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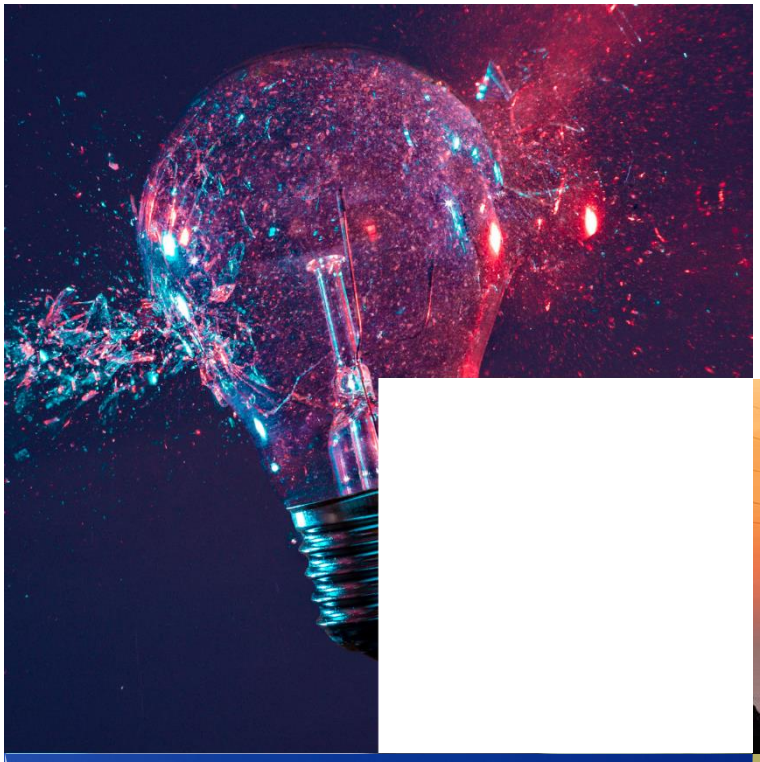
Durham Energy Institute Perspectives

Energy, Science and Society

Issue 12 | 2020 in British Electricity



2020 in British Electricity:

A review of the British Electricity mix in 2020 by MyGridGB and Durham Energy Institute

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Brian Matthews, Director, Terraursa

Since 2014, MyGridGB has tracked the real time changes in British electricity generation.

In this DEI Perspectives article, we look at what could well be a turning point in our decarbonising power system.

Highlights from 2020:

- British electricity carbon intensity has more than halved in a decade and continued to drop in 2020.
- 2020 was the first year to see more than 6 months with no British coal power stations online.
- Increase of EVs and electrification of heating will lead to an increase in demand for low-carbon electricity.
- Wind output reached record levels in 2020. For the first time ever, wind provided more than a fifth of British electricity and outstripped nuclear power.
- Nuclear contributed 10% less power in 2020 however there is uncertainty as to whether this trend will continue through 2021 and into the future.

