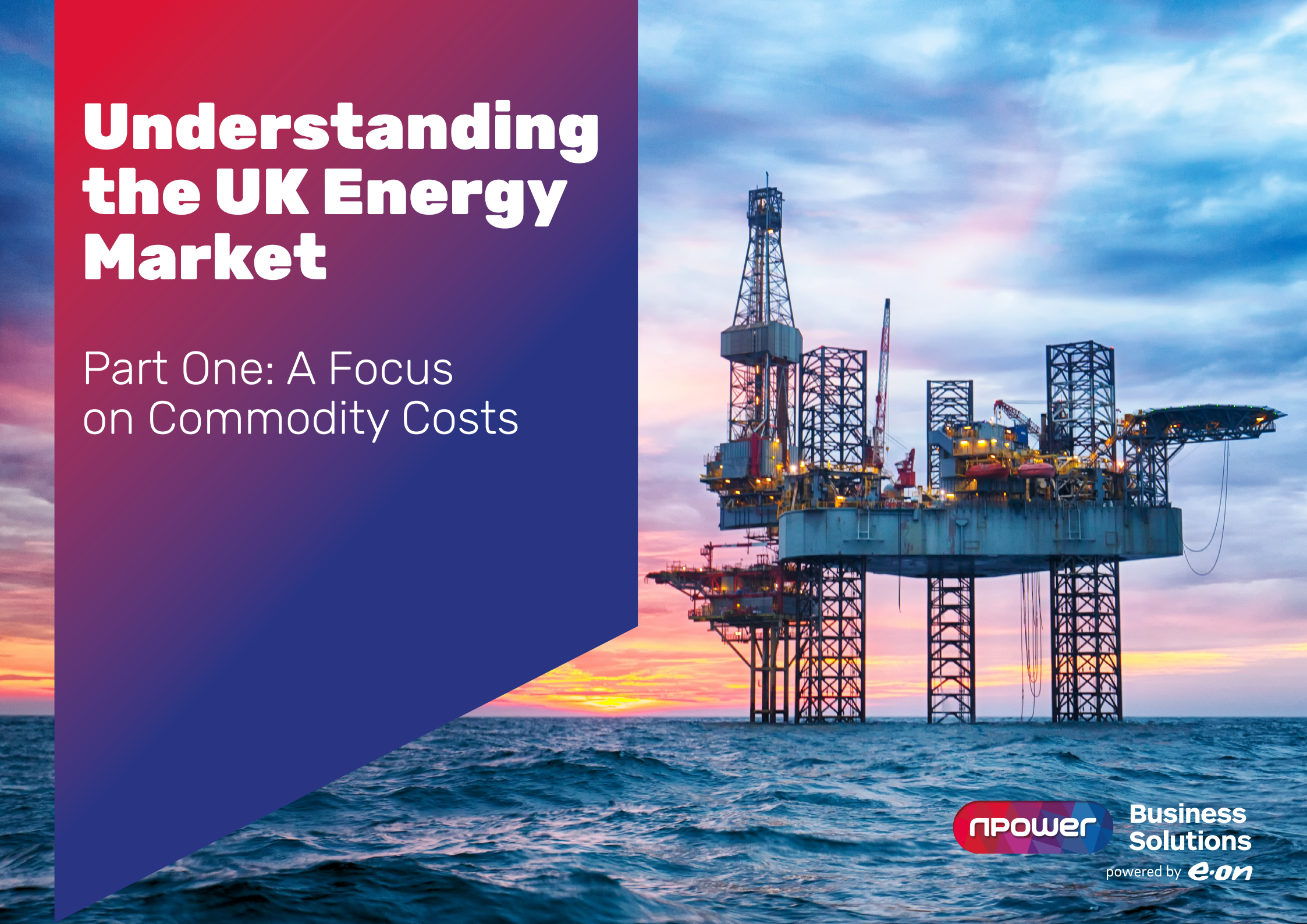
Understanding the UK Energy Market

Part One: A Focus on Commodity Costs



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Introduction

In all the history of UK energy supply, there has probably never been a more pressing time to understand how the energy we use is generated, traded and supplied – as well as all the different components that influence the price we pay for this vital commodity.

That's why we're creating a series of 'Energy Made Simple' reports – to provide a straight-forward explanation of all the key aspects of energy that will help you become more informed about the power and gas your business consumes.

