Location of major UK electricity generation capacity since 1920

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Key headlines:

This article uses maps and location data to trace changes in the UK's electricity generation capacity since 1920 and to examine the relationship between fuel type and capacity location.

- In 1920 the majority of the UK's electricity capacity was coal power plants based in London, but sites are now found all over the UK and electricity is generated by a variety of fuels.
- The UK has diversified its electricity generation capacity. Coal dominated from 1920 until the mid-1970s; it was then overtaken by gas and more recently by renewable technologies. By the end of 2023 just one coal plant remained in the UK, scheduled for closure in 2024.
- Electricity generation has moved out of cities and into more rural areas. This is especially noticeable for London but seen to a lesser extent around Manchester and Liverpool.
- Since 2000 the UK has increased renewable capacity from 2GW to over 32GW with wind alone increasing by 23GW. The past few years have seen record levels of generation from renewables, with 202 TWh in 2022.

Introduction

This article uses maps to highlight key changes in the UK's major electricity generation capacity since 1920 at a regional level. It uses data from chapter 5 of the Digest of United Kingdom Energy Statistics (DUKES) as well as the 2023 Energy Trends article 'UK Electricity Capacity and Generation by Fuel between 1920 and 2020'. It focuses on the shift from coal dominance in 20th century to the rise in renewables in the 21st. The maps in the article demonstrate the relationship between different capacity types and their location within the UK, including the move out of cities to rural locations and the different location requirements of new renewable technologies.

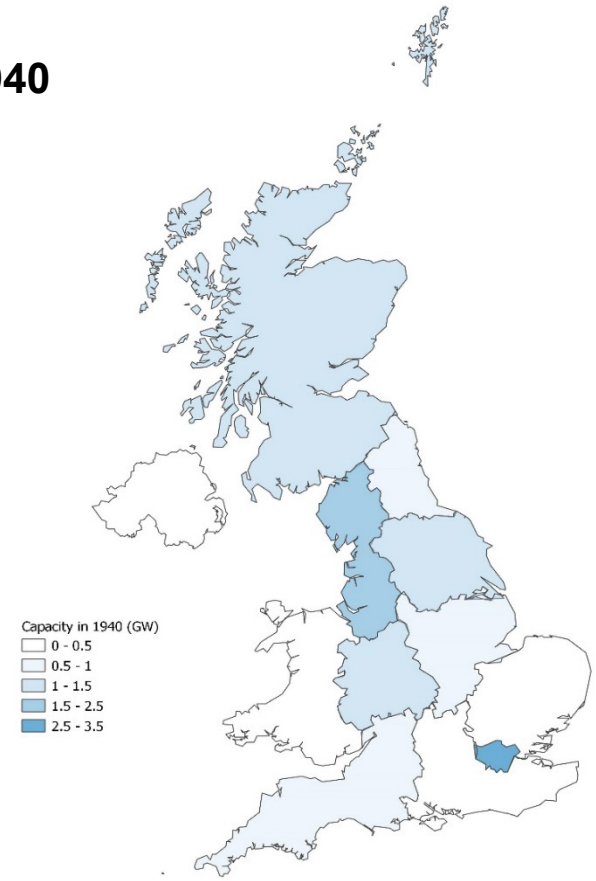
Methodology

The data in this article are taken from chapter 5 of DUKES 2023, previous capacity and generation articles and supplemented by desk and internet research. In particular, it builds on the historical dataset compiled for the 2023 Energy Trends article 'UK Electricity Capacity and Generation by Fuel between 1920 and 2020' and the 2021 Energy Trends article 'Capacity of UK Electricity Generation assets in the 21st Century, 2000 to 2019' which include detailed methodology notes. Data from the past was not as well documented as it currently is therefore estimates have been made throughout to provide a best approximation of the UK's capacity and generation mix throughout time. See accompanying spreadsheet for data used in production of the maps in this article. Full sets of maps can be found in the appendix.

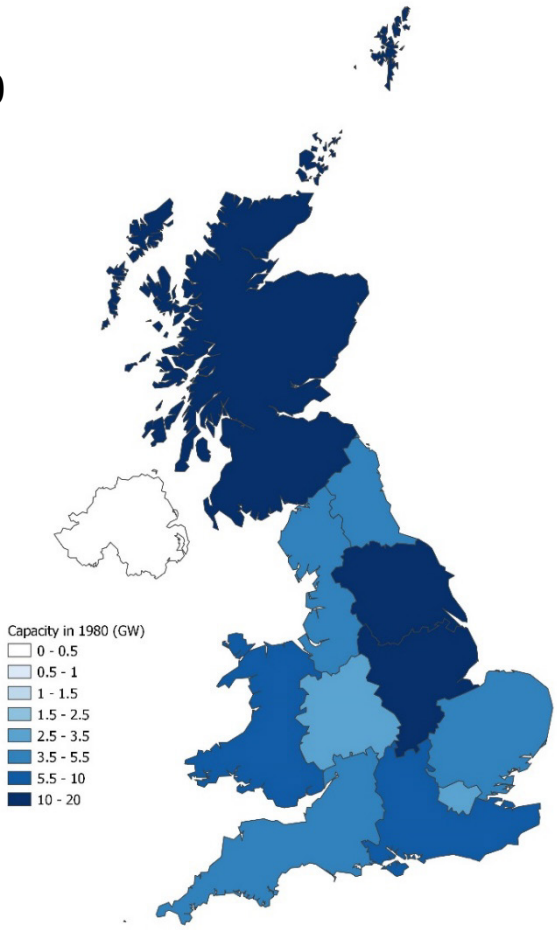
This article focuses on the major generation sites, excluding microgeneration such as domestic solar photovoltaics.

