NewStatesman

Spotlight

ENERGY: THE BALANCE OF POWER

Rebecca Long-Bailey MP / Jonathan Bartley / Paul Wheelhouse MSP

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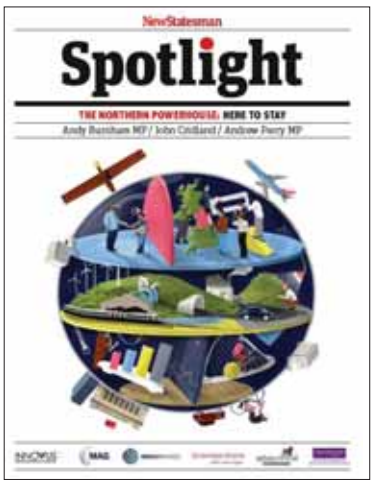

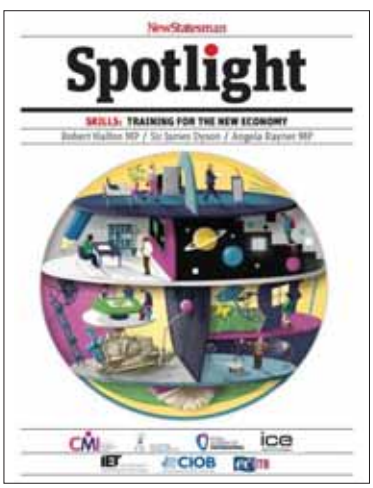

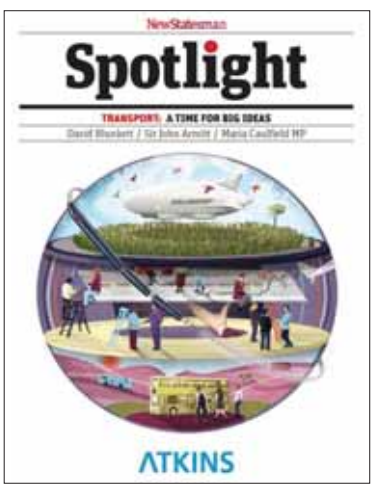

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Bright sparks

Last month, for the first time ever, the UK's demand for power was lower during the day on a Saturday than it was at night. This might not sound all that exciting a fact, but it represents a tipping point, because the lower demand upon the National Grid was created not by the nation collectively deciding to turn the TV off and read a book, but by the steady and distributed growth of solar panels. Years of subsidies and gradual installation of solar panels on the roofs of homes and businesses across the country meant that at the point when electricity demand on the grid is normally at its peak – between 4pm and 6pm – the sunny weather allowed local distribution networks, fed by solar panels, to feed in six times as much power as the country's remaining coal-fired power stations. Some 875,000 homes in the UK now have solar panels installed, and other industries – such as home batteries, which store power generated during the day for use at night – are springing up around this installed base of power.

A couple of weeks later came another announcement from a sunny future: Tesla, the electric car manufacturer, is now worth more on the stock market than Ford, the company that popularised the motor car. Ford may have created the production line (and, in doing so, shaped the modern world) but in Nevada, Tesla is building a factory that will be the biggest building by footprint on earth. It is building it to make not cars, but batteries. As power generation is democratised, the means of delivery will change too. At every level, technological changes that have been quietly growing in recent years – be they renewable generation methods, storage, or new oil and gas extraction techniques – are becoming serious propositions. The next 10 years will see a dramatic shake-up of the sector that powers all others.

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In 2007, London's City Hall installed photovoltaic solar panels, generating energy with zero-carbon emissions

How to fix a broken energy market

The Conservative government has failed to end fuel poverty but Labour won't, according to Rebecca Long-Bailey, Shadow Secretary for Business, Energy and Industrial Strategy

The world is changing and we need to evolve within it or risk being left behind. Nowhere is this more obvious than in energy, where a significant transformation has been taking place. When Theresa May first spoke of the need for an industrial strategy, it seemed like the Conservative government had finally seen the light, had listened to businesses, the trade union movement and indeed the Labour Party. But it soon became clear that while demonstrating a positive commitment to the notion of an industrial strategy, the reality is that, thus far, the government has provided very little detail to show how the so-called strategy will be enacted.

The government's industrial strategy green paper, advertised against an exciting pretext of "renewed vigour" and "fresh thinking", was viewed as a disappointment by many when it appeared to contain seemingly watered down, lacklustre proposals. This can be seen clearly in its energy and climate change policy. The sparse energy pages of the paper are testament to this government's inability to act seriously on this issue and to really get to grips with the oversight of energy markets.

This is further illustrated by the delays in the publication of the Emissions Reduction Plan, another important document which would seek to provide certainty to energy investors. In terms of energy prices, the government's position is even more worrying. Ofgem now confirm that energy bills account for 10 per cent of spending in the poorest households, compared with just 5.5 per cent in 2004, and since December 2016 five of the 'Big Six' have announced that they are increasing their energy prices even further. Worryingly, the Institute for Fiscal Studies stated following this year's Spring budget, that: "On current forecasts average earnings will be no higher in 2022 than they were in 2007." So, it appears that without significant

LUCIANO MORTULA/ SHUTTERSTOCK

"Countless families are suffering"

intervention from government in relation to energy prices, the picture looks bleak for many families in the years to come.

Moreover, the Competition and Markets Authority recently found that customers had paid £1.4bn a year in "excessive prices" between 2012 and 2015, with those on standard variable tariffs paying 11 per cent more for their electricity and 15 per cent more for their gas than customers on other tariffs. One major bone of contention is the issue of customers being switched automatically onto more expensive tariffs.

If the government had real resolve and determination to tackle these issues and stop those countless families up and down the country from suffering extreme hardship, then they would have acted upon calls from Labour as far back as 2013 to cap energy prices and embark on a programme of reform in relation to the broken energy market.

Of course as we know, they declined to take action and the results of this are plain to see. In relation to the impact on energy prices by the renewable energy sector specifically, energy from the sun and wind is getting cheaper every day and is predicted to be less than gas in 2020.

It remains important that we build a clean energy system as cheaply as possible, and to this end the Committee on Climate Change published a "lowest cost pathway", but the government again failed to heed good advice. But it is not just energy policy where the government is letting us down, it is also on the fundamental principles of economic policy. One of the underlying problems of the UK economy has been poor productivity performance. Our productivity is low relative to many of our counterparts, trailing significantly behind the United States, France and Germany. Output per hour in the UK was 16 per cent below the average of the G7 advanced economies in 2015, which is partly a result of our low levels of investment relative to other industrial economies.

Labour would take a very different approach. Our industrial strategy aims to place energy at its heart. Sustaining and increasing growth, but making sure that such growth is fairly shared, balanced across sectors and regions as well as being environmentally sustainable. Labour has drawn upon the work of leading economists such as Mariana Mazzucato in placing great emphasis on the importance of "missions" to drive forward key technological and scientific advances. Such missions sit alongside sector-based plans, providing a blueprint of the support industries and businesses need to develop, manufacture and sell such goods and services.

Our first mission is to source 60 per cent of our heat and power from low-carbon and renewable sources by 2030. We will work to make Britain a world leader in low-carbon and fuel-efficient technologies, creating new industries, UK-based supply chains and ultimately highly paid, highly skilled jobs where our expertise and goods will be exported

"There are still 4 million cold homes"

across the world. To achieve such a mission Labour would seek to fill the skills gap that might impede cutting edge industries. For example, while our nuclear industry is world class in some sectors, it is slowed down by a chronic shortage in skills. Similarly, as we develop and manufacture exciting new forms of energy we will need to re-train and re-skill our workforce to export into growing global markets.

New sources of energy like tidal power have yet to receive a green light from this government, despite the potential increase in energy security and the UK having some of the best tidal resources in the world. Building tidal lagoons which use new multi-directional turbines requires precision engineering, a highly skilled work force and thousands of tonnes of steel. Much of this material and labour can be locally sourced creating new supply chains which capture value in the UK.

The Labour Party is also testing alternative forms of ownership and learning lessons from the past. Energy used to be sold by city and regional councils which helped them capture value and reinvest in the local area. We're beginning to see a revival of local energy co-ops in places like Bristol which provide both cheaper and cleaner energy to local residents. With new technologies come new possibilities. Rather than just buying energy from the grid, consumers can now become "prosumers", interacting with the market, selling to it as well as buying from it and even balancing the grid. The spread of smart meters across the country means even more understanding of energy patterns which lead to efficiencies, increased energy security and savings for the bill payer.

We must also ensure our homes are properly insulated. The Conservatives broke their promise to end fuel poverty by 2016. In fact, there are still 4 million cold homes and over the last decade help to insulate them has fallen a startling 88 per cent . Labour would make insulating homes an infrastructure priority – if we can spend millions on generating energy, why don't we stop it being wasted through thin windows and bare lofts? These measures would not only help tackle climate change but would also lead to public health improvements. Insulating homes will lower bills, keep families warm and prevent illness. The NHS spends £1.4bn on treating illness from cold homes each year. Similarly, thousands die in our towns and cities each year from air pollution. Advancing new energy and transport solutions will bring down emissions and dramatically reduce these risks.

Finally, it is important to note that for years a portion of our energy has been imported cheaply from the continent. Theresa May appears to be hurtling towards the hardest possible Brexit deal but the simple fact is that if she plays fast and loose with energy market access, we risk being barred from cheap power from Europe without an adequate domestic energy infrastructure plan to plug the gap.

So focused is she on the hardest of all Brexits that for no discernible reason we're also leaving Euratom, the European Partnership on Nuclear Trade and Research. The UK nuclear industry is quite rightly raising serious concerns, and industry insiders have warned that nuclear power stations that are operating today may have to be shut down as a result. Who knows what that means for keeping the lights on or our bills down?

The government must protect our interests in terms of present energy market access within Europe but more importantly we need a progressive industrial policy for the energy sector. One which will support balanced growth, skilled jobs and decarbonisation. But rather than use the words "industrial strategy" as a rhetorical device as the Conservatives have, we must enact it. Only the Labour Party will do this.

Rebecca Long-Bailey has served as the MP for Salford and Eccles since 2015 and was appointed Shadow Secretary for Business, Energy and Industrial Strategy in February 2017.

A low-carbon future and the case for urgency

The transition to clean energy is irreversible but it needs to speed up, according to Professor Jim Skea, president of the Energy Institute and co-chair of IPCC Working Group 3

Democracies are complex animals. The consent and legitimacy they confer on those who govern is a stabilising feature of most modern societies and thankfully, generally, this serves us well. But amidst the issues competing for voter favour, short-termism and sensationalism can eclipse the long-term and the evidence-based.