In our first report of the series, 'Understanding the UK Energy Market', we look at UK supply – how this has changed and what sources contribute to our energy generation mix today. And crucially, how this impacts the cost.

Our next report will explore the wholesale market in more detail – and what drives prices, and especially the huge increases we've seen recently. This includes the influence Russia has on our energy market, despite the UK importing very little Russian gas.

Then in April, we'll look at all the non-commodity elements that make up around half of the total invoiced cost you pay. These are complex and ever-changing, so understanding how these work can help you manage business energy more effectively.

We hope that these reports will support you in making better-informed decisions about how best to meet your business's energy requirements in these challenging times.

Anthony Ainsworth

COO, I&C Energy Sales and Solutions,
E.ON UK and npower Business Solutions (nBS)

Where does our energy come from – and how does this impact what we pay?

The cost of energy has become a hot topic, particularly since wholesale costs started sky-rocketing last September.

A number of factors have contributed to these price rises – including increasing international demand for gas, and political tensions with Russia, which have escalated exponentially since its invasion of Ukraine. We'll be exploring these in more detail in our next report (part two).

Before we look at what influences the wholesale energy markets, we should start at the beginning of the energy journey to consider where our energy actually comes from, the shift to more renewable generation – and how this impacts the price we ultimately pay.

In this report, we will look at the:

- **Changing mix of energy generation in the UK**
- **Shift from coal to gas**
- **Rise of renewable generation**
- **Role of low-carbon nuclear**
- **Move from energy self-sufficiency to import dependency**
- **Growing supply from interconnectors**

And we'll consider the burning question: **despite the growth in renewables, why are energy prices so high?**

The changing mix of energy generation in the UK

Over the past decade, the UK has dramatically transformed its electricity supply.

Back in 2008, as the Climate Change Act came into law, around 80% of the UK's electricity came from fossil fuels. The majority of this was generated by large power stations burning coal, gas and oil. A further 13% was supplied by nuclear power.

As a result of government schemes to encourage more low-carbon power, more renewable generation was starting to emerge, accounting for around 6% of supply, with a further 1% from landfill gas.

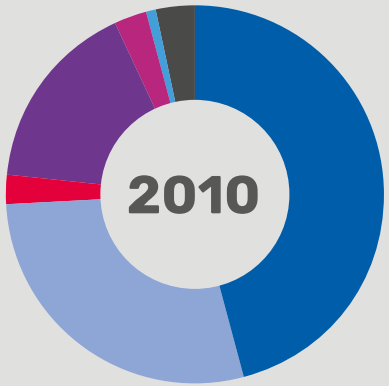
While that doesn't sound like much, by the end of 2008, the UK had become the world's largest producer of offshore wind.

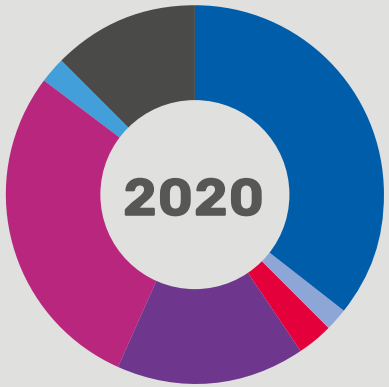
Fast forward to 2020, and the picture is very different.

The largest share of our electricity – almost 60% – came from low-carbon sources, including 28.4% from wind and solar, 14.7% from hydro and other renewables and 16.1% from nuclear.

The share of our electricity generated by carbon-emitting fossil fuels (mostly natural gas) had reduced to less than 41%. And we imported 8% from other countries via our growing number of undersea interconnectors, of which 66% was from low-carbon sources (e.g. French nuclear and Norwegian hydro).

UK energy mix





*Includes landfill gas and biofuels

Source: UK Energy in Brief 2021

The shift from coal to gas

The UK's relationship with the most polluting of fossil fuels – coal – has been a rollercoaster. From one of the earliest adopters and world's leading producers of coal, the government had committed to phasing out its use completely by 1 October 2024 (although it's likely coal plant will remain operational to supply back-up power as needed).

We started mining this 'black gold' in the 1770s, with output climbing year-on-year to peak at 292 million tonnes in 1913. Coal supplied fuel for everything – electricity, industry, heating – even British Rail used coal to power trains until 1968.

