



Clean Power 2030: Too fast, too furious?

By *Dr Mann Virdee*

EXECUTIVE SUMMARY

- The UK could achieve ‘clean power’ by 2030, but a rigid focus on this date may be counterproductive. A rushed transition risks infrastructure gaps, hindering future energy system development. That could increase environmental impacts, harm industrial competitiveness, raise energy bills, and erode public support.
- Acknowledging the challenges of the clean energy transition should not be used to justify inaction. Instead, this Primer advocates for a more realistic approach, prioritising a well-executed transition over an arbitrary 2030 deadline. Sir Keir Starmer, Prime Minister, recently clarified that the United Kingdom (UK) is targeting 95% clean energy by 2030, not 100%. This move should be welcomed as it provides valuable flexibility for a successful and sustainable energy future.
- The UK should continue to extend the lifespan of its large nuclear capacity, invest in small modular reactors, and carefully examine price formation.



Next time you switch on the kettle, take a second to reflect that this mundane action is something which most humans throughout history would find difficult to comprehend. Just imagine, for instance, showing this to Alexander the Great, or Hypatia, or Confucius. They would be in awe of you, absolutely dumbstruck by this simple invention. They would also, no doubt, wonder what mysterious force existed inside your wall, and how the kettle cable could channel that force to boil water.

The electricity we use every day – and the complex infrastructure needed to generate and supply it – is something most of us take for granted. It is just there whenever we need it, so most of us have not given it much further thought.

This Primer, the fourth in this series, takes a whistle-stop tour of electricity in the United Kingdom (UK). It highlights important ‘rules’ which govern the electricity system, provides a brief overview of Britain’s current situation, and then raises some questions about the road ahead.

The UK should start to talk openly about what energy experts are asking behind closed doors and in hushed whispers: reaching clean energy by 2030 is just about possible, but is it really advisable?¹ Pushing so hard for an arbitrary and absolute target risks bungling the transition and creating problems down the road.

There is, for example, the risk that more generation is connected with the expectation that it will have access to the market, but the network becomes so congested it increases congestion payments. That would result in a notable increase in costs without a tangible benefit in the short term.

Ultimately, a rushed transition will be more costly for the environment than taking a little more time and doing it right. How can we reach Clean Power 2030 when we haven’t yet decided what the future of the electricity system should look like?

There will be energy transition sceptics who want to use this argument to say Britain should not try for Net Zero at all. But there should be no doubt that these are two very different arguments and they should not be confused. It is imperative that all countries take action to tackle climate change – it is one of the defining challenges of our time – but we need to do it right. Wanting a quick transition may seem like the more caring option, or the morally superior choice. But if it means that infrastructure is not properly in place for further development and scale-up, and limits electricity system flexibility in the future, and undermines broad-based political support, it is not.

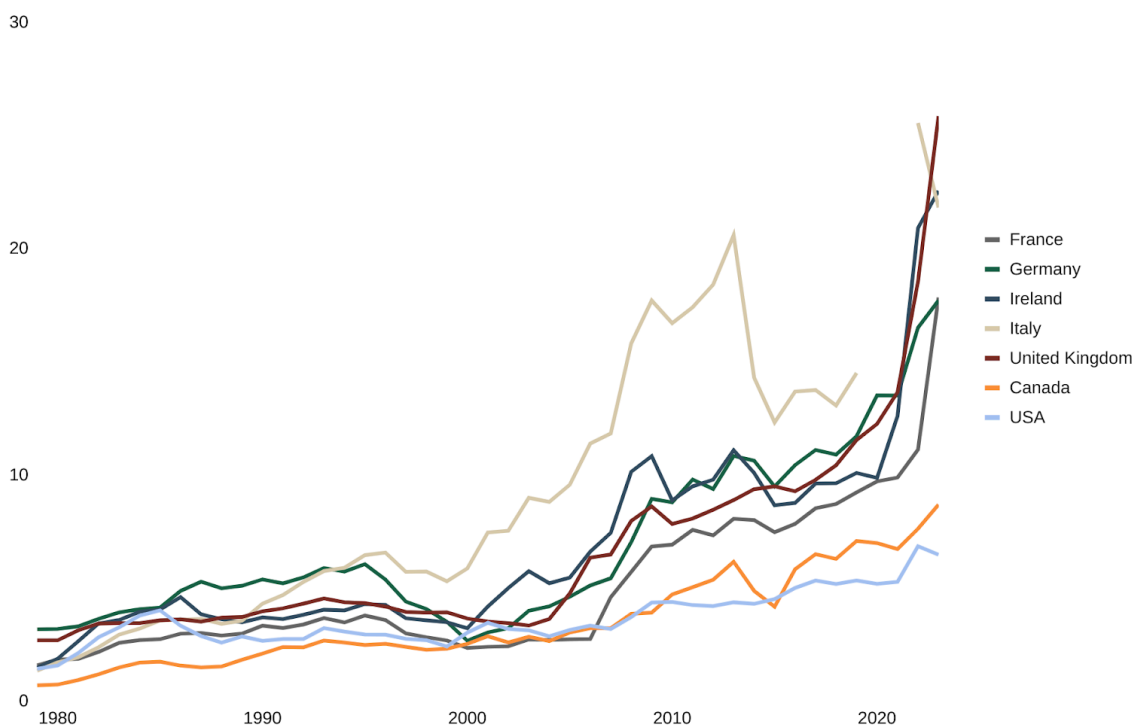
And it seems strange when His Majesty’s (HM) Government is so slow in almost every other respect (such as in building houses, roads, and railways, and investing in future technologies and capabilities) that it appeared intent on

