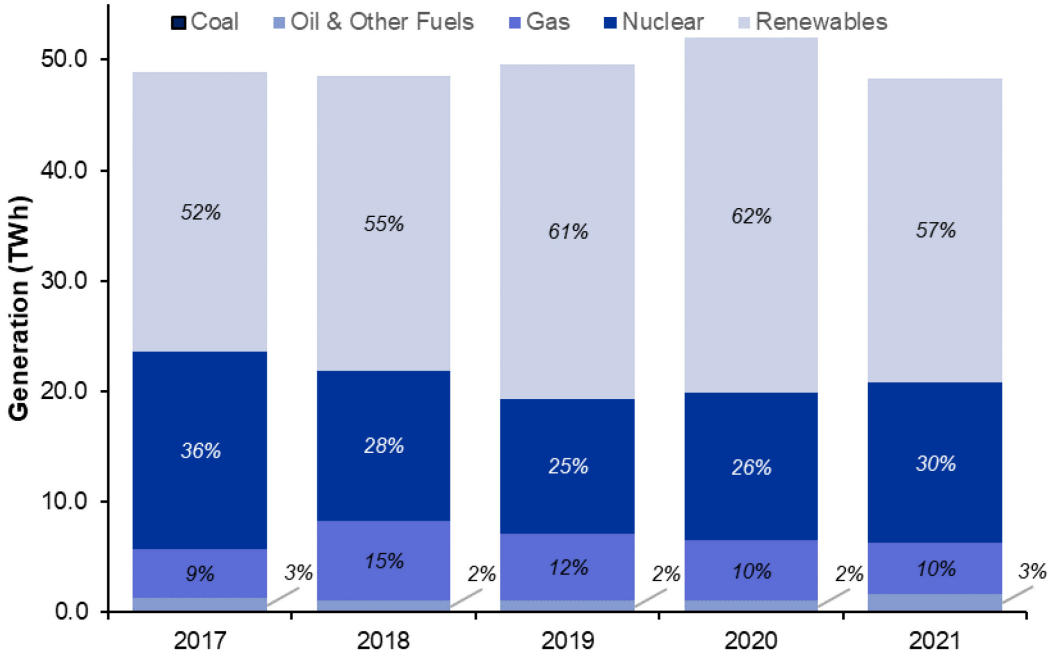


A map illustrating the distribution of Major Power Producers in Scotland, Wales, Northern Ireland and England is provided in Appendix B.

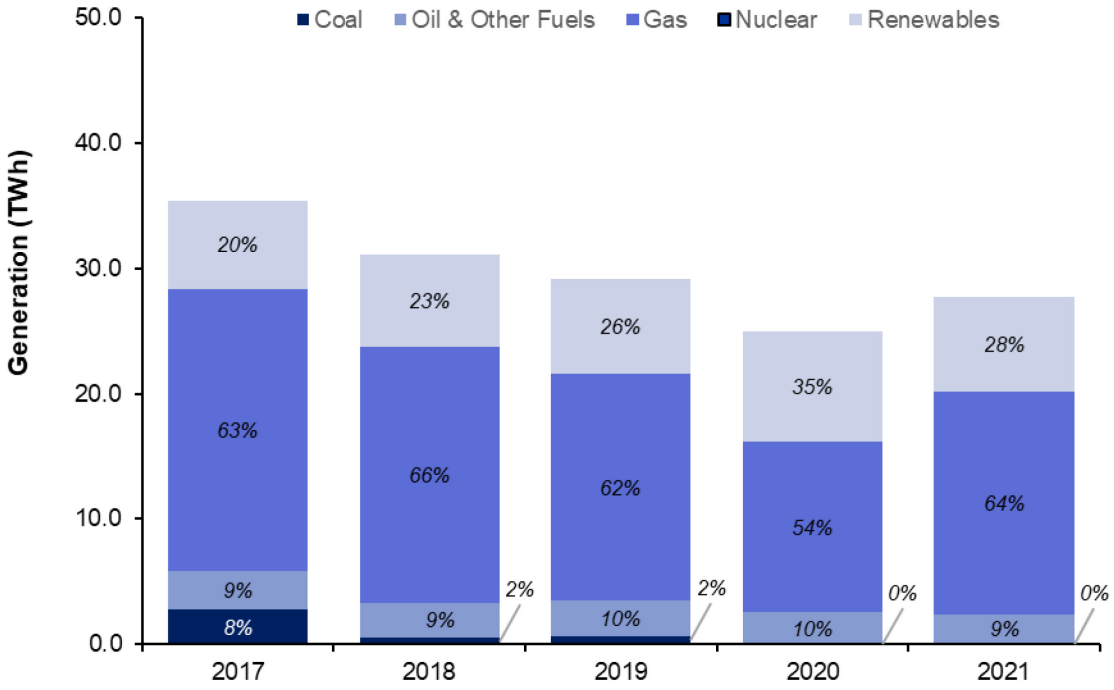
Chart 4 shows electricity generation by fuel (in all generating companies) in each UK country for the period 2017 to 2021. To illustrate the generation mix in each country, shares of electricity generated by fuel are shown as data labels.

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), 2017 to 2021.