Chart 1: Heat maps to show major electricity generation capacity per region between 1940 and 2023

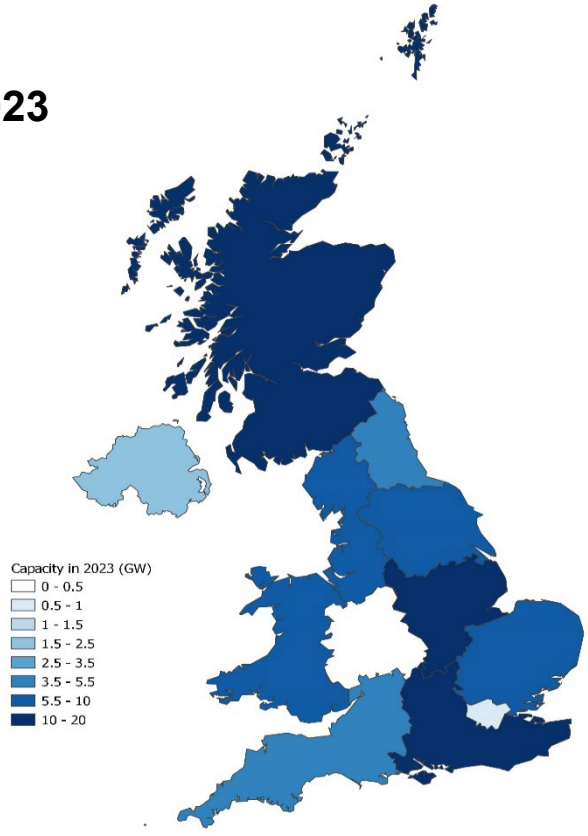
1940



1980



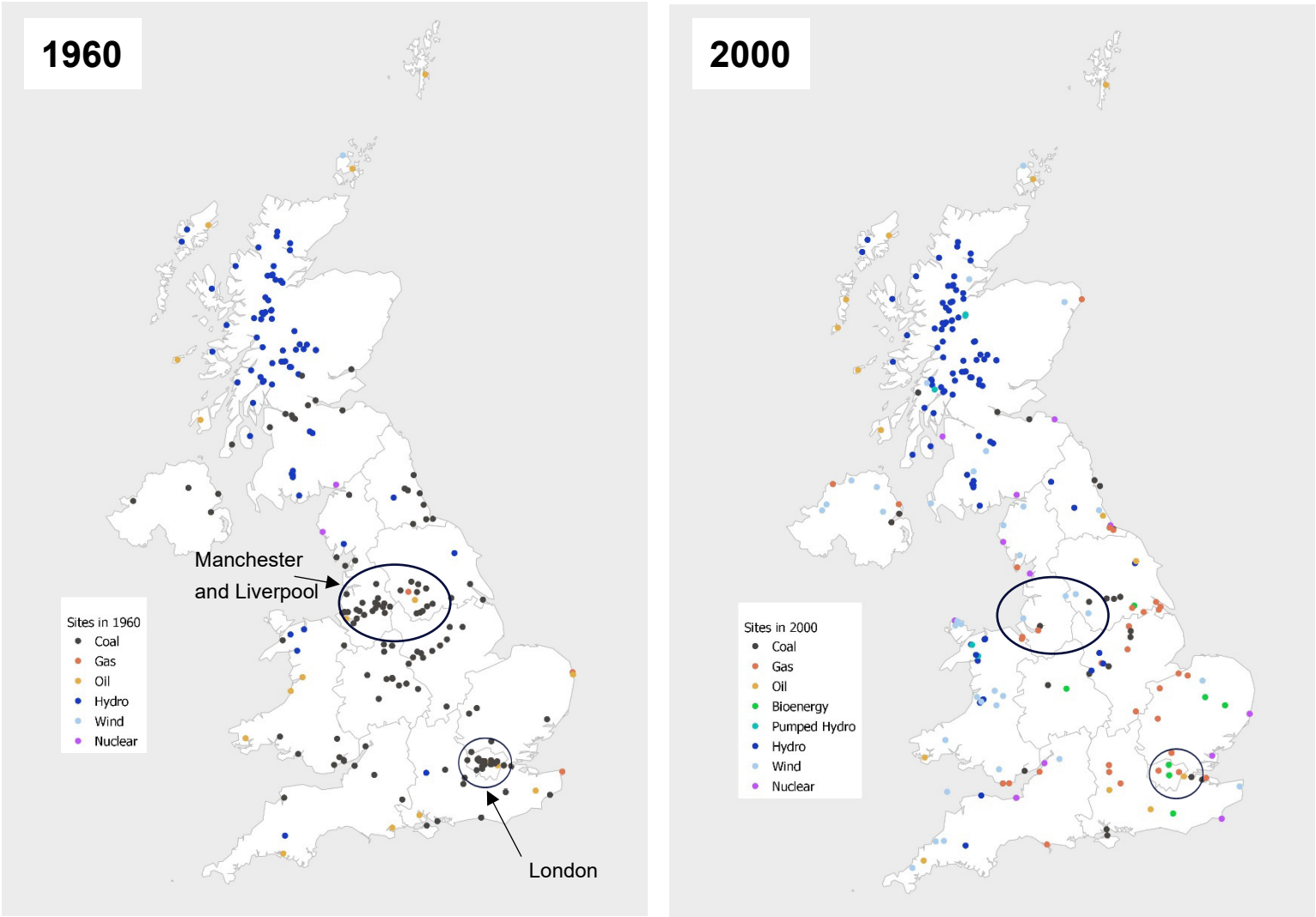
2023



How capacity has changed over time

In the 1940s, London had the largest capacity of any region in the UK due the number of coal plants in the city. However, by the 1980s the London region's capacity had decreased with the closure of coal plants. Scotland, Yorkshire and the East Midlands now had the largest regional capacity, this is in part due to their proximity to coal fields as well as the opening of the 3.8 GW Drax coal plant in 1974 in Yorkshire. These regions have remained the largest with the addition of the South East due to the opening of a number of nuclear sites. The overall capacity of the UK has increased between 1980 and 2023 however at a slower pace compared to between 1940 and 1980.