A challenge this poses to those of us wrestling with intergenerational concerns such as climate change is how to sustain backing for vital action over decades – how to ensure horizons extend beyond the next election. But despite changes in energy policy in individual countries, the global shift to low-carbon is now, I believe, hard-wired into our energy system in a way that will ride out the ups and downs of short-term political cycles.

Why am I certain?

First, although in some quarters it may not be fashionable, we should not underestimate the power of evidence. The Fifth Assessment report of the Intergovernmental Panel on Climate Change (IPCC) is the most unequivocal articulation yet of the direct link between human activities and the changing climate. And the evidence continues to mount – 2016 was the hottest year ever recorded , underscoring the urgency of emission reduction and adaptation.

How our economies respond to this challenge also calls for the application of evidence, by governments, the private sector and through institutions such as the Energy Institute, which works to bring the best expertise and knowledge to bear in the public debate.

Secondly, the global agreement reached in Paris sent an enduring signal. The world's nations have escaped the prisoner's dilemma and committed to decarbonise for the sakes of both our shared environment and their economies. Paris will survive any doubts– as we have seen in the continued commitments from China, India and the EU.

Thirdly, technological innovation, spurred by cost reductions in clean energy, is an unstoppable driver for change. The cost of manufacturing one watt of solar PV cell capacity fell from $76.67 in 1977 to a staggering 36 cents in 2014, according to Bloomberg New Energy Finance. This, combined with cost reductions in storage, is opening up extraordinary new possibilities. Global investment in renewable power capacity reached a record $265.8bn in 2015, according to UNEP, which was more than double that for new coal and gas generation.

Likewise in oil and gas, climate change has become a mainstream, existential issue. The Energy Institute's recent International Petroleum Week, attended by IPCC chair Dr Hoesung Lee and UNFCCC executive secretary Patricia Espinosa, saw meaningful dialogue about the industry's role in defining pathways to decarbonisation and bringing on the technologies such as carbon capture that will make it possible.

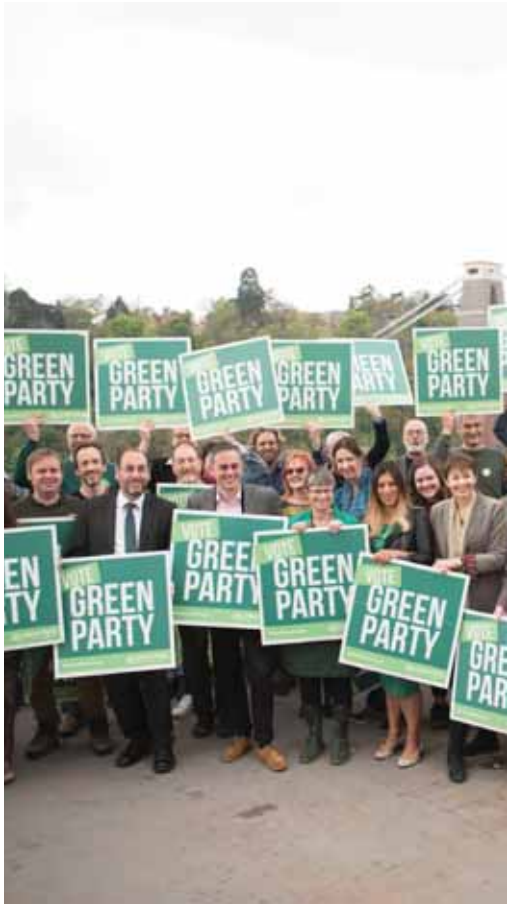
But is it enough?

The test of human ability to avert the most dangerous impacts of climate change won't be whether we decarbonise, but how quickly we do it. With the weight of scientific evidence and the strength of international resolve behind us, the pace of clean energy investment must speed up.

Just as the horizons for tackling climate change are beyond a single electoral cycle, so too are those for investing at scale in new technologies. The smartest companies have spotted the direction of travel and are taking the long view. And they will certainly reap the benefits.

Jonathan Bartley, co-leader of the Green party of England and Wales, talks to Rohan Banerjee about how to push the environment up the political agenda

Is energy policy a vote-winner?



Is the Green Party a single-issue party? "While we view all issues through the lens of the environment," the Greens' co-leader Jonathan Bartley admits, "I think we're much more than that." His answer carries a hint of frustration; it's not the first time he's been asked this.

The Green Party of England and Wales currently has a solitary representative in the House of Commons – Bartley's leadership partner Caroline Lucas has served as the MP for Brighton Pavilion since 2010 – but the dad of three insists: "Under a fairer [instant-runoff] voting system, we'd have around 24." The maths checks out. The Greens took 3.8 per cent (a raw figure of 1,157,613 votes) in the 2015 General Election, which proportionately would translate to 24.7 seats. It's worth noting, however, by the same token, UKIP should have had 81.9.

The 2017 election, announced surprisingly by Prime Minister Theresa May in April, is likely to be fought on issues relating to the European Union, immigration and sovereignty. How, then, can the Green Party elevate its own core policies, which relate to the environment, energy and climate change, up the agenda? Bartley says: "Well of course we have policies regarding those things as well, but by no means can we afford to think of energy issues as unimportant. In terms of how you convey that to people, you've got to take a joined up approach. Environmental issues aren't isolated – where you've got issues relating to unemployment, the renewables sector can provide a whole range of job opportunities; where you've got issues about budget planning and investment, you've got to consider how public money could be better spent. Right now the government is investing a lot of money into energy that simply isn't sustainable, cost-effective or even efficient."

Bartley hones in on Hinkley Point C as a particular bone of contention and believes that the Conservatives' faith in

the construction of Britain's first new nuclear power plant in more than 20 years has been grossly misplaced. "If you look at the money that's being spent on Hinkley, some £30bn, it's just totally uneconomic. We can create a centralised, job-poor nuclear option, which locks us into an expensive deal for decades, or we can invest in a decentralised, job-rich, clean energy renewables revolution."

The popular criticism levied against renewable energy is that it can't generate the same level or quality of power. According to Bartley, this simply isn't true. "Honestly, there are low carbon energy sources which could meet our annual electricity demand six times over. Six tidal power stations down the west coast of Wales could supply as much as Hinkley. We're an island nation, so why are we not using the resources afforded to us naturally?"

The government has forecasted that the Hinkley project will create between 20,000 and 25,000 jobs during construction and 800 to 900 permanent jobs once in operation. Is he confident that a shift to renewables could match or better those figures?

"I'm saying that not only can you preserve jobs within the energy sector, but transition them and create thousands of new ones in renewable technology." Quoting the Department for Business, Energy and Industrial Strategy's Energy Trends 2016 report, Bartley continues: "There's already precedent too. Taken in combination, offshore wind, tidal and wave energy currently support around 22,000 jobs and add £2.2bn to the UK's national income."

The UK's decision to leave the EU has been delivering curve balls across the political landscape ever since the referendum last year. The European Carbon Trading Scheme, the flagship policy agreed by the bloc aimed at cutting carbon emissions throughout the continent, is one of several elephants in the room. The UK is committed to providing around £1.7bn in funding, without which it is not yet clear how the scheme will survive. Equally, without EU regulations being imposed, where is the incentive to improve the UK's environmental standards? Bartley rues that the environmental discourse surrounding Brexit has been "conspicuous by its absence" and wants to make sure that environmental regulations become "enshrined" domestically. He adds: "The air pollution standards in London were pushed forward because of the deterrent of EU fines. Now, who holds us to account? This is why the Green Party wants to see an Environmental Protection Act, as well as a Clean Air Act."

The need to "democratise" the energy market, Bartley says, is obvious. "We've got to move away from the reliance on the 'Big Six' [energy companies] and decentralise. The Green Party wants to legislate to separate large energy generators from suppliers. Power prices would continue to be set according to the wholesale market where we expect the majority of electricity to be traded."

Is demand-side response central to the Green Party's vision? "We're looking at it in terms of both demand and supply. Crucially, we need to stop energy waste and improve efficiency of use – we must do better with less. We'd look to incentivise provision of capacity at times of peak demand. It's about cutting demand and creating a long-term plan to make new homes that are low- and zero-carbon, primarily by super insulation. Every home should be able to generate some sort of its own electricity, either through solar, wind or whatever it might be. The improvements in battery technology are increasing exponentially and community heating and municipal heating projects should be happening in every town. Places like Germany have got some incredible energy communities and distribution networks. People need to see what it's like to have control."

Bartley's and indeed the Green Party's aims are nothing if not ambitious, but the reality check pertains – with just one MP, how much can you really expect to achieve? Bartley, who attended the same independent boarding school as UKIP grandee Nigel Farage, draws another comparison in his answer.

"The fact is we've got a first past the post system and so you've got to be tactical and target. You start with the councils and then go for the seats where you've got the most support. We've made considerable progress in Bristol West with Molly Scott Cato and we're hopeful down there. You make a difference in politics with movements. UKIP managed to do it with the Leave movement, and despite having fewer MPs than us, have affected national politics in a huge way. The Green Party's movement has the potential to do the same."

It is there, though, the comparison ends. Bartley clarifies: "The difference is that while UKIP's movement was a right-wing coup, based on building walls and not bridges, ours is a clear message to Westminster about the benefits of being greener." He goes on to quip: "It's like Tony Benn said – 'I'm leaving the House of Commons to concentrate on politics.' You shift agendas with movements and that's what we intend to do."

Scotland's renewables journey

Paul Wheelhouse, Scottish government Minister for Business, Innovation and Energy, wants to unshackle the UK's supply chain

The choices we make about energy are among the most important decisions we face. The supply of safe, reliable energy underpins the continued growth of the Scottish economy, and is at the heart of meeting our international climate change obligations. Scottish renewable electricity output has almost trebled since the end of 2006 and in 2016 renewable sources generated almost 54 per cent of our gross electricity consumption. The low-carbon and renewable energy sector in Scotland supports 58,500 jobs, turning over £10.5bn and greenhouse gas emissions in Scotland had, by 2014, reduced by 45.8 per cent since 1990.

Onshore wind and hydro-power continue to be the leading contributors, though solar, tidal and others now play an increasingly important part in our vibrant, innovative energy community and offer exciting potential for the future energy needs of Scotland. Only last month we granted planning approval for the third floating wind farm off the Scottish coast. This means Scotland has now agreed planning permission for up to 92MW of floating offshore wind – enough for the equivalent of 60,000 homes – cementing our reputation as a world centre for this new and pioneering technology.