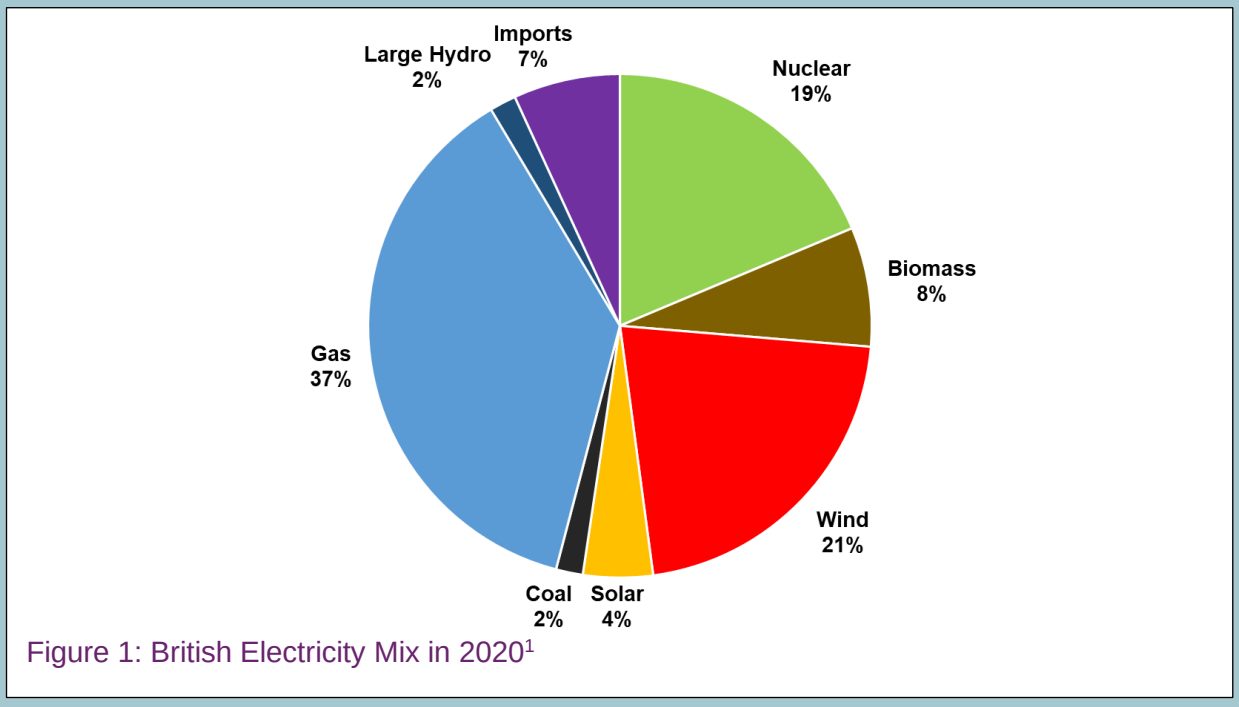

Figure 1: British Electricity Mix in 2020[1]

Continued Decarbonisation

The carbon intensity of electricity has more than halved in a decade. This trend continued in 2020, falling to around 220gCO2/kWh. UK electricity generation still has some way to go to meet a carbon intensity target of 100gCO2/kWh by 2030.

Three factors are reducing carbon emissions – reducing use of fossil fuel power stations, decreased demand and increasing renewable generation.

The dramatic fall in the use of coal captures the public's attention and just 1.7% of British electricity came from coal power stations. The statistics around coal power are astounding when we remember that 43% of British electricity came from coal just 8 years ago. It feels like only yesterday when Britain saw its first coal free hour of electricity back in 2016. Last year was the first to see more than 6 months with no British coal power stations online. This is expected to be zero by 2025 as the last of the coal power stations close (Drax, West Burton A, Ratcliffe on Soar and Kilroot).

> *"Last year was the first to see more than 6 months with no British coal power stations online. This is expected to be zero by 2025 as the last of the coal power stations close"*

The demand for electricity has been falling year on year since at least 2012. That trend continued through in 2020, with the lowest electricity demand in at least a decade. Reducing electricity demand is critical for carbon emissions as it has an immediate effect in reducing the use of fossil fuel power stations. As such, efforts to increase the efficiency of lighting and appliances are critical in our fight against human-induced climate change.

