

drax

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Dr Iain Staffell, Professor Richard Green, Dr Rob Gross and Professor Tim Green
Imperial College London

Dr Grant Wilson
University of Birmingham



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Electric Insights was established by [Drax](#) to help inform and enlighten the debate on Britain's electricity. It is delivered independently by a team of academics from [Imperial College London](#). Data courtesy of [Elexon](#), [National Grid](#) and [Sheffield Solar](#).

1. Headlines

The last decade has seen unprecedented changes in the power system, so we dedicate this issue of *Electric Insights* to looking at 'the ten years of transition'. 2019 was as a dramatic year for Britain's power system. It faced the most serious blackout for a decade, saw offshore wind become cheaper than wholesale power, and renewables produce more output than fossil fuels for much of the year. Despite fears that low-carbon generation had stalled in 2019, we reveal that carbon emissions fell once again, by a staggering 14% on the previous year.

2019 also marked a major turning point for energy and the environment. Climate change has grabbed mainstream attention as fires raged across Australia and the Amazon. Glasgow was selected to host the COP26 intergovernmental climate conference this coming November, putting the UK front and centre of the global energy transition. Now is a critical time to show environmental leadership.

Thankfully, Britain's power sector is rapidly moving in the right direction. Our first article looks back over the last ten years of transition. In 2019, the average carbon intensity of Britain's electricity fell below 200 g/kWh for the first time ever, ending the decade 60% lower than at the start. Renewables continued to grow and coal retreated to less than 2% of supply. However, Britain's weather is also moving into new territory, with heat waves becoming ever-more common, pushing up peak summer temperatures by 5 degrees Celsius.

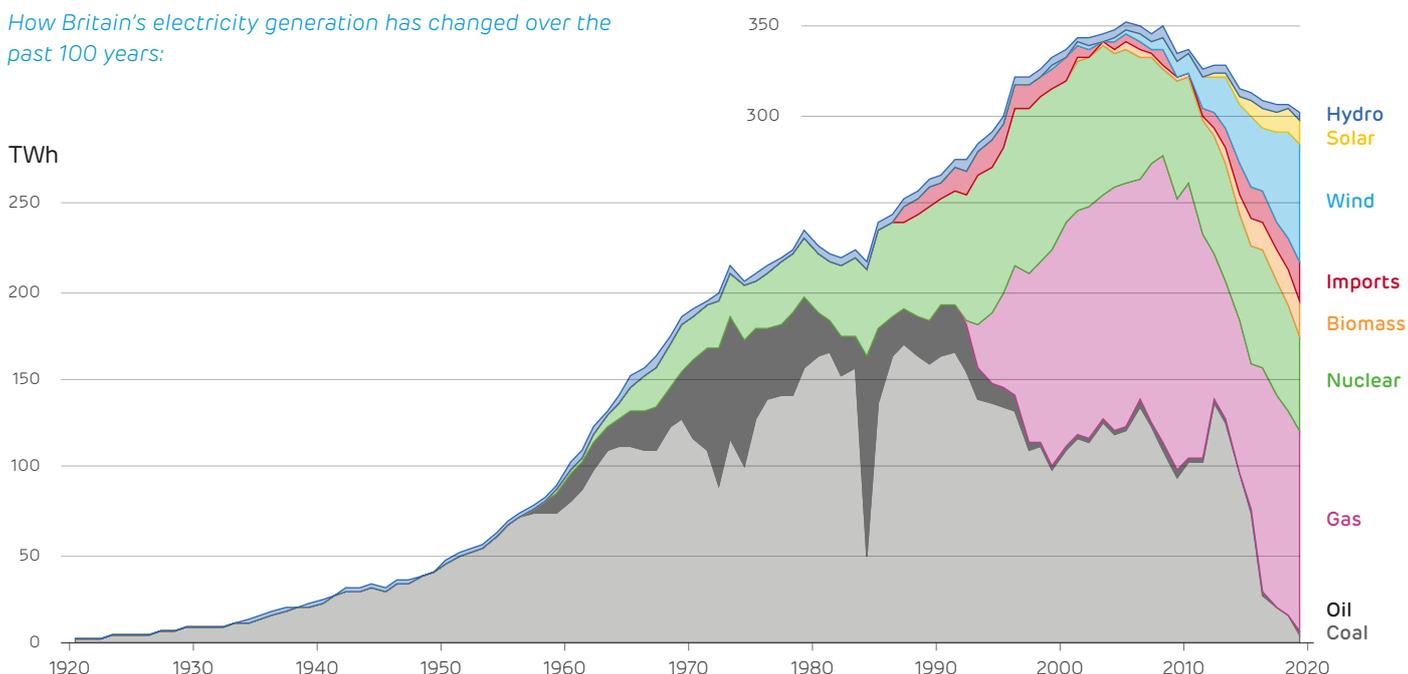
We then look back over the past century of electricity generation to put this decade into context. Britain's power system is being transformed at never-before-seen speed. Next, we turn to the decade ahead of us, looking at what predictions we can make about the 2020s with some confidence, and what things are just impossible to forecast.

Article 5 looks at which elements of last decade's transition contributed the most to decarbonisation, and how they impacted on power prices. New analysis shows how coal phase-out, the growth of renewables and increasing carbon prices have impacted the environment and the economy.

Finally, we begin a series of primers in the run up to COP26 which take a broader view on how Britain's clean electricity can contribute to decarbonising other sectors of the economy. This quarter, we look at the options for tackling heat production, and a new milestone for clean electric heating.

This issue concludes with the capacity and production statistics for Quarter 4 of 2019, and a review of the British power system records.