This is only one example. From testing the world's most powerful 2MW tidal turbine off Orkney to opening a 70-acre solar farm in rural Perthshire, we continue to champion fresh ideas and approaches to both energy provision and use. We can be proud of these achievements. The task to fully decarbonise electricity production has been largely achieved in Scotland – well ahead of other countries that will now have to make a similar transition to prevent the damaging effects of climate change.

We cannot, however, afford to be complacent. We are therefore currently consulting on a draft energy strategy that has further, more ambitious targets at its heart. This includes consulting on our commitment to deliver the equivalent of 50 per cent of all the energy required for Scotland's heat, transport and electricity needs from renewable sources by 2030.

Our strong success on electricity

Whitelee Wind Farm in Eaglesham is the largest onshore wind farm in the United Kingdom

IAN DICK/FLICKR

"Scotland supports 58,500 jobs and £10.5bn of turnover"

supply leaves us with a different kind of energy challenge from that of most countries – one where renewable sources for heat and transport take on even greater significance. In sectors such as low-carbon heating, our supportive policy environment has allowed Scottish-based companies to compete globally. Such opportunities are likely to increase in future years, as the international market for low-carbon goods and services continues to grow.

Our patterns of energy use are changing too. We are now more efficient than ever in the use of energy – and further major shifts in our energy use lie ahead. Our future transport needs will be met substantially through electricity or alternative fuels, such as hydrogen.

How consumers engage with these choices will be guided by 'smart' technologies, providing better information on energy use and a better platform for informed decisions on when it is best to consume energy. We are also helping communities to engage and benefit from their local renewable resources, with an ambitious new target on shared ownership of renewables.

Our energy strategy will prepare us for this future, guiding and shaping progress to 2050 and beyond. That is not to say this continued progress is assured. The UK government's recent reductions in support for key renewables technologies continue to cast a shadow over the sector.

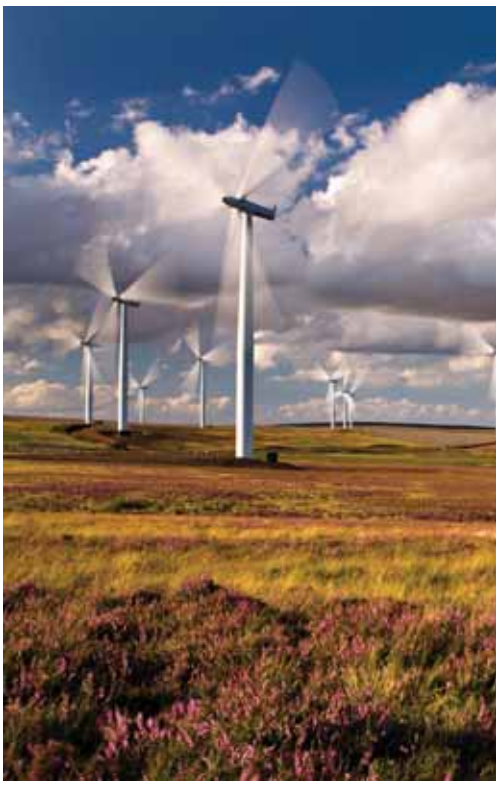
Scotland has a pipeline of consented energy projects, worth billions of pounds in capital expenditure for Scottish and UK construction and engineering sectors, awaiting final investment decisions. I would like to see these projects developed at the earliest opportunity and at the lowest cost to the consumer.

But the UK government's failure to ensure they even have a route to market is creating deep uncertainty and delay. The UK government must remove the damaging uncertainty around timing and eligibility across many sectors, including remote island wind, onshore wind, wave and tidal. There is also no price stabilisation mechanism for pumped hydro storage energy as yet, despite large scale storage being a key requirement in the emerging energy system. In pumped-hydro, again Scotland has been a world leader for many decades, but at present consented projects, worth hundreds of millions of pounds are denied a route to market by UK Ministers.

To answer these concerns, the UK government must – in the short to medium-term – develop a new approach to its relationship with Scotland on energy issues, with key decisions on energy policy made following a process of consultation and agreement with the Scottish government, as set out in the Scotland Act 2016.

A good start would be for the UK government to clarify its commitment to renewables and the UK supply chain in the final version of its own industrial strategy. The people of Scotland will have a choice on their constitutional future. In making that choice, they can be assured we will never cease in our work to combat climate change and build a greener, fairer and wealthier country, by harnessing the power of Scotland.

A benchmark for renewable success



Through performance benchmarking turbine health can be determined quickly and accurately, writes **Lauren Wheatley**, technical director at Natural Power

As the UK's onshore wind industry matures and more assets become operational, the battle to achieve predicted production levels whilst keeping costs low is on. Put simply, those that manage their costs most efficiently whilst developing the most effective and proactive maintenance strategies will be those who prevail.

It sounds simple but in reality, how can wind farm owners and operators develop strategies to succeed? It is no longer enough to deliver against time-based availability warranties. The industry requires a far more proactive approach to operational wind farm management that takes market complexities and owner needs into consideration. Crucially, there has to be a strategy for processing and interpreting data. Modern wind turbines produce data through their control systems – where real time and historic information on the performance of the turbine, current conditions and equipment health is gathered and available through the SCADA (supervisory control and data acquisition) system for analysis. When you consider that the average turbine SCADA system records 60 signals per second, working out at 5,184,000 data points per day or over 40MB of data, it is easy to see why effective analysis of data is crucial for informed decision making and the potential automation of systems.

How do we make the 'big data' work in the onshore wind industry?

Perhaps we should look to the other energy industries for inspiration. The oil and gas and thermal industries have been using analysis and benchmarking tools to determine relative performance for years. Likewise, the UK's offshore wind industry has developed its own benchmarking tool-set in the shape of SPARTA. By regularly comparing one company's business processes and performance metrics to others in the

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natural power

same industry, a baseline from which individual performance can be compared and can be drawn. This industry baseline then becomes the target to beat, and with competition comes greater innovation, efficiencies and lowering of costs. Within the powerhouses of the oil and gas industry, real time performance dashboards are displayed on monitors, reception screens and tablets for everyone in the workforce to see. We can drive performance optimisation and share increased knowledge and understanding; the theory being that if everyone can access the information, they will be encouraged to achieve better results.

So why, then, isn't this happening in onshore wind?

First of all, the industry is relatively young compared to some of its energy counterparts so established data collection channels are still in their infancy. Secondly, the original equipment manufacturers (OEMs) have not always shared historical operating data for assets. Equally, wind farm owners and operators are notorious for hoarding data and shrouding their asset performance in secrecy.

For the industry to truly drive change and thrive, it needs to learn to share information. Collaboration with others will provide a holistic view and give top-line information where current data are insufficient. Anonymising data will be the first step in achieving information sharing however, this is voluntary and will have to be adopted by far more of the industry than we are seeing currently if it is to compete with the baselines its mainstream energy counterparts currently enjoy. And finally, an industry baseline needs to be established with standardised operational and maintenance criteria developed.

Benchmarking

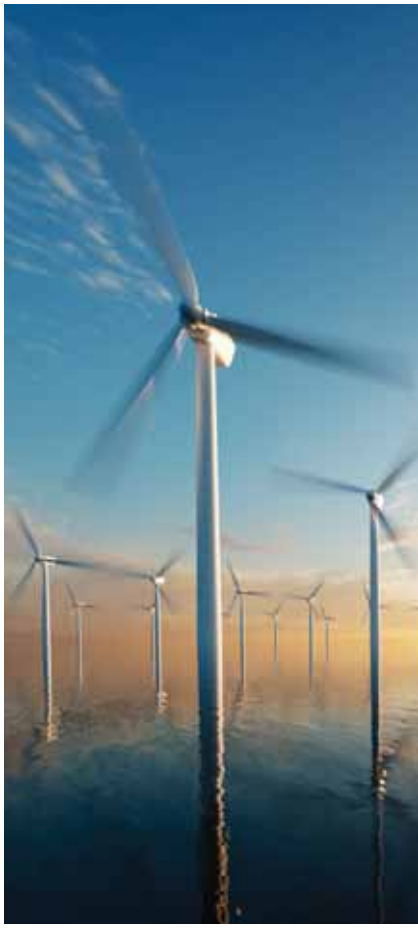
Benchmarking is the comparison of a value against a standard or average, highlighting outliers or opportunities for improvement. The purpose of benchmarking is to help companies achieve maximum effectiveness and efficiency by comparing their processes to best in class.

Natural Power recognises the need for benchmarking with its operational activities expanding rapidly and with the growth, the associated need to receive targeted information on the availability, reliability and performance of the assets under its control. To establish performance standards within a cost-competitive marketplace, Natural Power understands that benchmarks are required across three levels: at the turbine level within a specific site, at wind farm level within a specific portfolio and at an industry-wide level.

The team knew that it would be challenging to achieve performance standards at all three levels, and therefore took the decision to start at turbine level and work up. Natural Power has been gathering data from sites across the UK and has developed a number of variable monthly performance metrics KPIs for production, availability, operations and reliability. In the process of doing so, it has been able to identify and flag assets that are failing to meet standards with respect to downtime KPIs, to identify recurring component failures and to identify long-term trends in component downtimes. Armed with this knowledge, as well as service and inspection teams, Natural Power can now create maintenance protocols within reliability-centred maintenance programmes. As a wind farm owner or operator, having access to this information also provides leverage by which to work collaboratively with a service provider. The results are compelling but we are just at the start of a journey where greater knowledge will inevitably lead the way to greater efficiency. As an industry there is still a long way to go.

In a recent report by GCube, around a third of all wind turbines are now reaching the end of their operation and maintenance service agreements. This presents an opportunity for operators and owners to review their current arrangements versus the option of an independent service provider maintenance contract where lower costs and impartiality make them increasingly more attractive. During this period of decreasing subsidies and low auction prices, lowering operational costs will be even more critical and having clear baselines from which to help the decision making process may just create the environment needed for standardised industry benchmarking. Let's hope so.

> **"Greater knowledge means greater efficiency"**



For the greater grid: Europe's balance of power

Interconnector technologies could breathe new life into the UK's energy scene, writes **Chris Anderson**, CEO at 4C Offshore

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There is a realisation within the electricity generation sector that we need to evolve our power supply faster than we could ever imagine. My company continually reviews the offshore energy market in a global context, so I am aware that since 2008 the UK has been on the brink of an electricity supply crisis. The fact that this has been averted is due to the hard work conducted by our National Grid, world events such as the onset of a recession, tight grid access control, better energy conservation, and the rapid evolution within the renewable energy sector. Through all of this, our leaders and their opposition, those who supposedly work for us, in my opinion, wasted time arguing over wind turbines, exaggerating issues, and misinforming voters rather than ensuring a restructured energy supply fit for the coming decades.