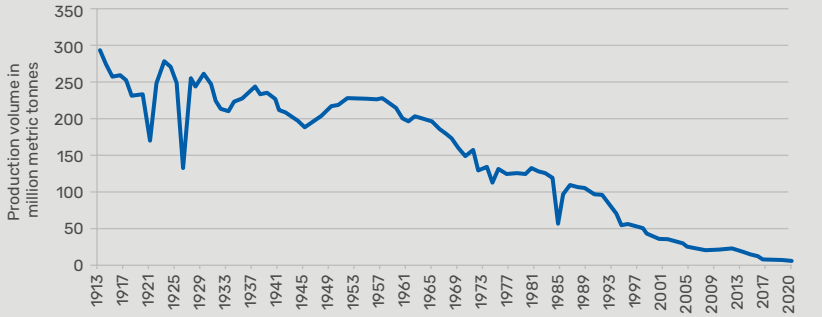
But the discovery of North Sea gas and oil, and cheaper imports from abroad, meant our coal production started to rapidly decline from the 1960s, although it still fuelled many of the UK's existing coal-fired power stations.

Up until 2011, 35% of the UK's electricity was generated by coal. But after the government committed to closing coal plant by 2020 (although some still operate now), many chose to close early rather than invest in upgrades to keep running. New gas-fired power stations, as well as more renewable power, started to pick up the slack.

By 2016, coal supplied less electricity than wind energy – and the first coal-free generation days, weeks and months started emerging in the following years. By 2019, just 2.1% of UK electricity was generated from coal, with only 2 million tonnes supplied from our own coal mines, and 6.5 million tonnes imported, mostly from Russia but also the USA and Venezuela.

The decline of coal

Coal production in the UK from 1913 to 2020



Source: GOV.UK; UK Department for Business, Energy and Industrial Strategy (BEIS)

Despite the shift to gas, the amount of electricity it generates is also declining, supplying 35.7% in 2020, down from 46% in 2010, as the share of renewable power increases.

However, unlike for power generation, there isn't yet a low-carbon commercial substitute for the many direct uses for gas. More than 22 million households still rely on it for home heating. And industry is still dependent on gas for heat and a range of industrial processes, such as the manufacture of steel, iron, paper, chemicals and glass.

So it's unlikely our requirement for gas is set to reduce any time soon. The volume of gas we extract from our North Sea reserves is also falling, leaving us more exposed to international prices for the growing share we import. And it's these dependencies that are predominantly behind the high energy costs we are currently paying (more on this on page 10).

The rise of renewables

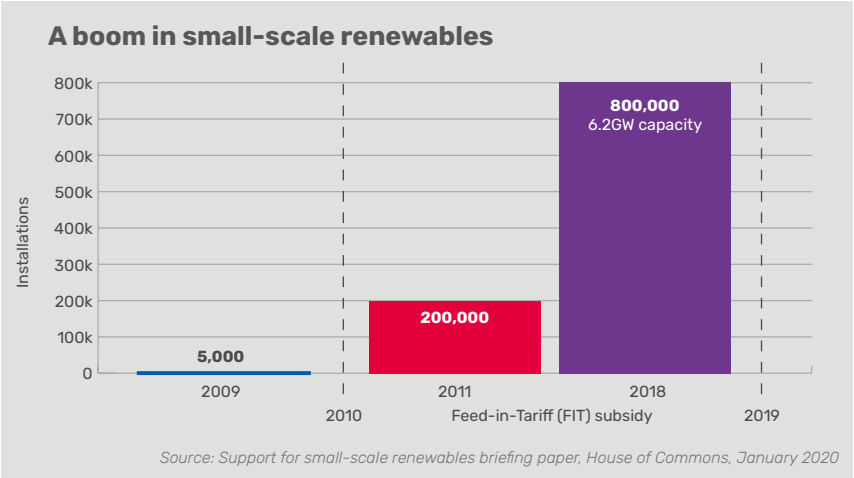
Over the last decade, renewable generation has expanded exponentially. Compared to a 6% contribution in 2008, renewable technologies today account for a larger share of our total electricity generation than fossil fuels.

This shift really started ramping up after 2009, when the government launched its low-carbon transition plan to move the UK towards generating 40% of our electricity from low-carbon sources by 2020. As a result, more wind energy, solar and bioenergies (energy derived from burning biological matter such as wood, plants and animal materials) began to emerge.

