

Wise Minds: The energy transition and large utilities

Insights from energy industry and political
leaders on the rapidly changing UK
energy system



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About Forum for the Future

Forum for the Future is an international non-profit working with business, government and civil society to solve complex sustainability challenges.

We believe it is critical to transform the key systems on which we rely, to shape a brighter future and innovate for long-term success. We have a track record of over 20 years of working with pioneering organisations in one-to-one partnerships, and also as part of multi-stakeholder collaborations to address system-wide challenges.

Find out more at forumforthefuture.org, or follow us on Twitter and LinkedIn

If you are interested in finding out more about our work in energy systems and climate change please contact **Will Dawson** on **07824 692 149** or **w.dawson@forumforthefuture.org**

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About **Friends Provident Foundation**

Friends Provident Foundation is an independent endowed charity working to create a fairer economy and better world, supporting greater economic resilience through building knowledge and taking action at the strategic and local levels. The Foundation takes an integrated approach to its mission and capital base - alongside grant making, it uses its endowment as a tool for change, including through social investments and shareholder engagement.

Friends Provident Foundation's main grant giving and investment programme, Building Resilient Economies, was launched in 2013. The aim is to build a more resilient, sustainable and fairer economic system - one that distributes social and economic goods and services more fairly, and balances short-term and long-term needs more effectively.

Find out more at friendsprovidentfoundation.org, or follow us on Twitter.

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Volker Beckers CEO RWE npower (2010 - 2012)

Sir Ed Davey Secretary of State for Energy and Climate Change (2012 - 2015)

Charles Hendry Minister of State for Energy (2010 - 2012)

Steve Holliday CEO of National Grid (2007 - 2016)

Joan MacNaughton Director General of Energy at the former Department of Trade and Industry (2002 - 2006)

Ian Marchant CEO of Scottish and Southern Energy (2002 - 2013)

We are also grateful to the Energy and Climate Intelligence Unit for advice and Carbon Brief for sharing their data.

Executive **summary**

The UK energy system is in flux. It is changing more quickly – and more fundamentally – than at any point since the Industrial Revolution.

Since 2008, European utilities have lost over €100 billion in value. New players and new business models have started to gain traction, and technological change – not only from within the energy sector, but from outside too – promises a future much different from today.

This report sets out fresh insight into the factors at play. Drawing on in-depth discussions with six ‘Wise Minds’ – senior

industry and political leaders who have recently left the established energy sector – the report outlines what these experts see as driving the energy transition, how the system is changing, and what these changes mean for the large utilities that currently dominate the sector.

Given the critical importance of energy to a functioning society, there is an urgent need for investors, regulators and sector leaders to engage proactively to ensure the transition is smooth, just and effective – and delivers the best outcomes for British households. Forum for the Future and Friends Provident Foundation hope this report will help to guide that engagement.

The Wise Minds

Volker Beckers CEO RWE npower (2010 - 2012)

Sir Ed Davey Secretary of State for Energy and Climate Change (2012 - 2015)

Charles Hendry Minister of State for Energy (2010 - 2012)

Steve Holliday CEO of National Grid (2007 - 2016)

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Drivers of change

The Wise Minds highlighted three ‘landscape-level’ drivers of change:

1. The rapidly improving economics of renewable power, supported by the growing prospect of cost-effective energy storage and the emergence of electric vehicles
2. The Digital Revolution
3. Energy policy

These top-level drivers interact with each other to shape and reshape the foundations of how energy is produced and transported, and the value it creates. There are also a number of emerging – and unpredictable – niche drivers (such as blockchain-based trading) that have the potential to be highly disruptive.

Combined, these drivers are shaping a future that is very different from today. We can’t know precisely what this future will look like or what disruption will bring it about, but we do know that major innovations and events will cause rapid change. To survive and thrive, the large utilities dominant today will need to be nimble and flexible in the future.

How the system is **changing**



Decentralisation

This reflects the clear trend towards distributed power generation, covering everything from wind farms down to rooftop solar. The UK, previously supplied by some 80 power stations, now has over 900,000 generating facilities.