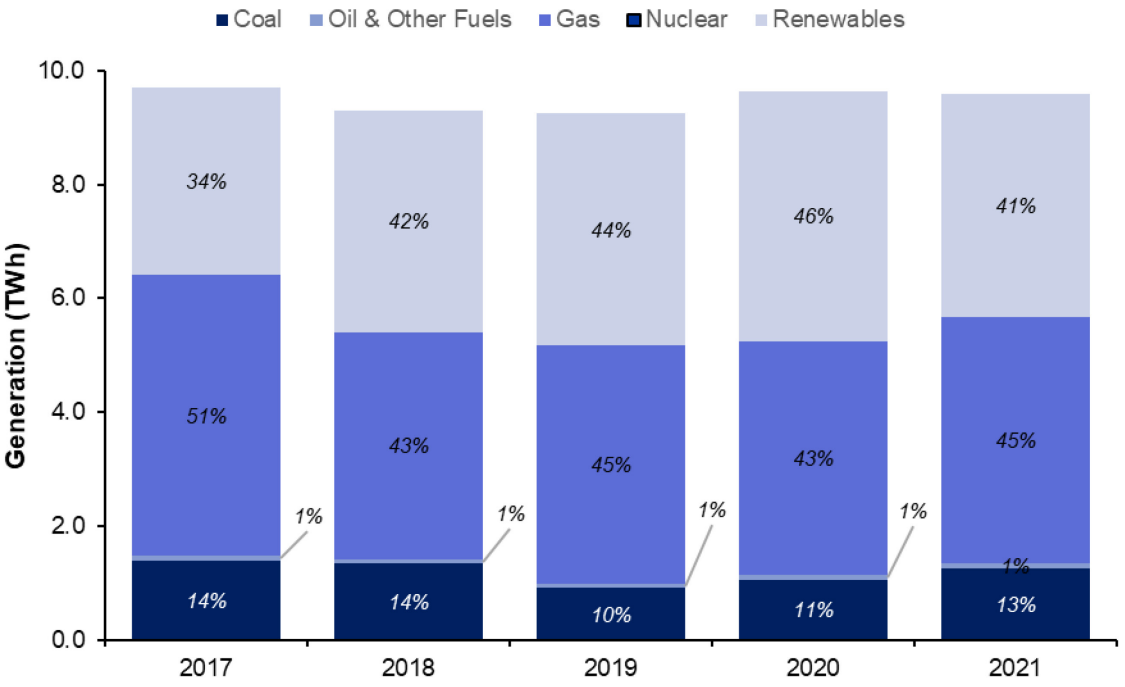
A - SCOTLAND



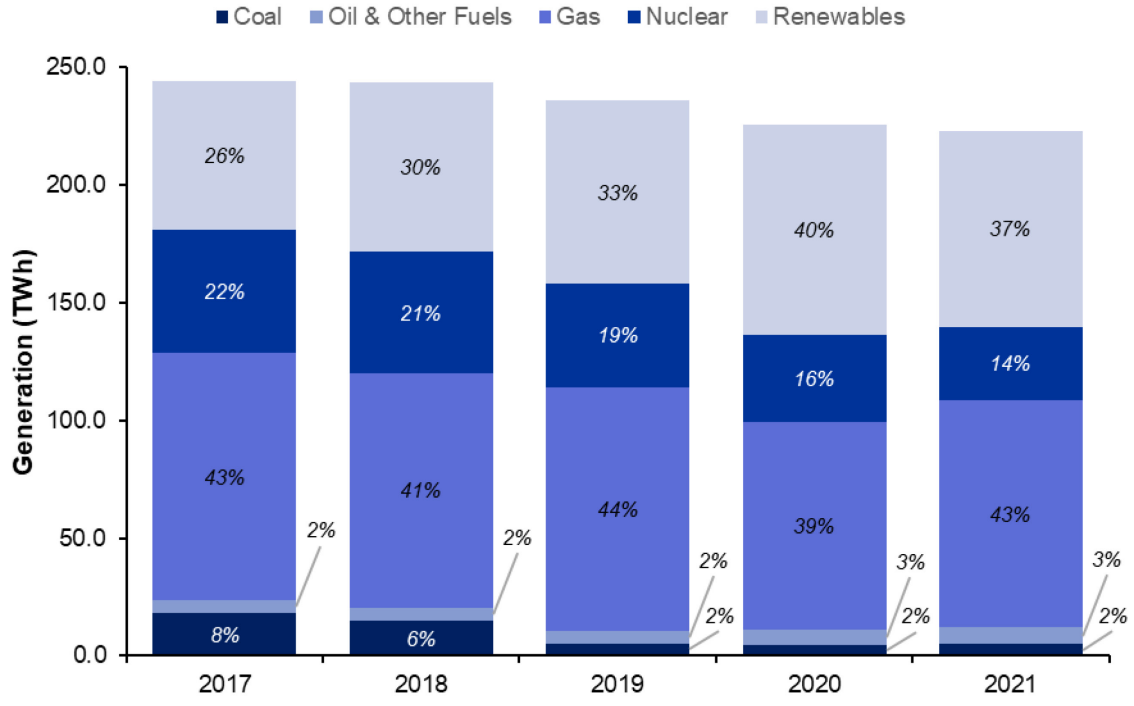
B - WALES



C – Northern Ireland



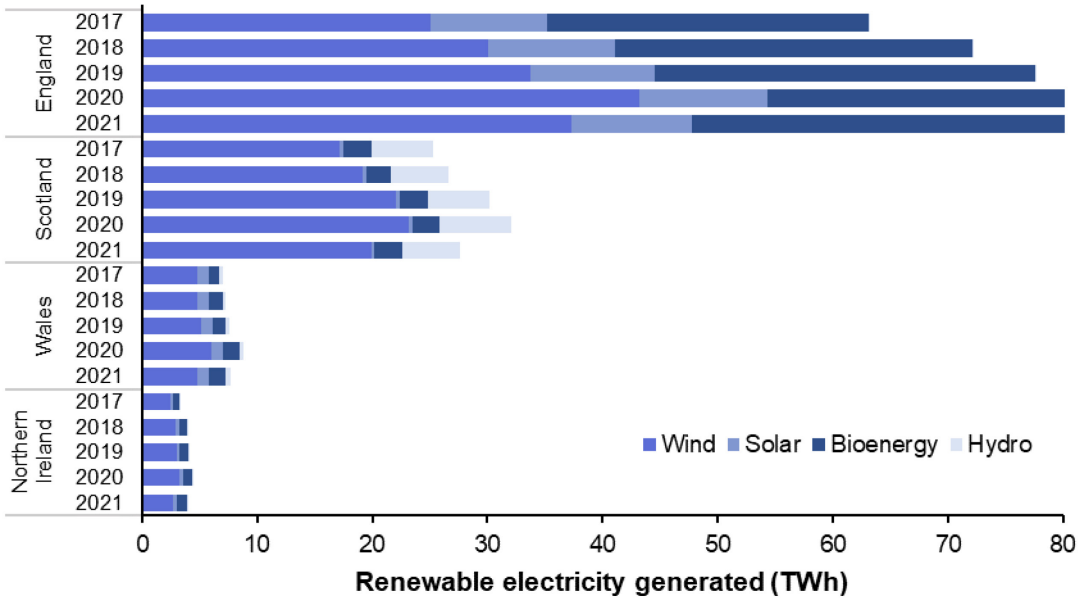
D – England



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 2017 and 2021.