Chart 2: Maps of the UK showing electricity generation sites per primary fuel type in 1960 and 2000



Changes in the cities

Comparing the location of generation capacity between 1960 and 2000 shows that capacity has moved out of cities and into more rural areas. This is particularly noticeable for Manchester, Liverpool, and London, (see chart 3). In 1960 cities were well populated with power plants. This was due to a combination of plentiful work force, demand for a growing population as well as easy access to coal. As coal generation declined and awareness of the environmental effects of coal burning increased, coal plants moved out of cities or closed. Focusing on London, the maps show that the majority of coal stations have closed but some have been converted to gas or biomass sites, which have lower levels of pollutants. Some generation sites are still located in cities due to the higher levels of demand.

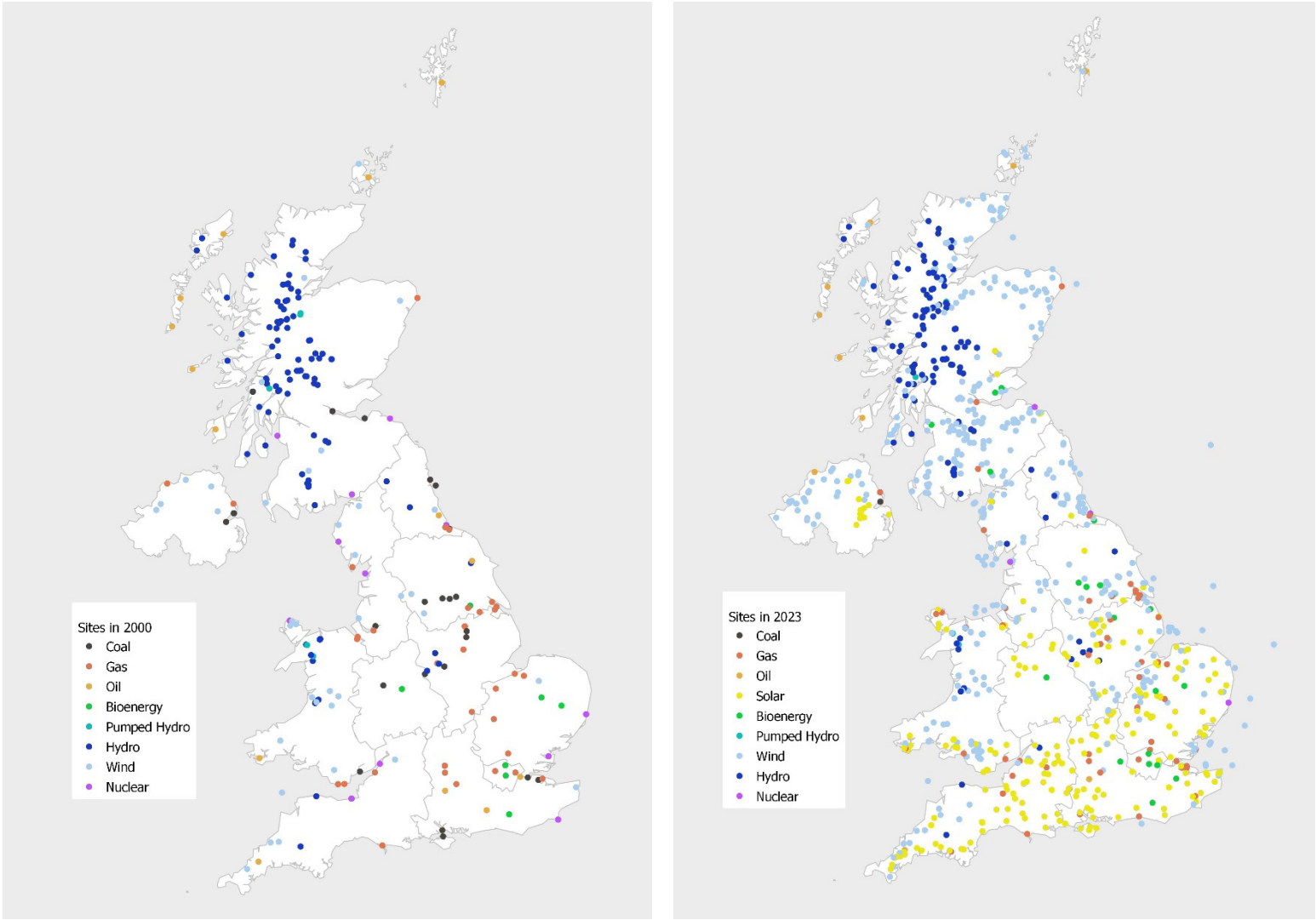
Different location requirements for new types of plant

Generation capacity diversified between 1960 and 1980, from 86% coal in 1960 to 68% coal, 13% oil, 7% gas and 13% low carbon sources in 1980, a trend which has continued. With a more diverse range of capacity types, more locations are needed. To maximise efficiency of power plants, they are generally located in areas which are best able to meet their needs. For example, coal plants were mostly found near coal fields. The major coal fields in the UK were in Durham, Scotland, and the Midlands. Therefore, it makes sense that a large amount of coal plants were located in these areas. Waterway and trainline links are important, this is how London coal plants got their fuel. Some coal sites were also then converted to gas or biomass, continuing in sites that were suitable for coal. Drax, the UK's largest biomass site was

converted from coal in 2013 and benefits from the railway to receive its fuel. In contrast, gas plants are often located next to gas terminals, such as Teeside in the Northeast and St Fergus in Scotland. Nuclear stations are built in isolated areas with low population density and close to a large water source, usually the sea, due to the need for water for cooling.