By 2013, the number of large renewable energy schemes topped the 1,000 mark, more than double the number in 2008, along with more than 500,000 small sites (mostly solar rooftops). With nuclear, this meant a third of UK power generation came from low-carbon sources.

The launch of the Feed-in Tariff (FIT) subsidy in 2010 encouraged more small-scale renewables, with the number of installations increasing from just 5,000 in 2009 to around 200,000 by 2011 – and more than 800,000 by 2018.

The FIT scheme closed to new participants in 2019. But over its nine years of operation, it was responsible for around 6.2 gigawatts (GW) of installed capacity – that's double what's expected from the new Hinkley Point C nuclear power plant.

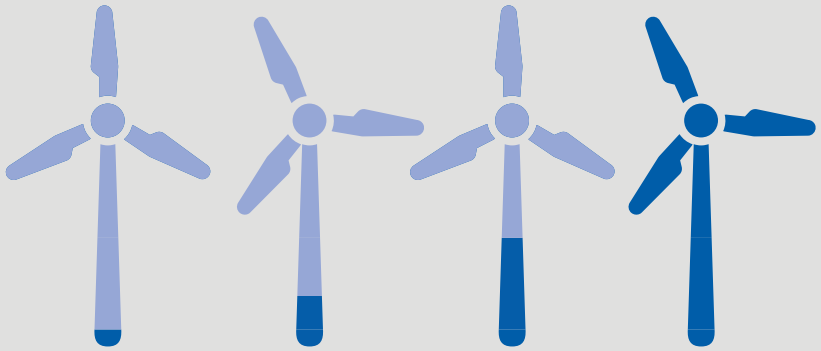


Source: Support for small-scale renewables briefing paper, House of Commons, January 2020

When it comes to large-scale renewable generation, the biggest growth area has been offshore wind. By 2020, the UK's offshore wind farms provided more than 10GW of power capacity to the grid.

The UK government is aiming to quadruple this to 40GW by 2030, which would provide the equivalent energy to meet the power demands of every UK home today. But what the impact would be on electricity prices isn't clear (see page 10 for more on this).

Offshore wind capacity takes off



2000
4 megawatts (MW)

2010
688MW

2020
10.4GW

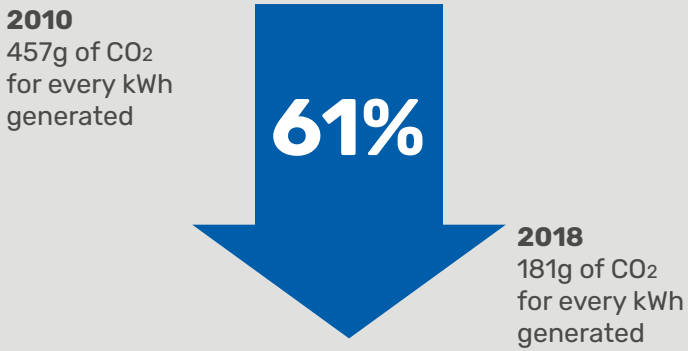
2030
40GW
(enough to power every UK home)

Source: Catapult Offshore Renewable Energy

By 2020, renewable electricity outpaced fossil fuel generation for the first time, providing 42% of the UK's power versus 41% for gas and coal plant.

This has had a dramatic impact on the carbon intensity of the UK's electricity. In 2008, we produced 495g of CO_2 for every kilowatt hour (kWh) generated. This fell to 457g by 2010. And over the next decade, decreased by a further 61% to 181g by 2020.

Plummeting carbon intensity of UK electricity



Sources: Carbon Brief and National Grid ESO

The main downside of renewable energy is its intermittency, which means we need back-up from other sources to ensure continuity of supply. Fossil fuel and nuclear generation currently fill this gap. But in time, more battery and other storage is expected to emerge.

Low-carbon nuclear

Nuclear plays a key role in the UK's low-carbon generation mix. And unlike renewable energy, it provides continuous, predictable energy.

However, the UK's nuclear fleet is ageing, and electricity from nuclear generation is falling. In 2021, it decreased by 9% to just 46 terawatt hours (TWh) (supplying 14% of UK electricity), less than half its peak in 1998 and the lowest in nearly four decades.

As many of the current reactors reach their scheduled retirement – with all except Sizewell B in Suffolk due to close by 2030 – nuclear generation is set to decrease further.