Consequently, we are now in a race against time to bring on secure, cleaner power generation through a mixture of renewable and conventional carbon energies as old nuclear plants and dirty coal power stations are removed from the system. By 2025, all coal power stations are planned for closure. While new nuclear energy could assist in securing our supply and reducing carbon emissions, there is little empirical evidence to demonstrate such projects can be built as fast as promised. So far only Hinkley Point C is underway with the rest still under consideration.

We need a quick solution. While renewable costs are falling far faster than expected, renewables do highlight a problem that until recent years has been gone unnoticed by the public at large. You can't store electricity cheaply or efficiently. You never could. Furthermore, many renewable sources

PETRMALINAK/SHUTTERSTOCK

are intermittent. The sun needs to shine, the wind needs to blow.

But to make matters more complicated, electricity generation and its use has to be finely balanced. Too much electricity and low demand – the grid trips and fries. Not enough and it, too, trips, and blackouts occur. To ensure power to your home and workplace, this balancing act takes place all day every day. Power is brought online when needed and taken offline when not. But such a system is incredibly wasteful. In order to ensure power is ready when needed, power stations are kept in reserve but off whilst others are being kept running but disconnected from the grid.

There are several commercial means of balancing supply. One is simply turn up the power. Surprisingly, this is not easy to do for several types of power stations. Coal and nuclear need long lead times to ramp up their power output, hence they are assigned as base load (continuous supply). Another means of balancing the power is to keep power stations in reserve (spare capacity) or store surplus electricity so we can use it when needed.

Global research into improved battery storage technology is ongoing, but while commercial units are becoming available, the costs are still relatively high. However, both National grid and the UK government are so certain that electricity storage solutions will become cost-effective that National Grid has now introduced batteries into its future planning, and the Department for Business, Energy & Industrial Strategy (BEIS) includes projections of battery storage, already stating capacity will reach 3GW in 2030.

One other balancing solution that is available and proven, and has come to the fore in recent years is that of connecting to other grids or interconnecting, usually to other countries. Interconnectors are just large capacity electricty cables taken from a grid connection point from our shores, buried into the seabed through to an equivalent connection point at one of our European neighbours. They enable each side to take advantage of different times in their peaks and flows of electricity. This works well when countries are on different time zones.

While our nation is looking to each of the balancing solutions described, the UK has become a leading investment opportunity for Interconnector. Interconnectors could provide a vital component of a flexible grid, enabling the overall system to cope as it expands the supply of variable renewables in the mix. We already have three electricity interconnectors in place linking us to France, Ireland and the Netherlands. Currently an interconnector to Belgium is being built with plans for new connections to Norway, France and Denmark already in development, and more planned to countries such as Ireland and Germany.

Each electricity interconnector brings the potential to provide the UK with the equivalent energy of a large Nuclear power station at the fraction of the cost. By having connections to multiple partners, offshore electricity interconnectors offer a promise of energy security, improves overall resilience, reduces the need for redundancy, and given the difference in wholesale electricity prices between the UK and the rest of Europe we could reduce our electricity costs.

Once we have built up our infrastructure we could even go on to sell our surplus. We can install electricity interconnectors with minimal environmental impact, and if the will is there, do it quickly. In the short term rising interconnector capacity would increase power imports. This has been supported by the BEIS who projects electricity imports reaching over 20 per cent of total supply in 2025.

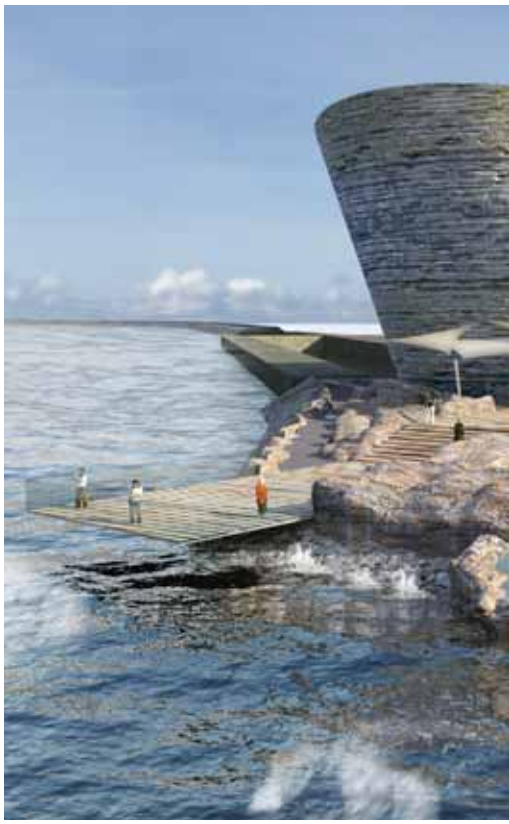
But after years of energy policy argument and vacillation, the UK government is running out of time. We need a solution fast and this could be it. The government has paved the way by providing an incentivised system called the 'Cap and Floor' regime. Under the cap and floor approach, if developers' revenues exceed the cap then revenue above the cap is returned to consumers.

Conversely, if their revenues fall below the floor then consumers top up developers' revenues to the level of the floor. The system is proving successful in encouraging interconnectors to be built as it insulates developers' exposure to the full potential loss, and makes their investment less risky.

There is a large gap in UK low-carbon power supply due in part to the government's opposition to expanding onshore wind and solar, at times contradictory and limited support for offshore wind, lack of clear signals on tidal power and ongoing delays for new nuclear programmes. Interconnectors connecting us to Europe are not the solution, but definitely part of the solution if we want to keep the lights on.

For more information, please visit: www.4coffshore.com

Can tidal lagoon energy be both clean and green? India Bourke finds out



Tidal power's £1.3bn experiment

Seven thousand years ago, a group of Mesolithic children and adults made their way across marshland near what is now the Gower Peninsula in Wales. The estuary they looked out on was around 16m lower than its present level and nearby Swansea Bay was still completely dry. Even though the Ice Age was over, enough water remained locked up in ice to keep sea levels low – allowing the group's footprints to sink into mud and survive the centuries. Today, however, it is feared that rising sea levels will drive communities away from the coast. By 2100, human-induced climate change threatens to raise temperatures by 2-4C and push up tide-lines by 4-6m. In Wales alone, 220,000 households are at risk of flooding.

The government has promised to help counter this global trend by reducing UK carbon emissions 80 per cent from 1990 levels by 2050. And with the second largest tidal range in the world, British marine energy could play an important role in this shift. But harnessing the power of the tides is not without consequence. In 2013, plans to construct a £34bn barrage across the Severn estuary were rejected after concerns were raised about its effect on local ecosystems; wildlife groups worried the structure would block the safe migration of fish and impact the river's thousands of species of wintering birds.

So can tidal technology be both clean and green? A company called Tidal Lagoon Power (TLP) believes it has the answer. Instead of entirely dissecting estuaries with a row of turbines, the company proposes building U-shaped breakwaters out from the coast. At a proposed pathfinder project in Swansea Bay, 16 gated turbines installed inside a 9.5km breakwater wall would generate regular electricity each time the tides go

Swansea Bay Tidal Lagoon will be the world's first tidal lagoon power plant

in and out.

The project promises to supply clean energy to 155,000 homes and to enhance the local environment for nature and humans alike. Its eco-minded plans include turning the breakwater into an artificial reef, as well as creating a roost for birds, and new areas of saltmarsh, grassland and dunescape. Wardens will be employed to keep an eye on activity above ground and underwater acoustic camera technology will monitor happenings beneath. A hatchery and ponds for baby oysters will even attempt to restore and conserve native species.

At £1.3bn, this green scheme does not come cheap and the company is seeking government support through a Contract for Difference subsidy. But TLP also views the Swansea project as a "pathfinder" for a series of larger plants. The company claims these subsequent schemes would improve the technology's cost-efficiency and create further employment, both directly and across a UK-focused supply chain. It is estimated that Swansea development could support 2,260 jobs during its construction and operation alone.

A recent independent review agrees and has found in favour of the pilot. According to the review's author, the former energy minister Charles Hendry, the long life-span of tidal lagoons makes them an attractive and cost-competitive complement to other low-carbon options, as well as a potential asset to Britain's wider economy. "As Britain moves into a post-Brexit world, we need to ask if we want to be leaders or followers. If the answer is that we should be leaders, as mine unequivocally is, then tidal lagoons offer an early, achievable and long-term opportunity," the report advises.

Major environmental organisations have also given the Swansea pathfinder scheme their qualified support. Doug Parr, Chief Scientist at Greenpeace UK, told the *New Statesman*: "If environmental concerns can be addressed the government should get on with it because it could be the first of a wave of tidal lagoons across the UK, and even internationally. We can lead the world in providing a new, renewable innovation to meet our clean energy needs."

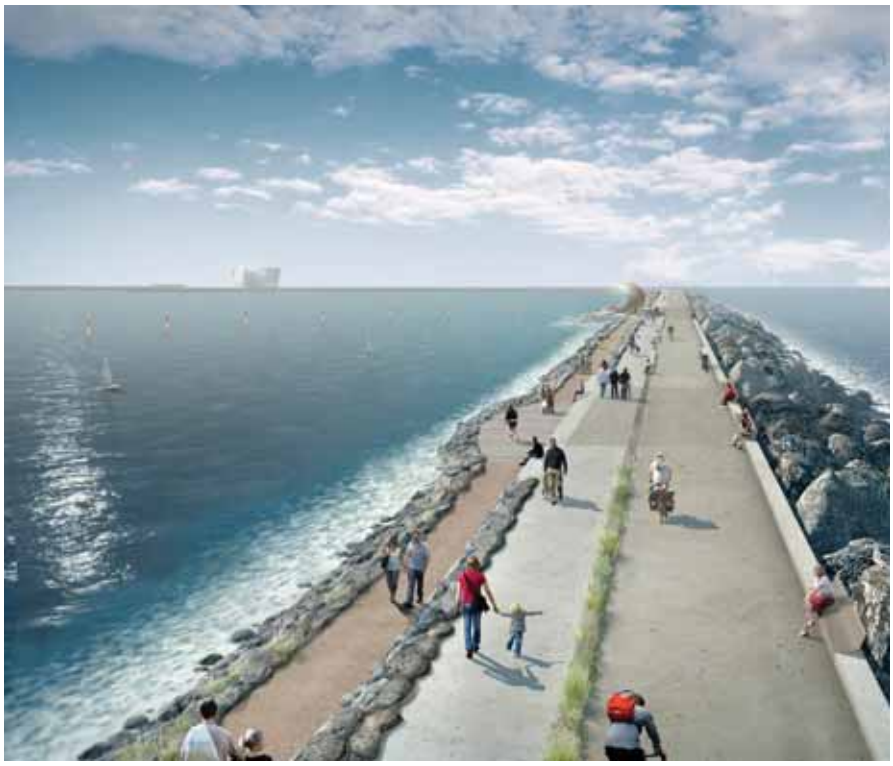
But some large green question-marks still remain. The lagoon at Swansea has already received development consent but has yet to obtain a Marine Licence from Natural Resources Wales. And plans for larger tidal projects to come will require further permissions under EU law. According to NRW the process of examining the application has been both "challenging and instructive". Concerns from wildlife groups include the build-up of silt and unforeseen changes to the movement of floodwaters, as well as the impact on marine and bird life.