Non thermal renewables rely on weather conditions to generate and are therefore located where they are most likely to experience these conditions. Solar is most commonly found in the south of the UK as average solar intensity is greater in the South compared to the north of the UK. Wind farms are located in areas of high wind, onshore this could be on hillsides or fields and in areas with a low population. The UK has one of the largest offshore wind capacities in the world, due to the North Sea offering positive conditions for the construction of wind farms (in that it is one of the windiest places in the world, but it has shallow parts which make erecting turbines easier). Hydro and pumped hydro need a combination of hills and rain, this makes Scotland an ideal location. The large hills provide the energy needed to generate electricity when water is released from high reservoirs. North Wales has half of the UK's pumped hydro stations, as similarly to Scotland is has large mountains and high rainfall that this technology can utilise.

Chart 3: Maps of the UK showing electricity generation sites per primary fuel type in 2000 and 2023



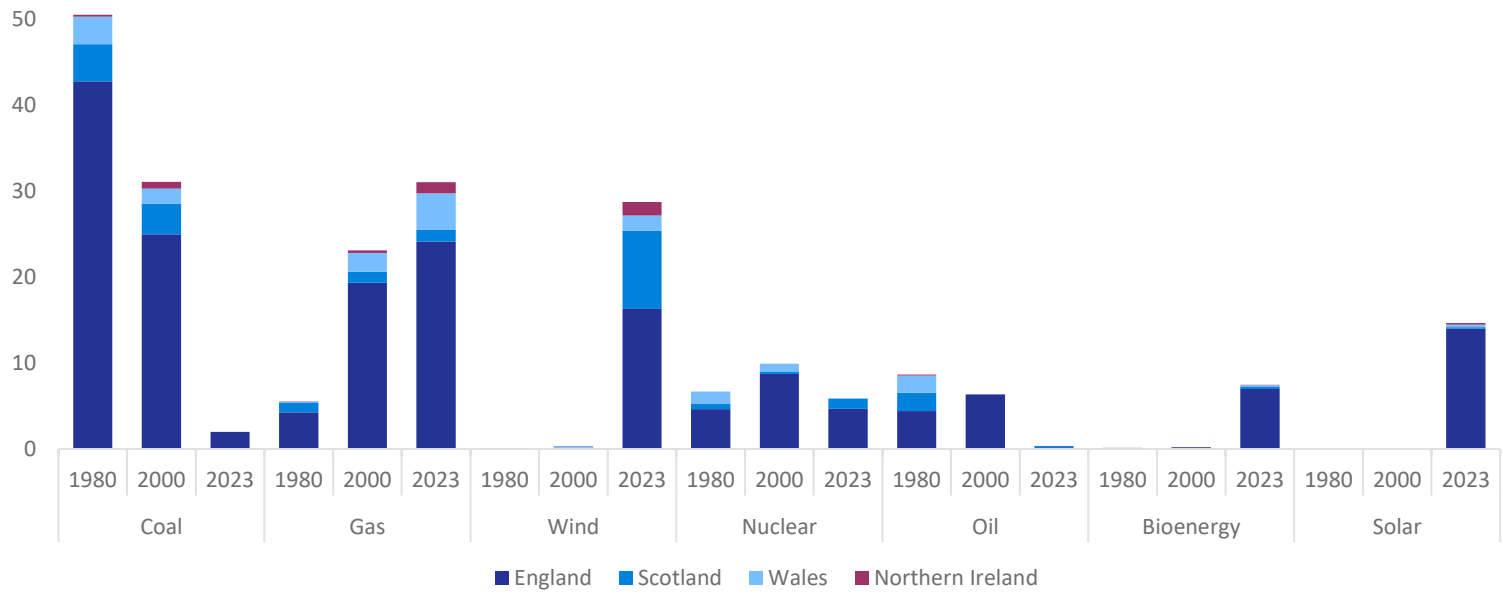
Rise in renewables

Since 2000 there has been a substantial increase in the number and capacity of renewable sites. In 2000 most of the UKs share of renewable capacity came from hydro power stations located in Scotland. By 2013 there were a handful of small solar sites dotted around the south of England, but by 2023 the number of solar sites has reached over 240. The largest site, Shotwick solar park, was added in North Wales in 2016 with an installed capacity of 72 MW. Capacity for wind generation shows a similar trend but tends to be located in the North of England and in Scotland. In 2000 there were less than 40 small scale wind farms; in 2023 there were over 460 with a combined capacity of over 25 GW. Not only have the number of sites increased, but the technology has also been advancing and increasing its capabilities, this means capacity of sites has been growing as well. Hydro sites are the exception to this trend as they had a major increase in the 40s and 60s with only 40 being built since 1980 compared to over 100 prior to that. Bioenergy sites do not have specific location requirements so are located around the country with many converted from old coal plants utilising existing infrastructure. The number of bioenergy sites tripled between 1999 and 2019.