But the government is hoping to maintain current output, with two new reactors due to be completed at Hinkley Point C in Somerset later this decade. And it's working to replace the retired Sizewell A plant with a new Sizewell C power station during this parliament.

However, nuclear power stations are expensive to build, require huge volumes of water to operate, and it is costly to dispose of the radioactive waste they produce.

So, while nuclear offers a low-carbon generation option, it's by no means a perfect solution.

Self sufficiency to import dependency

Historically, the UK has been relatively self-sufficient when it comes to energy, with our own coal mines and North Sea oil and gas fields supplying the fuel we needed.

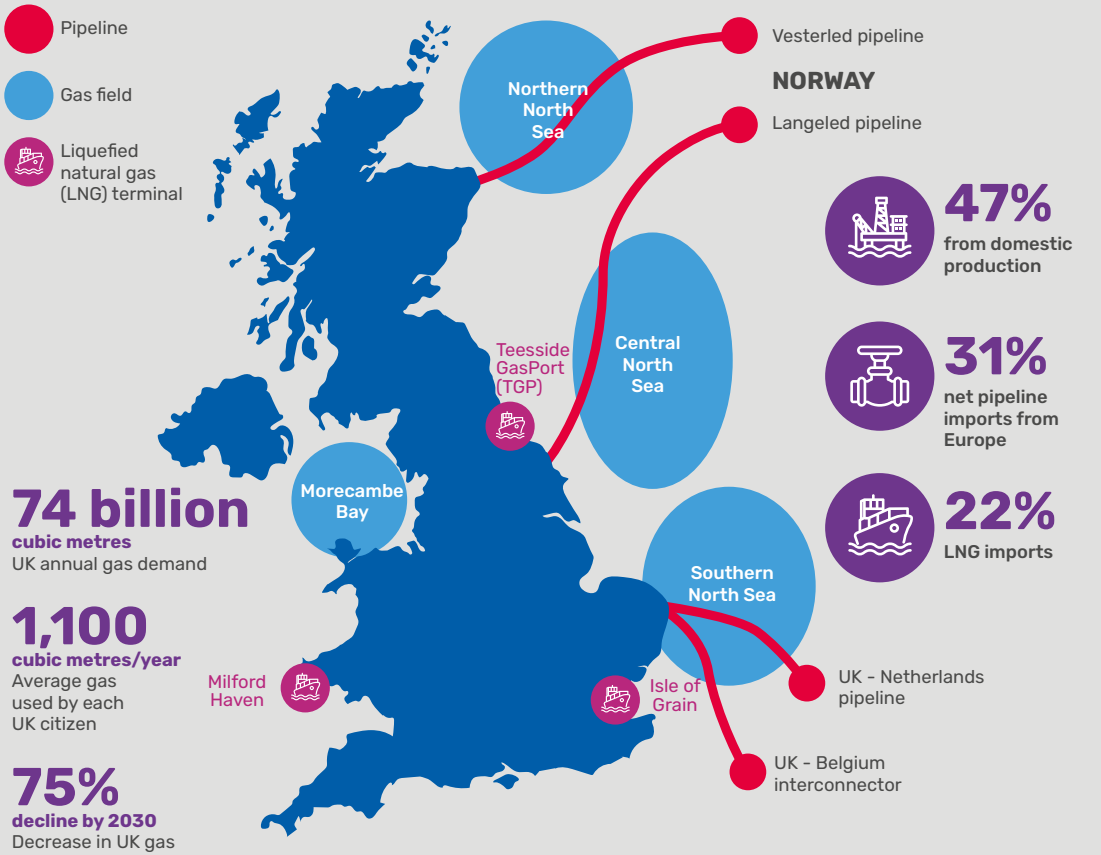
But as these reserves depleted and the government started phasing out coal, we've had to import more fuel.

We already import more coal than we extract – 6.5 million tonnes, predominantly from Russia, versus 2 million tonnes from our own reserves.

And when it comes to gas, industry trade body Oil & Gas UK calculates we get 47% of our supplies from UK fields in the North Sea and import 53%.

With just over 25% of our energy imported in 2008, this peaked at nearly 48% in 2013. But as the UK's wind generation capacity has increased – and our overall energy consumption reduced due to increases in energy efficiency and a decline in industrial activity – it's now around the 36% mark.

How does the UK get its gas?