How Britain's electricity generation has changed over the past 100 years:

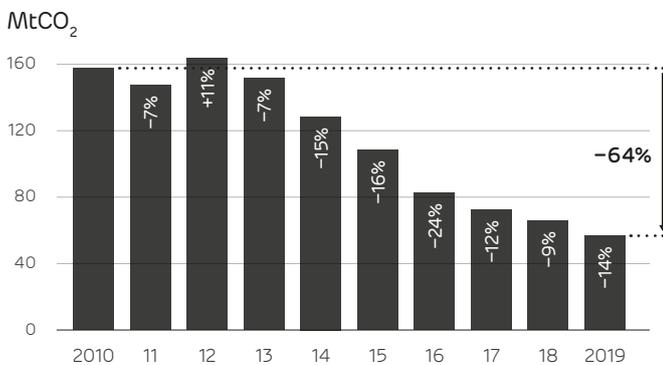


2. Britain's decade of decarbonisation

Looking back over the last decade, Britain's power system has changed beyond recognition. Carbon emissions from electricity consumption fell by almost two-thirds, [the fastest rate of decarbonisation anywhere in the world](#). Emissions fell 14% in the last year alone, quelling fears that low-carbon generation has stalled.

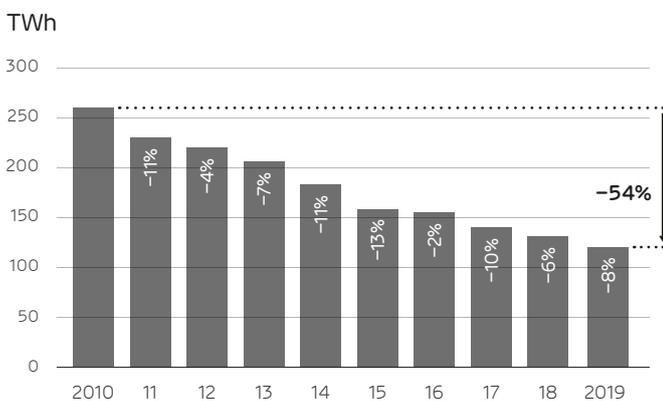
Electricity generation added 2.6 tonnes of CO₂ to every Brit's carbon footprint back in 2010. Last year, that fell below 1 tonne for the first time since the 1940s. A major cause of this has been reducing our reliance on coal and gas.

Carbon emissions:¹



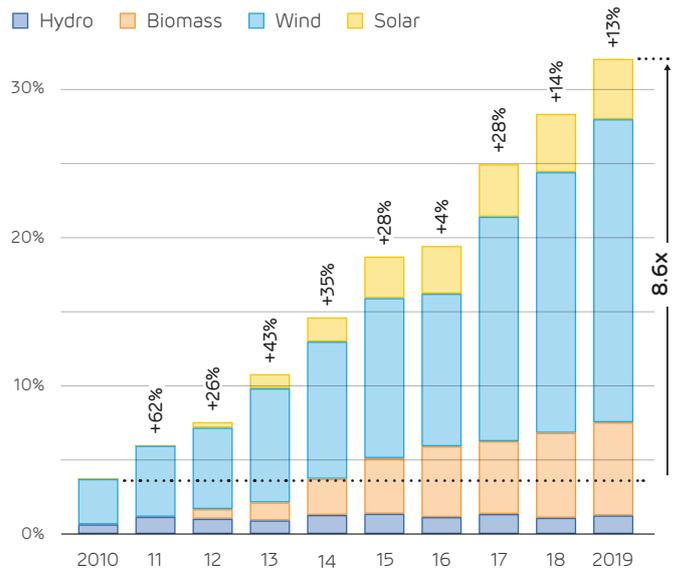
Generation from fossil fuels fell every single year during the decade, and last year was no exception with an 8% fall from 2018. Britain's power system now burns half as much fossil fuel as it did in 2010, saving the equivalent of 32 million tonnes of oil each year.² This is roughly the total consumption of all cars, vans and lorries on Britain's roads. Given that 40% of the UK's fossil fuels are imported, this has a significant impact on the country's trade deficit, reducing our energy import bill by around £3.6 billion each year.

Electricity generation from fossil fuels:



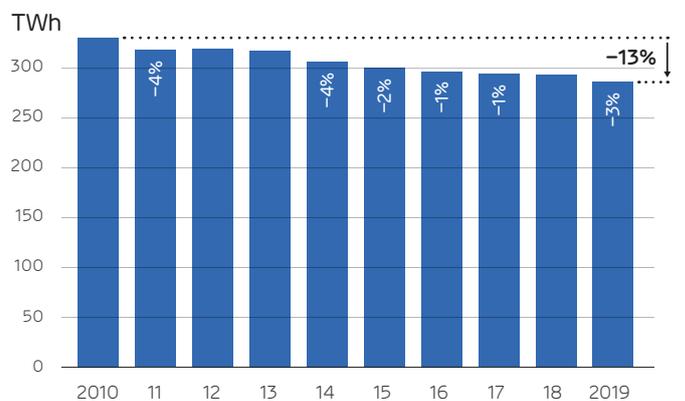
In contrast, output from renewables has grown every year, with output in 2019 being more than eight times higher than in 2010. The capacity of wind, solar, biomass and hydro has grown six-fold in that time, from 5.2 GW in 2010 to 38.5 GW in 2019.

Share of generation from renewables:



Electricity demand has fallen steadily over the decade even though the population has grown 7% and GDP risen by a quarter in that time.³ Britain now consumes one-eighth less electricity, through a combination of shifting economic production, milder winters meaning less demand for electric heating, and improving energy efficiency. For example, a modern 42" LCD TV has triple the screen area of an old 21" square TV, but uses only half as much electricity.

Electricity demand:



¹ This includes the emissions released abroad due to imported electricity and the biomass supply chain. See the [Electric Insights methodology page](#) for more detail.

