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Review of Energy Policy 2024

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Foreword

Robert Gross, UKERC Director

The new Labour Government is embarking on a pivotal few years for the energy transition.

The new Government appears to be very serious about its manifesto commitment to deliver clean power by 2030. This is being taken forward by a newly formed Clean Power Mission, announced by Secretary of State Ed Miliband just weeks after July's election. The Mission is an ambitious commitment to reducing reliance on unabated fossil fuels and fostering a transition towards a predominantly low carbon energy system.

But while the target has garnered attention and aims to motivate all actors towards the goal, it is only the first step towards a more expansive vision for sustainable energy beyond 2030. This review highlights some of the steps that must be taken across the whole energy system to hit the UK's 2035 target to reduce greenhouse gas emissions by 81%, as reaffirmed by Keir Starmer at COP29 in Baku.

With industry responsible for nearly 14% of carbon emissions in 2023, the development of a more comprehensive industrial decarbonisation strategy integrating a wider range of cleaner technologies than low carbon hydrogen, electrification, and carbon capture, is imperative. The industrial landscape of South Wales exemplifies the issues facing industry, which we bring to light, and underscore the importance of devolved strategies that interlink with UK energy policies. There is also a chorus of concern about the current skills gap across the four nations of the United Kingdom, with many new jobs required to bring these policies to fruition.

There is significant work to do around the infrastructural implications of the move away from gas, in both electricity generation and heating. For now, take-up of low carbon heating technologies remains low, but the plans for clean power will change the role of gas in power generation fundamentally – retaining much of the infrastructure (both power stations and pipelines), whilst burning less gas. As the transition progresses, questions arise about how to allocate the substantial costs associated with maintaining, then ultimately decommissioning gas infrastructure.

In the immediate term it is also important to take action to protect the most vulnerable consumers from high energy prices. Gas prices remain elevated as a result of the war in Ukraine, with the impacts on the least well off exacerbated by limited progress with energy efficiency. This review considers the role of tariff reforms that might help rebalance the retail market to benefit the least well off. The design of any such tariff would be critical in shaping who benefits and the overall impact on the economy. Looking forward, we also ask how place-based approaches can help facilitate building retrofits that reduce both emissions and bills.

It is important to ensure that renewable energy expansion goes hand in hand with the protection of nature, and seeks opportunities for environmental improvement. Key issues include skills shortages in local authorities and limited community involvement. Protection of nature needs to be placed at the heart of plans to accelerate renewable energy installations.

We bring the report together with a focus on Wales as a case study for many of the themes above. The Welsh perspective exemplifies the fact energy policy cannot be solely technical and environmental, but also economic, social and catered for regional context.

Clean Power by 2030

Keith Bell, University of Strathclyde

The new Government in Westminster has put a lot of weight on the idea of Britain having 'clean power' by 2030. In recent statements, the Secretary of State for Energy Security and Net Zero, Ed Miliband, and Director of Mission Control, Chris Stark, have acknowledged some of the key challenges in delivering it, namely, *"planning, grid, supply chains and skills"*.[1] But what does the goal actually mean? And might the amount of attention being given to it do more harm than good?

The National Energy System Operator (NESO), established in October, is defining the supply of 'clean power' as a year in which no more than 5% of production comes from unabated fossil fuels and low carbon sources produce more electricity than Great Britain consumes in total.[2] The previous UK Government had already said that "*By 2030, 95% of British electricity could be low-carbon; and by 2035, we will have decarbonised our electricity system, subject to security of supply*".[3] Pursuit of that ambition got off to a slow start with the failure to procure any new offshore wind capacity in the fifth auction round for low carbon contracts for difference (CfDs).[4] The previous Government did, however, recognise one of the main challenges and commissioned advice on how to address it: delivering transmission network connections and reinforcements sufficiently quickly.[5] The new Government now has the task of implementing the Electricity Networks Commissioner's recommendations, most particularly around planning and consenting.

From targets to delivery

With decarbonisation targets having become very familiar, there is, as the Climate Change Committee has said repeatedly in recent progress reports,[6] a need to get on with delivering and, by implication, avoid that familiarity becoming contempt. The focus on a clear but ambitious date for 'clean power' has the potential to concentrate minds, show private investors that policy makers are serious, bring Government departments and the Devolved Administrations together and draw the sting of expected – but understandable – objections such as those to 'pylons'. It can bring to an end prevarication in pursuit of the perfect and engineer acceptance of what's good enough.

The focus on one particular date, and one particular objective, also carries risks. Officials and NESO representatives have said that they understand that and recognise that it's part of a longer journey. Although there are questions about the deliverability of the 2030 target, there are perhaps even bigger challenges post-2030 when the whole electricity system needs to expand as end use of energy is electrified.