¹ ‘Energy sector doesn’t believe we’ll get to net zero’, *Energy News Live*, 05/12/2024, <https://www.energylivenews.com/> (checked: 13/01/2025).

rushing ahead in this one area that could have so many spillover effects and long-term consequences if not managed properly.

We should ask HM Government to take the time to think through reforms and roll them out carefully so that the UK improves its economic competitiveness, and that consumers are not driven into poverty through increasing energy bills. Britain now has, for example, the world’s highest industrial electricity costs (Figure 1); which may be weighing down growth and undermining national prosperity.²

Figure 1: Industrial electricity prices (including taxes), selected countries³



The new government’s pledge for clean power by 2030 had been interpreted as a 100% target but the prime minister recently clarified that his aim is to ensure that the UK is on track to achieving at least 95% of low carbon generation by 2030, following advice from the National Energy System Operator (NESO). This 95% target should be welcomed. While 95% clean power by 2030 is still a bold and arbitrary target, having such room to manoeuvre is important for future electricity system scale up, development and flexibility.

² Matt Oliver, ‘Britain paying highest electricity prices in the world’, *The Telegraph*, 26/09/2024, <https://www.telegraph.co.uk/> (checked: 13/01/2025).

³ ‘International industrial energy prices’, Department for Energy Security and Net Zero, 28/11/2024, <https://www.gov.uk/> (checked: 13/01/2025).

A few rules of the electricity system

Various ‘rules’ govern the electricity system. These can constrain what type of energy sources can be used to power it, but are poorly understood by numerous people who participate in debates around energy and climate change. NESO refers to these rules in terms of stability (specifically voltage, thermal, restoration), and balancing (specifically frequency, within-day flexibility, and adequacy).⁴ Two of these will be focused on here. The electricity system should be balanced and it needs inertia.

Rule I: The electricity system must be balanced

The electricity system is constantly being balanced on a second-by-second basis. The supply of electricity generated must be balanced with demand from consumers: if demand exceeds supply or vice versa, it can lead to frequency fluctuations, instability and large-scale blackouts.

That means that when there is a spike in demand, such as when everyone gets home from work and switches on the kettle at the same time, supply must ramp up immediately to meet that demand. But that also means that when most of us go to sleep, supply must ramp down. This can result in odd scenarios, such as paying windfarms to shut down wind turbines when supply is too high. In 2024, UK taxpayers spent over £1 billion to shut them down.⁵ If they did not shut down, the electricity system would not be able to handle the excess supply.

Of course, excess electricity should be exported or stored or exported. However at the moment, Britain lacks the infrastructure for long duration energy storage (LDES). For electricity to be stored, long-term and at scale, it needs to be converted into a different kind of energy. Batteries, for example, convert electricity into chemical potential energy. In October 2024, HM Government announced a new scheme to attract investment for LDES but this technology is still far from being able to be widely rolled out because of the long lead times for developing storage projects.⁶

⁴ ‘Operability Strategy Report’, National Energy System Operator, 12/2024, <https://www.neso.energy/> (checked: 13/01/2025).