Democratisation

The rise of decentralised power has gone hand-in-hand with a democratisation of the energy system. Not only are individuals and communities across Britain increasingly setting up – and co-owning – energy assets, but new business models are emerging that seek to scale up community involvement in energy.



Digitisation

The line between energy producer and energy consumer has been further blurred by the emergence of digital tools that enable much greater control of energy use by consumers. The age of ubiquitous data connectivity and ever more powerful algorithms promises to transform our relationship with energy (and with the companies that historically have supplied energy to us).



Decarbonisation

The Wise Minds were clear that the emphasis on decarbonisation alongside affordability and energy security has always fluctuated, and that the UK’s longstanding legislative commitment to decarbonisation helped to lay the groundwork for what is now seen as an unstoppable transition. With market forces now at the fore, and investor interest in climate risk increasing, the question is how soon – rather than whether – the UK energy system will be fully decarbonised.

What does this mean for large utilities, their investors and the government?

The scale and pace of change in the UK energy system pose critical questions for its established players, namely, the utilities and grid operators, investors and regulators.

Utilities and grid operators face a choice: will they embrace – and play a positive role in – the transition, or will they attempt to block it? Given the multiple forces driving the energy transition, the latter approach appears a fool’s errand, no matter how threatening the transition might appear to established players. Accepting and supporting the transition nevertheless raises the fundamental question of how far utilities can “own their own disruption.” A number are trying, and a variety of approaches are being explored and adopted. To succeed in the long term, utilities will need to take the emerging opportunities to the heart of their business, rather than just the fringes, and be flexible enough to adapt to continuing change

across the energy system. This will require an openness to radical innovation that is not currently apparent.

Investors have a key role in ensuring this happens. Decisions being made by utilities now will determine their success over the medium term and, given the potential for stranded asset risk across the energy sector, passive non-engagement is no longer an option for investors. If the utilities in which they invest are to have a viable future, investors need to engage with the sector to develop business models that are much more resilient to market disruption.

Government, like the utilities, has been caught off-guard by the pace and scale of the energy transition. Official projections and forecasts have repeatedly – and significantly - underplayed the potential for the substantive changes that have come to be. One reason for this is the way some new technologies and innovations, such as distributed solar, have been viewed as a threat to security of supply, rather than an opportunity to build a better energy system

for the country.

New technologies and business models are emerging all the time. The question is: how then can policy, the regulatory environment and governance structures not only keep pace with the transition, but encourage further innovation? And how can the UK Government ensure a just and managed transition that doesn’t disadvantage communities who currently rely on major energy utilities for employment?