Chart 5: Renewable electricity generation by technology, in each UK nation between 2017 and 2021.



Since 2017 renewable generation has increased by 24 per cent, and though renewable generation did decrease between 2020 and 2021, this was largely due to less favourable weather conditions. 2021 saw renewable capacity increased substantially with new wind and solar sites. UK wind installed capacity increased by 5.3 per cent to 25.7 GW, with a 3.0 per cent increase in onshore wind, and an 8.4 per cent increase for offshore wind. Solar capacity also saw an increase of 2.8 per cent to 2.4 GW. Generation capacity for bioenergy and waste rose by 1.3 per cent to 8.1 GW in 2021.

Wind

Wind has the largest generation of the renewable technologies, with UK wind generation increasing 30 per cent from 2017 to 2021. Wind power accounted for 41.2 per cent of Scotland's generation in 2021, the greatest proportion of any nation and more than double the proportion of English and Welsh wind generation (16.7 per cent and 17.2 per cent respectively). Wind was however down for all four nations in 2021 against 2020, and only England saw an increase in wind generation against 2019. However, this decline in generation is largely the result of unusually low average wind speeds, down 14 per cent against 2020, and down 11 per cent on the 20-year mean. Total installed capacity for wind increased 5.3 per cent to 25.7 GW in 2021, notably including the opening of Triton Knoll off the coast of Lincolnshire, adding 0.9 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 had the second largest share of the renewables in 2021, at 12.9 per cent of total generation. The majority (88.1 per cent) occurred in England. Since the conversion of coal units at Lynemouth and Drax to biomass in 2018, the majority of biomass generation by major power producers takes place at these two sites, which are both in England. Biomass capacity continued to grow in 2021, rising 1.3 per cent to 8.1 GW in 2021, now representing over a tenth of UK generation capacity. Bioenergy generation increased in all four countries against 2020, with the largest increase in Northern Ireland (up 10 per cent), followed by Scotland (up 4.2 per cent), Wales (up 3.5 per cent), and England (up 0.9 per cent).

Solar
Solar generation, like wind, fell in 2021 due to less favourable weather conditions. Average daily sun hours were down 12 per cent against 2020, and down 6.6 per cent against the 20-year mean. Overall, this meant that UK solar generation fell 5.9 per cent in 2021, despite 2.8 per cent additional capacity. Wales was the only UK nation to experience an increase in solar generation (an increase of 1.2 per cent on 2020), meanwhile England, Scotland, and Northern Ireland all saw solar generation reduced (down by 6.6 per cent, 11 per cent, and 1.8 per cent respectively).

Hydro
The vast majority of the UK's hydro generation assets are in Scotland, however low average monthly rainfall (down 30 per cent on 2021, and down 15 per cent on the 20-year mean) meant hydro generation decreased 21 per cent. In turn, UK hydro generation fell by 20 per cent in 2021. Total installed hydro capacity remained broadly level over this period.

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, 2016 to 2020:

https://www.gov.uk/government/publications/energy-trends-december-2021-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 2021:

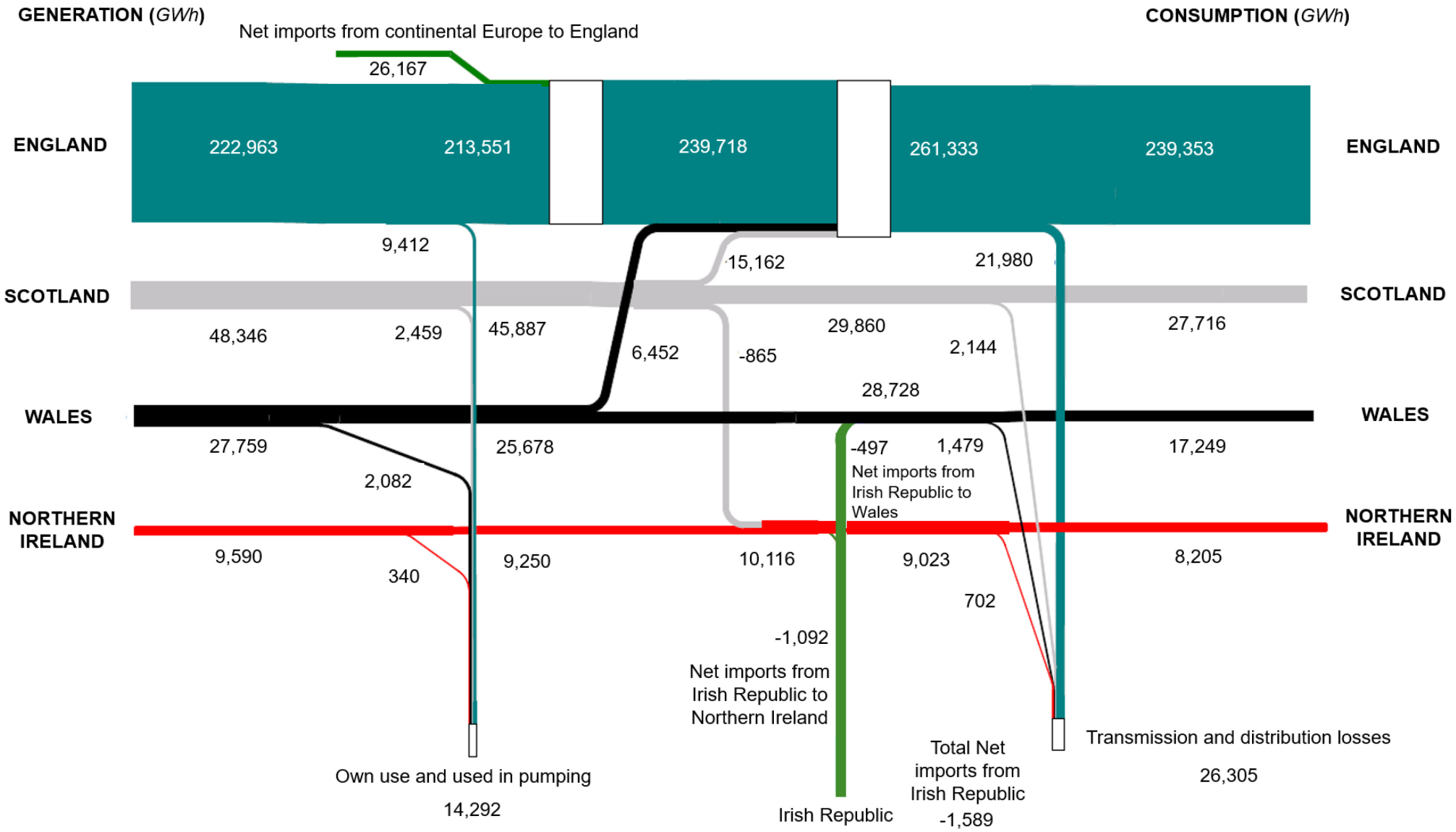
https://www.gov.uk/government/publications/energy-trends-september-2022-special-feature-articles