⁵ Only part of this cost is due to balancing; network constraints also contribute to the cost. For example, in very windy conditions, transmission cabling does not have the capacity to transport the electricity generated by windfarms, so supply has to be reduced. See: Matt Oliver, ‘Cost of switching off UK wind farms soars to “absurd” £1bn’, *The Telegraph*, 02/12/2024, <https://www.telegraph.co.uk/> (checked: 13/01/2025).

⁶ ‘New scheme to attract investment in renewable energy storage’, Department for Energy Security and Net Zero, Ofgem and Michael Shanks, 10/10/2024, <https://www.gov.uk/> (checked: 13/01/2025).

Rule II: The electricity system needs inertia

This one is a bit more complicated, but think of a shopping trolley which is filled with groceries. When it is stationary, it will stay stationary – and you need to give it a hard push to get it moving. But once it starts moving, it will keep moving. Your moving shopping trolley has a lot of momentum and you have to pull it hard to get it to stop.⁷

The electricity system needs inertia too. In the electricity system, inertia is about the ability of the system to maintain its current state and to resist change. Inertia in the electricity system is primarily provided by synchronous generators, which are large spinning machines that generate electricity. Here is the important part: these generators have a large mass. When a fault occurs in the electricity system, such as a short circuit, the inertia of the generators helps to maintain voltage and frequency, preventing a system collapse.

When demand increases, the frequency tends to decrease. The inertia of the generators resists this change, helping to maintain a stable frequency. While gas, coal and nuclear sources provide inertia, solar generation has no rotating mass, and wind turbine generators are connected via power converters, so their rotational speed is isolated from the system frequency.⁸ Wind and solar convert direct current (DC) to alternating current (AC) at the frequency of the electricity system – in the UK's case, 50 hertz.

With the move away from coal and gas, the need to substitute the displacement of the loss of inertia from synchronous generators presents technical challenges. One proposed solution to this is synthetic inertia, which is a way of mimicking the release of kinetic energy from a spinning machine using the input of additional electrical power.

Why cannot we just keep gas and coal generators?

So if coal and gas provide inertia and are dispatchable sources of power, could we just carry on using them?

Well, the industrial revolution was one of the most important events in human history. According to Deirdre McCloskey, Professor of Economics at the University of Illinois Chicago, the economic growth and technological progress brought about by industrialisation has led to:

⁷ This is what Sir Issac Newton termed the 'first law of motion': an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

⁸ Robert Eriksson, Niklas Modig, and Katherine Elkington, 'Synthetic inertia versus fast frequency response: a definition', *Institution of Engineering and Technology Renewable Power Generation*, 12:5 (2018).



The increase of income per head by a factor of 15 or 20 since the 18th century in places like Britain...It is certainly the most important event in the history of humanity since the domestication of animals and plants, perhaps the most important since the invention of language.⁹

But human action, starting with the industrial revolution, has fundamentally changed the planet and led to widespread environmental degradation. We now live in an epoch primarily defined by humanity's impact on the Earth's system – the 'Anthropocene'. Although this descriptor has not been formally adopted as a defined geological epoch, it is nevertheless an invaluable descriptor of humanity's impact on our environment.

Human activity is causing widespread greenhouse gas emissions that are warming the planet. In the 2015 Paris Agreement, countries around the world agreed to cut greenhouse gas emissions and try to limit global temperature rise to 1.5°C, and to keep the global temperature well below 2.0°C compared to before the industrial revolution.

Yet, the world is now already on the cusp of 1.5°C of warming. 2024 is on track to be the hottest year on record.¹⁰ For 16 consecutive months – from June 2023 to September 2024 – the global average temperature exceeded the record for that month.¹¹ In 2023, the Antarctic's sea ice extent fell to record lows, reaching unprecedented values for both the summer minimum and the winter maximum.¹²

So it is important that countries reduce greenhouse gas emissions to protect the planet and ensure a sustainable future. In 2023, fossil fuels made up around 33% of UK electricity supply – of which gas was 31%, coal just over 1% and oil just below 1%.¹³ In order to achieve this, many countries around the world are pursuing Net Zero targets, where there is a balance between the amount of greenhouse gases produced and the amount removed from the atmosphere.

Many have chosen to see Net Zero as a burden. But there are also those who are racing to seize opportunities offered by Net Zero. It has even been called the growth opportunity of the 21st century – and it may well be for some countries such as the People's Republic of China (PRC).¹⁴ If the economy of the future will

⁹ Deirdre McCloskey, 'Review of The Cambridge Economic History of Modern Britain', *Prudentia*, 15/01/2004, <https://www.deirdremccloskey.com/> (checked: 13/01/2025).