Source: OGUK

The growing role of interconnectors

As well as importing gas and coal, we also import ready-made electricity directly from neighbouring countries via undersea cables. These 'interconnectors' work both ways, so we can export electricity too. For example, if we have excess renewable energy being generated.

As of 2022, we have seven interconnectors with 8.4GW capacity linking us to France, the Netherlands, Norway, Belgium, Northern Ireland and the Republic of Ireland. The first of these – Interconnexion France-Angleterre (IFA) to France – became operational in 1961. And the most recent – the North Sea Link to Norway – went live in October 2021.

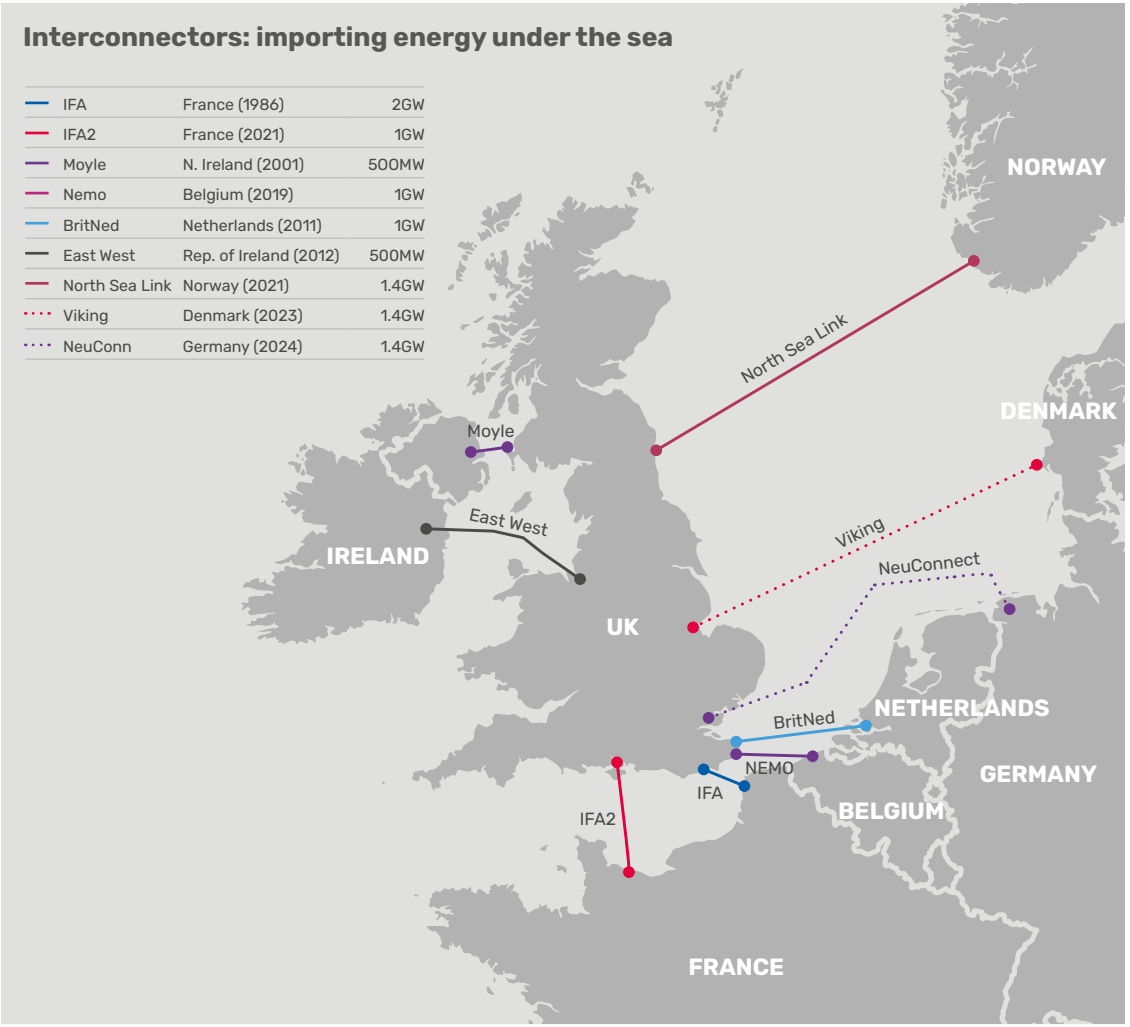
Between 1990 and 2019 (which is a better comparative year than 2020 or 2021, due to the impact of the Covid-19 pandemic on energy use), the volume of electricity we imported each year nearly doubled to 25TWh – or 8% of the UK's overall energy supply.