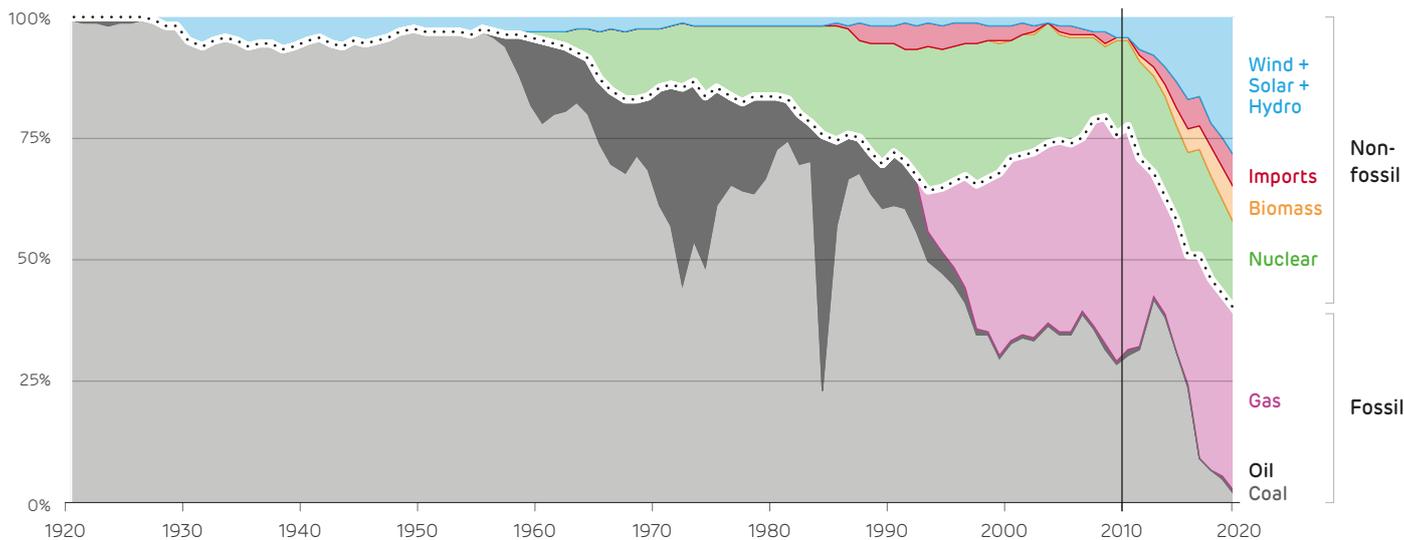
² Comparing 2019 to 2010, 38 million tonnes of coal has been saved (equivalent to 23 million tonnes of oil), and 10 billion m³ of natural gas (equivalent to 9 million tonnes of oil). The current market value of these savings is approximately £2.2 and £1.4 billion respectively.

³ Population grew from 62.8 to 66.9 million people, and GDP rose from £1.7 to £2.2 trillion, according to the Office of National Statistics.

3. The 100 years from coal to clean power

Energy sector transitions are meant to be slow.¹ Power stations have long lifetimes and are expensive to replace, so it usually takes decades to shift the supply mix. The chart below shows how Britain’s power system is rewriting the rule book. The electricity generation mix changed more in the 2010s than in the previous ninety years combined.

Britain’s electricity generation mix over the last 100 years²



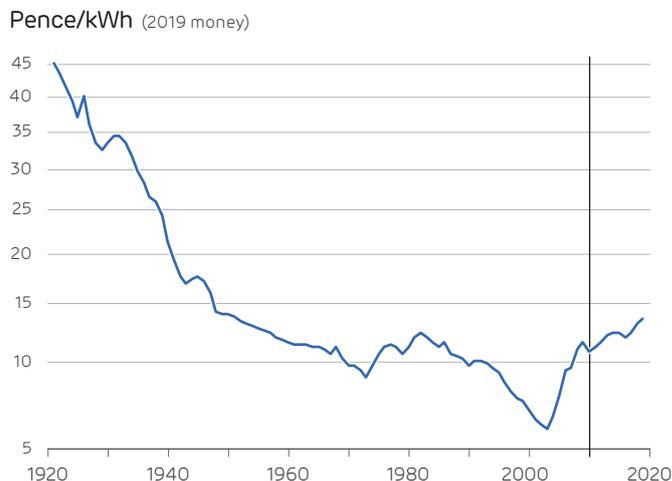
In previous decades there have been big shifts *between* fossil fuels, but not *away from* them. The chaos caused by the 1970s oil crises and the 1980s miners’ strikes saw huge swings between coal and oil, and expanding gas production in the North Sea drove a rapid switch from coal to gas in the 1990s. Overall reliance on fossil fuels has been very hard to shift though.

Previously, the fastest changes we had seen were in the 1960s and 1980s, both of which saw the share of fossil fuels fall by around 10% due to the growth of nuclear power. These changes were gradually reversed as nuclear went into decline and demand continued growing. Overall, between 1920 and 2010, fossil fuels barely loosened their grip, from 100% to 80% of electricity generated. Between 2010 and 2019 they halved to just 40%.

But has this radical change come at a price? Retail prices rose 3% faster than inflation over the 2010s, in part due to the growing pot of subsidies used to fund new renewable investment. For context though, this is half the rate of price rises seen during the 2000s; and has brought electricity prices back to their long-term average over the latter half of the 20th Century.

If this pace of change can be maintained, renewable sources could be providing more than half of Britain’s electricity by the end of this decade, and Britain’s power system could be practically carbon free.

Retail price of electricity in Britain (average across all sectors)³



¹ E.g. see Vaclav Smil or Shell’s Energy Scenarios.
² Data from BEIS, Digest of UK Energy Statistics, BP.
³ Data from BEIS, Digest of UK Energy Statistics, Quarterly Energy Prices.

4. What to watch in the 2020s

The 2020s are billed as the ten years we have to save the climate. What might they have in store for Britain's power system? The old saying goes that predictions are difficult, especially if they're about the future. However, several aspects of the coming decade's transition are already baked in through investment and retirement decisions. So, can we already say whether or not the rapid changes of the 2010s will continue or not?