What's likely to be deliverable by 2030 is the subject of NESO's report to Government published in early November.[7] Although they've presented two scenarios – one with a very large variable renewables capacity ("*Further Flex and Renewables*"), the other with less renewable capacity but a larger amount of schedulable low carbon plant ("*New Dispatch*") – NESO has said that there is little flexibility in such short time frames. The development of most energy sources that have any chance of being online by 2030 must already be very well advanced; and transmission network projects to accommodate them must already have been well-defined. The key differences between the scenarios are that one has less offshore wind and storage capacity than the other (7.5 and 8 GW), and more nuclear (0.6 GW) and plant burning hydrogen or natural gas with carbon

capture and storage (2.4 GW). Both scenarios retain 35 GW of unabated gas generation capacity, expected to operate with very low capacity factors but there as insurance against unfavourable weather conditions.

At this stage, at the very end of 2024, there appears to be very little room for error in meeting a 2030 target. However, in the overall scheme of things, would it really be a failure if 'clean power' is achieved in 2031 or 2032? This would still be a landmark achievement and help the UK meet the country's wider goals of the 6th Carbon Budget and the 2035 Nationally Determined Contribution (NDC) for greenhouse gas emissions reduction.

More questions than answers

Impetus does seem to be gathering and large investors are getting ready. Planning is still going to be a big challenge with lots of devilish detail. Public acceptance means different things to different people leaving the regulator, policy makers and network companies to resolve tensions between lower bills and low visible landscape impact against a background of little public understanding of what the different technology options entail and lack of trust for the companies. However, even if these hurdles are overcome, there could still be issues with finding enough suitably qualified people to spend the money fast enough.

Many questions are left, including the extent to which more optimal dispatch of resources can be enabled by wholesale market reform without hindering investment in generation, or better IT systems which can improve utilisation of batteries and network capacity – NESO has admitted that "*we have not always been able to take full advantage of new technologies connected to the network as quickly as the industry needs*".

Buyer's regret?

Clean power' by 2030 is just one step on the way to a bigger mission and should be consistent with what we need for 2035 and 2040. One question NESO has been asking itself is whether anything currently expected to come after 2030 could be accelerated to be commissioned by then. Stakeholders will want to know if a speeding up of delivery of electricity sector infrastructure could lead us to regret anything. Given that we will certainly need greatly expanded generation capacity post-2030 and, according to studies to date by NESO, much more transmission capacity, we might expect not. However, by going so fast, it's possible that we could, for example, end up paying a premium to gain access to limited supply chain capacities for wind turbines, electrical equipment and construction, or missing opportunities to secure significant 'local content' in the assets that are built.

Acceleration of the reduction of greenhouse gas emissions from the production of electricity could be argued to give some margin for error in delivery of the more challenging aspects of meeting the 2030 NDC and compensate for delays in decarbonising the transport and buildings sectors. A clear path to acceleration can be seen in NESO's "*Further Flex and Renewables*" scenario. However, there is a

danger that development of renewables grows too fast relative to the growth of demand to use the energy it produces and we start to see substantial curtailment of wind output simply for minute-by-minute energy balancing rather than lack of network capacity.

Is the route to the "*High Dispatch*" scenario any clearer? It relies on combinations of technologies that are yet to be demonstrated at scale with dependency on infrastructure, such as for CO_2 transport and storage, that doesn't yet exist. Key business models and enablers of investment, such as the Dispatchable Power Agreement, have not yet been proven. The future energy system will, regardless of the pathway, need low carbon storable fuels to meet demand when the wind isn't blowing and the sun isn't shining. 2030 might be too soon to see very much of them, but business models and pilot projects need to be operational by 2030 to stand a chance of delivering what needs to come later in the decade.

Delivering low carbon energy at the lowest cost

NESO has the challenge of producing a Strategic Spatial Energy Plan (SSEP) that needs to look beyond 2030.[8] Proponents of radical wholesale market reform claim that stronger locational signals will lead to reduced cost of electricity system infrastructure.[9] It will be interesting to see if an SSEP has investments in the same places as could be expected if locational pricing was implemented, and what mechanisms will be proposed to deliver what the SSEP describes.

A key element in maintaining widespread public support for the energy transition will be that, all other things being equal, electricity in a low carbon power system would be cheaper than in a high carbon one. A number of analyses suggest that, over the long-term, it will be.[10] In its Clean Power report, NESO says that, "*while our system cost analysis points to a slight increase from a move to a clean power sector, there will be direct benefits offsetting these, suggesting that overall costs to consumers would not increase from the shift to a clean power system*". Among those factors, it seems, is that "*our analysis points to [gas setting the wholesale price less frequently] reducing average electricity prices by around £10 /MWh under a clean power system. This reduction would not happen without the shift to clean power.*" NESO also, correctly, points out that a 'clean' power system would be much less sensitive to fossil fuel price shocks than today's system.