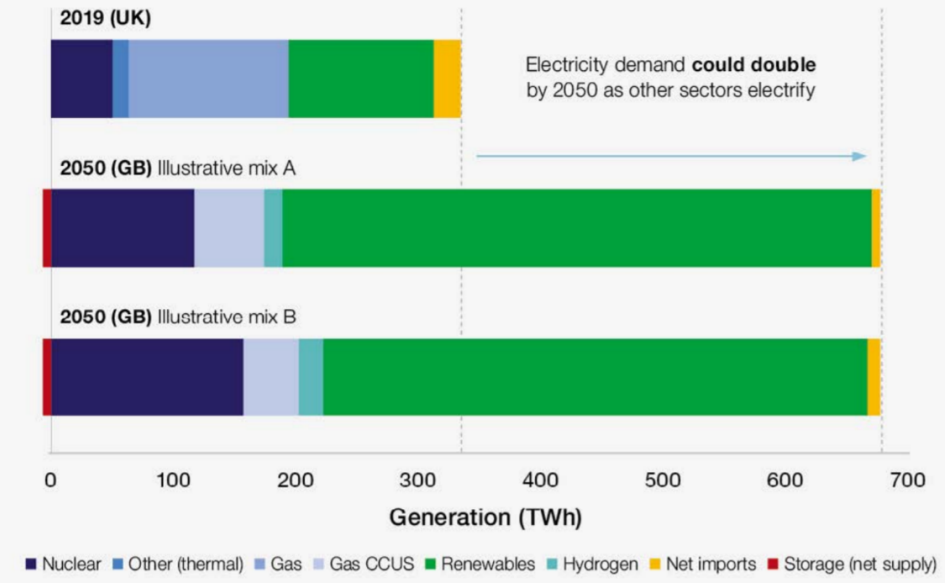

Figure 2: Electricity mix in 2019 and illustrative electricity mix in 2050[2]

The focus of British decarbonisation is increasingly shifting to heat and transport. Transport alone contributed 34% of our carbon emissions in 2019. Electric cars and electric heat may well drive up demand for low carbon power. As such, an increased focused is needed on identifying alternative ways of meeting our demand for energy. Work on geothermal heat and heat storage are just two examples of promising technology research to address this.

The rise of wind continues, but solar remains dampened

Wind output reached record levels in 2020. For the first time ever, wind turbines provided more than a fifth of British electricity and also outstripped nuclear power for the first time. The commissioning of new turbines led to wind producing more than 54TWh. Wind plays a major role in our electricity sector- pushing gas and coal power stations offline. This trend is set to continue with new ambitious targets in wind energy growth outlined by the Government Energy White Paper. This includes a four fold increase in offshore wind to 40GW by 2030.

Limited growth in solar power meant that the sector was relatively stable in terms of electricity generated. Renewed support for solar to provide long term investment security is critical to return the sector to growth – particularly since solar can have

such an acute impact on domestic energy poverty across our country. Guidance by the Microgeneration Certification Scheme (MCS) has shown how solar can reduce domestic electricity bills between 30% and 50% without a battery, and by up to 80% with a battery.

> *"Renewed support for solar to provide long term investment security is critical to return the sector to growth – particularly since solar can have such an acute impact on domestic energy poverty across our country"*

A significant fall in gas use

For the first time since the advent of major renewable electricity, in 2020 it was gas that started bearing the brunt of renewable energy growth. With coal providing less than 2% of British electricity, this is a timely milestone as our focus shifts very quickly to gas as the major high carbon fuel on the grid. Although demand for electricity was supressed in 2020, the statistics show that low carbon energy provided more electricity than ever before and started to squeeze gas off the grid.

It must not be forgotten that gas plays a vital role in generating electricity when renewable power stations are at low output. There is never a time when gas power stations are not used and they provide a baseload of energy to keep our lights on. The use of gas actually increased in 2016 to fill the void filled by closing coal power stations. Since then, wind and solar output reduced the use of coal leaving the gas sector relatively untouched.