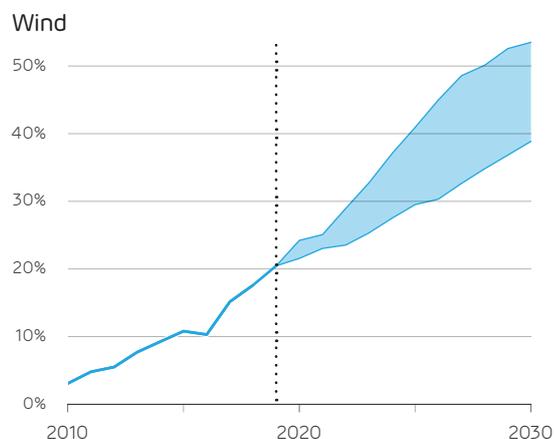
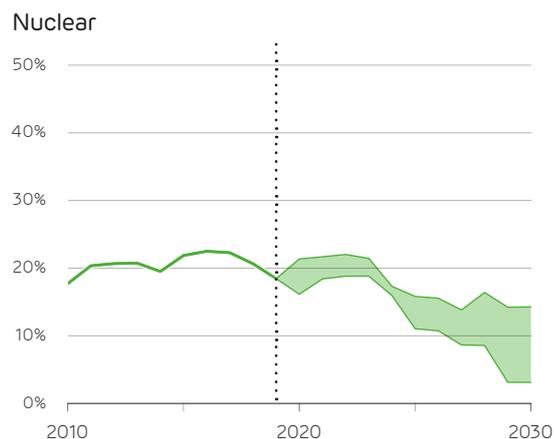
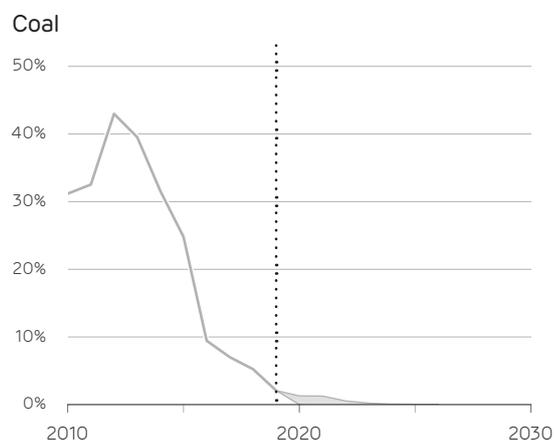
Coal phase-out is pretty much certain, and is being actively implemented by government. The last coal power station should have switched off by 2024, but this could happen as early as 2022 according to National Grid.¹ This is largely symbolic now that coal provides only 2% of power, but perhaps it would be useful to keep the remaining plants available for times of high system stress. The Beast from the East from back in 2018 could have been catastrophic if not for the 10 GW of coal plant that came online. It is not the capacity, but the energy output which matters to the climate.

Coal-free runs will become longer and more frequent. No coal power stations operated during two-thirds of hours in spring and summer of 2019, up from just over one-third in 2018. This coming spring could potentially see the first ever month completely free from coal generation.

Nuclear output will also decline as every existing reactor except for Sizewell B comes up for retirement. The UK's only new nuclear reactor (Hinkley Point C) should come online in the second half of the 2020s. Given the extremely long lead times for nuclear new build (planning for this reactor began ten years ago), it is relatively certain that Britain's nuclear capacity will halve over the coming decade.

The outlook couldn't be more different for wind power. Offshore wind will grow rapidly during the 2020s, boosted by auctions that have delivered record low prices, and government intentions to reach 40 GW of offshore wind by 2030 (more than quadruple today's capacity). This direction of travel can be said with relative confidence as several GW-scale projects have already secured financial support or planning permission, but there is wide uncertainty about ultimately how large the wind fleet will grow.

Historic and projected shares of the electricity generation mix, based on National Grid's Future Energy Scenarios



¹ Possible future trajectories for the electricity supply mix were taken from National Grid's four Future Energy Scenarios.

The future for onshore wind and solar power is less clear, as the withdrawal of government support means new investment depends on when (and to what extent) they become profitable on the open market. The first such ‘merchant’ projects are already operating or under construction, but whether this becomes mainstream depends on how quickly technology costs continue to fall and what happens to wholesale prices – both of which are highly uncertain. Growth of onshore wind will be modest (perhaps half the rate of offshore), whereas forecasts for solar power capacity range from almost no increase on today’s levels through to capacity more than doubling by 2030. In either case, solar will remain relatively small, at less than one-tenth of Britain’s annual electricity generation (though a higher share of capacity).

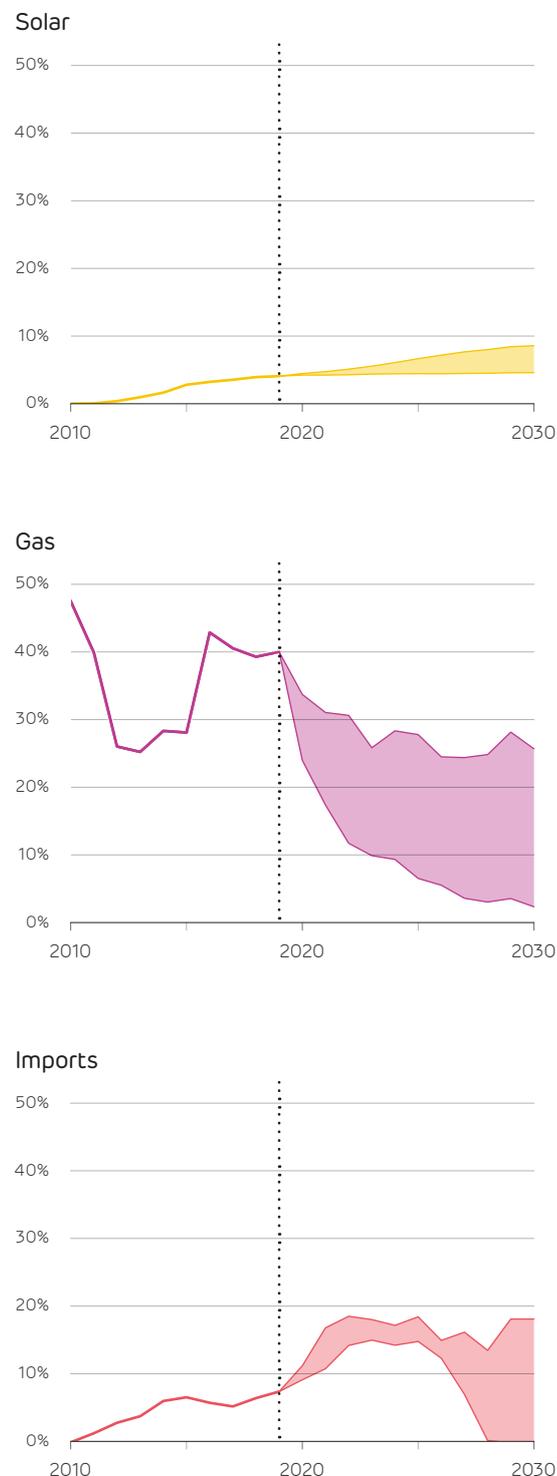
The role of gas power stations is already changing from bulk electricity production to balancing out variations in wind and solar output. Their future depends largely on how much new wind capacity is developed. Some of the oldest stations will retire during the 2020s, so capacity will decrease slightly unless others are built. The running hours of the remaining capacity will likely fall with each passing year, but it is impossible to say by how much – reflected in the wide uncertainty through the 2020s. The big unknown is when we see the [transition from zero-coal to the first ever zero-fossil hours](#).