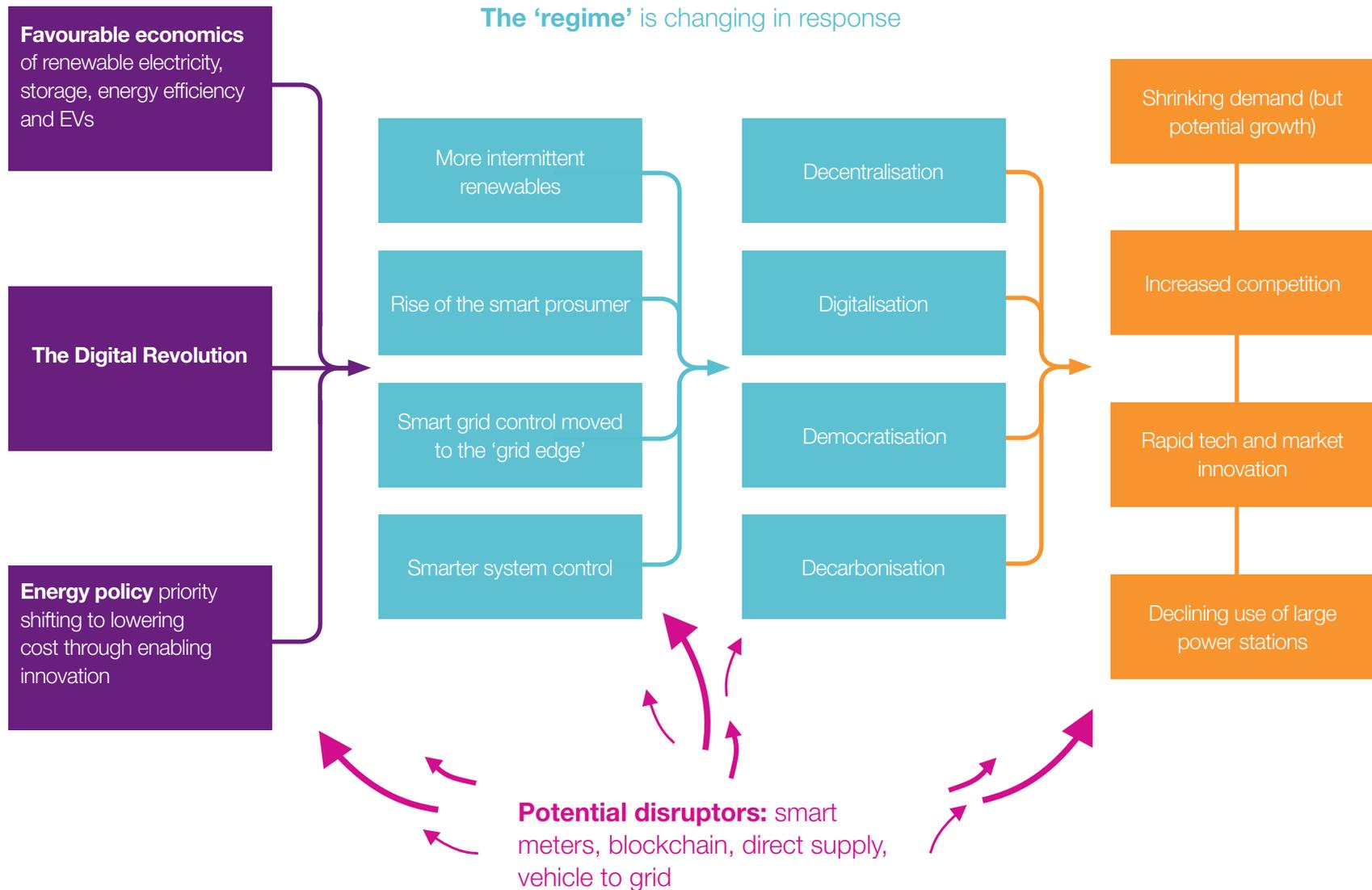
Next steps

Using insights gained from this and other research, Forum for the Future is building a programme that any organisation or business can participate in to learn more about how the energy system works now, and how they can benefit from and contribute to a better energy system in the UK.

If you are interested in taking part please contact Will Dawson,
w.dawson@forumforthefuture.org.

The 'landscape' driving the trends

Creating challenges for large utilities





Introduction

The UK energy system is changing at a pace not seen since the dawn of the Industrial Revolution.

Back then, steam power enabled an eruption of industrial activity and innovation that eventually led to energy access for all, but at the expense of unsustainable levels of resource depletion and pollution. Today, it is much more bytes of data than bits of coal that are driving change. Digital innovation is supporting wholesale transformation not only of the technologies used to generate electricity, but also the business models used across the energy system – and, indeed, the relationships that individuals, organisations and communities have with energy. Here are some facts to support this view:

1

Around 1.5 million UK households – or 6% of all homes – now control their heating with smart thermostats⁴

2

The market share of the Big 6 energy companies has fallen from 99% in 2013 to 85% in 2016 as more suppliers entered the market⁵

3

The UK now has over 100,000 electric-only and plug-in hybrid electric cars on the road⁶

4

In 2013, coal was the UK's biggest source of electricity, providing 37% of the overall mix. By 2016, coal had fallen to less than 10%, and was overtaken by wind power for the first time¹

5

The UK Government has proposed to completely phase out coal-fired power stations by 2025²

6

The UK has over 900,000 solar PV installations – up 12,000% from 30,000 at the end of 2010³

“We are in the midst of the biggest technological revolution – from LEDs to graphene, it is utterly transformative.”