Shares of capacity over time

The UKs electricity generation has diversified over the past 100 years, with coal generation replaced by a diverse mix of capacity, particularly gas and wind. The different location requirements for these technologies saw the generation mix change for the separate countries of the UK. All four countries have seen coal almost removed from the capacity mix, with the last coal site located in England. Coal and oil capacity fell to near zero in 2023 compared to 1980 when coal was dominant, the majority of UK coal was located in England however all regions have had coal plants. 2000 was a transition year as coal declined and gas increased. Like coal, the majority of gas plants are now in England with Wales having the second largest capacity. Nuclear has declined in the past 20 years as plants came to the end of their planned life; however, until recently nuclear consistently comprised the UKs third largest capacity, with sites based in England, Wales and Scotland. Now, only England and Scotland have nuclear plants. On the other hand, wind capacity has grown significant and is now the UK's second highest generation capacity. Similarly to wind, solar has grown significantly predominantly in England to become the technology with the 3rd largest capacity after wind and gas. Bioenergy has seen a rise in capacity since the 2000s, though less pronounced than other renewables. The majority of bioenergy sites are located in England.

Chart 4: Capacity of major electricity generators, by fuel and UK region, 1980 – 2023 (GW installed)



Conclusion

Overall, the UK has seen significant changes in the way it generates its electricity over the past 100 years. The changes have been brought on by a variety of factors including increasing population, advancements in technologies and environmental awareness. Generation sites continue to be found all over the UK from isolated communities to busy cities. They are situated in areas that maximise their fuel, providing the greatest efficiency and stability for the electricity network.