Anyone expecting that the much expanded use of generation that has the lowest levelised cost of energy would translate into lower energy bills is likely to be disappointed that NESO has not been clearer in its commentary on the direct cost impact of changing the generation mix. NESO might feel that its equivocal messaging around cost is justified by the large number of uncertainties and the dependency of energy bills on multiple dimensions of consumer action and public policy such as energy efficiency and treatment of security of supply. Nonetheless, reduced exposure to the volatility of the global gas market is an important benefit of the transition and there are policy options that have the potential to reduce electricity bills in the short-term. However, policymakers face significant challenges both in delivering clean power within the timeline the Government desires and doing so in a way that ensures consumers benefit.

Will the Modern Industrial Strategy Energise Industrial Decarbonisation?

Peter Taylor & Imogen Rattle, University of Leeds

Final energy consumption in the industrial sector has been decreasing since 1970.[11] However, industry still accounted for over 16% of total UK final energy consumption in 2023. More than half of this was provided by fossil fuels.[12] Given its substantial contribution to UK energy demand, and the need to replace much of the fossil fuel use with a combination of electricity, low carbon hydrogen and some bioenergy, developments in the sector will have far reaching implications for the future structure of UK energy use. Developing a comprehensive industrial strategy with a strong focus on decarbonisation will be essential to achieve the UK's net zero goals.

In last year's Review of Energy Policy[13] we identified key priorities that a new government should address to reduce industrial greenhouse gas emissions. We also noted that "*...a decarbonisation strategy is just one aspect of government policy affecting industry. Introducing a refreshed and comprehensive industrial strategy would provide businesses and other stakeholders with greater clarity on how a new government sees the role of industry in a low carbon economy.*" Recognising this need, October saw the release of a Green Paper consulting on the new Government's proposals for a 'Modern Industrial Strategy'.[14]

Elements of an Industrial Strategy

The substance of the Strategy sets out a 10-year plan designed to deliver long-term sustainable growth across the highest potential sectors in the economy. This growth is also intended to support the UK's net zero ambitions and promote regional development, economic security and resilience. In terms of net zero, the Government wants to identify and support clean energy industrial sectors that have the greatest growth potential and align sector plans with net zero and broader environmental objectives. To achieve these goals, the Green Paper sets out a mission-oriented approach, overseen by an independent Industrial Strategy Council "*to ensure stability and longevity*".

The Strategy identifies eight sectors across services and manufacturing as priorities for stimulating investment and growth, of which two: advanced manufacturing and clean energy industries have direct relevance to the challenge of industrial decarbonisation, while others, including digital and technologies and life sciences, could have an important supporting role.

Alongside this mission-orientated approach the Strategy also adopts a place-based perspective. As noted in the Green Paper, this is not the first attempt by a national government to deliver a place-based industrial strategy. The Conservative's 2017 Industrial Strategy[15] outlined plans for Local Industrial Strategies, but only seven were finalised before the COVID-19 pandemic struck.

The Green Paper proposes instead local growth plans – 10-year strategies for mayoral combined authorities (MCAs) to leverage their devolved powers and funding to drive regional growth. Additionally, the Government plans to build on existing initiatives to support high-potential clusters and align them with the industrial strategy. Crucially, the Green Paper recognises the interconnectedness of industrial decarbonisation, investment, and growth, highlighting issues like timely grid connections that pose significant risks to demand-side decarbonisation measures. This marks the first time a UK industrial strategy has explicitly linked electricity grid infrastructure constraints to broader investment concerns, and we welcome this more integrated approach.

However, the place-based focus may also marginalise the decarbonisation of industry when it is located outside the identified focus areas of city regions, high-potential clusters and strategic industrial sites. As we have argued elsewhere,[16] not all industry is sited in such areas. In fact, of the 13 winners in the recent local industrial decarbonisation plan competition,[17] only five are within MCA regions. It is essential that prioritising city regions and clusters does not result in other locations missing out on the critical infrastructure upgrades needed for decarbonisation. Industries outside the designated regions will still require support to meet emissions targets and remain competitive.

The future of UK industry

So, does this Green Paper present an industrial strategy that can provide businesses, investors and other stakeholders with the necessary clarity about how government sees the future of UK industry, while supporting industrial decarbonisation goals? The short answer is potentially, but more detail is required in key areas.

The Government's overarching approach to industrial strategy is promising, particularly in its focus on sectors with high growth potential, including advanced manufacturing and clean energy. But the Strategy currently says very little about how the Government sees the future of energy intensive industrial sectors, such as steel, cement and chemicals, that have underpinned UK manufacturing for decades and still provide around a quarter of its total value-added. The Green Paper mentions developing Sector Plans, including for 'Foundational' sectors that supply critical inputs and infrastructure to growth-driving sectors. Ideally, these Plans will address energy intensive sectors and the places where they are located. Many of these industries are vital parts of the supply chain for the more headline grabbing "*clean energy sector*". To retain or even enhance UK based supply chains for clean energy, the Government will need to find a way to reduce emissions from energy intensive industry while maintaining its competitive position. Without this support, there is a real risk that these industries will relocate offshore.