Joan Edwards, the Head of Living Seas at the Wildlife Trusts, fears that the lagoon may interrupt the homing instinct of salmon, which migrate upstream close to the coast using smell. She is also concerned about the effects of the estuary flow. "When you build sandcastles on the beach, the sea comes in and you don't know exactly where the water will go – what channels it will choose to flow through."

Ultimately, there is still too little information to make accurate predictions. In evidence submitted to the review by the Environment Agency, the following caution was issued: "We currently have little knowledge of, and low confidence in, the modeling proposals for some of the schemes being proposed." Objections are also being raised to TLP's plans to source building material for the project from a disused quarry on the Cornish coast, which the company's CEO, Mark Shorrock, has recently purchased. Alison McGregor of Cornwall Against Dean Superquarry doesn't think Shorrock, "is as green as he makes out to be." She is particularly ↵

SWANSEA BAY TIDAL LAGOON

"The project promises to supply 155,000 homes"



fearful for the impact the re-opened quarry would have on the adjacent Manacles Marine Conservation Zone.

Such concerns prompted the review to call for the adoption of careful monitoring systems. Hendry recommends that if tidal lagoons are built, "the government should require a high level of ongoing monitoring of environmental impacts". He also suggests the adoption of a National Policy Statement and a Tidal Power Authority, to provide all-round support and oversight for any future industry.

What is harder to settle on is how much monitoring at Swansea should conducted before further lagoons are green-lit. The review recommends that no larger projects should be approved before the Swansea pathfinder is operational. While according to NRW, monitoring the effects of such a project "could take many years to complete given the complex life cycles of many species."

So how much monitoring is enough? Even if the impacts at Swansea are deemed manageable, the cumulative impact on multiple lagoons in the same estuary would still be unknown. On the other hand, the economic and environmental case for action is compelling. The government's decision on whether or not to support the Swansea scheme – and the wider technology – thus faces a deep challenge: of having to commit to a path forward in the face of constant change. Not just the changes that the Swansea pilot scheme will bring to the estuary, but those brought by climate change itself, as well as continuing developments in competing forms of marine and renewable energy.

At least here the government is in ancient company. When the Mesolithic peoples of early Wales inhabited the region, they did so in the face of constantly moving tides and climate. Most likely travelling in response to flood and resource shift, they made adaptation and flexibility central to their success. Now the government must do the same.

What are you really paying for?

Martyn Lambert, head of client acquisition at Black Sheep Utilities, explains non-commodity costs and how they affect UK businesses

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Black Sheep Utilities

It's no secret that compared to previous years the wholesale energy market in the UK is low. In fact, from 2013 to 2016 prices plummeted more than 23 per cent and average wholesale energy prices have fallen more than 14 per cent in the last five years.

In the face of such significant drops in wholesale energy prices you'd be forgiven for expecting to see some huge savings on your bills. Unfortunately, the exact opposite is happening – energy bills are rising at an alarming pace.

Why is this?

Your bill is going up thanks to the charges that make up the bill which are not for the energy itself, known as non-commodity charges. It's common to hear about "falling energy prices" because it's exciting (and is technically true). It's not so interesting to hear that by 2020, non-commodity costs will account for at least 60 per cent of your bill.

To put that into perspective: a site with an annual consumption of 1,000,000kWh will see an increase in cost of approximately £21,000 between 2017 and 2020.The average business uses 50,000 kWh of electricity, so the average business will see an increase in cost of at least £1,000 between 2017 and 2020 even if the wholesale cost of energy remains the same.

Most significantly, energy suppliers have no control over non-commodity costs. Their control starts and ends at the wholesale energy cost based on their buying strategy which is becoming progressively less significant in the overall makeup of your energy bill.

In the simplest of terms, non-commodity costs can be separated into one of two categories: Transportation and Distribution and Charges; and Commissions, Government Levies and Taxes. Over the next few months and years, you'll continue to see your energy bills rise and you'll start to see some of these additional items appearing on your bill. The diminishing power of wholesale energy prices means that prices are less responsive to market conditions, so a large drop in the wholesale market isn't as noticeable as it once was, but a large rise in the wholesale market is still going to result in higher prices.

How can I keep my costs down?

A company which has purchased its energy for the next three years can do so with a 2 per cent cost increase compared to its previous contract. However the bad news is that the delivered cost of energy (non-commodity costs) will increase 32 per cent over the same period.

Increases in cost at this level will pose a significant problem for most organisations so the first step is to identify the risks that your business could face. By providing your supply number, site capacity and usage data, Black Sheep Utilities can calculate the probable impact of non-commodity costs on your business.

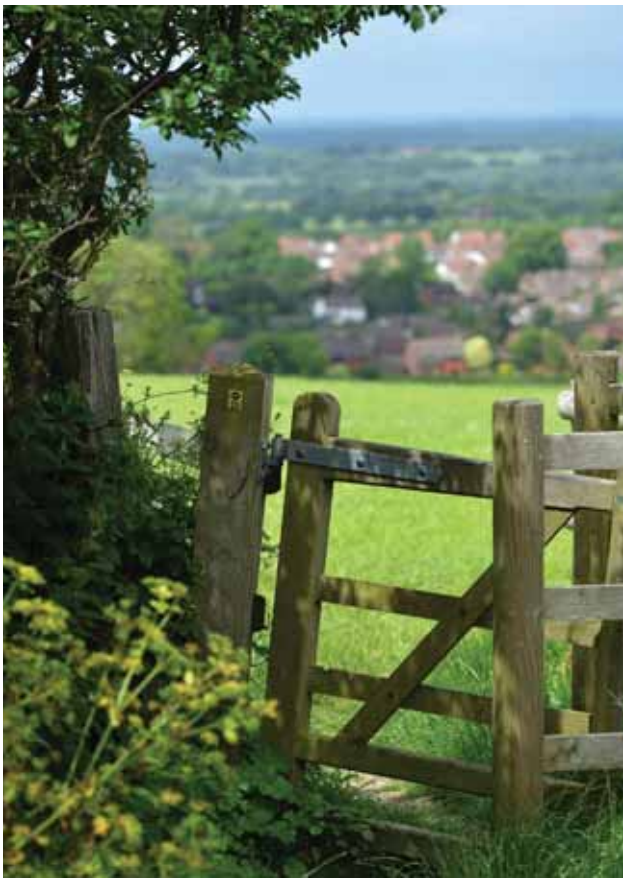
There's no such thing as a 'one size fits all' solution, but by shifting your peak usage times, looking into on-site generation and energy storage mechanisms you can control and limit the impact of non-commodity costs and protect the financial stability of your business.

Learn how Black Sheep Utilities can help you deal with progressively complicated energy bills, the diminishing impact of wholesale energy prices and the increasing impact of non-commodity costs by speaking to one of our experts who will talk you through the right solutions for your business.

For more information, please visit: www.blacksheeputilities.co.uk

In recent years the rolling green hills of Sussex and Surrey have been found to contain huge volumes of oil. Will Dunn spoke to the companies, campaigners and locals at the centre of the Home Counties oil rush

A blackness beneath the village green



PETER CRIPPS/SHUTTERSTOCK

In 1896, engineers working for the London, Brighton and South Coast Railway began drilling beneath the platform at Heathfield Railway Station in Sussex. As they passed 300 feet, the engineers discovered not the water that they had been looking for, but natural gas. For 35 years the gas burned in the station boiler and the platform lights, until the station was connected to the main grid and the well was sealed. For another half-century the hydrocarbons beneath the Weald – the Old English term that describes the wooded hills of Sussex, Hampshire, Kent and Surrey – remained for the most part unexploited until the 1980s when a number of companies drilled exploratory wells in the Weald that produced oil – but not at a scale that interested global firms. For decades these wells kept up a steady trickle of up to a few hundred barrels a day until, in 2015, a flurry of headlines declared that new wells and extraction technologies could make the Home Counties an oil-producing region that could compete with the North Sea. Statements at the time suggested that there could be 100 billion barrels of oil in the Weald.

The headlines were not welcomed by everyone. In 2013 Michael Fallon, who was at the time minister of state for energy, prefigured the debate that was to emerge in the Weald when he told a private Westminster meeting that "the beauty" of the oil in the Weald Basin "is that of course it's underneath the commentariat. All these people writing leaders saying 'why don't they get on with shale?' – we are going to see how thick their rectory walls are, whether they like the flaring at the end of the drive." Fallon's

comments, though he never intended them to be made public, were prescient.

A protest against oil exploration in a wood near Balcombe, in West Sussex, began in 2012 and is still under way. Similar protests have emerged at other places in Sussex and Surrey, including Leith Hill, designated as an Area of Outstanding Natural Beauty. "Swampy and the Surrey stockbroker unite" wrote the *Daily Mail* at the beginning of this year, as middle-class villagers and campaigners joined forces to oppose drilling. Last month, tempers flared again as it was alleged that one company, Angus Energy, had drilled an extension to its well in the village of Brockham, without planning permission.

Brockham surrounds a large, triangular village green that is overlooked by houses, the village church and two pubs. The green, archetypical among Surrey villages, has hosted cricket matches for centuries. WG Grace is said to have played here. A recent survey by a private investment firm listed the surrounding Mole Valley area as the second-most prosperous council area in the UK; and Zoopla lists the village's average house price at over £650,000. But for Stephen Sanderson, the real value lies further down.

Sanderson, a petroleum geologist who has uncovered multi-billion barrel wells off the coast of Norway, is the executive chairman of UK Oil and Gas (UKOG) – the biggest company involved in exploring oil in the Weald. "We have interest in 12 licenses," says Sanderson, "which is about 950 square kilometres. Our primary focus is on the Kimmeridge limestones. Think of the white cliffs of Dover – that's limestone. We tested oil from two of these limestones, which cover pretty much the whole of the south-east of England,and got a stable flow rate of almost 1700 barrels a day. Compared to everything else in the basin, it's an order of magnitude greater."