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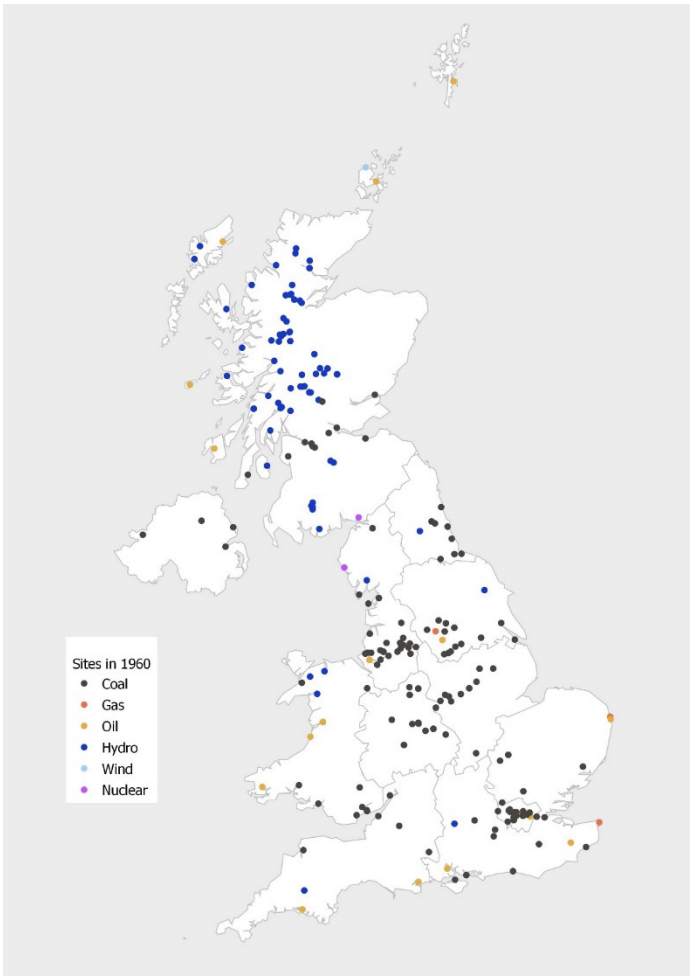
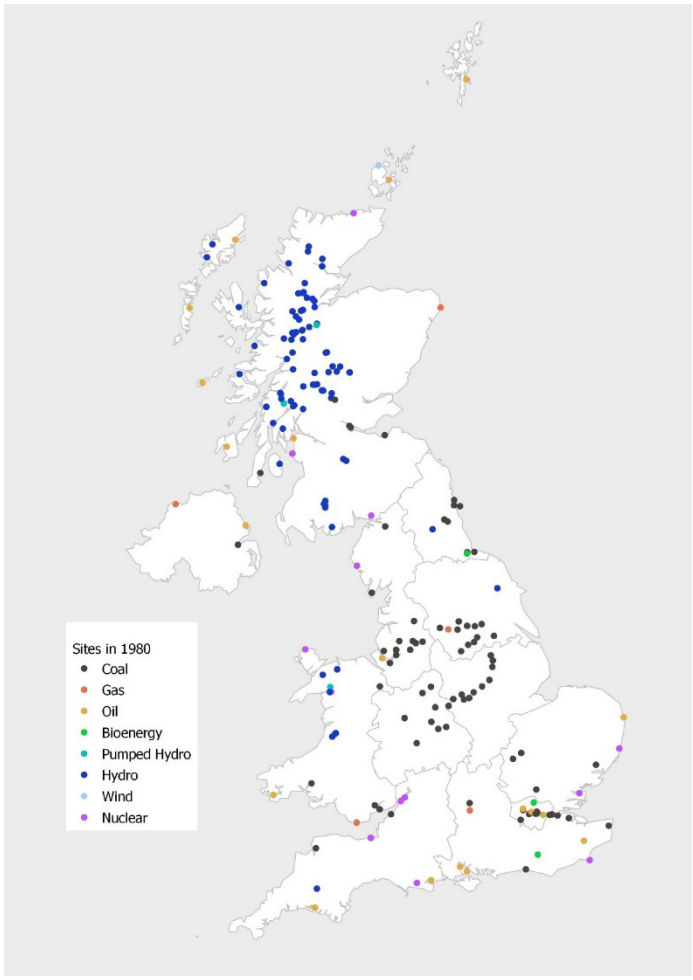
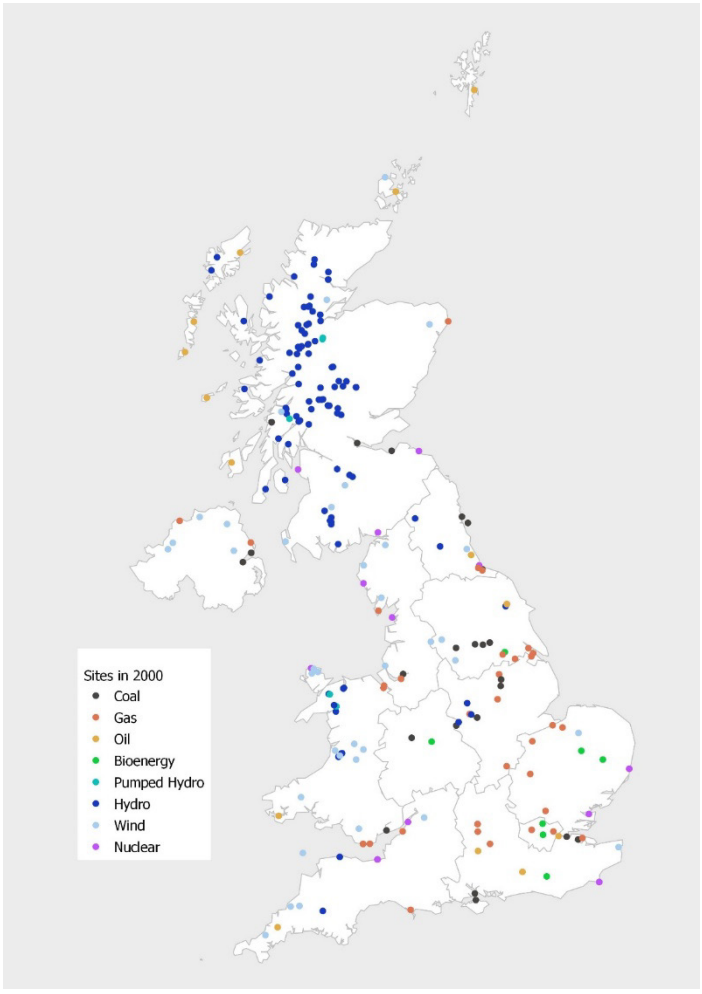