Conclusion

It is welcome that the Government has brought forward a modern industrial strategy, but its current focus on the new, exciting, high growth sectors of industry is only part of the story. What are its plans for the traditional industries that underpin clean energy, infrastructure, and regional economies beyond London and the South East? We look forward to seeing further details in the full Strategy, as well as in the upcoming strategy on the circular economy and the refreshed plans for industrial decarbonisation.

Gas Security, Demand Reduction, and Transition Risks

Louis Fletcher and Michael Bradshaw, Warwick Business School

The UK's new government has embarked upon an ambitious push for clean power, in part to reduce the country's exposure to international gas price volatility.[18] However, efforts to accelerate gas demand reduction will bring to the fore transition risks that will challenge the integrity and resilience of the gas pipeline network that connects supply and demand in the UK.[19] Demand reduction is thus both a necessary answer to supply insecurity and, if poorly managed, a source of risk.

Clean Power 2030?

The energy security case for expediting the phase-out of natural gas is now familiar. Under any scenario, North Sea gas production will fall faster than the decline in national gas consumption. Even though absolute gas demand will plunge, the proportion of UK gas consumption reliant on imports will rise. That will leave the country increasingly dependent upon spot Liquid Natural Gas (LNG) cargoes, the dangers of which were starkly illustrated in 2022-2023.

Ed Miliband, Secretary of State for Energy Security and Net Zero, spoke in September of how both energy security and climate goals "*now point in the direction of investing in clean energy*".[20] Broadly, the problem of gas supply insecurity has been folded into the solution of the Labour Party's mission of achieving a clean power system by 2030. The National Energy System Operator's (NESO) report,[21] modelling a pathway to achieve this 2030 target, envisions the UK retaining almost the same nameplate gas capacity as today, but with an 83% fall in annual output (82.5 TWh to 14.35 TWh). In this scenario, gas would provide standby dispatchable capacity, switching on to balance the grid when the sun is not shining and the wind is not blowing.

What is missing? Today, UK gas consumption is dominated by residential use (34%), primarily for space and water heating, and by electricity generation (29%), followed by industry (12%).[22] Gas demand reduction – including as an answer to gas supply insecurity – is about more than clean power.

On domestic heating, the continued failure of the boiler upgrade scheme requires redress. After half a decade of discussion, the ban on the installation of gas boilers in new builds should now be introduced without delay. The Labour Party's flagship 'Warm Homes' plan will increase support for home insulation, but final clarity on the scale of government funding has been deferred until spring 2025. On industry, as in the power system post-2030, the mix of gas abated with CCS, blue hydrogen produced with gas and CCS, and green hydrogen produced via electrolysis, will prove pivotal to the UK's future gas demand and thus gas imports. Across the spectrum, the UK's current 1:4 ratio of gas-to-electricity prices is enervating decarbonisation.[23]

Gas system decline

Perhaps understandably, the new Labour government has focused steadfastly upon the need to replace gas demand – especially in the power system. But this necessarily entails the acceleration of gas system decline, which throws up its own 'transition risks'. Declining throughput will undercut the

technical and commercial viability of critical gas infrastructure on which the UK will continue to depend in the medium-term. It represents a daunting coordination challenge, and decommissioning infrastructure comes with a gigantic price tag. It is therefore concerning that these issues appear to be given so little attention by successive governments.

None of the UK's gas infrastructure escapes the problem of decline, whether that's gas interconnectors, storage facilities, power plants, or LNG terminals. But the issues vary from case-to-case. It is helpful to draw into focus one of the UK's largest and most critical pieces of infrastructure, where these challenges are especially sharp – the gas pipeline system.

Unanswered problems

The gas network comprises a 7,600km arterial 'transmission' pipelines, and 276,000km of small-diameter 'distribution' pipelines branching out to deliver gas to households and businesses. Only a small fraction of the value of the network is likely to be repurposed for hydrogen.

Gas network decline raises three key problems. First, because the capital investments of network companies are recouped from billpayers over a frontloaded 45-year depreciation timetable, years of new investments in the network won't be fully repaid until after 2050. In total, £3bn and counting is scheduled to be recovered after 2050. Yet there will be no customers left on the network in 2050. Second, falling gas consumption means costs will be divided between a shrinking number of customers.[24] It is the most vulnerable – renters and low-income households – who will be least able to leave the network. Third, Arup has estimated that it could cost as much as £29 billion to disconnect customers from the gas network, and £25 billion to physically decommission the pipelines.[25]

In July, Ofgem released its 'methodology' for the RIIO-3 price control period running from April 2026 to March 2031, and it's here that we find its first real engagement with these problems.[26] It has decided that it will bring forward the network's depreciation schedule, lifting bills up in the short and medium-term while there are still a large number of customers on the network.

Crucially, however, it defers whether this will cover the entire regulatory asset base, or just new investments in the network. Ofgem disavows any decision on how to fund system decommissioning, awaiting a "*government-led decommissioning strategy*".