The advantage of the limestones beneath the Weald, says Sanderson, is that "they're naturally fractured," meaning expensive and highly controversial fracking is not required."It all results from the Horse Hill well. That was the first well drilled with modern data acquisition and analysis techniques. I looked at the data from it, and it didn't fit with the existing model in the Weald, which stated that this Kimmeridge shale rock wasn't ever buried deep enough to have generated significant volumes of oil. The Horse Hill well showed that to be incorrect. With that information I came to the conclusion that the Kimmeridge limestone is a viable target, and that there could well be a very decent prize in that. The rate that we got out was beyond my wildest expectation."

The next stage for UKOG will be to conduct production tests, which it will do from the end of this year. At that point, says Sanderson, "we should be able to make a declaration of commerciality." If commerciality of the Kimmeridge Limestone is proved at Horse Hill and UKOG's other test wells, the question of oil in the Weald will become much more significant. The whole region may become attractive to a new wave of developers.

One of the people hoping this won't happen is Ada, a spokesperson for Brockham Oil Watch. Ada says she is "not part of this anti-fracking movement", but that she became involved in scrutiny of oil exploration in the area "because it's all happening on my doorstep." Ada lives between Brockham and Leith Hill. "When we found out about what was happening it was a shock, especially at Leith Hill, because it's an Area of Outstanding Natural Beauty. You go there and it's like being in the mountains, it's very special. Brockham is different, because there's been a well there since 1987. People are used to it; they don't have a problem with it because it's out of sight."

Ada found out about the Brockham well "because there was a camp by the side of the road. Originally, people in the village were just upset about the camp – they were slowing down lorries, blocking traffic on the lane. It's generally quite a conservative village, politically, and the feeling was, what's the fuss?".

That feeling changed abruptly on the 9th March, when a BBC news report alleged that Angus Energy had drilled without permission. "People here trust the regulatory system. They trust the Environment Agency to look after them. So when the news came out, it challenged that trust. There is interest, now from local people, and it's mostly around these new [extraction] technologies." The technology that most worries Ada and her fellow villagers is not fracking, but something less well-known: acidisation.

UKOG's Stephen Sanderson says acidisation "has been around for 120 years or more. We use a dilute hydrochloric acid that dissolves the limestone. Most wells on the planet have a bit of dilute hydrochloric acid in there, to 'clean up' the well. We also use it to dissolve a little bit of the limestone immediately surrounding the well, so it allows a good connection from the fractures into the well. It's not fracking at all. In order to frack a formation you have to inject very large amounts of liquid in, at very ↵

Would you be happy with an oil well in your garden?

high pressures. To do that you need massive pumps, and permission from the Environment Agency. Acidisation is entirely misunderstood, and there's a huge amount of scaremongering going on. The techniques we use to drill through the rock are exactly those used by the water-well drilling industry."

Brockham Oil Watch, however, says there is a difference between what Sanderson describes and "matrix acidising, or acid fracking. The "acid wash" is a benign method of cleaning the well. But if you start pumping larger quantities that are squeezed into the formation itself, as opposed to the well, that is a different process. The industry will say that "we've got the same acid in our stomachs", but it's not just hydrochloric acid they're using. Other chemicals are pumped with it too." Ada refers to a study on acidisation carried out in California that lists 26 chemicals used in the process that are 'F' graded as hazardous. "Neurotoxins, carcinogens, developmental toxins. It's a nasty cocktail. Nothing like that study has been done in the UK. The impact on human health and the environment has not been evaluated."

Ada says the Leith Hill Environment Agency application includes a request to vary the permit to allow "acid squeeze", which she understands to mean matrix acidising, while the Markwells Wood application uses a vague definition to "muddy the vocabulary" around matrix acidising."In California, they developed an equation to determine when acid washing becomes matrix acidising. It has to do with the size of the drill bit, the porosity of the rock and the volume of acid. That definition is quite clear. In the UK, there isn't anything like that."

It is not only new technologies that concern local residents, but the attitudes of the companies using them. Mole Valley councillor Clayton Wellman says amendments to planning applications at Leith Hill and Brockham were "passed straight up to Surrey", without local district councillors having the chance to give their opinions. "If it was all above board, that would foster trust," he says, but refers to one company as operating "in an underhand way". Wellman does not oppose drilling per se, but he says it's vital to have "a strategic view, if this is something that's going to happen often."

Will it happen often? Joseph Gatdula is a senior analyst at Global Data, which provides intelligence on the energy industry (Global Data is also owned by the same parent company as the *New Statesman*). Gatdula says the question is not so much whether the oil is there, but whether you can make from getting it out. "The common method that's used in evaluating whether or not a discovery is economical is looking at the cost to develop it. How much is it going to cost per barrel of oil? That number can float from anywhere from less than five dollars to in excess of 100 dollars a barrel. Where it's more expensive, you generally need a higher [oil] price to justify it." Gatdula says that given "the cost of the wells in this area of the UK, in addition to the properties of the reservoir," Horse Hill "looks like it would probably warrant development at this point." However, Gatdula also points out that new extraction technologies benefit other producers, too. "It's a bit of a catch-22, where you develop this great technology but now it reduces the cost elsewhere. So now you're going to have to compete with the best metrics in places where it might be a lot cheaper to buy the same thing." The Weald is not likely to become a hotspot for the "supermajor" companies, but "smaller firms, without large pockets... this type of investment size fits that type of company." With investments and profit margins still comparatively small the Weald won't take off overnight, Gatdula concludes, but "It's got potential."

As production increases, the one certainty is that more disputes along similar lines to Brockham will arise between the UK's various regulators, energy companies pushing for margins, and the villagers who don't want to see oil wells springing up beyond their mullioned windows. After all, would Stephen Sanderson put up with an oil well at the end of his garden? "As long as I had a royalty on it," he answers, "yes."

There's no reason why greener can't also mean richer

Ethan Higgins, director of Ignite Energy, says that greater energy efficiency helps, rather than hinders, a company's economic performance

The resistance to adopting greener energy practices has historically centred on one concern: the cost. Renewables, the cynics suggest, are too expensive to put in place and simply can't satisfy the same power demands as fossil fuels. The same can be said for the adoption of more energy-efficient technologies, with many sectors viewing the amount of capital required for their implementation as outweighing the positive impact they could have. But according to a report from the International Energy Agency (IEA), the UK has been the most successful of the G7 Group of nations in boosting its economy and cutting its climate emissions over the past 25 years. The Energy and Climate and Intelligence Unit (ECIU), meanwhile, has correlated the relationship between the average Briton's carbon footprint being 33 per cent less than it was in 1992 and the finding that people are more than 130 per cent richer in 2017.

The Climate Change Act 2008 has already committed the UK to reducing its greenhouse gas emissions by at least 80 per cent of 1990 levels by 2050. This means a concerted effort from both individuals and businesses will be needed to meet this target. Energy efficiency is a key part of delivering this, and one which makes real-world financial sense for most businesses.

Ignite has worked collaboratively with some of the UK's leading retailers to help reduce their impact on the environment and the cost implications of energy consumption over large estates. Through greatly improved supply management and the implementation of more efficient technologies, Ignite's clients have been able to dramatically cut costs while reducing carbon emissions.

Ignite has developed a long-standing and ongoing partnership with nationwide pet store chain Pets at Home and assisted them in streamlining their supply and billing practices, while slashing operational costs and the impact on the environment. Over the past two years, Ignite has developed and implemented a demand reduction solution with Pets at Home made up of two key elements: LED lighting upgrades and control systems to manage in-store assets and optimise savings. Although logistically challenging, these two elements were rolled out in tandem in order to reduce interference with normal store operations.

Working throughout the entire development of the project, Ignite assisted by managing supplier selection and tendering processes to ensure that the best matches from both quality and cost perspectives were chosen. Ignite acted as principle contractor to bring each element of the project together and report progress back to Pets at Home. LED equivalents of existing lighting were installed throughout stores to maintain existing light levels but increase efficiency. Pets at Home's innovative approach to energy reduction allowed this to go a step further by selecting replacement High Bay fittings, that make up the majority of their sales floor lighting, with built in sensors to take advantage of natural light entering the stores, furthering both the financial and environmental impact of the project.

Control systems were installed to manage lighting, air conditioning and other systems such as signage and optimise their potential efficiency. Temperature sensors also ensured that strict pet welfare standards could be monitored and adhered to, key to Pets at Home's "Pets before profit" approach. Pets at Home now has an estate of well-managed, energy-efficient stores and has achieved substantial savings in energy and maintenance costs.

Ultimately, the shift towards better energy efficiency should not be viewed as an impediment but rather an opportunity. Ignite can provide the catalyst to capitalise on this movement.

Bringing power to the people

Smart grids and storage technologies can ease the pressure on our energy sector, according to Kathryn Magnay, head of energy programme at the Engineering and Physical Sciences Research Council

The world faces an ever-increasing demand for power, for both personal and business use. Consider that according to Cisco, there will be 11.6bn mobile-connected devices by 2021. As countries advance and populations grow, competition for resources has the potential to increase economic and political tensions. In the UK, meanwhile, the move towards a more balanced economy is leading to an increased focus on manufacturing; but these industries are often energy-hungry and need to keep production costs down.

So, what can science and engineering do to help address these demands sustainably, while reducing greenhouse gas emissions? The UN's Intergovernmental Panel on Climate Change's most recent report says: "Without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally." Concordantly, the UK Committee on Climate Change has advised that reducing demand is the most effective intervention to meet 2050 greenhouse gas emission targets.

The UK's Research Councils' (RCUK) Energy Programme, led by the Engineering and Physical Sciences Research Council (EPSRC), funds UK researchers and international collaborations to find new ways of storing, generating, distributing, and saving energy. Since 2012 the Research Councils have invested £40m in six End Use Energy Demand Centres. They look beyond developing more energy-efficient machines, into how and why people use energy and how energy use can be reduced by greater understanding of the issues.

EPSRC fellow, Professor Jim Skea, co-chair of the IPCC's Working Group 3, which is focused on mitigation measures, comments: "To move towards a low-carbon energy system we will need energy demand reduction and a diverse energy supply mix that could include renewables, nuclear and gas combined with carbon capture and storage. The increased ambition set out in the Paris Agreement needs investment in research that will bring forward [new] technologies."

The Energy Programme has made strategic investments in many of these areas. For example, looking to the medium-term the EPSRC recently put £21m into research that will improve technologies in offshore wind in the UK. It also supports a collaborative research initiative called Supergen that brings together researchers from universities and industry to research renewables. Seven hubs seek to improve the sustainability of the UK's power generation and supply. They focus on the key technologies likely to contribute to our future energy system: wind and solar power, bio-energy, hydrogen and fuel cells, and marine energy. In particular, the HubNet Centre at Imperial College London looks at the wider issue of energy systems, integration and smart grids.