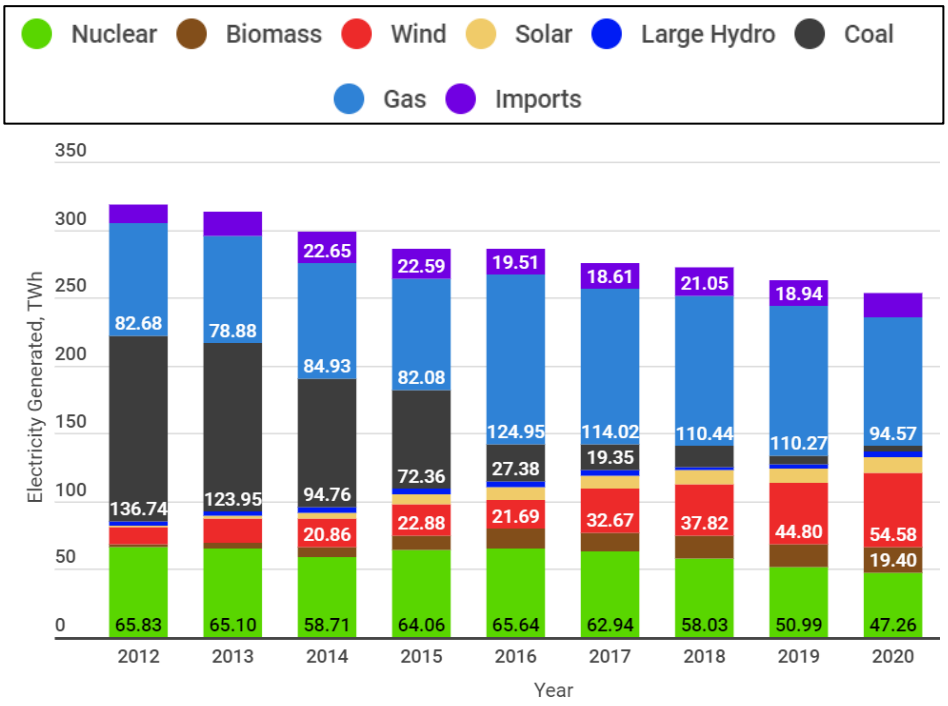

Figure 3: British Electricity yearly change in generation mix 2012 to 2020

What is now significant is that a number of factors may start to see gas use fall. Government commitment to wind power now looks set to push gas power stations off of the grid when the wind blows.

There's increasing international evidence of battery storage plants displacing gas peaker plants – due to the lower costs and longer life of battery storage facilities. Gas Peaker plants are power plants designed to balance the fluctuating power requirement in the electricity network and operate during periods of high level demand for electricity or shortfalls of electricity supply.

Increasingly flexible demand, such as smart EV charging, may also begin to shape electricity consumption to the production from renewable electricity – reducing the need for gas to fill the gaps!

Let's also not forget that hydrogen trials and an upcoming ban on combi boilers in the UK looks likely to dimmish the role of gas in our homes.

A challenging 2020 for Nuclear

Extended shutdowns of some of Britain's nuclear power stations meant that nuclear contributed less electricity in 2020 than at any time over the past twenty years.

Nuclear contributed 10% less power in 2020 a reduction of 5.34 TWh to 47.34 against 2019 52.68 and a big drop from 63.9TWh in 2017 (the equivalent of having 2 power stations offline). Extended shutdowns (outages) for graphite core inspections in 2019

continued into 2020. However, the nuclear regulator permissioned the restart of these reactors at Hunterston B and Hinkley Point B. Dungeness B continued its extended outage focused on steam pipework replacement. Sizewell B was asked to reduce load by 50% following a contract agreement from the 7th of May till the 24th of September to support grid stability requirements.