The other driver of uncertainty is Britain’s trade balance with other countries. [Several new interconnectors will be built over the coming decade](#), with over 3 GW already under construction. Capacity is expected to grow from 5 GW today to between 10 and 20 GW by 2030, but it is hard to predict whether Britain will remain a net importer, or if these links will have balanced two-way trade (as is seen currently with Ireland). [Investment in grid-scale energy storage is one to watch](#): Britain’s total storage capacity might double or triple over the coming decade. This is highly dependent on how rapidly costs continue to fall, and whether electric vehicles start to be employed as distributed storage through smart charging systems.

Electricity demand may bottom out and then begin growing towards the end of the 2020s, or it may continue its gradual decline. This depends largely on uptake of electric vehicles and long-term energy storage (such as hydrogen). These ‘new’ sources of demand could form anything from 1% to 10% of total electricity demand by 2030, and represent one of the biggest sources of uncertainty on the system’s future.

With demand changing in nature and more than half of supply coming from weather-dependent renewables, the “minimum headroom” on the system² will likely hit zero in the next 2–3 years. System operability will undoubtedly become more difficult in the years to come, [and National Grid anticipate being ready for periods of zero-carbon generation by 2025](#).

Historic and projected shares of the electricity generation mix, based on National Grid’s Future Energy Scenarios



² Demand minus output from weather-driven renewables and inflexible nuclear (i.e. supply from flexible and dispatchable sources).

5. What drove Britain's decarbonisation?

Many things have helped to reduce Britain's power sector carbon emissions: coal phase-out, new renewables, rising carbon prices and falling demand. But how much did each of these contribute, and what was their impact on the cost of generating electricity?

Two-thirds of coal power stations have retired since 2010 due to clean air laws, conversion to biomass, or because they were simply no longer profitable. These have been replaced by over 30 GW of new renewables. Carbon prices have trebled,¹ as prices on the EU Emissions Trading Scheme eventually rose and the UK government added an extra £18 per tonne of pollution. All the while, international fuel prices have surged and collapsed, and the economy has shifted in ways which are beyond anyone's control.

A national electricity system is not a laboratory, so it is not possible to re-run history with some of these changes 'switched off' to find out how important each one was. Similarly, each change didn't happen in a vacuum, they all happened together and interacted to amplify or constrain one another. The IDLES research programme at Imperial College is developing a suite of computer models of the power system which allows us to investigate *what if* scenarios.² What if carbon prices had remained flat; or what if all the retired coal power stations were still running?

By testing each possible combination (some 16,000 of them) we find out the influence of each change, and its

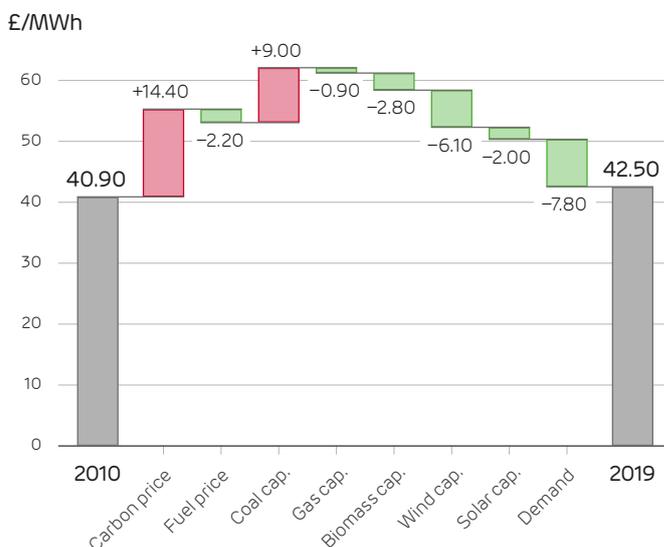
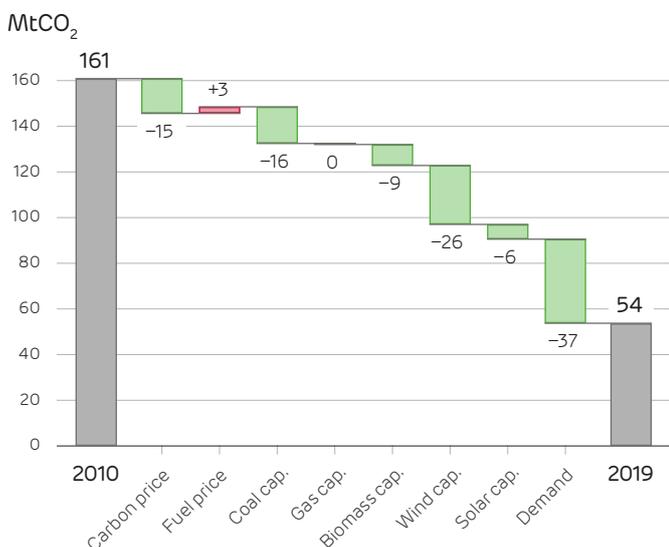
'interaction' effects from combining with other changes. For example, without the rise in carbon prices, coal would be cheaper to burn than gas, and without the coal retirements and conversions we would be able to burn much more coal. The two changes put together have more impact than each could have done alone.

The charts below show how emissions and power prices changed between 2010 and 2019, and what influenced them. Five changes stand out as having a major effect: carbon prices, coal retirements, coal-to-biomass conversions, wind capacity and demand reduction.

It should be of little surprise that carbon pricing, coal and wind were big drivers. However, these were all dwarfed by reductions in demand – reinforcing the often-overlooked mantra that efficiency is the 'first fuel' that should be considered. But, whereas carbon prices and coal retirements pushed up wholesale power prices; renewables and efficiency improvements reduced them.³ Demand reductions genuinely pushed down both prices and environmental impact: a rare win-win.