A whole system plan for the retirement of the network is desperately needed. This requires a decision on the technology mix for home heating and clarity on phaseout dates for gas boilers, a decision from Project Union on whether it is practicable to incorporate fractions of the gas transmission system into a national hydrogen backbone, and a longer-term understanding of demand from gas-fired generation and blue hydrogen production. Clarity on the coordination and cost of disconnecting from the gas network, and how this will be managed area-by-area, will be key for consumer decisions – starting immediately.

But there also remains a question about how this decline is best engineered. Inevitably, Ofgem is trying to tackle these problems through its own regulatory framework, but policy-makers should first assess whether that is the right approach. Bringing depreciation costs forward onto current billpayers, and potentially adding a further ~£54bn of decommissioning costs, would involve a large hike in bills. The fragmented private ownership of the gas system, with the distribution network split between four companies, and the transmission system owned by a consortium led by Macquarie, also poses profound incentive and coordination problems. Richard Lowes argues that the only route to a coherent, cost-effective gas phaseout is nationalisation.[27] The National Infrastructure Commission suggests that we look to the conversion of 14 million households from town gas to natural gas between 1967 and 1977 for lessons, in which the government "*had a central role in both coordination and delivery, via the nationalised gas boards*".[28] These proposals deserve serious consideration.[29]

Equity and Fairness in Delivering Net Zero Energy Systems

Jess Britton, University of Edinburgh

In recent months the new Labour Government have put a lot of emphasis on large-scale net zero projects including accelerating grid upgrades, funding carbon capture and storage (CCS) projects, support for nuclear, and refocussing on industrial strategy.

There have also been commitments to lower bills and ensure communities benefit from the energy transition through the GB Energy Local Power Plan and the Warm Homes Plan, however energy bills this winter remain unaffordable for many, and decarbonisation of heating is not on track. Its therefore essential that ensuring the energy transition is fair, equitable, and accessible to all segments of society remains a top priority.

Price squeeze

Under the October to December 2024 price cap the average annual bill for a typical gas and electricity dual fuel customer is £1,717. While this is well below the peak level of £2,380 under the Energy Price Guarantee from October 2022 to June 2023, National Energy Action[30] estimate that 6 million UK households are now in fuel poverty.[i] Bills are likely to remain high until the end of the decade and a survey of adults in GB found that almost half (46%) say they are likely to ration their energy use this winter.[31]

In September the government made the decision to limit winter fuel payments[ii] to those on low incomes who receive certain benefits, including pension credits. This means that over 10 million pensioners[32] will not receive a payment of £200-£300 (depending on circumstances) to help with energy bills during the coldest part of the year. It's important to ensure that energy price support is targeted to those most in need, but these changes are likely to exclude many pensioners who are struggling to pay bills.[33]

Action is still needed to support those least able to pay their energy bills; wider reforms to retail pricing are being considered by government, and could offer significant benefits to poorer households. Ofgem have stated[34] that the price cap was not designed to protect customers during periods of price volatility and are open to the idea of more fundamental reforms. This could include introducing a social tariff for energy. Social tariffs offer discounted energy prices to low income or vulnerable consumers and already exist for broadband and telephones.[35] Evidence suggests that a creating a tariff at a rate below the price cap for a targeted group, could reduce fuel poverty and improve distributional outcomes.[36] The design of any such tariff would be critical in shaping who benefits and

i NEA define fuel poverty as a household needing to use 10% of their income on keeping their home warm. Other definitions of fuel poverty combine measures of poverty and housing efficiency and may suggest lower numbers in fuel poverty. For example at least 3.6m UK households living in fuel poverty are identified in: Turner K., Katris A., Corbett H., Zhou L., Higginson S. 2024. The economy-wide impacts of different approaches to addressing fuel poverty: the importance of where, when and how public funds are spent. Access here.

ii The Scottish Government has made similar changes to the Winter Heating Payment in Scotland.

the overall impact on the economy. UKERC researchers at the Centre for Energy Policy at Strathclyde University will be exploring these issues in the coming months, assessing how different levels of social tariff may affect the extent of fuel poverty, impact on real disposable incomes and spending power, and the evolution of fuel poverty indicators.

Retail reforms

Ofgem have initiated a number of consultations influencing domestic bills this year, including on innovation in the energy retail market[37] and standing charges.[38] The average electricity standing charges for domestic direct debit consumers on standard variable tariffs have risen from £86 per year in October 2021 to £219 in 2024, and have been criticised as regressive with costs not linked to consumption, household income, or consumers' ability to pay. Without reform, standing charges are likely to increase as fixed system costs, such as network costs, continue to grow.