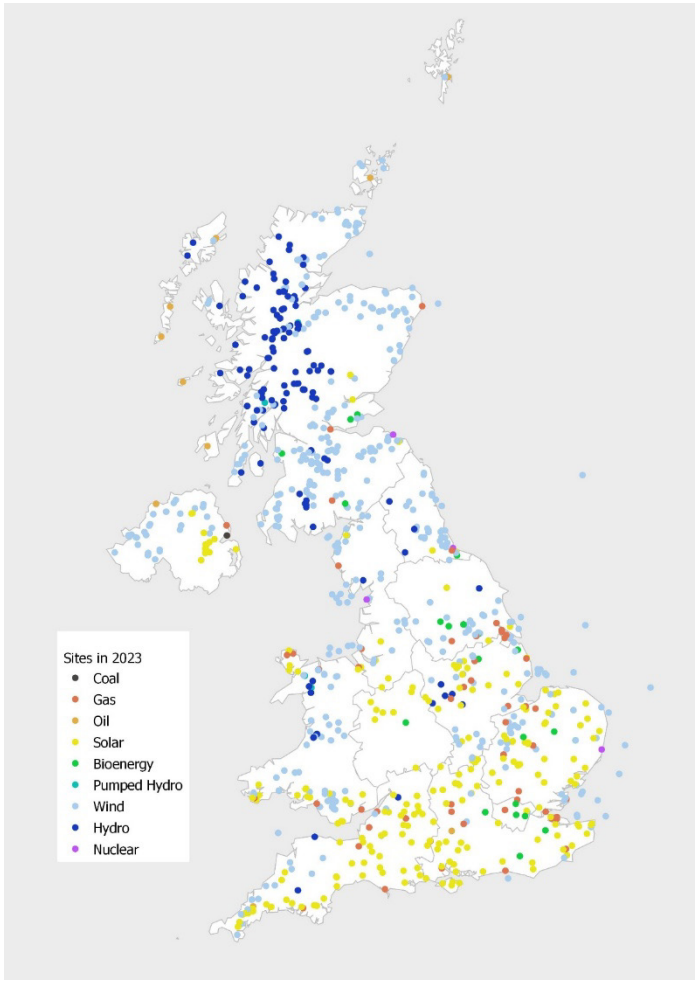
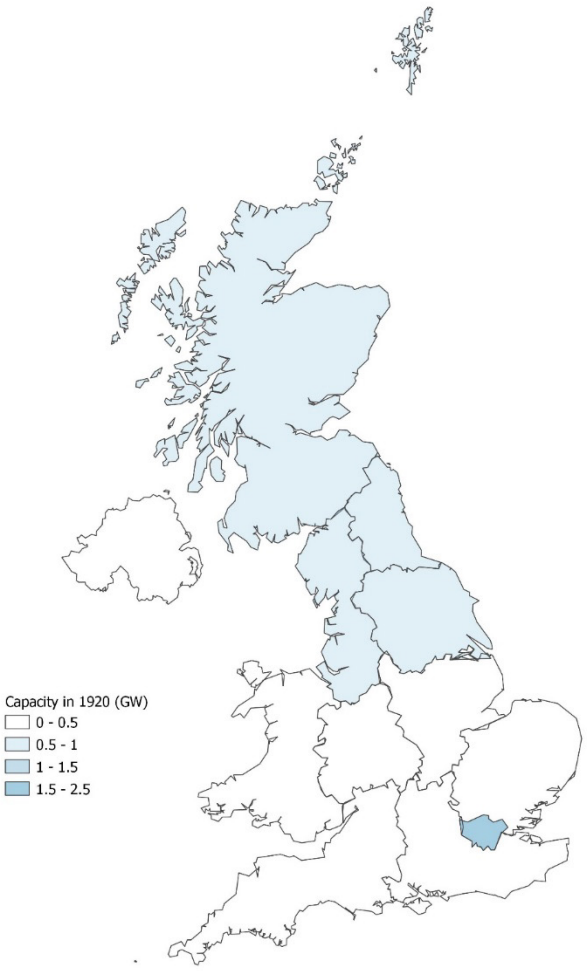
Appendix – Maps of major UK electricity generation capacity sites and heatmaps