Energy Trends: weather

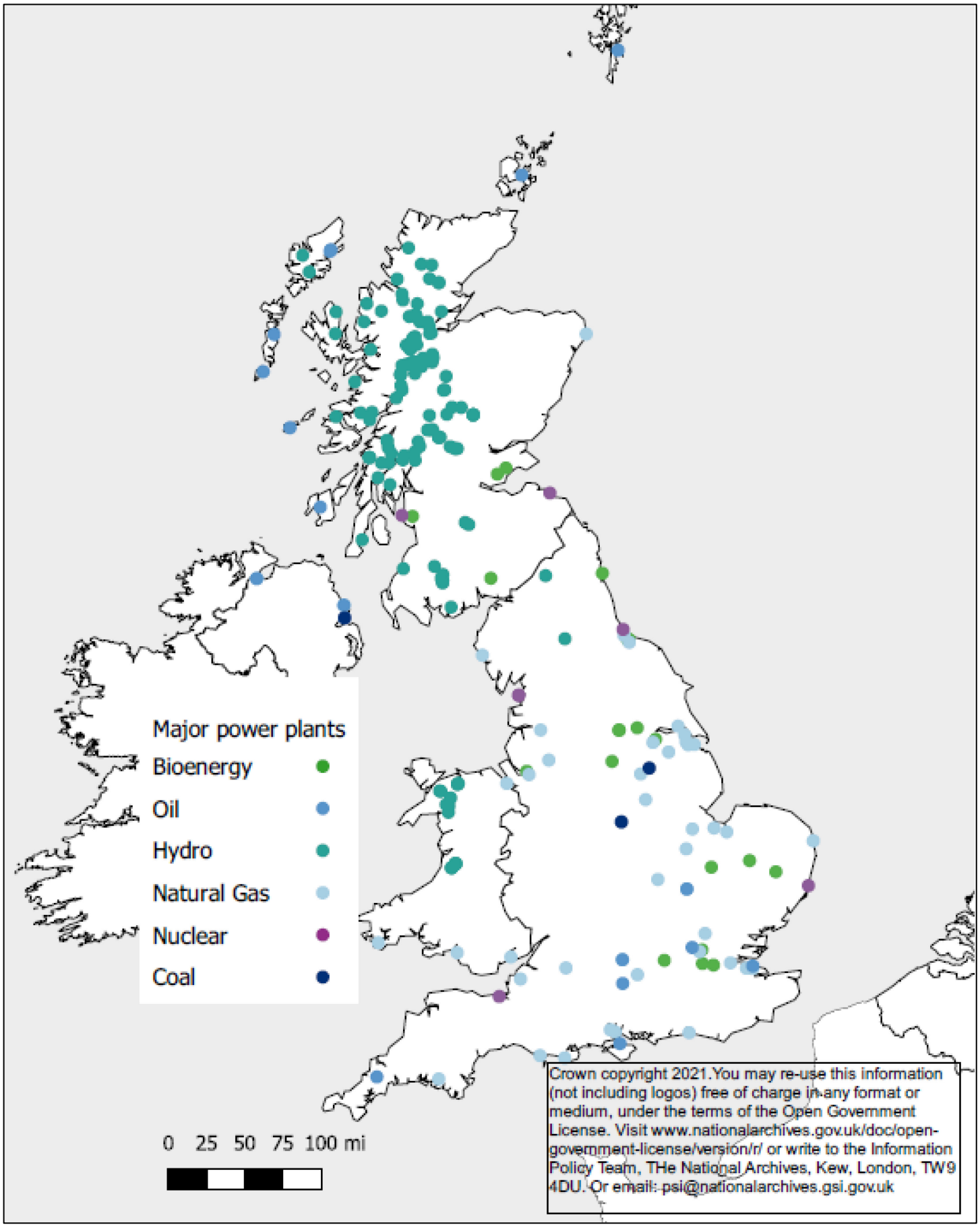
www.gov.uk/government/statistics/energy-trends-section-7-weather

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 2022)



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Feed-in Tariff load factor analysis: 2021/22

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Key headlines

Median load factors for wind, solar and hydro installations decreased in 2021/22. Unfavourable weather conditions were the main driver, with this financial year being drier and less windy than previous years.

The median load factor for solar photovoltaics (PV) was 10.2 per cent in 2021/22, a small 0.2 percentage points fall with respect to 2020/21. The load factor is closely associated with average daily hours of sunlight, which decreased slightly in the latest financial year.

Wind load factors fell by 2 percentage points to a median of 17.4 per cent, the lowest load factor since 2016/17. Windspeeds in 2021/22 were the lowest across all the years considered in this analysis, although weather does not always perfectly align with wind load factors.

North East and South West England had the highest median load factor for solar PV, while Scotland had the highest wind load factor this year. Wind load factors continue to exhibit greater regional variability than that seen for solar PV.