These consultations should be acted upon, but there is a need for more fundamental reform. Moving environmental and social levies from bills to general taxation could save consumers, who heat their homes with electricity, £300 and create an additional incentive for the switch to heat pumps.[39] Wholesale market reforms, which decouple the price of electricity from gas would also better reflect the cheaper cost of renewables in consumer bills,[40] and help the UK be more prepared for future fossil fuel volatility.[41]

Place-based heat transitions

Retrofit is not happening at the pace or scale required,[42] but there have been a range of welcome commitments from government on energy efficiency and home heating. An additional £6.6bn has been promised to upgrade 5 million homes in this Parliament. Local and combined authorities will play a central role in delivery through a new Warm Homes: Local Grant scheme which will fund energy efficiency and low carbon heat upgrades for homeowners and private renters on low incomes. Commitment to reinstate minimum energy efficiency standards for rented homes by 2030 is also a positive step forward.

Despite these announcements, uncertainties remain about delivery at scale. The Autumn budget only committed an 'initial' £3.4bn over the next three years, with details of further spending expected in the Spring Spending Review. Much of this funding is allocated to fuel poverty schemes (£1.8bn) and new ways of financing and delivering home retrofit will be required for other types of properties. Place-based approaches could play an important role in delivery[43] and programmes which co-create solutions with communities, combine interventions on a street-by-street basis, and develop new financing models are being tested in places such as the West Midlands.[44] These pilots could provide considerable learning to inform the Warm Homes Plan and the approach of GB Energy.

UKERC research, led by the University of Edinburgh, will examine neighbourhood retrofit approaches and work with communities to understand how programmes can be best tailored to individual needs. Researchers will also work with Innovate UK's Net Zero Living Programme (NZLP) demonstrators to understand the predominantly non-technical factors which limit wide-spread progress on place-based decarbonisation.[45]

The decarbonisation of heating also requires the government to send clear long-term signals about technologies. While the Autumn budget signalled additional funding for the Boiler Upgrade Scheme, Ed Miliband made a pre-election pledge that a Labour Government would scrap the previous government's ban on installing new gas boilers from 2035.[46] The Government has not yet given a clear position on the phase out of gas boilers creating unnecessary uncertainty. Introducing novel heating technologies and systems at household and neighbourhood level does have the potential to be controversial, but government could learn from experience in the Netherlands[47] on the importance of public engagement and locally-tailored approaches. More deliberative and participatory approaches could help to understand community views on heating technologies and UKERC research, led by Cardiff University, will test the role of such approaches in understanding and mediating potential conflicts in domestic heat decarbonisation.

Amidst the push for clean power by 2030 there is a risk that action to protect the most vulnerable from high bills and to decarbonise heating gets side-lined. There have been some positive measures from the new government so far, but significant uncertainties remain. A large part of delivering net zero is about changes to electricity, heating and transport systems in people's homes and communities. Understanding the varying impacts and opportunities of net zero energy systems across society, within localities, and for the wider economy, is therefore integral to delivery.

The Integration Principle: Challenges in Energy Infrastructure Investment

Andrew Lovett and Trudie Dockerty, University of East Anglia; Steve Watson and Nicola Beaumont, Plymouth Marine Laboratory; Jan Webb and Jess Britton, University of Edinburgh

The new Labour government has made a series of proposals to increase the rate of installation for renewables as part of the Clean Power 2030 Mission.[48] [49] [50] [51] One challenge it will face is reconciling these ambitions with the 'integration principle' embedded in the Environment Act 2021 which involves considering *"...the potential to cause a negative environmental effect which could be avoided, minimised, or reduced through alterations to the policy in proportion to other policy aims."*[52]

Integrating environmental protection

An illustration of how the Government intends to approach this challenge is provided by the Marine Delivery Routemap[53] published by the Crown Estate (which manages the seabed around England, Wales and Northern Ireland) in September 2024. The Routemap aims to support the growth of key industries alongside the creation of thriving biodiversity and marine environments. This follows legislation brought forward in the King's Speech, currently being debated by Parliament, to modernise The Crown Estate's borrowing and investment powers, alongside the new Great British Energy-Crown Estate partnership. The partnership has also published its thinking on the Future of Offshore Wind,[54] which sets out its approach to leasing additional capacity out to 2040 in support of the UK's net zero and energy security ambitions.

A recent UKERC Phase 4 project examined the extent to which environmental protection is integrated into current decision-making processes related to the transformation in energy infrastructure that is required to reach net zero. The study examined a wide range of policy documents relating to the energy transition and environmental protection, and carried out a series of interviews with experts at the energy-environment interface to gain further understanding. Twelve interviews were completed across England, Wales and Scotland in 2023-24, comprising local authorities and regional governmental organisations, energy industry representation and environmental organisations.

The document review revealed that potential environmental impacts are acknowledged in energy policy documents, along with the intent and need to mitigate them, but generally without specifics. Environmental policy documents, however, exhibited little awareness of potential impacts from energy infrastructure, though the issue may simply have been outside of their scope.

Planning reform

The need for planning reforms to speed up consenting for grid infrastructure and the rollout of renewables is highlighted in the Clean Power 2030 proposals. A need for improved coordination between local authorities was also highlighted in the interviews, both in relation to speeding

up consenting and also to ensuring potential environmental impacts are given full consideration.