¹⁰ Eric Roston, 'Global Warming Is Already on the Cusp of 1.5C, New Research Finds', *Bloomberg*, 11/11/2024, <https://www.bloomberg.com/> (checked: 13/01/2025).

¹¹ '2024 is on track to be hottest year on record as warming temporarily hits 1.5°C', World Meteorological Organization, <https://wmo.int/> (checked: 13/01/2025).

¹² Ella Gilbert and Caroline Holmes, '2023's Antarctic sea ice extent is the lowest on record', *Weather* 79:2 (2024).

¹³ Simon Evans, 'Analysis: UK electricity from fossil fuels drops to lowest level since 1957', *Carbon Brief*, 03/01/2024, <https://www.carbonbrief.org/> (checked: 13/01/2025).

¹⁴ 'Net Zero Review: UK could do more to reap economic benefits of green growth', Department for Business, Energy and Industrial Strategy, Department for Energy Security and Net Zero and The Rt Hon Grant Shapps, 13/01/2023, <https://www.gov.uk/> (checked:13/01/2025).

be based on low carbon technologies and fuels, the countries which build up skills and supply chains may have a competitive advantage.

Beyond the environmental imperatives to move away from fossil fuels, there are also economic arguments. The Covid-19 pandemic and Russia's war of aggression against Ukraine have shown how susceptible the UK is to economic shocks. These events have disrupted global energy supply chains, pushing gas prices up significantly. If the UK wants to maintain its independence in an increasingly volatile world, the green transition will also help with that.

Current British challenges

In light of all these challenges, where does the UK currently sit?

Towards the end of 2024, Britain shut down its last coal-fired power plant and became the first Group of Seven (G7) country to phase out coal. The UK's biggest steelworks – Port Talbot – closed its coal-powered blast furnaces, and will now build electric-arc furnaces instead. HM Government announced £22 billion to fund carbon capture and storage projects. NESO was established by the Department for Energy Security and Net Zero (DESNZ) to oversee the strategic planning and design of the country's electricity and gas networks. One of NESO's first recommendations was for the UK to target 95% clean power by 2030 instead of the 100% implied in early policy targets.

While renewable energy is a growing segment of the UK's electricity mix, gas plays an important part in balancing Britain's electricity system because gas is dispatchable and can be switched on at short notice. This is useful when there is lower supply from intermittent energy resources, such as wind and solar. So, at present, flexibility in the electricity system is predominantly supplied by gas generation, with approximately 50% of its gas being imported from the international market.¹⁵

At present, gas tends to set the marginal price for the whole power system. While the large role played by gas will disappear if the UK can reach 'Clean Power' by 2030, prices will not necessarily go down – because it depends on whether system management costs would stay stable in that scenario, as well as the role of subsidies such as Contracts for Difference.¹⁶

¹⁵ 'Energy prices and their effect on households' Office for National Statistics, 01/02/2022, <https://www.ons.gov.uk/> (checked: 13/01/2025).

¹⁶ Contracts for Difference (CfD) is a contractual mechanism designed to incentivise investments in renewable energy projects in the UK at the least cost to the consumer.



Industrial electricity cost

Official data shows that Britain now has the world's highest industrial electricity prices. There are some who argue that energy intensive industries – such as data centres – should be offshored to countries with lower energy costs, and that the UK should instead focus on growing its service economy.¹⁷ But this perspective overlooks the realities of the current geopolitical and economic landscape in an increasingly contested and volatile world.

A strong domestic industrial base and energy system is crucial for national security, economic resilience, and technological innovation. It is necessary for critical goods and services, to mitigate against economic shocks and drive economic competitiveness. Continuing to rely heavily on foreign sources of energy will expose the UK to geopolitical risks and price volatility. By maintaining a strong domestic industrial base, Britain can reduce its dependence on foreign suppliers and protect their economies from external shocks. Britain has made the mistake before of offshoring critical capabilities; it should not do so again.

Infrastructure

Crucially, if Britain is to meet its Net Zero targets and be resilient to external shocks, it will need to either add or upgrade an estimated 600,000 kilometres of electric cables across the UK – something the country is not sufficiently prepared for.¹⁸ Put simply, you can't invest in renewables without investing in the grid.