Introduction

This article analyses load factors of small-scale renewable 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 schemes. Detailed tables are available as an Excel workbook, at the following link (opens in a new window): www.gov.uk/government/publications/quarterly-and-annual-load-factors.

This year, we have made several changes to the methodology to make the analysis more robust. A summary of these changes is available in an annex at the end of this publication, but note that the changes have not resulted in materially different load factors.

Background

Load factors are a measure of the efficiency of electricity generation. A load factor is defined as how much electricity was generated over a certain time period expressed as a proportion of the total generating capacity.

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)

[1] The article published in December 2021 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

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 has been allowed to a small number of installations since then. 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).

Data cleansing

Table 1 shows how many installations were registered on the Central Feed-in Tariff Register at the start of FIT year twelve 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 2021, and a corresponding reading approximately one year later. See the annex below for more information on how readings were chosen.

Of the 869,971 schemes registered for FiTs at the start of the financial year[3], 26 per cent were found to have sufficient meter readings for the annual analysis. Extreme load factor values were further excluded (as in previous years' analysis), accounting for around 4,700 (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 data is included in the main results, but this data must be treated with caution as the number of valid data points remains very low.

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	231	199	47%
Hydro	1,206	419	359	30%
Micro CHP	525	19	7	1%
Photovoltaic	860,252	223,396	219,102	25%
Wind	7,561	2,700	2,445	32%
All Technologies	**869,971**	**226,765**	**222,112**	**26%**

Results

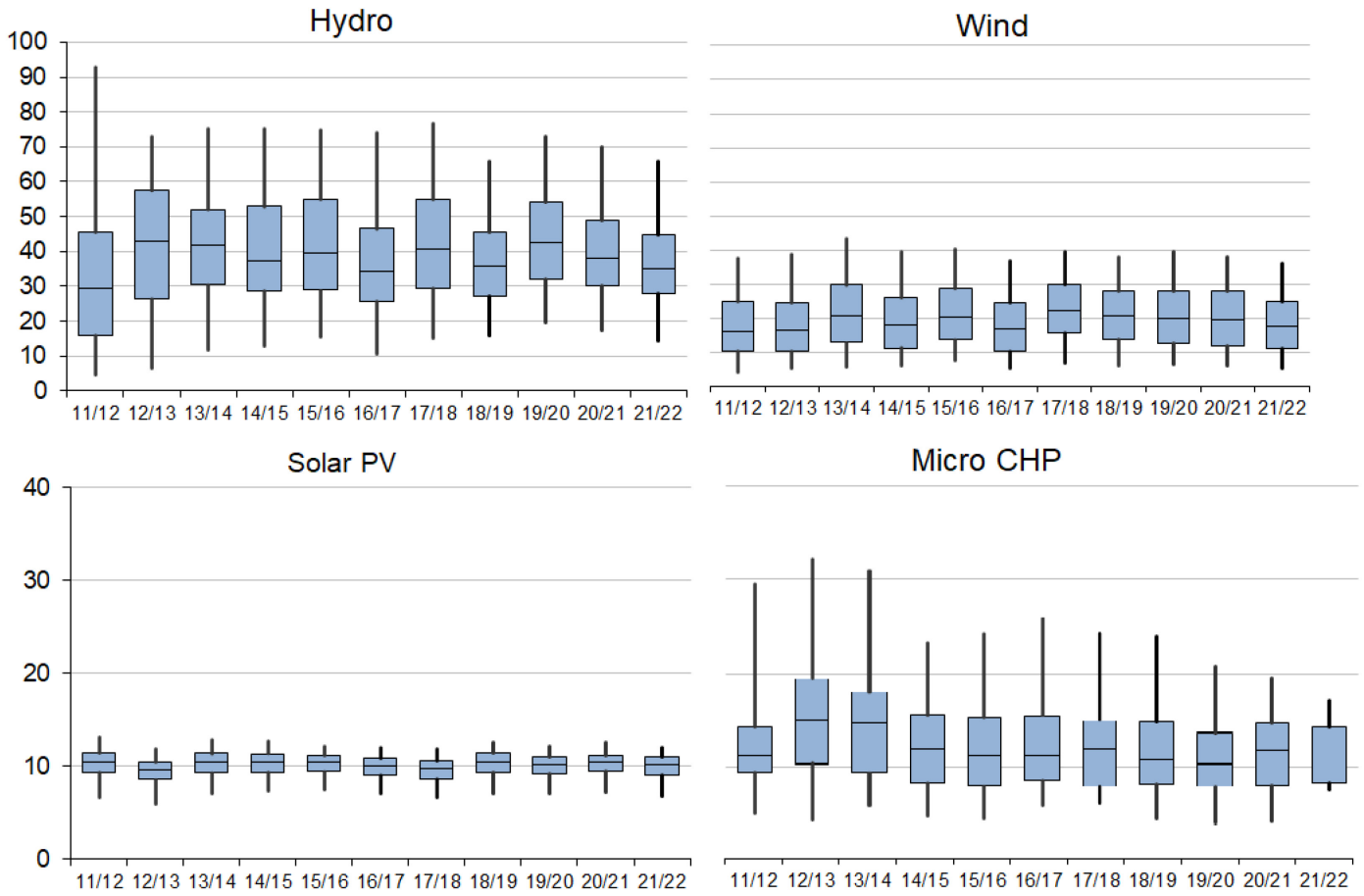
Chart 1 below illustrates the annual load factors for each technology reported in the accompanying Excel workbook. Load factors are presented on box-and-whiskers plot for each technology and across all the FiT years, displaying their median value and the range spread across it.

The plots reveal the differences between the technologies: although primary electricity technologies (solar PV, wind, and hydro) are all dependent on weather conditions, hydro and wind exhibit a wider spread around the median, implying that their load factors are more volatile when subject to a change in weather. Whereas load factors for solar PV are more closely distributed and less likely to drift away from the median.

The variation of the percentiles from year to year are partly due to different weather patterns, although the size of the sample used is likely to have some influence. In particular, the sample size for Micro CHP is very small in the latest year, with only 1 per cent of all accredited stations covered in the analysis this year. Figures for this technology should therefore be treated with caution. Solar has the largest sample each year which is likely to be why the percentiles are less volatile than the other technologies.