CHARLES HENDRY, APRIL 2017

¹ <https://www.carbonbrief.org/analysis-uk-wind-generated-more-electricity-coal-2016>

² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/615869/Solar_photovoltaics_deployment_April_2017.xlsx

³ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/615869/Solar_photovoltaics_deployment_April_2017.xlsx

⁴ <https://www.bsria.co.uk/news/article/domestic-heating-controls-market-forecast-to-grow-22-by-2017/>

⁵ https://www.ofgem.gov.uk/system/files/docs/2016/08/retail_energy_markets_in_2016.pdf

⁶ <http://www.nextgreencar.com/electric-cars/statistics/>



“ The [energy] utility currently faces a perfect storm. ”

NAVIGANT RESEARCH, AUGUST 2016

These changes have fundamental implications for the energy market, particularly the large incumbent utilities. In Germany, which has a high concentration of decentralised renewables, electric vehicles and smart homes, the big energy companies have lost as much as 80% of their value⁷. How the UK sector and the Government respond to the changes will be a key factor in determining what role the major utilities play in the economy over the next decade. Yet, despite the gravity of the situation, there is as yet no consensus on how the energy sector and the Government, as well as business and investors, should respond. Without a coherent vision and approach from these key stakeholders, innovation towards a system that works best for UK citizens will be too slow.

Forum for the Future (Forum) and Friends Provident Foundation (FPF) believe that the future of the large energy utilities is likely to be very different from their past. Enabling these companies

to navigate this uncertainty so that they can play a positive role in this transition will be critical for their shareholders and wider society. We believe what's needed is a deeper understanding of what the future might look like, and how the industry can play a positive role. To contribute to greater understanding, Forum and FPF convened a group of industry and political leaders who until recently held very senior positions at the very top of the energy sector, to share their expertise, wisdom and insight.

The individuals consulted for this report, collectively referred to here as 'Wise Minds' are:

Volker Beckers CEO RWE npower (2010 - 2012)

Sir Ed Davey Secretary of State for Energy and Climate Change (2012 - 2015)

Charles Hendry Minister of State for Energy (2010 - 2012)

Steve Holliday CEO of National Grid (2007 - 2016)

Joan MacNaughton Director General of Energy at the former Department of Trade and Industry (2002 - 2006)

Ian Marchant CEO of Scottish and Southern Energy (2002 - 2013)

This report is based on a review of credible sources of published data and analysis, as well as discussions with the Wise Minds. The report distils these opinions on what is changing in the UK energy system and how the sector's future could play out.

The aim of the report is to help investors and other key stakeholders make informed decisions through better understanding of the many factors affecting the energy system, both now and in the future.

⁷ <https://goo.gl/pSx6eJ>



Drivers of change

in the UK energy system

“ Decarbonisation should eventually bring about the end of fossil fuels, but they face a much more immediate threat. That threat is digitalisation. Everything digital is electric. The future of energy is therefore electric too.”

PROFESSOR DIETER HELM,
UNIVERSITY OF OXFORD, MARCH 2017

Multiple drivers are dovetailing to drive change in the energy sector across the globe, and the UK is no exception.

The three key drivers identified from our research are:

1. The rapidly improving economics of renewable power, supported by the growing prospect of cost-effective energy storage and the emergence of electric vehicles

2. The Digital Revolution

3. Energy policy

These top-level drivers interact with each other to shape and reshape the foundations of the way energy is produced and transported, and the value it creates. The power balance between the three has shifted rapidly at times over the last decade and before, when the Wise Minds were at the heart of shaping the system. It is clear to them that change is happening and accelerating. There are also a number of emerging – and unpredictable – niche drivers (such as blockchain-based trading) that have the potential to be highly disruptive.

Alongside these three dominant drivers, there are a host of currently less influential niche factors that have the potential to grow rapidly in terms of their impact, and disrupt the future substantially.

Combined, these drivers are shaping a future that is very different from today. We can't know precisely what this future will look like and which factors will cause the disruption that creates it, but we do know that there will be innovations and events that cause rapid change. To survive, and thrive, the currently dominant large utilities will need to become nimble and flexible.