Storage

The UK's commitment to renewable energy, particularly solar and wind power, is admirable. However, as mentioned earlier, these sources are inherently variable, subject to the whims of the weather. Periods in which little energy can be generated with wind or solar power because of weak wind and darkness are known as '*dunkelflaute*'.¹⁹ In November 2024, a *dunkelflaute* period meant that wind farms were only able to meet 3-4% of the UK's electricity demand, and gas-fired power plants met around 60%.²⁰

To address this, energy storage solutions are essential. By storing excess energy generated during peak production periods, these systems can release it

¹⁷ Tom Forth, Post on X, 31/10/2024, <https://x.com/> (checked: 13/01/2025).

¹⁸ Jillian Ambrose, "It's like buying an iPhone and not having a cable": UK's bid for net zero in the balance due to grid "blind spot", *The Guardian*, 25/11/2023, <https://www.theguardian.com/> (checked:13/01/2025).

¹⁹ Gavin Maguire, 'German wind-reliant power firms brace for annual "dunkelflaute"', *Reuters*, <https://www.reuters.com/> (checked: 13/01/2025).

²⁰ Matt Oliver, "Dunkelflaute" sends wind power generation plummeting in UK and Germany', *The Telegraph*, 05/11/2024, <https://www.telegraph.co.uk/> (checked: 13/01/2025).



when demand is high or renewable generation is low, ensuring a consistent and reliable energy supply.

This has several advantages. It stabilises the electricity system by smoothing out fluctuations in renewable energy output. It allows for the integration of larger amounts of renewable energy into the electricity system. It helps reduce reliance on fossil fuel-based power plants, leading to cleaner and more sustainable energy generation. It can also increase energy independence by reducing the need for imported energy. Various energy storage technologies are being explored, including lithium-ion batteries, pumped hydro storage, and compressed air energy storage.

The China challenge and supply chain issues

Another significant challenge for the UK is that the PRC has established itself in a dominant position in the global solar industry, controlling most of the supply chain, from raw material extraction to solar panel manufacturing. This dominance extends to critical minerals essential for renewable energy technologies, such as those used in wind turbines.

An overreliance on the PRC for the energy transition poses several risks. It creates a vulnerability in the global supply chain. Any disruptions, whether due to geopolitical tensions, trade disputes, or natural disasters, could lead to shortages and price increases for these vital technologies.

The PRC's dominance also gives it significant economic leverage. By controlling the supply of these critical materials and technologies, Beijing can influence global energy markets, potentially using them as a geopolitical tool. This could lead to unfair trade practices, theft of intellectual property, and other forms of economic coercion.

And there is no point in the UK transitioning away from unstable and unpredictable supplies of fossil fuels to renewables if that just means the pollution is emitted in a different part of the world, and the supply also becomes unstable if the PRC seeks to use it for economic leverage.

To mitigate these risks, countries need to diversify their supply chains and develop domestic manufacturing capabilities for renewable energy technologies. This involves investing in research and development, supporting domestic mining industries, and fostering international partnerships to secure alternative sources of critical minerals. By reducing reliance on a single supplier, countries such as Britain can enhance their energy security and reduce their vulnerability to geopolitical pressures.

There is a more fundamental issue here beyond the PRC. Supply chains are not robust or ready to reach Clean Power or Net Zero.²¹ Joseph Northwood, a

²¹ David Blackman, 'Lack of supply chain investment puts electrification targets at risk', *UtilityWeek*, 16/09/2024, <https://utilityweek.co.uk/> (checked: 13/01/2025).



director at National Grid, has said that Net Zero demands supply chain overhaul, while the energy regulator Ofgem has proposed an £8 billion ‘fast-track fund’ to ease supply chain constraints.²²

Next steps

The UK needs to extend big nuclear...

In 2010, Nick Clegg, then Leader of the Liberal Democrats and soon-to-be Deputy Prime Minister, dismissed the possibility of increasing the supply of nuclear energy on the grounds that the effects would not be felt until 2022.²³ This decision now looks extremely short sighted. HM Government cannot afford to make the same mistake again.