This analysis shows us what worked in the past. In the decade to come, the power system will change in new and different ways. One thing is clear though, there is no single silver bullet that delivers the radical change required; many changes in many areas must all work together.

The factors influencing the changes seen in Britain's power system over the last decade, showing how much emissions were increased or reduced (left), and how wholesale electricity prices were raised or lowered (right). Note: Cap. = capacity



1 From £12.40 per tonne average in 2010 to £37.90 per tonne average in 2019 (£18 of which is from the UK's Carbon Price Floor).
 2 Ofgem conducted a similar analysis for their State of the Energy Market report; but it only considered one policy change at a time, and so misses these important interactions.
 3 This is not the same as saying that wind, solar and biomass reduced retail prices (which householders pay), as the cost of subsidising renewables is passed onto consumers, adding an extra component to bills.

6. A major milestone for electric heat

The UK's ambition for net zero means that all sectors of the energy system must rapidly decarbonise. In the run up to COP26 in Glasgow, Electric Insights will look across these sectors to discuss how clean electricity can help.

The way we heat our buildings presents a major challenge for reaching net-zero emissions. Heat accounts for 80% of the energy consumed in our homes, and is the second largest source of CO₂ emissions in the UK behind only transport. Unlike the power sector, emissions from heating show little sign of reducing because [measures to reduce heat demand through improving insulation were scrapped](#), and most of our buildings are still heated by gas boilers as alternatives have yet to gain ground. This is about to change though, as [from 2025 it will be illegal to build new homes which use fossil fuels for heating](#).

Two low-carbon options for the heating sector are hydrogen and electricity. Both are more expensive than natural gas though, so first and foremost it will be critically important to improve building thermal efficiency to bring down energy consumption whilst maintaining comfort levels.

Hydrogen heating

Hydrogen has recently gained attention and could be seen as the 'continuity candidate'. It has the benefit of using similar appliances to natural gas, so it should feel familiar to consumers and require little change to home life. This is critically important as for everything to change, we need everybody on board.

It should be technically possible to blend 20% hydrogen into our current natural gas pipelines, as is being tested at [Keele University](#). However, [this only gives a 7% reduction](#) in methane consumption and carbon emissions, because hydrogen is a much lighter and less energy-dense gas. Alternatively, we could switch entirely to hydrogen, but this would require changing every gas-burning appliance in every home. Manufacturers are already offering ['hydrogen ready' boilers](#), much like the 'digital ready' TVs that were marketed in the five years before analogue TV was turned off. Achieving a complete switchover could take decades, but would offer the deep decarbonisation that is needed.

Pure hydrogen is not naturally occurring, so it must be manufactured from other molecules. Hydrogen can be split out from water (H₂O) by electrolysis, or reformed from natural gas (CH₄). These will only give environmental benefits if the electricity is clean, or if the reforming is integrated with carbon capture and storage.

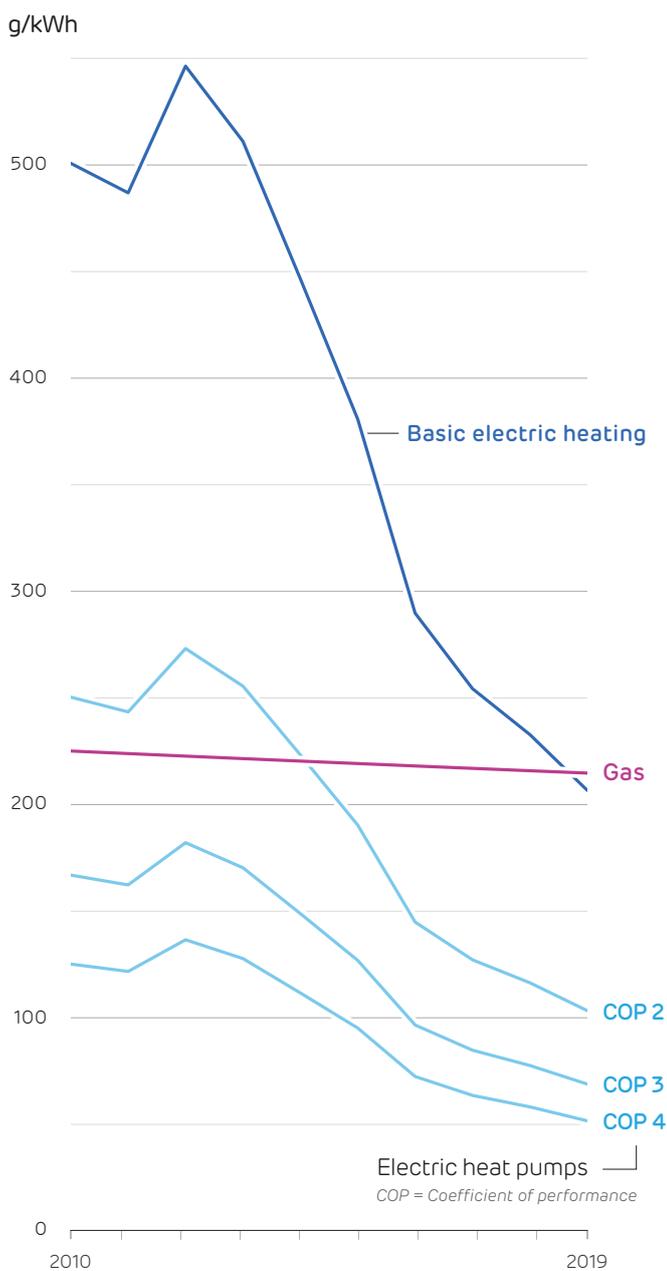
Electric heating

Electric heating is already used in around a tenth of British houses, primarily electric radiators or night-storage heaters. Electric heat pumps are a more efficient alternative which use the same technology as a refrigerator, scaled up to suck heat from the outside air or ground (rather than out of your food) and pump it into your home. They offer much higher efficiencies, producing 2–4 units of heat per kWh of electricity consumed, referred to as having a coefficient of performance (COP) of 2–4. However, homes must be much better insulated than is typical in the UK, as heat pumps have lower peak power output than gas boilers. Heat pump performance is sensitive, so high-quality installation and user education are essential (more so than for other technologies).