[3] Subject to further revision.

Chart 1: Load factor range by technology and year



Lines indicate range from 5th to 95th percentile. Boxes indicate the range from lower to upper quartile (25th to 75th percentile) with the median indicated as a horizontal line.

The median load factor for solar PV in 2021/22 was 10.2 per cent, 0.2 percentage points lower than in 2020/21; this can be explained by the slightly lower average sunlight hours reported for this year. The load factors for solar PV shows a close relationship with average sunlight hours, with patterns repeating in the two series. The relatively small variation measured across the sample and the small difference between weighted mean and median also indicates that the efficiency of solar PV installations is less dependent on factors such as location and size of the installation than other technologies, although some regional differences exist which are discussed further below.

Table 2: Solar PV load factors and average sun index

Year	Median load factor	Average daily sun hours
2011/12	10.5	3.7
2012/13	9.6	4.5
2013/14	10.5	4.5
2014/15	10.4	4.4
2015/16	10.4	4.3
2016/17	10.1	4.2
2017/18	9.7	4.1
2018/19	10.5	4.9
2019/20	10.2	4.4
2020/21	10.4	4.5
2021/22	10.2	4.4

In 2021/22, the median load factor for wind was 17.4 per cent, decreasing by 2 percentage points since 2020/21. This is the lowest value reported since 2016/17 and reflects a low average windspeed for 2021/22 compared to previous years. Although windspeeds were similar to those seen in 2011/12, load factors were higher this year, likely reflecting the introduction of newer, more efficient turbines during the past decade.

As in previous years, the weighted mean of the load factor for wind is higher than the median, though it tends to grow in the same direction. 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 the upper band.

As can be seen from Table 3 (below), there is a relationship between wind speed and wind load factors, but it is weaker than the relationship between solar PV and sun hours. As shown in Chart 1, load factors for wind vary more than those for solar PV, with percentiles spreading further away from the median. It is also worth noting that windspeeds can vary considerably by location and by height above the ground, making an accurate nationwide analysis more difficult to achieve.

Table 3: Wind load factors and average wind speed

Year	Median load factor	Weighted mean load factor	Average wind speed (knots)
2011/12	15.9	18.3	9.2
2012/13	16.3	22.3	8.0
2013/14	20.5	27.2	9.3
2014/15	18.1	25.3	8.6
2015/16	20.3	28.7	9.2
2016/17	17.0	24.6	8.2
2017/18	22.2	27.3	8.8
2018/19	20.6	26.0	8.5
2019/20	19.8	26.9	8.8
2020/21	19.4	26.6	8.4
2021/22	17.4	25.1	8.0

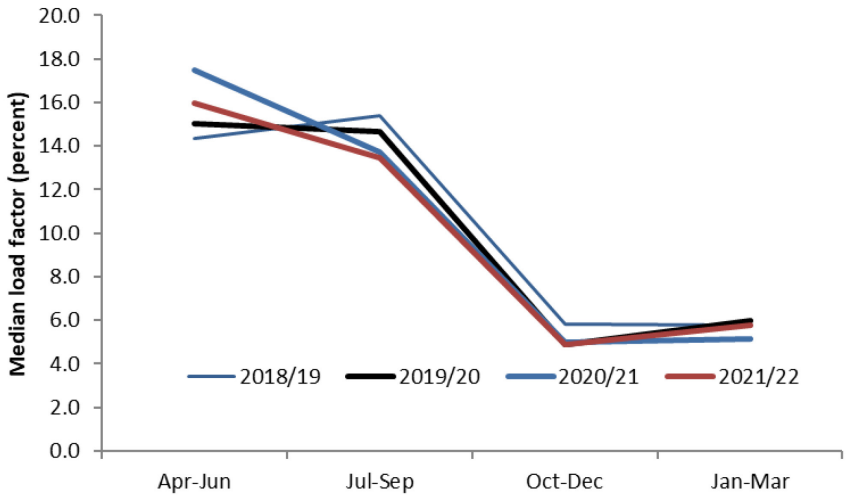
The median load factor for hydro in 2021/22 was 35.2 per cent, down from 38.1 per cent the previous year. Load factors for hydro installations tend to vary a lot within the sample, although the median value has remained fairly stable over the years, following the trend of average rainfall quite closely. The average load factor is particularly low compared with the 2019/20 value of 42.4 per cent, this can be attributed to the latest financial year being the driest in the last decade.

Quarterly Solar PV load factors

Quarterly load factors for solar PV installations are available in the accompanying Excel workbook and the last four years are presented graphically in Chart 2. These show an expected association between load factor and daily hours of sunshine, while the winter and autumn quarters have the lowest load factors.

In 2021/22, the spring quarter (Apr-Jun) had the highest load factor of the year (16.0 per cent) and this has often been the case over the previous ten years. The median load factors were lower in the first two quarters than in 2020/21, reflecting lower average sun hours.