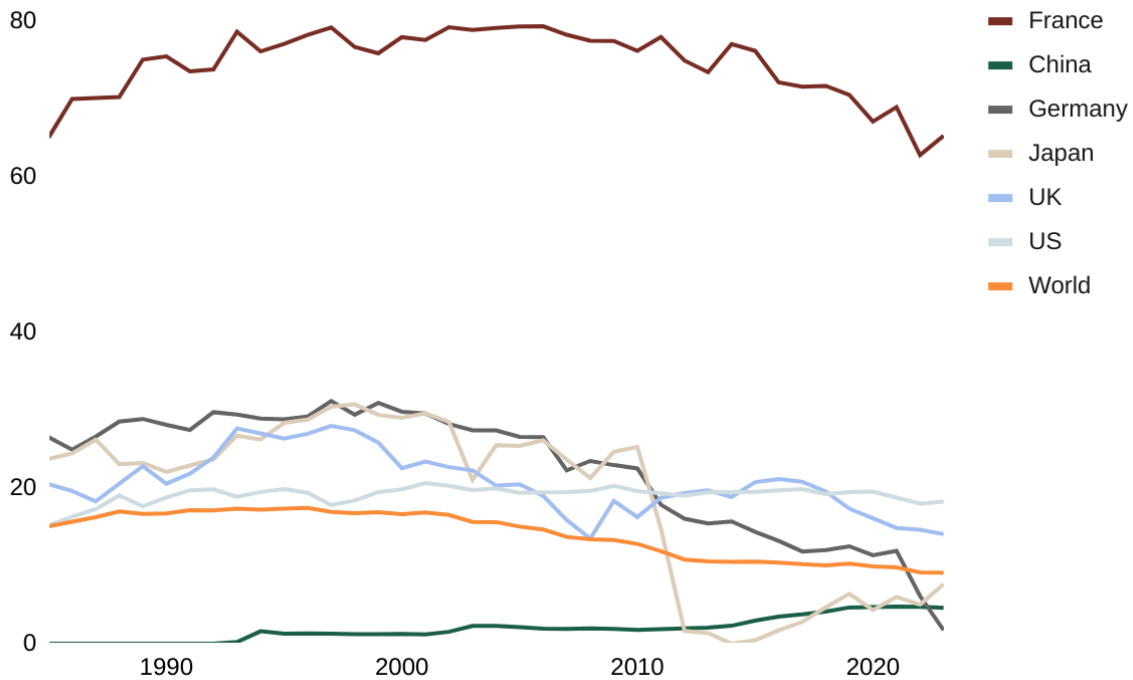
Britain ought to move faster on nuclear power. At present, the UK is one of the most expensive places in the world to build new nuclear power plants. In the middle of the last century, the UK was the leader in nuclear power. In 1965, it had more nuclear reactors than the rest of the world combined, but that engineering expertise has since been lost as the nuclear industry atrophied in part through reliance on gas.²⁴ It has been almost 30 years since Britain last completed a new nuclear power station, although Hinkley Point C and Sizewell C are now under construction. France, meanwhile, has generated most of its energy from nuclear power for decades, many times the world average (Figure 2).

²² Jane Gray, ‘Net zero demands “supply chain overhaul”, says National Grid director’, *UtilityWeek*, 10/09/2024, <https://utilityweek.co.uk/> (checked: 13/01/2025) and Adam John, ‘Ofgem proposes £8bn “fast-track fund” to ease supply chain constraints’, *UtilityWeek*, 20/11/2024, <https://utilityweek.co.uk/> (checked: 13/01/2025).

²³ Liberal Democrats, ‘Nick Clegg Answers Questions from Reddit.com’, *Youtube*, 03/02/2010, <https://www.youtube.com/> (checked: 13/01/2025).

²⁴ Sam Richards, ‘The future is nuclear, whether Labour like it or not’, *CapX*, 28/11/2024, <https://capx.co/> (checked: 13/01/2025).

Figure 2: Share of electricity production from nuclear in selected countries, measured as a percentage of total electricity production.²⁵



The UK’s declining nuclear output means that HM Government’s target for a clean electricity system by 2030 is at risk, with a recent report from NESO stating that the target requires around four gigawatts of nuclear power in the electricity system. In December, EDF Energy announced that the lifespan of four advanced gas cooled nuclear reactors would be extended. So, the Government should continue to explore options for safely extending the life of the existing fleet for baseload power.

...and invest in small nuclear too

Alongside this, Small Modular Reactors (SMRs) offer a promising solution to the UK’s energy needs. They can be deployed in smaller, modular units, allowing for a phased approach to deployment, reducing upfront costs and minimising risks. They can also be manufactured off-site in factories, significantly reducing construction time and costs. This can accelerate the deployment of new nuclear capacity and help meet growing energy demands.