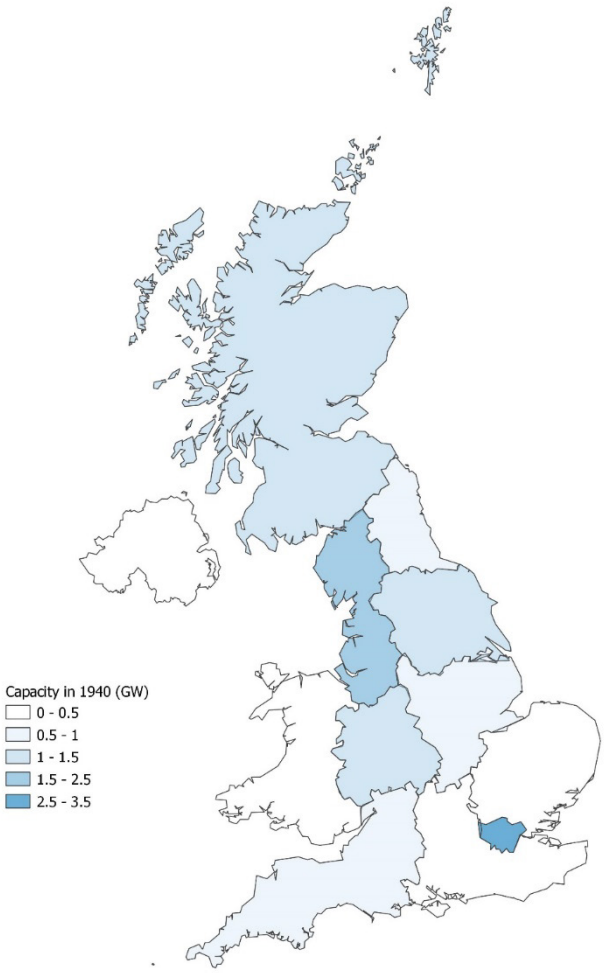


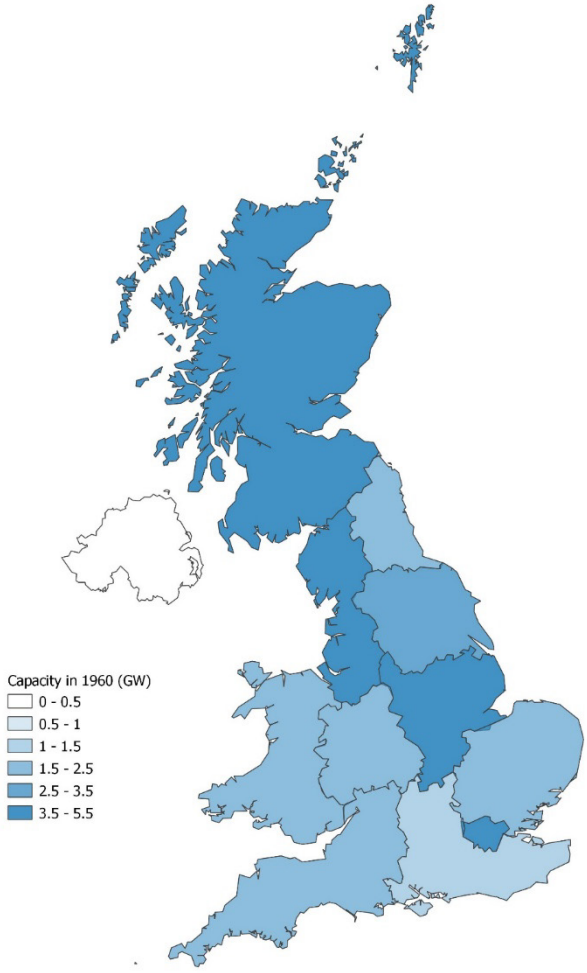


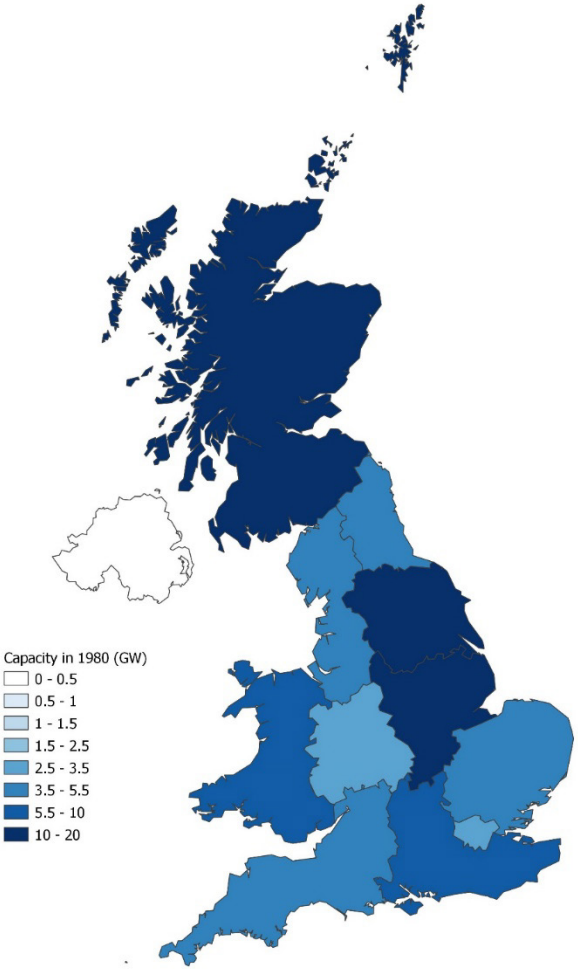


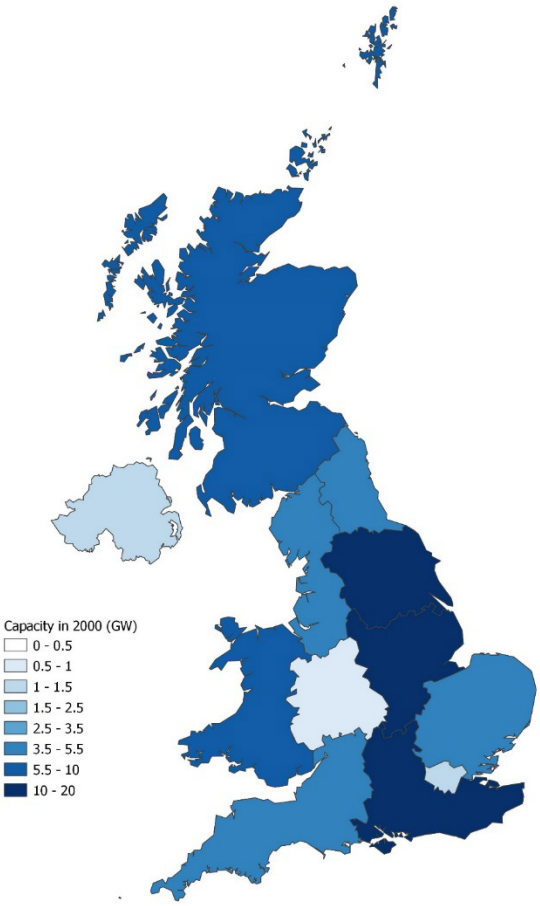



Capacity in 1920 (GW)
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2.5


Capacity in 1940 (GW)
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2.5
2.5 - 3.5


Capacity in 1960 (GW)
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2.5
2.5 - 3.5
3.5 - 5.5


Capacity in 1980 (GW)
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2.5
2.5 - 3.5
3.5 - 5.5
5.5 - 10
10 - 20


Capacity in 2000 (GW)
0 - 0.5
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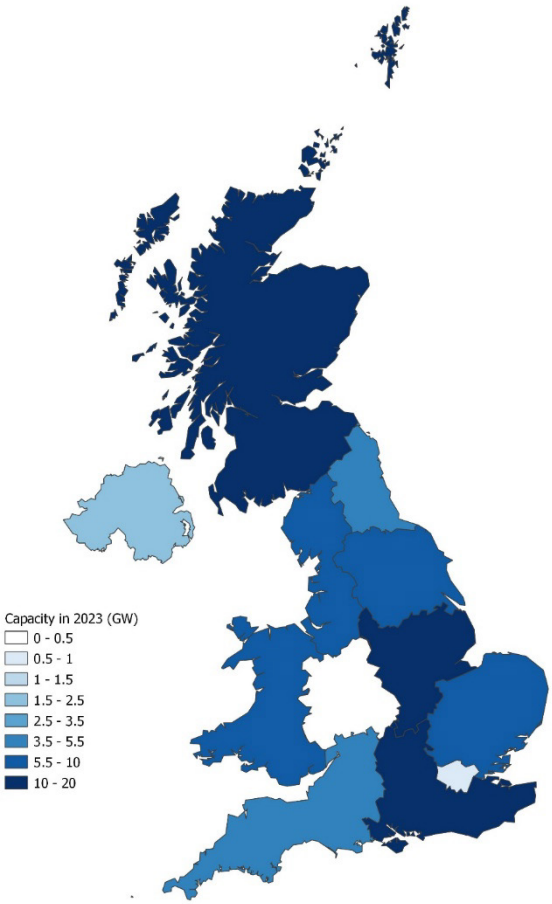
1 - 1.5
1.5 - 2.5
2.5 - 3.5
3.5 - 5.5
5.5 - 10
10 - 20


Capacity in 2023 (GW)
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2.5
2.5 - 3.5
3.5 - 5.5
5.5 - 10
10 - 20