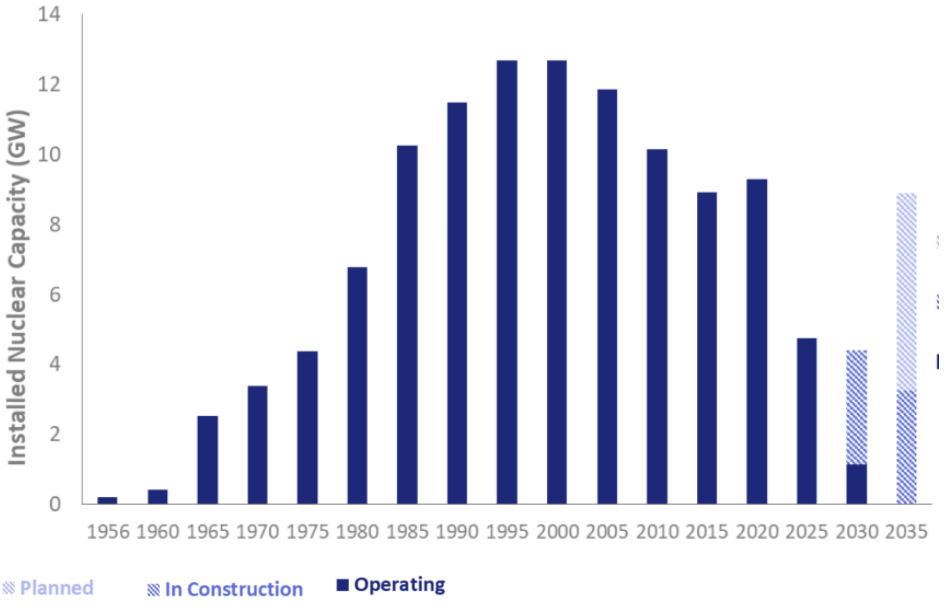

Figure 4: Nuclear capacity in the UK- operating, in construction and planned, 1956-2035

Following this the ESO created a new turndown service, which pays embedded generators to curtail output. This has seen less than 5GW of nuclear capacity throughout 2020. Sizewell B confirmed it ambition to extend the power station's life by 20 year which will see it running until 2055 if achieved.

Looking into 2021 the first of the Advanced Gas Cooled reactors (AGR) will come to the end of their lives and move into defueling and decommissioning, starting a series of closures over the next decade. There is a risk that this reduction will be partially replaced by gas until sufficient wind, solar and new nuclear comes on line, which could see emissions increase from the power sector.

However in January 2021 Sizewell B has announced its ambition to extend the power station's life by 20 years which could see it running until 2055 if achieved.

What does the future hold?

Future Gazing - New Nuclear Power Stations

by Brian Matthews, Director, Terraursa

The construction of Hinkley point C (HPC) continued successfully despite the challenges of COVID-19. This will add 3.2GW of low carbon electricity to the grid (the equivalent of 3 of the stations currently operating).

The UK governments Energy White paper confirmed the ambition to further support at least one more large nuclear power station, development of a UK designed small modular reactor and a target for a commercially viable fusion reactor by 2040. Supplementing this, EDF have develop a European Pressurised Water Reactor (EPR) design centre to support future new nuclear builds. Long term nuclear generation scenarios show between 15-20GW of nuclear capacity by 2030, and more than doubling of the sector by 2050. It will take serious growth in nuclear power plant construction to achieve that target.

There is still work to be done to reduce the whole cost of nuclear and factor in the opportunities for cogeneration, including the production of hydrogen and how grid stability will be achieved, if new cheaper nuclear doesn't come on line soon as the UK moves towards reducing its gas use.

Future Gazing – Using Carbon Capture and Storage to Decarbonise Hydrogen Production

by Professor Jon Gluyas, Durham Energy Institute

The development of both Carbon Capture and Storage (CCS) and hydrogen are often thought to be independent. Several initiatives have been launched over the previous decades in CCS but all have failed in large part because

of shifts in government expenditure which have seen manifesto commitments to develop CCS set aside.

Hydrogen can be produced via electrolysis of water. Whilst this is a clean process in itself, to be so-called “green” hydrogen, it must use renewable electricity, this option has challenges to overcome with scale-up and also putting an increasing strain on the electricity system. Currently most hydrogen is produced through natural gas reformation, a process which produces the cheapest form of hydrogen but directly emits a highly pure stream of CO2. It is reasonably straightforward to retrofit this process such that this CO2 can be stored or utilised.

This opportunity would yield low-carbon hydrogen built as an extension to existing energy and hydrogen infrastructure and supply chains. As such, there is now serious interest in deploying CCS in this way enabling low carbon hydrogen to be synthesised in the UK.