However, in September 2021, a fire in the IFA French interconnector knocked out around 1-2GW of the UK's supply, which is not expected to fully recover until later this year.

In future, we could potentially import as much as 25% if required, especially with two new interconnectors to Germany and Denmark under construction, which will add another 2.8GW of capacity by 2023-24.

Interconnectors: importing energy under the sea

IFA	France (1986)	2GW
IFA2	France (2021)	1GW
Moyle	N. Ireland (2001)	500MW
Nemo	Belgium (2019)	1GW
BritNed	Netherlands (2011)	1GW
East West	Rep. of Ireland (2012)	500MW
North Sea Link	Norway (2021)	1.4GW
Viking	Denmark (2023)	1.4GW
NeuConn	Germany (2024)	1.4GW



Sources: National Grid ESO, Statista and Electrical Review

Why, with the growth in renewables, are energy prices so high?

Despite having a broad mix of energy sources to draw on – and an increasing volume of domestic renewable generation – one of the most commonly asked questions during the current energy crisis is: why are energy prices still so high in the UK?

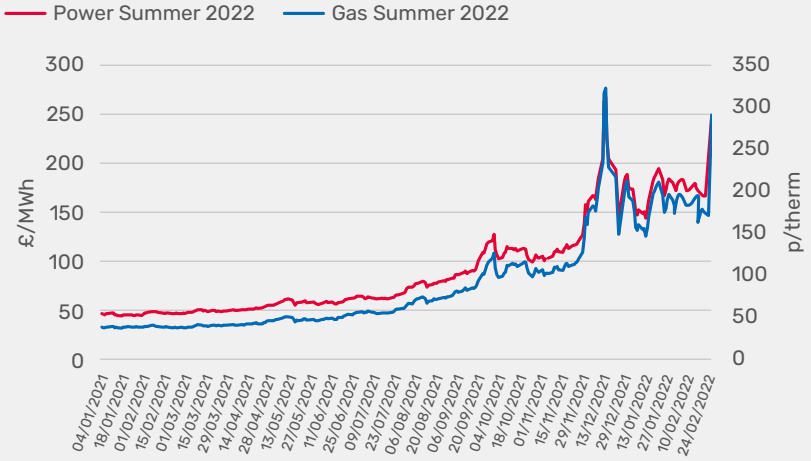
In one word, the answer is: gas.

Due to the move away from coal, gas has become our dominant fuel. As well as supplying heat for 87% of UK homes, around 40% of our electricity is generated from natural gas.

There's a similar reliance across Europe. And globally, there's strong demand for gas, especially as economies pick up after the slow-down caused by the pandemic. So gas is a hot commodity.

It's this dominance that allows the value of gas to influence the price of power. As so much power generation relies on gas, power markets therefore closely track gas markets.

UK Power and gas price development



Source: nBS Optimisation Desk

Oil remains the other main global fuel commodity, so changes to oil prices also impact both the gas and power markets.

This is despite almost half the UK's electricity now being supplied by low-cost renewables – where the resources they run on, i.e. wind and sunshine, are free.

And rather than having separate markets to trade each energy technology separately, or having a combined market that's adjusted for the wider range of generation types we see today, all generation – regardless of source – is instead bundled together and traded as units of energy (MWh), with gas values influencing the price.

Many in the industry believe this system is in need of reform.

For example, Dieter Helm, Professor of Economic Policy at the University of Oxford and the author of a government-commissioned independent review on the Cost of Energy in 2017, says: "We should plan for a 21st century energy market structure, not carry on with a fossil-fuel-driven 20th century wholesale market framework."

He advocates changes to the market that bases the price of electricity on its "cost, not on the basis of the cost of the most expensive fuel at any point in time."

But that's unlikely to happen any time soon. Although change would certainly be helpful to the many businesses struggling with escalating energy costs right now.

In our next 'Understanding the UK Energy Market' report, we'll look in more detail at the range of international, economic and geopolitical factors that influence energy markets and prices.

Following reports will then consider how the UK's changing energy mix will impact the transmission and distribution costs added to invoices, plus the other non-commodity costs that together make up as much as 60% of electricity invoices.

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