“ We are likely to see an increasing trend towards more local generation, where homes, businesses and communities move from [being] passive energy consumers to more active prosumers. ”

CBI, FEBRUARY 2017





The favourable economics of renewable power, power storage and electric vehicles

In 2002, the International Energy Agency forecast that by 2020 the amount of solar power installed globally would double to 10GW⁸.

Like many others who have tried to forecast solar uptake – including the UK Government (see Figure 2) – they hugely underestimated growth. In fact, the UK alone exceeded this global projection as early as 2016 following the installation of 900,000 solar PV projects, mostly on rooftops. Worldwide, solar PV capacity now exceeds 300GW⁹. Why the error? Firstly, costs fell far faster than predicted. Secondly, policymakers underestimated how desirable a prospect it would be for consumers to produce their own power rather than buy in from the grid.

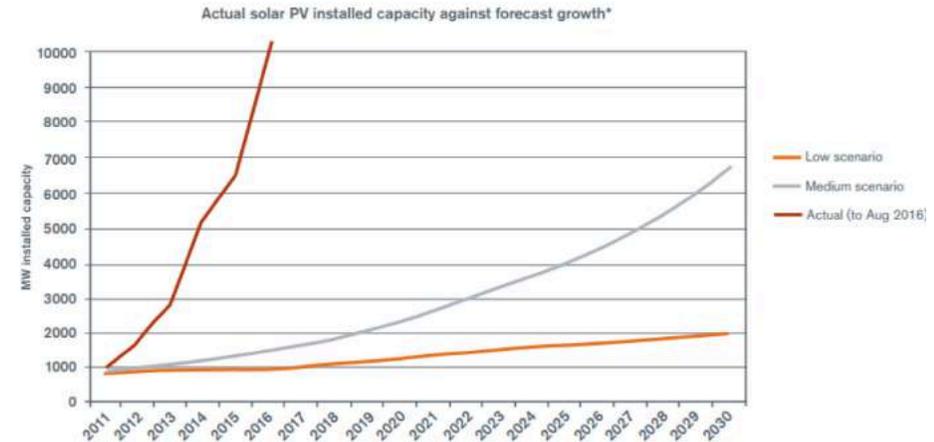


Figure 2 - The UK Government's scenarios developed in 2011 for solar PV deployment versus the actual installed capacity. (Source: Ofgem 2017: Future Insights series¹⁰)



“ The electricity landscape is a prime example of the Fourth Industrial Revolution as it undergoes transformation, becoming more complex than ever before, with rapidly evolving technologies, emerging innovative business models and shifting regulatory landscapes. ”

WORLD ECONOMIC FORUM, MARCH 2017

⁸ <https://arstechnica.co.uk/science/2017/04/whats-next-for-solar-energy/>

⁹ http://www.iea-pvps.org/fileadmin/dam/public/report/statistics/IEA-PVPS_-_A_Snapshot_of_Global_PV_-_1992-2016__1_.pdf

¹⁰ https://www.ofgem.gov.uk/system/files/docs/2016/10/future_insights_overview_paper.pdf

Solar and wind are clean sources of power that are also intermittent, meaning they cannot be told when to generate power, unlike a gas or coal-fuelled plant. Power storage is one of a number of rapidly emerging solutions to this issue, and the fastest growing technology within this space is lithium-ion batteries, which are already universally used in mobile phones. As Figure 3 shows, the cost profile of lithium batteries has been strikingly similar to that of solar PV, falling four-fold in six years. This huge cost reduction has enabled exponential growth in electric vehicles, although it should be noted that the growing interest in electric vehicles has in turn catalysed the economies of scale in battery production. The UK now has 100,000 electric vehicles, including plug-in hybrids, on its roads. While this represents only 0.3% of all road vehicles in the UK, still far short of Norway's 5%¹¹, the sector is growing fast. Batteries are also starting to be used to charge up static power banks, thus enabling renewable power to be stored for later use.