Collaboration with countries facing similar energy pressures is vital to addressing global challenges. For example, RCUK has made a number of significant partnerships with India and China to further research into the development of smart grids that can deal with mixed supply and fluctuating demand. Adopting a whole systems approach to research and development is possibly the next big research challenge. Integrating mixed energy sources with smart grids and storage, and developing an approach that encompasses other infrastructure networks and systems will be essential if we are to bring power to the people.

Beyond the North Sea

Dale Vince, founder of Ecotricity, says that gas generated from grass has the potential to transform Britain's energy sector

In 2016, it cost the British taxpayer £400m to subsidise the terminal decline of oil and gas in the North Sea, immediately proposing the question: where to next? The government's chosen answer is fracking, but this is as uneconomical as it is unpopular. That the government had to water down environmental protections, change land ownership and planning law, promise the most generous tax regime of anywhere in the world, and literally force this new industry on a countryside in revolt, underscores its unviability.

But there is another way for Britain to replace North Sea gas – and with a source that is sustainable in all senses of the word. Ecotricity recently released a report – *Green Gasmills: The Opportunity for Britain* – which shows that by 2035, green gas from grass could provide all of the gas needs for 97 per cent of Britain's homes, pump £7.5bn annually into the economy, and create a new industry with up to 150,000 jobs.

Green gas made this way is virtually carbon-neutral, so could play a significant role in Britain meeting its climate targets, and create new habitats for wildlife on an unprecedented scale. And the green gas revolution is already underway. Ecotricity has recently received permission to build its prototype 'Green Gasmill' at Sparsholt College in Hampshire –the first of its kind in Britain.

It's become possible to make green gas and put it into the grid, in the same way we've been doing with green electricity for the last two decades. The current way of doing that is through energy crops and food waste – but both have their drawbacks. Through our research, we've found that using grass is a better alternative, and has none of the drawbacks of energy crops, food waste or fracking.

Grass can yield twice as much gas per tonne of feedstock than food waste, and the gas is cleaner and significantly easier to upgrade to grid quality. Grass can be sourced from permanent pasture or grown as a break crop on food producing land. It doesn't need to compete with food grown for human consumption, and it's not based on intensive farming or a monoculture either. It needs no artificial fertilisers or pesticides – and in the process of growing it, we can create wildlife habitats.

Grass for gas also offers the potential for farmers to diversify from raising animals for human consumption – an industry that is not only in decline in Britain, and economically very challenging, but one that produces a significant amount of the world's climate change gases. According to a report published by the Worldwatch Institute, over 50 per cent of global greenhouse gas emissions are caused by animal agriculture. The United Nations says that farming livestock is "one of the top two or three most significant contributors to the most serious environmental problems, at every scale from local to global". So making green gas from grass will cut carbon emissions, help Britain become energy independent, support food production by improving soils, create wildlife habitats, and provide support for farmers who are set to lose EU subsidies following Brexit too.

Our first Green Gasmill has been given the go-ahead, and we hope to starting building it this year – though that does depend on whether government energy policy will support this simple, benign and abundant energy source. As our report shows, the benefits of Britain making its gas this way are astounding. And in the light of this new option available to us, Theresa May should review the government's plan for where Britain gets its gas – post-North Sea.

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Rewriting the rules of power

Technology and innovation in energy markets will boost the UK's economic performance, writes **Jorge Pikunic**, managing director of Centrica Distributed Energy and Power

The energy landscape of the years to come will be shaped by three trends: connectivity, consumer attitudes, and clean energy.

Connectivity is everywhere. By 2015, 15.4 billion connected devices were installed, and this number is expected to rise to 30.7 billion by 2020. Energy suppliers can now give customers meaningful insights from an intelligent energy system, prompting more informed and efficient energy use.

In the home, that means giving our customers products and services that help them easily manage the energy they use. Our successful Hive technology products give customers the ability to remotely manage central heating, lights and security - something that would have seemed far-fetched 10 years ago.

In the business environment, the rapid growth in connectivity has been a key factor in underpinning our Distributed Energy & Power (DE&P) business. The premise for this business is simple; to help organisations and businesses take control of their energy and turn it into an opportunity.

The growth of our Distributed Energy business is also dependent on the second trend in the energy landscape – changing attitudes to energy.

Our customers want affordable energy, choice and control. Sometimes they also want to reduce carbon emissions, but above all they want simplicity. The most progressive businesses are thinking about their energy strategies and see energy through a new prism. Where once they saw energy as just a cost, we are helping businesses see energy as a source of value, resilience and competitive advantage. A first step for many businesses is to understand exactly how they are using energy.

Key to our DE&P business is our range of Panoramic Power solutions. These products bring a pioneering approach to helping businesses to understand their energy consumption. Panoramic Power provides an affordable way of bringing together wireless sensor technology and cloud-based analytics to give businesses real-time, actionable insights on their energy usage. But it is not only about understanding the energy they are using. It is also about

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optimising their operations. Devices and machinery can "talk" to customers to tell them if they're performing badly, need maintenance, or if they're wasting energy. Some of our customers are already enjoying the productivity rewards of this technology by bringing down energy and maintenance costs and preventing downtime.

The third and perhaps most visible trend is renewable energy. In 10 years the UK's wind power capacity has grown from 2 gigawatts (GW) to over 15GW, and our solar capacity has grown from a negligible amount to almost 10GW. Because they are intermittent, however, the fluctuating availability of energy from renewable technologies creates significant challenges for the power grid. An increasing proportion of the energy bill covers the cost of managing this fluctuating availability.

Such is the expansion of renewable energy – in particular the amount of solar energy being harnessed by businesses and homeowners – that National Grid recently predicted record lows for peak power demand this summer. This prediction came following a sunny weekend in March this year, when net power demand during the afternoon on the Saturday and Sunday was lower than the demand during both the nights over that weekend.

This shift in the pattern of demand was unprecedented, but it is likely to be repeated. If smarter and cheaper ways of providing flexibility to the system are not developed, this could lead to periods where expensive options, such as turning off inflexible generation, will have to be used to balance the system.

These three trends – connectivity, consumer attitudes and clean generation – are happening at a pace. They will change the energy system in many ways, and energy companies have had to adapt or risk becoming obsolete.

Firstly, we will see major growth in flexibility. Flexible generation, demand response and storage will become more valuable. People and businesses will have the information they need about their energy use at their fingertips, and they will manage it intelligently. The grid will function in a different way. When more power is needed, that power will not only come from large power stations but also from smaller and more flexible power stations, from large batteries, and from domestic batteries (sometimes charged by customers' own solar panels). Businesses will choose to turn down – or off – equipment that isn't in use. The smartest (and cheapest) options will prevail.

Power infrastructure, too, will become more flexible. Our battery storage project in Cumbria, for example, is being built on the site of a former coal power station, but offers a 49MW supply that can respond to fluctuations in demand in under a second. It is one of the largest and most sophisticated projects of its kind, but others will follow its lead.

The location of energy, too – where it is produced and managed – will change. There will be a need for some large-baseload power stations, but energy production is starting to decentralise. We will see a large increase in energy generated closer to the point of use.

This can already be seen in the £19 million Local Energy Market trial in Cornwall, in which we are testing the use of flexible electricity demand, generation and storage. In this project, businesses will receive grants to cover the cost of a variety of initiatives, including energy audits, smart technology upgrades and new energy-storage units. The project will provide valuable real-world insight to help the government, regulators and the private sector understand how the UK can best develop a flexible and less centralised energy system.

The thread that runs through all of these changes is the democratisation of energy. The balance of power is shifting from a handful of producers to thousands of large energy users and millions of consumers, all of whom also have the power to produce energy.

We believe this democratisation will help to contribute to productivity, boost quality of life and create new industries that deliver jobs. The days of energy as a one-way transaction – only produced centrally, and supplied to end users – are coming to an end.

Hear the Li-ion roar: how electric cars became more efficient

Professor Dave Greenwood, Head of Advanced Propulsion Systems and Energy Systems WMG, University of Warwick, says that Lithium-ion technologies can re-invent the automotive industry

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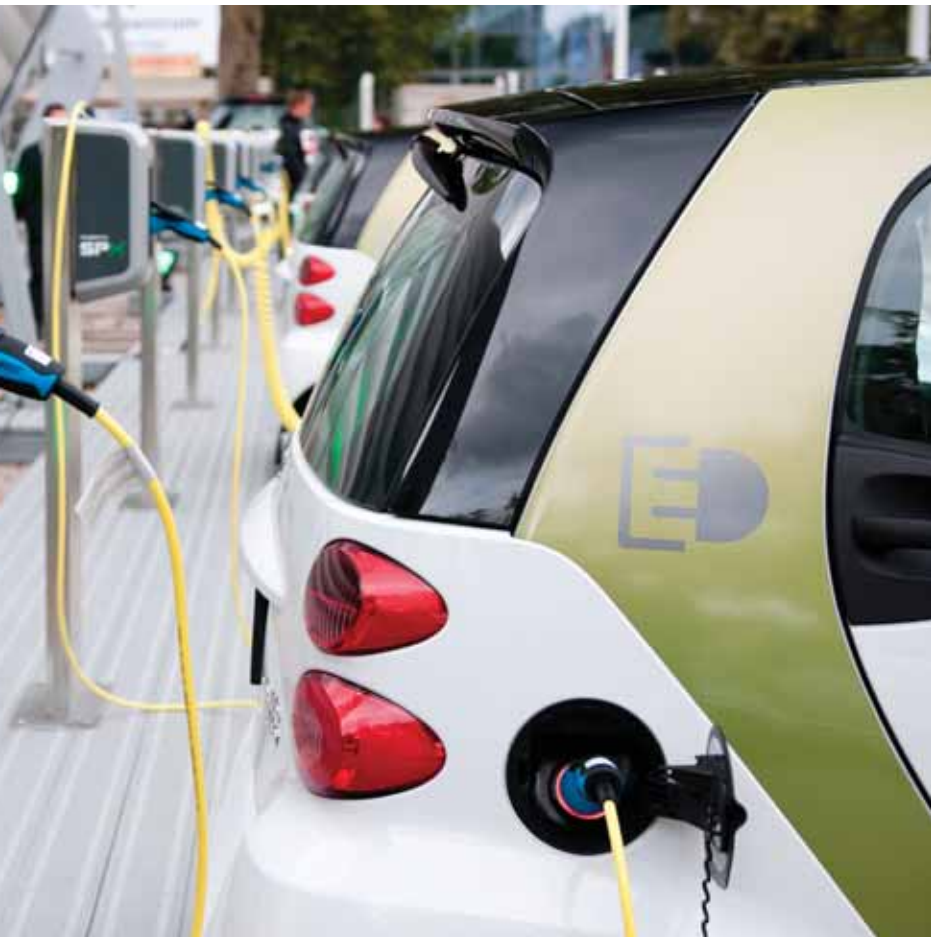
It's the question on everyone's lips. Once the politicians have negotiated terms and we're no longer part of the EU, what's next? The government's Industrial Strategy aims to build on the UK's strengths and to make it one of the most competitive places in the world to do business. So, how will the UK make its mark and grasp new opportunities on uncharted terrain?