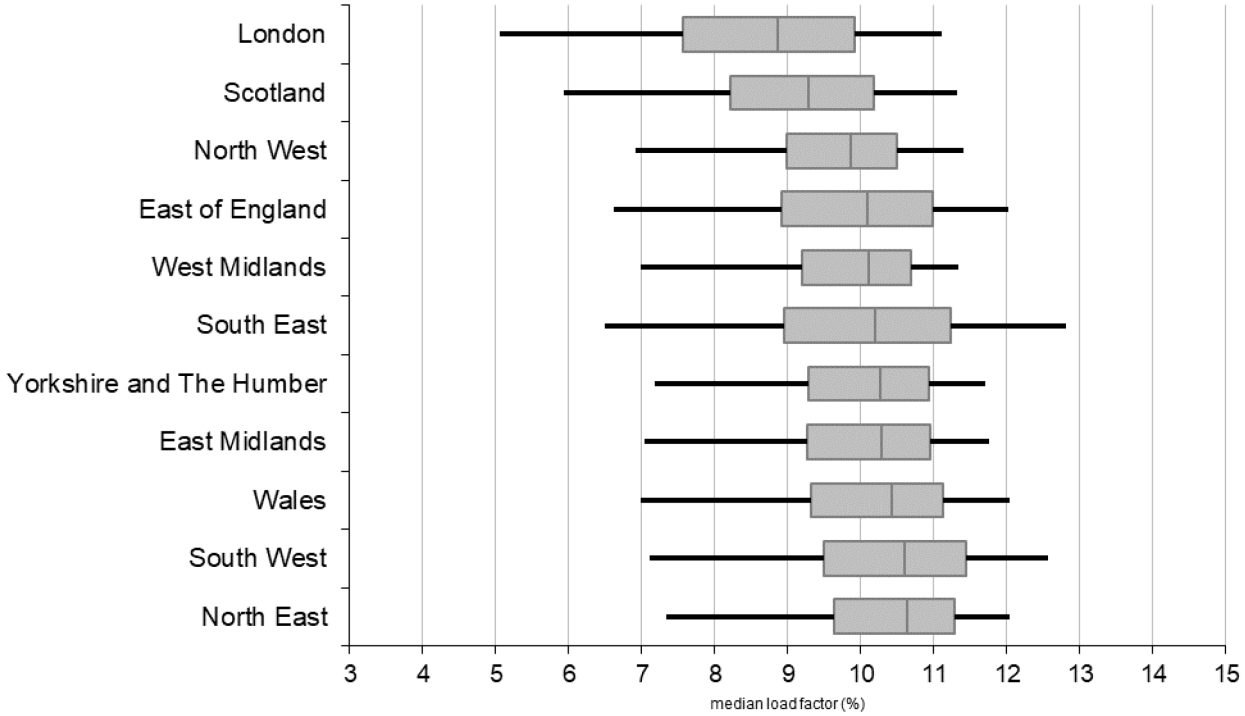
Chart 2: Quarterly Solar PV load factors by FIT year



Regional Solar PV load factors

Chart 3 below displays the solar PV load factor for Scotland, Wales, and each region of England in Year 12. The median load factor varies across regions, but the load factors' distributions are similar from region to region.

Chart 3: Solar PV regional load factor for FiT Year 12.



In 2021/22, North East and the South West had the highest load factor of 10.6 per cent. London had the lowest median load factor in 2021/22, being lower than Scotland for the first time. This may be due to pollution, particles settling on the panels or because panels are shaded by tall buildings nearby. London typically has one of the lowest regional load factors. When compared to 2020/21, median load factors decreased in all regions except in the north, where the North East saw the highest absolute increase (0.4 percentage points) and the other regions were broadly unchanged. The increases in the north were offset by decreases in the south. London, the South West and the South East saw the largest absolute decreases compared to last year.

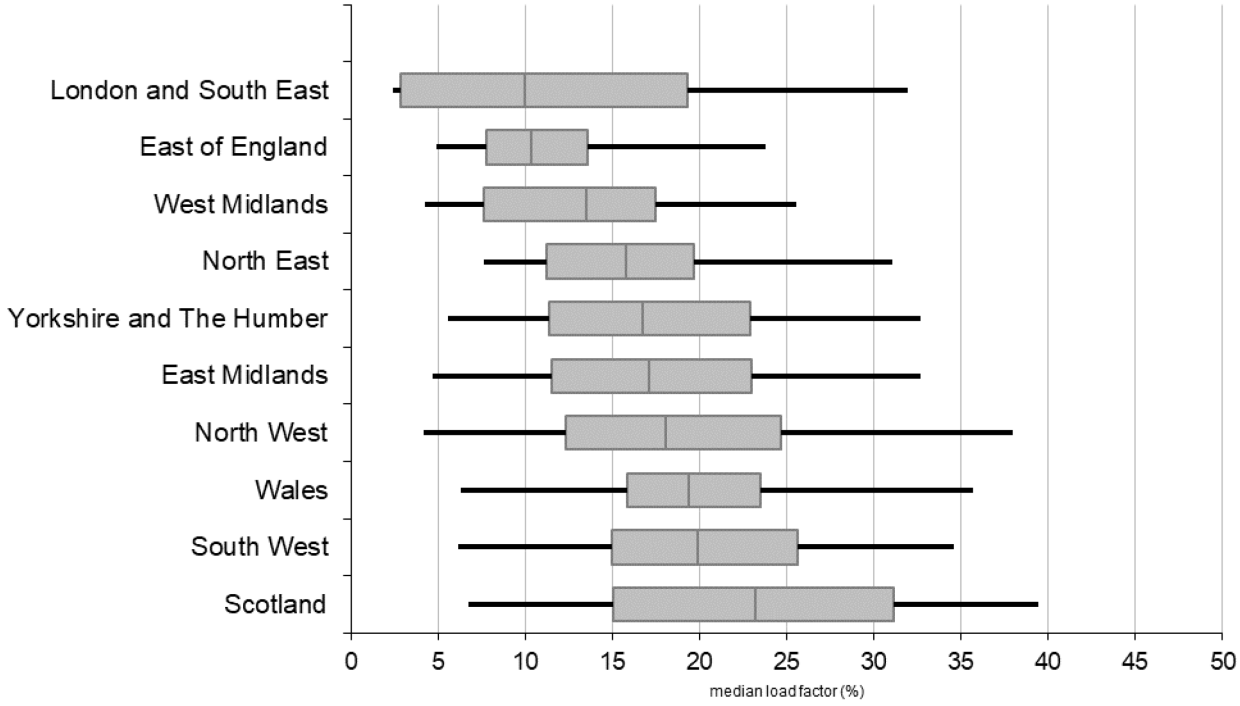
Regional Wind load factors

Chart 4 below 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 23.2 per cent**, followed by the South West then Wales. Load factors have decreased in all regions except London and the South East when compared to last year, with the largest fall being seen in the North West (down 3.6 percentage points).

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. Moreover, with the exception of 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 4: Wind regional load factors for FITs year 12



Annex: Summary of methodology changes

This year we have made several changes to the methodology for producing load factors which have led to an increase in the sample size used and therefore more robust statistics. We have used the updated methodology to produce the 2021/22 (FiT year twelve) statistics and have revised the published load factors for FIT years 8 to 11. These changes are detailed below.