The overwhelming consensus from the interviewees was that although they could see the intention at high-level to make energy and environmental policies align, in reality "*net zero trumps the environment*". Other comments were that "*these are two quite different worlds*" where "*energy people and environment people have different mindsets*".

Additionally, due to the different ways policy is implemented in England, Wales and Scotland, interviewees working at the local authority or regional levels felt that a whole energy system view of Great Britain didn't currently exist, creating difficulty in obtaining consensus for cross-boundary infrastructure. Similarly, the document review found no cross referencing or evidence of collaboration between nations regarding environmental strategy and practice or for achieving cross-boundary conservation objectives. Lack of co-ordination or awareness of who has overall oversight of policy direction and decisions on energy infrastructure developments, were also key concerns of interviewees.

The introduction of NESO

The National Energy System Operator (NESO) has now been commissioned by the UK, Scottish and Welsh Governments to develop the first Strategic Spatial Energy Plan (SSEP) for Great Britain.[55] The proposal to create such a plan was generally well supported by interviewees (and should address the cross-boundary concerns noted above). The main challenges foreseen in creating the plan were coordinating stakeholders with different interests and mindsets, and particularly –

the lack of essential skills. There were frequent mentions of the need for upskilling within government bodies tasked with delivering infrastructure change; for having appropriate funding for recruiting, training and retaining skilled staff and building long-lasting teams to engender trust between developers and local communities.

In terms of the environment and community costs and benefits, the prevailing view was that these need to be raised to be on equal terms with energy development, with communities more involved in both the design of energy schemes and allocation of benefit funding. Aligned with recommendations in recent reports,[56] [57] there were calls for these funds to be pooled across projects to provide more meaningful benefits to local communities, extending to those affected by new transmission infrastructure as well as those local to new energy generation sites. Engaging the public was felt both to be important but also a potential challenge that might slow delivery. Once more, the issue of skills and resourcing of delivery teams in local authorities to help build relationships and facilitate community benefits was flagged.

Has the integration of energy and environmental policy improved?

Interviewees were also asked if they felt that the integration of energy and environmental policy or practice had changed over recent years. Some felt that integration has stalled or even rolled back; that there are difficulties, for example, ensuring that local authorities link energy and environment, and that a coherent approach is needed to mediate between objectives in the different policy areas. They also expressed a need to find the means to upskill, inform and engender trust between local authorities and other organisations working in these areas and energy infrastructure developers, but stated that there is a willingness to find ways to make this happen.

One implication of these findings is that a skills and training gap needs to be addressed if the integration principle is to be observed while meeting ambitious targets for increased use of renewables. Upskilling is required, particularly in decision-making authorities, to enable them to employ, train and retain the best people to ensure informed decisions are made when considering energy-environment trade-offs in new energy infrastructure developments. Another important requirement is for better coordination, both between local authorities and across the boundaries of the devolved nations. Current government initiatives relating to spatial energy planning will need to address these issues as part of a more strategic and holistic approach to energy infrastructure roll out.

A Welsh Perspective on Energy Policy

Jianzhong Wu, Nick Pidgeon and Meysam Qadrdan, Cardiff University

The critical interplay of Welsh and UK energy policies

Wales is well-positioned to leverage its natural resources, such as wind, tidal and solar energy, to significantly contribute to its energy needs, resilience and sustainability. However, the energy landscape in Wales is intricately linked to broader UK energy policies, creating a multifaceted relationship that influences both local and national strategies. This relationship must be strengthened in the coming years, fostering collaborative governance that enables Wales to play a full role in the UK's energy transition.

The Welsh Government has taken proactive steps in developing policies that tackle local challenges while aligning with UK-wide objectives. The Well-being of Future Generations (Wales) Act 2015[58] provides a comprehensive framework for sustainable development, and the Environment (Wales) Act 2016[59] requires reductions in Welsh emissions to Net Zero by 2050. The Welsh Net Zero Strategic Plan[60] outlines a framework for achieving this, emphasising the urgent need for transition across all sectors.

Context of energy system development in Wales

Wales has embarked on a transformative journey, focusing on integrating renewable energy, enhancing local energy planning, decarbonising heat, fostering community involvement, and exploring longer-term options such as nuclear power, industrial decarbonisation and CCS/hydrogen. Key Developments Include:

- **The Renewable Energy Deep Dive Update 3:**[61] Emphasising the development of a national plan that scales up local energy plans and maps future energy demand and supply across Wales. It advocates for engaging local communities, improving grid capacity, and enhancing public engagement to support behaviour change towards energy efficiency. The update aims to create a robust framework for integrating renewable energy sources while maximising local ownership and socio-economic benefits.

- **The Heat Strategy for Wales:**[62] Along with the Warm Wales programme to improve social housing, it plays a crucial role in the transition towards net zero. Heat accounts for approximately 50% of total energy use in Wales. The Strategy outlines targets for home and industry, including the installation of 580,000 heat pumps by 2035. It also recognises that heat impacts public health, social services and the wider economy, outlining near-term commitments to address barriers across public awareness, trust, costs, supply chain growth and planning regulation.