²⁵ ‘Share of electricity generated by nuclear power’, *Our World in Data*, 20/06/2024, <https://ourworldindata.org/> (checked: 13/01/2025).



In 2024, the Czech power company CEZ signed a deal with Rolls-Royce SMR to form a strategic partnership to develop and deploy small modular nuclear reactors. Under this agreement, CEZ will acquire a 20% share in Rolls-Royce SMR. So, while other countries are getting on with adopting SMRs, the UK is dithering. The UK should be doing more to support and invest in such domestic enterprises.

Zonal energy pricing

Regional energy pricing, also known as zonal pricing, has been proposed as a solution to some of the UK's electricity problems. Under this system, electricity prices vary across geographic regions based on local supply and demand conditions. This approach is supposed to create a more efficient and equitable energy market by aligning prices with local conditions.

For example, in regions with abundant solar and wind, prices may be lower, encouraging greater use of clean energy. Meanwhile, in regions with limited supply, such as those heavily reliant on fossil fuels, higher prices may incentivise conservation and investment in new generation capacity. This can also stimulate investment in renewable energy projects by providing a clearer picture of the potential returns in different regions.

Regional energy pricing may help to alleviate grid congestion by encouraging consumers to shift their energy consumption to times of lower demand or to areas with excess capacity. This can reduce the need for costly grid upgrades and improve overall system reliability.

Zonal pricing has been predicted to reduce costs. Ofgem found that regional pricing could benefit consumers, including industry, by saving between £28 billion and £51 billion across the period from 2025 to 2040.²⁶ Octopus Energy has also found that businesses would enjoy a significant reduction in wholesale energy costs, and that consumers would see their bills go down.²⁷

But there is still a problem at the heart of zonal pricing: many energy-intensive industries have vast factories and infrastructure which cannot simply be relocated. These industries may find themselves in more expensive zones (relative to other parts of the UK) and may have to shoulder the burden of comparatively high electricity costs through no fault of their own, while other businesses will be able to situate themselves in more favourably priced regions and reap the advantages that come with that. However, proponents of zonal pricing argue that the policy should, in turn, attract new generation to areas with higher prices to benefit from the situation, and thereby lower prices in those areas.

²⁶ Tom Grimwood, 'Ofgem throws weight behind locational pricing', *UtilityWeek*, 31/10/2023, <https://utilityweek.co.uk/> (checked: 13/01/2025).

²⁷ Rachel Fletcher, 'Case Study: how regional pricing could save businesses (and everyone) on bills', Octopus Energy, 30/07/2024, <https://octopus.energy/> (checked: 13/01/2025).

In order to address the high cost for energy intensive industries, HM Government established the British Industry Supercharger in 2023, a set of measures to bring energy costs for key UK industries in line with other major economies, and thereby levelling the playing field for British businesses. However, as network costs are rising rapidly, such a mechanism may soon prove ineffective without market reform. As Jack Richardson, Head of Policy at Octopus Energy, put it: ‘Compensating for high electricity prices by taxing households’ electricity is not a long-term solution’.²⁸

Conclusion

The UK faces a critical moment in its energy transition. While the ambition to achieve ‘clean power’ by 2030 is commendable, the focus should shift from an arbitrary deadline to a carefully planned and executed pathway. Rushing this transition risks destabilising the electricity system, hindering future energy development, and ultimately increasing costs for consumers and industry.

HM Government should focus on electricity system stability and development, acknowledging the limitations of intermittent renewables and the crucial role of sources such as nuclear. Extending the life of existing nuclear plants and investing in advanced technologies such as SMRs are essential for a secure and reliable energy future.

The UK should address the challenges of its current energy landscape: high industrial electricity costs, a vulnerable supply chain reliant on the PRC, and the need for significant electricity system infrastructure upgrades. Implementing policies such as zonal pricing, while carefully considering the impact on existing industries, can help reduce costs for businesses and consumers.

Ultimately, the success of the UK’s energy transition hinges on a balanced approach: one which embraces innovation, prioritises electricity system stability, reduces the UK’s emissions, and ensures a just and equitable transition for all. That requires open and honest dialogue about the Clean Power 2030 target, a long-term vision, and a commitment to evidence-based decision-making.

²⁸ Jack Richardson, ‘Nerves of steel’, *The New Statesman Spotlight*, 13/01/2025, <https://spotlightonpolicy.substack.com/> (checked: 13/01/2025).



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