A large uptake of heat pumps could push up electricity demand during peak winter evenings too far, so hybrid heat pumps (which combine a small heat pump with a boiler for backup) are gaining interest. If these use a natural gas boiler, they will also fall short of being zero-carbon – but this could instead be a hydrogen boiler to combine the best of both technology groups.

The rapid changes in Britain's power system are shifting the goal posts for clean heating. Just as we think about the carbon intensity of electricity, it is useful to compare these technologies on the carbon intensity of the heat they produce.

The carbon intensity of heat produced from gas and electricity, based on the UK average gas boiler mix, and average generation mix



The move towards condensing boilers means the efficiency of the UK's gas boilers is improving over time, but too slowly to help with climate change.¹ The average efficiency of gas heating has risen from 82% to 86% over the last decade, meaning that the carbon emissions from producing 1 kWh of central heating or hot water only fell from 225 grams in 2010 to 215 grams in 2019.

In comparison, standard electric heating would have produced 500 grams of CO₂ per kWh² of heat delivered back at the start of the decade, more than double that from a gas boiler. As electricity production has shifted away from fossil fuels, Britain has reached the point where it is cleaner to use electric heating than a gas boiler for the first time ever.

Averaged over 2019, simple electric heaters produced 207 grams of CO₂ per kWh of heat. We would now have to blend 12% hydrogen (by volume) into the mains gas grid for Britain's boilers to be as clean as simple electric radiators. As the carbon intensity of electricity continues to fall, it will be impossible for hydrogen blending to keep pace with the carbon reductions, and only complete hydrogen switch-over will have the chance to compete on environmental grounds.

Electric heat pumps can boost these savings further, offering heat with as little as 50–100 g/kWh. However, carbon cannot be the only consideration. Retail electricity prices are three times higher than gas (at around 15 p/kWh versus 5 p/kWh), meaning electric heat will be more expensive unless a high-efficiency heat pump is installed. Having time-of-use tariffs (such as Economy 7) can help to reduce these running costs. The cost of producing hydrogen is difficult to quantify as it is not available for the domestic heating sector.

Ultimately, new hydrogen and electric technologies need to offer low carbon heat without pushing up consumer bills if they are to gain popular support. **The next five years are critical for decarbonising Britain's heat**, so pressure is mounting to find the right solutions, to engage wider interest from the public, to build the social licence for a costly programme of transformation, and to decide how to equitably fund such a transformation.

¹ Energy efficiency standards meant that for the last decade only 'condensing boilers' could be installed. These burn around a tenth less fuel as they capture the heat that is otherwise wasted as steam in the exhaust flue. Their market share has grown from just 2% of gas-heated homes in 2000 to 38% in 2010 to an estimated 74% of homes last year.

² 466 g/kWh carbon intensity of electricity generation, plus transmission & distribution losses.

7. Capacity and production statistics

Wind supplied its largest ever share of electricity over the fourth quarter of 2019, beating nuclear again to supply 23%. Four out of the last five quarters have seen wind being the second largest provider of electricity.

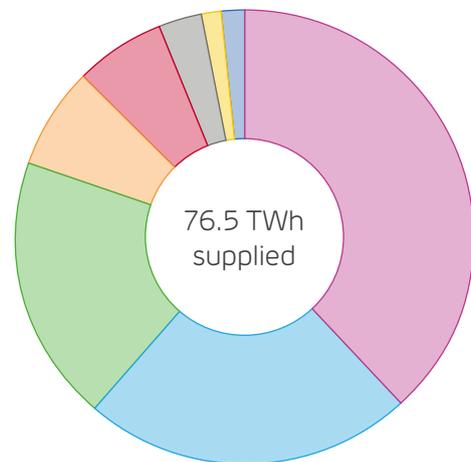
Coal output was down by half on this quarter last year. It supplied less than half the output of Britain’s biomass power stations, despite having more than twice the installed capacity.

Imports continued to grow, up 25% on this quarter last year. Over the fourth quarter, Britain imported five times more electricity than it exported.

Wholesale power prices were uneventful, averaging £39/MWh over the quarter. The highest instantaneous price was just £86, whereas the lowest price was a record-breaking –£73/MWh.

Prices have fallen by a one-third over the last year, driven by the falling cost of natural gas and coal. Futures contracts for natural gas have plummeted in recent months, halving since September 2019.

Britain’s electricity supply mix in the fourth quarter of 2019



Installed capacity and electricity produced by each technology^{1 2}

	Installed Capacity (GW)		Energy Output (TWh)		Utilisation / Capacity Factor	
	2019 Q4	Annual change	2019 Q4	Annual change	Average	Maximum
Nuclear	9.5	~	14.6	+1.0 (+8%)	70%	79%
Biomass	3.2	~	5.3	+0.2 (+5%)	77%	100%
Hydro	1.1	~	1.1	-0.2 (-16%)	44%	94%
Wind	21.6	+1.4 (+7%)	17.7	+0.9 (+5%)	38%	78%
– of which Onshore	12.8	+0.7 (+6%)	10.5	+0.1 (+1%)	38%	86%
– of which Offshore	8.9	+0.8 (+9%)	7.2	+0.8 (+13%)	37%	73%
Solar	13.0	+0.2 (+1%)	1.2	-0.1 (-5%)	4%	55%
Gas	28.1	+0.4 (+1%)	29.3	-0.4 (-1%)	48%	91%
Coal	8.5	-2.0 (-19%)	2.3	-2.3 (-50%)	10%	43%
Imports	5.0	+1.0 (+25%)	6.2	+1.2 (+24%)	57%	98%
Exports			1.2	+0.1 (+14%)	11%	65%
Storage discharge	3.1	~	0.5	-0.1 (-12%)	7%	64%
Storage recharge			0.5	-0.1 (-16%)	8%	61%

1 Other sources give different values because of the types of plant they consider. For example, BEIS Energy Trends records an additional 0.7 GW of hydro, 0.6 GW of biomass and 3 GW of waste-to-energy plants. These plants and their output are not visible to the electricity transmission system and so cannot be reported on here.
 2 We include an estimate of the installed capacity of smaller storage devices which are not monitored by the electricity market operator. Britain’s storage capacity is made up of 2.9 GW of pumped hydro storage, 0.6 GW of lithium-ion batteries, 0.4 GW of flywheels and 0.3 GW of compressed air.