Another potential opportunity comes from the integration upstream of biomass or waste products and passing them through a gasifier to produce syngas (a gas mixture composed of methane and hydrogen & others), which can be reformed to yield hydrogen. If combined with CCS, this has the potential to offer a significant and scalable pathway to net-negative CO2 emissions.

A growing number of consortia in Scotland (Acorn project), England (HyNet in Liverpool, Net Zero Teesside, Drax CCS on the Humber, Thames) and Wales (South Wales Industrial Cluster) have declared their intention to capture and store CO2 from their power and other industries and the UK government has pledged an initial £850 million of support to bring the first few projects online.

As a result, now seems a realistic probability of carbon dioxide being injected to offshore storage sites within the next 5 years. It could be that shifting the narrative of CCS to one with hydrogen production is one of the most important to have occurred in recent years.

Future Gazing - Geothermal Energy

by Prof Jon Gluyas, Executive Director, Durham Energy Institute

With significant gains already made in decarbonising UK electricity there is strong agreement that a significant challenge still remains in decarbonising heating. Much of Government policy has focused on switching from gas produced heat to electrification of heating combined with an increase in renewable electricity. However, to avoid over burdening our electricity grid in future, more focus is needed on direct heat options such as waste heat capture, heat storage, heat networks and geothermal energy.

Geothermal energy may have the potential to help meet the increasing challenges of decarbonising heat. Although geothermal delivery remains small in the UK, there have been some very positive and important developments in the last two years which are shifting focus on this technology. In Cornwall, Geothermal Engineering’s United Downs project saw the drilling and testing of deep geothermal wells including a production well to 5,275m into a hot granite with the aim of using the heat to produce steam and thus zero carbon electricity. Geothermal Engineering with partners Thrive, Cornwall Council and the European Union Regional Development Fund will deliver the first geothermal power station in the UK.

Elsewhere and especially in the NE of England (Durham, Gateshead and other local councils) are turning to their old and abandoned coal mines to deliver low grade sustainable low carbon heat for space heating. Wells have been drilled at Stanley near Durham and in Gateshead to test the heat delivery potential and at Seaham on the Durham coast work has begun to build 1,200 homes that will be heated by taking heat out of the water in the old flooded mines. With 25% of UK home built in former coal mining areas, the opportunity for using this enormous heat source to decarbonise heating in the UK is massive. Deployment of low grade heat from flooded mines as well as from industrial waste heat will go a long way towards decarbonising heat in the UK, currently our biggest source of greenhouse gas emissions.

References

[1] MyGridGB https://www.mygridgb.co.uk/last-12-months/

[2] 2019 UK greenhouse gas emissions, provisional figures (March 2020) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875485/2019_UK_greenhouse_gas_emissions_provisional_figures_statistical_release.pdf

[3] UK Energy White Paper (Dec 2020) https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

[4] Special feature – Nuclear electricity in the UK https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/789655/Nuclear_electricity_in_the_UK.pdf

"How can we meet global energy demands while tackling climate change?

Our research is helping to address the world's energy challenges as we switch from fossil fuels to clean energy sources.

We investigate how the geothermal potential of former coalmines can provide a low carbon, clean, heat source.

We work to make wind turbines more efficient to increase their capacity to generate clean energy.

Our researchers are also developing more efficient, cost-effective materials for solar cells, batteries or machinery.

Alongside this, we examine the impact of new and existing energy sources on society and how more flexible or integrated energy systems could shape our energy future.

Our aim is to work alongside industry, government and communities to best meet future energy and environmental demands.

www.durham.ac.uk/dei/

Partner with Durham Energy Institute

DEI are helping to drive forward the UK net zero transition through our research and work with industry-policy partnerships such as the leading Offshore Wind Regional clusters and Teesside Industrial cluster.

DEI has an expert consultancy team that will help organisations and business achieve Net Zero. We are always looking for new partnerships or research opportunities!

Please get in contact with **evelyn.tehrani@durham.ac.uk** to discuss partnership opportunities.

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