- **The Future Energy Grids for Wales project:**[63] It focuses on developing system scenarios that explore various pathways for decarbonisation while engaging diverse stakeholders. The project identifies key infrastructure needs, emphasising the importance of integrating electricity, gas, heat, and transport systems to achieve net zero by 2050.

- **The Net Zero 2035 Challenge Group:** It has published pathways for energy, heat and transport, calling for an honest national conversation about the climate and nature crises in a holistic way to bring Welsh citizens into a dialogue about creating a safer, more prosperous future.

In setting its ambitious net zero target the Welsh Government aims to establish the nation as a global leader. However, achieving this vision requires a thorough re-examination of the infrastructure required to facilitate rapid and effective change, while ensuring that no citizens are left behind due to outdated systems. The planning relaxations to facilitate new transmission grid connections indicate a shift towards more integrated energy solutions. However, challenges remain regarding the economic viability and environmental impact of these extensive investments in Wales.
To support this transformative agenda, several notable initiatives have also been launched:

- **Local Area Energy Planning (LAEP):** This is critical for enabling communities to develop energy strategies that reflect their needs, by integrating local resources, such as community solar projects and energy efficiency programmes, to promote energy self-sufficiency.
- **Warm Home Programme:** This initiative aims to tackle fuel poverty by improving energy efficiency in homes across Wales, by providing grants and support for insulation and heating upgrades.
- **Ynni Cymru:** This programme is designed to promote local renewable energy generation, enabling communities to harness their own resources effectively.
- **Trydan Cymru:** This initiative focuses on generating onshore wind power through the Welsh forestry estate.
- **Offshore Wind Development:** The Welsh Government is supporting the expansion of offshore wind, including floating wind farms in the Celtic Sea, delivering significant renewable capacity.

Challenges faced by the South Wales industry cluster

The South Wales industry cluster, with significant players like Tata Steel at Port Talbot, faces unique challenges in decarbonisation. The UK Government has agreed with Tata Steel to transition production at Port Talbot to electric arc furnaces. The site will decommission both of its blast furnaces in 2024, switching to electric arc from 2027, eliminating more than 90% of the site's direct emissions. This deal included £500 million of Government funding as part of a £1.25 billion total investment in the site.[64] One of the key questions here is where the necessary cheap green electricity will come from? The recently announced £20 billion carbon capture, usage and storage (CCUS) project support in the UK, while promising, is insufficient to ensure low-cost power without imposing a high carbon price for Welsh industry.

The complexities surrounding Tata Steel underscore the multifaceted nature of industrial decarbonisation in Wales. Key challenges include:

- **High energy costs:** Current electricity prices remain among the highest in Europe, posing a barrier to competitive industrial operations.
- **Investment uncertainty:** The reliance on CCUS and the transition to low carbon technologies, including hydrogen and hydrogen-based fuels, necessitate substantial upfront investments.
- **Decarbonisation policies:** The existing policies must evolve to support a transition that balances economic viability and environmental responsibilities, requiring greater collaboration between industry and government.
- **Just transition:** Ensuring that the industrial transition is fair, equitable and timely for existing communities dependent upon traditional industries is critical. Wales needs to avoid repeating the experiences of local communities as the coal regions declined.
- **Skilled workforce shortage:** South Wales faces a skilled workforce shortage due to an aging workforce and limited training opportunities. Transitioning from heavy industries to low carbon technologies requires new skills. Moreover, industry and manufacturing sectors must compete with other sectors for talent.
- **Revenue support:** There is a need to reach agreement on the shared decarbonisation outcomes for Welsh Government and industry. This must be supported by share of Wales' actual industrial emissions, rather than the current by-population method.

Recommendations

To effectively navigate the complexities of energy policy in Wales, a holistic and integrated approach is paramount. This requires:

- **Whole systems actions:** Balancing energy security, affordability, and sustainability, collaborative governance will need to involve DESNZ, Ofgem, NESO, RESP, other utility companies, and Welsh Government and Welsh communities to ensure significant devolved participation in decision-making.

- **Integrated energy system planning with a community focus:** Bridging the gap between top-down and bottom-up approaches in energy planning is crucial. A new framework for energy system planning should incorporate community engagement and acceptance, facilitating a more participatory approach to energy governance and decision-making, while enhancing the democratic legitimacy of energy initiatives.

- **Long-term vision:** Investment in new technologies and infrastructure must be underpinned by a commitment to a just transition that prioritises both environmental sustainability and economic viability for the long-term.

By prioritising these key areas, Wales has the potential to forge a transformative energy landscape that also serves as a blueprint for sustainable development across the UK. Energy policy should not merely focus on technical and environmental challenges, but be a holistic endeavour that integrates economic, environmental, and social considerations through an integrated whole-system policy framework involving the central government, devolved administrations, industry, and local communities.

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