8. Power system records

2019 saw all clean electricity sources break their previous records for annual production. 2019 saw all clean electricity sources break their previous records for annual production. For wind, solar and biomass, these were all-time highs; for nuclear, it was the lowest output recorded this century. Wind supplied more than a fifth of Britain’s electricity for the first time, while coal fell to a new low of just 2%. 2019 was also the first year where Britain’s electricity averaged below 200 grams of CO₂ per kWh.

On the **8th of December**, wind supplied a record 43% of demand through the day, and total generation from low-carbon sources exceeded 30 GW for the first time ever. Overproduction and constraints in the transmission system led to wholesale prices reaching a new low of –£73 per MWh, and the first ever day with a negative average power price. Just **two days later**, wind broke its instantaneous record, surpassing 16 GW output for the first time ever.

The tables below look over the past decade (2009 to 2019) and report the record output and share of electricity generation, plus sustained averages over a day, a month and a calendar year. Cells highlighted in blue are records that were broken in the fourth quarter of 2019. Each number links to the date it occurred on the Electric Insights website, allowing these records to be explored visually.

	Wind – Maximum	
	Output (MW)	Share (%)
Instantaneous	16,886	52.4%
Daily average	14,492	43.2%
Month average	9,292	25.8%
Year average	6,682	20.1%

	Solar – Maximum	
	Output (MW)	Share (%)
Instantaneous	9,550	29.4%
Daily average	3,386	12.0%
Month average	2,464	8.1%
Year average	1,331	4.0%

	Biomass – Maximum	
	Output (MW)	Share (%)
Instantaneous	3,452	12.8%
Daily average	3,298	9.7%
Month average	2,839	7.9%
Year average	2,053	6.2%

	All Renewables – Maximum	
	Output (MW)	Share (%)
Instantaneous	22,730	68.0%
Daily average	18,261	57.2%
Month average	13,112	36.8%
Year average	10,475	31.5%

¹ Note that Britain has no inter-seasonal electricity storage, so we only report on half-hourly and daily records. Elexon and National Grid only report the output of large pumped hydro storage plants. The operation of battery, flywheel and other storage sites is not publicly available.



Gross demand		
	Maximum (MW)	Minimum (MW)
Instantaneous	60,070	18,214
Daily average	49,203	24,704
Month average	45,003	28,592
Year average	37,736	32,659



Demand (net of wind and solar)		
	Maximum (MW)	Minimum (MW)
Instantaneous	59,563	8,118
Daily average	48,823	12,308
Month average	43,767	20,212
Year average	36,579	24,646



Day ahead wholesale price		
	Maximum (£/MWh)	Minimum (£/MWh)
Instantaneous	792.21	-72.84
Daily average	197.45	-4.62
Month average	63.17	30.83
Year average	56.82	36.91



Carbon intensity		
	Maximum (g/kWh)	Minimum (g/kWh)
Instantaneous	704	43
Daily average	633	76
Month average	591	157
Year average	508	192



All low carbon – Maximum		
	Output (MW)	Share (%)
Instantaneous	30,435	89.0%
Daily average	25,367	79.3%
Month average	20,899	60.7%
Year average	17,902	53.4%



All low carbon – Minimum		
	Output (MW)	Share (%)
Instantaneous	3,395	8.3%
Daily average	5,007	10.8%
Month average	6,885	16.7%
Year average	8,412	21.6%



All fossil fuels – Maximum		
	Output (MW)	Share (%)
Instantaneous	49,307	88.0%
Daily average	43,085	86.4%
Month average	36,466	81.2%
Year average	29,709	76.3%



All fossil fuels – Minimum		
	Output (MW)	Share (%)
Instantaneous	2,421	9.1%
Daily average	3,921	14.9%
Month average	10,020	34.2%
Year average	13,756	41.3%



Nuclear – Maximum		
	Output (MW)	Share (%)
Instantaneous	9,342	42.8%
Daily average	9,320	32.0%
Month average	8,649	26.5%
Year average	7,604	22.0%



Nuclear – Minimum		
	Output (MW)	Share (%)
Instantaneous	3,705	8.7%
Daily average	3,754	10.3%
Month average	4,446	12.9%
Year average	6,023	17.2%

 Coal – Maximum		
	Output (MW)	Share (%)
Instantaneous	26,044	61.4%
Daily average	24,589	52.0%
Month average	20,746	48.0%
Year average	15,628	42.0%

 Coal – Minimum		
	Output (MW)	Share (%)
Instantaneous	0	0.0%
Daily average	0	0.0%
Month average	28	0.1%
Year average	678	2.0%

 Gas – Maximum		
	Output (MW)	Share (%)
Instantaneous	27,131	66.3%
Daily average	24,210	59.6%
Month average	20,828	54.8%
Year average	17,930	46.0%

 Gas – Minimum		
	Output (MW)	Share (%)
Instantaneous	1,556	4.9%
Daily average	3,071	9.5%
Month average	6,775	19.9%
Year average	9,159	24.6%

 Imports – Maximum		
	Output (MW)	Share (%)
Instantaneous	4,884	18.3%
Daily average	4,490	14.3%
Month average	3,796	10.6%
Year average	2,850	8.6%

 Exports – Maximum		
	Output (MW)	Share (%)
Instantaneous	-3,870	-11.8%
Daily average	-2,748	-6.1%
Month average	-1,690	-3.8%
Year average	-731	-1.9%

 Pumped storage – Maximum ¹		
	Output (MW)	Share (%)
Instantaneous	2,660	6.0%
Daily average	362	1.2%

 Pumped storage – Minimum ¹		
	Output (MW)	Share (%)
Instantaneous	-2,782	-10.8%
Daily average	-622	-1.7%

¹ Note that Britain has no inter-seasonal electricity storage, so we only report on half-hourly and daily records. Elexon and National Grid only report the output of large pumped hydro storage plants. The operation of battery, flywheel and other storage sites is not publicly available.