It is worth noting that the changes to the methodology have not had a material impact on the published load factors, implying that the previous methodology was sound. Table A quantifies the impact of the new methodology on the median load factors. Across all technologies there has been little change in median load factors, with solar PV factors remaining particularly stable despite the notably broader coverage.

Table A. Comparison of the newly calculated median load factors against former publications, by technology.

	FiT year 8 (2017/18)		FiT year 9 (2018/19)		FiT year 10 (2019/20)		FiT year 11 (2020/21)	
Technology	Previous	Revised	Previous	Revised	Previous	Revised	Previous	Revised
Anaerobic digestion	86.9	85.6	87.2	84.2	84.0	82.4	85.3	83.1
Hydro	44.2	40.7	37.1	35.8	41.8	42.4	38.7	38.1
Solar photovoltaic	9.8	9.7	10.5	10.5	10.3	10.2	10.4	10.4
Wind	20.5	22.2	20.4	20.6	19.1	19.8	19.1	19.4

Existing methodology

Since 2013, we have obtained meter readings for registered installations from energy suppliers and used this to produce quarterly and annual load factors for financial years back to 2011/12 (FiT year two). Data from FiT year one is not available as the number of installations running for the full year was very small.

The methodology originally used for the load factor analysis was described in detail in an Energy Trends article published in September 2014[4]. In 2015, an additional step was included, whereby metering data corresponding to multiple installations were removed from the analysis. This introduces a break in the series from FiT year 5 onwards.

Changes this year

Up to 2021, the data processing was carried out through a series of SAS scripts that were manually adjusted every year. For this edition we have made the additional step of consolidating the entire process into a self-contained, reproducible, and documented pipeline. This has resulted in a more robust and consistent process that makes the best use of all the available data.

The increase in coverage is mainly a result of relaxing the criteria for readings to be included in the analysis. Prior to 2021, readings were included in the analysis if, and only if, they fell within the month of the cut-off period (e.g., March and June for the quarter 1 analysis). This year, we have implemented some flexibility in this mechanism, allowing readings to fall within a larger window that spans over different months. To cover the full financial year and to prevent bias induced by seasonal effects, the number of days between readings must also fall within a prescribed range. See the Assumptions and Methodology sheet in the accompanying Excel workbook for more details: www.gov.uk/government/publications/quarterly-and-annual-load-factors.

[4] The article published in September 2014 can be found at the following link (opens in a new window)

The methodology review focussed on three different areas:

Improving process efficiency.

- Processed data weren't previously held in a single dataset, but raw returns were processed straight into the final analysis. This required a long, manual process to make returns machine-readable, with many data points being removed unnecessarily or lost due to human error. As data are now stored in a SQL table only when they pass through a strict pipeline, more data points have been successfully reformatted. Thanks to these improvements, we were able to retain more data in the final sample; for example, we have recoded the FiT installation number in several returns which were not consistent with Ofgem's numbering system for extensions (a 1-indexed progressive integer), but only where a different numbering system occurred (e.g., 0-indexed). The previous method recoded all FiT extension numbers regardless of any anomalies in the numbering of extensions, which is likely to have led to some errors. However, the number of installations with extensions is small so this has a small bearing on the load factors.

Greater flexibility on dates.

- It became apparent that several cleaning procedures in the previous method were over-simplistic. Readings were previously chosen using a strict criterion (only readings recorded in the opening and closing months of the financial year / quarter were kept). However, a reading date may have been available in the following month which may have been more suitable. For example, in the old method, an installation with a reading on 1st April 2020 and 1st April 2021 would not be included in the analysis for 2020/21 as there was no corresponding reading in March 2021.

- It should be noted that in all cases the exact number of days between meter readings is calculated to produce an accurate load factor. This was also the case in the previous methodology.

- We have developed a method to select the best reading if more than one were available: in the scenario that there are two valid readings in the same month for a single installation, the pipeline would automatically choose the one with the closest date to the nearest cut-off point – e.g. if the month is at the end of a quarter (March, June, September, December), this would be the latest reading in that month, if the month is at the start of the quarter (April, July, October, January) this would be the earliest reading. This has resulted in a sample which more closely represents the quarter or year that we are analysing.

- As we have revised previous years, we have taken the opportunity to match data from one financial year to data for the following financial year. This had not been done in previous versions of this publication and has also added to the amount of valid data. For instance, if an installation had a meter reading in April 2020 but not in March 2021 it would have been discarded in the old method, now it may be included if there is a valid meter reading in April 2021. In this publication we have matched data to the following financial year back to 2017/18.

Quality assurance.

- Given the piecemeal nature of the previous process, errors and spurious changes were extremely hard to track down. The new process is more transparent as assumptions can be specified explicitly in the code, and results are guaranteed to be consistent between years. It is also possible to keep track of excluded data points, allowing the analyst to gauge whether some assumptions might be too strict or too lenient.

Tables B and C below report the coverage for the 2021 survey (FiT year 11), calculated using the two different methods. With the exception of Micro CHP, whose sample size continues to be very small, for all other technologies there has been a 10 percentage point increase in the coverage. As a result, the overall coverage jumped to 31 per cent.

Table B. Installations included in the analysis (FiT year 11, previous method)

Technology	Commissioned by 31st March 2019	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	425	165	155	36%
Hydro	1,177	260	245	21%
Micro CHP	525	21	14	3%
Photovoltaic	859938	181,867	177,826	21%
Wind	7,552	1,981	1,876	25%
All Technologies	**869,617**	**184,294**	**180,116**	**21%**

Table C. Installations included in the analysis (FiT year 11, new method)

Technology	Commissioned by 31st March 2021	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	427	251	202	47%
Hydro	1,206	436	363	30%
Micro CHP	525	34	20	4%
Photovoltaic	860252	271,183	267,702	31%
Wind	7,561	2,971	2,658	35%
All Technologies	**869,971**	**274,875**	**270,945**	**31%**

This publication is available from: www.gov.uk/government/collections/energy-trends

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