Some say batteries. It's a topic that is getting deservedly more attention. Critical across so many areas of industry and infrastructure, including consumer electronics, utilities, and transportation; the ability to store and convert energy, and to do it efficiently, is key. The whole world is looking for ways to offer solutions to the increasing demands for electrification in applications, but one area of the world has forged ahead in leaps and bounds: 80 per cent of Lithium-ion (Li-ion) batteries are now produced in Asia.

With the automotive industry forecasting a significant shift towards vehicle electrification, the opportunities for those who can create the energy storage solutions to make this happen are huge. If the UK were able to carve out a share of the market, the supply chain opportunity alone could be worth over £5bn per year.

So how did Asia become the major player? Much of the research and development in battery technologies to date has been driven by the consumer electronics industry, which boomed in countries like Japan and South Korea in the 1970s and 1980s. Manufacturing giant Sony licenced the technology for



Li-ion battery chemistry, which had resulted from research conducted in the UK at Oxford University, and since then Li-ion battery production has soared.

The success of the technology can largely be attributed to its applications in highly competitive and rapidly growing markets for products such as laptops, tablets, and mobile phones. But, the energy density and life cycle properties of Li-ion, as well as its potential power output, also make it the electro-chemistry of choice for the electric and hybrid vehicle battery market.

Electric and hybrid vehicles (xEVs) are increasingly affordable alternatives to conventional petrol and diesel-powered transport. For example, over the last decade, the cost for batteries for automotive applications has more than halved as a result of improvements in Li-ion technology and premature over-capacity in global automotive battery manufacturing. But the rise in popularity is not just down to technology. Vehicle electrification is also being driven by concerns over CO_2 and air quality, particularly in cities.

However, a big problem remains; compared to conventional engines, Li-ion batteries are still too big, too heavy and have a limited life span. Significant R&D must continue to offer innovative solutions to meet the specific demands of mainstream markets, such as increasing energy and power density, reducing cost further and ensuring longer, more predictable life cycles. Importantly, these battery performance improvements must also maintain existing rigorous safety standards of vehicle manufacturers.

With battery manufacturing for xEVs representing a major commercial opportunity, international competition to secure this supply chain is strong. In addition, vehicles and their batteries would ideally be manufactured in close proximity, so the ability to anchor battery manufacturing is likely to have an important influence on the future location of high volume xEV assembly.

The UK already has capability, which puts it in an excellent position to stake a claim to a leading role in the market, but the challenge going forward is whether it can hold on to it. Nissan's plant in Sunderland is currently the only operational automotive battery manufacturing facility in the EU. Indeed, a quarter of Europe's low-emission vehicles are currently manufactured in the UK, and car manufacturing represents around 12 per cent of the UK's exported goods. If UK industry can hold onto and build on that advantage, the future is bright.

An excellent base of supply chain manufacturers as well as small and medium-sized enterprises already exists which could support future growth. The UK is also home to a world-class academic science base who are already working closely with industry to develop future applications and improvements, just as we are doing at WMG; both in existing Li-ion technologies, as well as producing new battery chemistries and materials with superior properties.

But it's only through co-ordinated and sustained action and investment across research, development, industrial validation and through to full-scale manufacturing that we can secure and capitalise on this potential technology leadership and opportunity.

This is where industry and academia need to continue to work together to deliver. The performance of xEV batteries can, and will continue to improve over the next 10 to 20 years, and if the UK is to capture the value on offer, it needs to grab every opportunity to lead on the design, development, and manufacture of this technology.

Powering down to power up

A new, flexible approach can help shape a more intelligent energy sector, writes Robert Groves, CEO at SmartestEnergy

The future of the UK's energy sector rests on three critical elements: decarbonisation, decentralisation and digitalisation. The continued over-reliance on coal and other non-renewables is no longer an option. Government and industry alike have a responsibility to provide a solution.

The UK has already committed itself to the mass roll-out of low-carbon power generation by 2030 as part of the cost-effective path towards the statutory 2050 target. The Climate Change Act 2008 compels government to reduce greenhouse gas emissions by at least 80 per cent of 1990 levels by 2050. Notwithstanding the destructive headlines of some tabloids, these reductions aren't something to be feared. Rather, they are an opportunity to manage our power more efficiently.

According to Energy Trends' 2016 figures, power is directly responsible for 23 per cent of the UK's total greenhouse gas emissions. There are many low-carbon options available and businesses can move to 100 per cent renewable supply for a very small incremental cost, typically below 1 per cent of delivered cost.

In order to achieve the necessary rate of decarbonisation, demand side response (DSR), battery storage and a fundamentally flexible approach to how we manage our electricity represent much of the road to becoming sustainable in the long-term. DSR comes into its own when the total demand for electricity across the country is at its highest – for example in winter after school when all the lights and heating are on in homes whilst businesses and industry are still hard at work. Rather than simply generating more to satisfy a short spike in activity, DSR lets us use electricity more shrewdly. This doesn't mean your appliance will be switched off; instead, supermarkets might turn down their freezers or large factories might defer energy-intensive processes to another time when there isn't so much pressure on the National Grid.

There are only a few periods throughout the year when demand is very high, so rather than building a new power station that will only be used sparingly, it is more economical to use existing resources and look to large energy users to occasionally reduce

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demand. In addition, we should also appreciate that at times of very high demand the grid tends to be at its most polluting. DSR limits the number of hours that older, less efficient generators are running and helps to maximise renewable generation.

Commercial batteries will also help. With around two-thirds of existing UK power stations expected to reach the end of their working lives within the next 13 years, battery storage can reduce the investment needed in replacement capacity. They are able to react quickly and correlatively to demands and help integrate intermittent generation such as wind and solar into the energy mix.

Digitalisation, meanwhile, refers to the advent of big data. With the introduction of smart meters providing a wealth of data designed to inform and temper consumption. When the wind doesn't blow or the sun doesn't shine, both individuals and companies will need ways of keeping on top of their energy requirements. Smart meters record data for total electricity usage in real-time, allowing their owners to adjust their habits accordingly, courtesy of a user-friendly interface. Smart meters mean the end of estimated bills and a better understanding of consumption allowing action to be taken.

SmartestEnergy is a new type of energy company. We don't own any generation facilities but are the leading purchaser of electricity from over 550 independent generators. These and many other independent generators are responsible for over 6,000 projects with a combined capacity in excess of 12GW. Decentralisation is taking place and will continue to grow in significance.

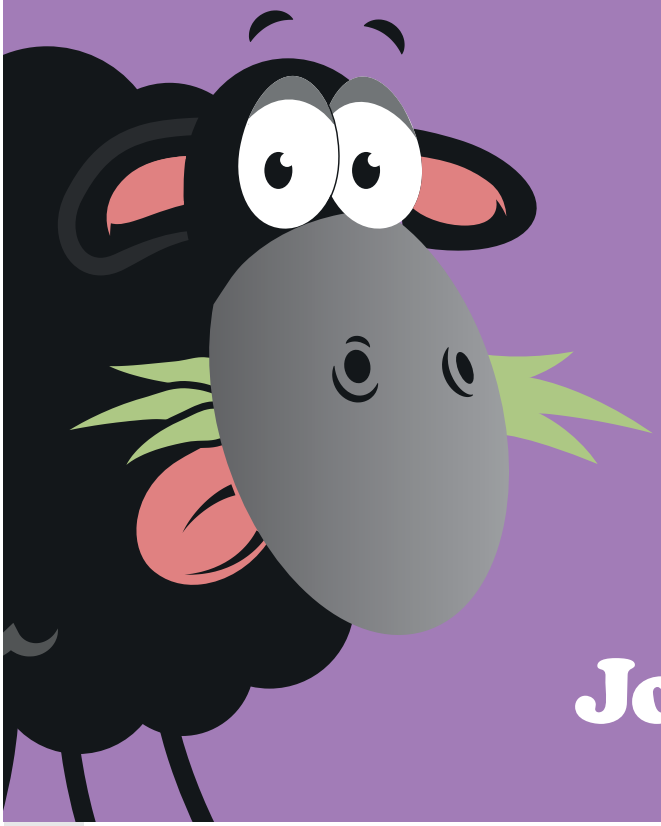
We are also a licensed supplier to large industrial and commercial organisations, and the first company in the UK to have a Carbon Trust-certified 100 per cent renewable electricity supply. We work with more than 1,000 business electricity customers from high-street brands such as John Lewis, to major manufacturers like Saint-Gobain.

Our bespoke DSR service (SmartDSR) helps businesses to find a flexible solution for their energy needs which suits them. With the right guidance, companies can stop viewing electricity as a utility and start regarding it as a revenue-creating asset, while avoiding costly peak charges and playing a part in the collective drive to relieve pressure on the National Grid.

With the government having introduced the Capacity Market to ensure there is always sufficient electricity supply, consumers who use DSR services are presented with two big attractions: they get financially rewarded for curtailing their consumption during periods of peak demand, and simultaneously, avoid the higher costs of consuming that power during that time. With energy price volatility increasing, those savings will become increasingly material. Already we see that a customer could save an additional £2,000 from peak charges for every £1,000 earned from offering DSR to the National Grid.

One customer that has benefited from shifting demand is Saint-Gobain. UK purchasing manager Linda Burgess said: "Saint-Gobain UK has been working with SmartestEnergy for five years because of its renewable product, relationships with independent generators and innovative approach." Last year they saved £165k by reducing demand around peak periods. Engineering manager for glass, Michael Dickinson added: "As well as reducing our costs and helping maintain our competitiveness, it also ties in well with the wider aims of our company to minimise our environmental impact and contribute to the economic and social development of the communities we operate in. Reducing our peak demand plays a part in helping balance the grid, ensuring the UK's energy supplies are maintained and reducing the need for more generation capacity to be built. It's a real win-win."

Ultimately, politics leads economics and the transition to a low-carbon economy signifies a rare point of consensus. If the consumers of electricity adapt to new technologies and new regulations, they face a real chance to create competitive advantage against those that don't.



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