Bloomberg New Energy Finance see a future where storage for vehicular and static power grows exponentially. As UK trade body Energy UK said in 2016, "The combination of small-scale renewables and electricity storage could create a complete paradigm shift in how the power sector operates". This was echoed by Sir Ed Davey during the Wise Mind discussions, who stated that "solar plus storage could very well be a complete gamechanger" since it enables people, communities and businesses not just to produce power, but also to use it themselves, thus relying less and less on the grid and power stations.

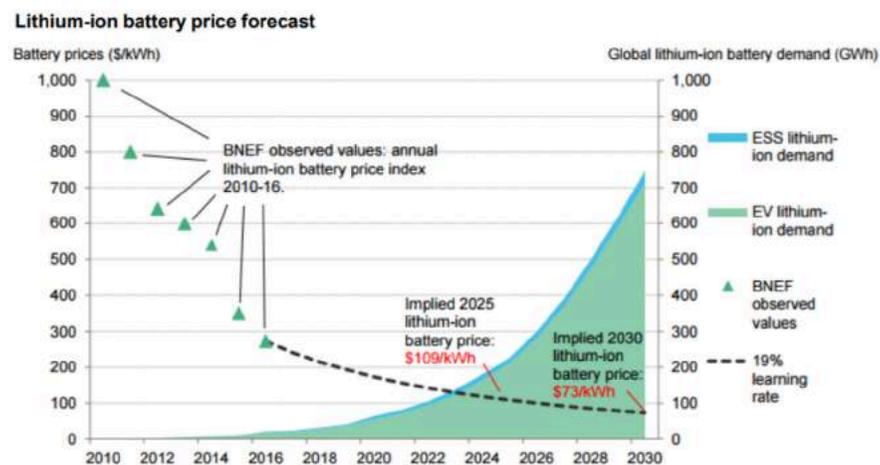


Figure 3 - Observed and forecast costs of lithium-ion batteries and global demand (Source: Bloomberg New Energy Finance, 2017)

Even without widespread storage, renewables can be highly disruptive to traditional business models. As The Economist explained in 2017, "in an industry structured around marginal costs, renewables have a disruptive punch above their weight."¹²

¹¹<https://cleantechnica.com/2017/02/22/37-new-cars-sold-norway-evs-100-2025/>

¹²<https://www.economist.com/news/briefing/21717365-wind-and-solar-energy-are-disrupting-century-old-model-providing-electricity-what-will>



The **Digital** Revolution

In an age of ubiquitous connectivity, where white goods connect with smart phones through the internet of things, the implications for the energy system are immense.

Today, it is bytes of data not bits of coal that are driving change, as digital innovations pave the way for user-led control of energy. Not only are supply and demand patterns shifting in response to new devices and habits, but new energy-specific innovations – from smart meters, sensors and grids to digital networks and demand-response technologies – are coming online and fuelling disruption to the status quo. As Citigroup reported in 2016, the digital revolution “affects the entire energy value-chain, from finding energy faster and producing it more inexpensively in the upstream, to more customised energy at the downstream user level, almost as if energy becomes un-commoditised.”

We are seeing this play out in the UK, where around 1.5 million homes now have an internet-connected smart thermostat¹³, despite the technology only coming onto the market in the last few years. Similarly, more and more British businesses are taking advantage of new flexibility markets by automating and remotely controlling their fridges, water pumps and other devices through mobile data.

“ An important evolution in the provision and consumption of electricity services is now under way [...] A range of more distributed technologies – including flexible demand, distributed generation, energy storage, and advanced power electronics and control devices – is creating new options for the provision and consumption of electricity services. In many cases, these novel resources are enabled by increasingly affordable and ubiquitous information and communication technologies and by the growing digitalisation of power systems. ”

MIT ENERGY INITIATIVE, DECEMBER 2016

¹³ <https://www.bsria.co.uk/news/article/domestic-heating-controls-market-forecast-to-grow-22-by-2017/>

¹⁴ <http://www.telegraph.co.uk/news/politics/conservative/10464415/David-Cameron-reportedly-tells-aides-to-get-rid-of-the-green-cp.html>



Energy – and climate – policy remains important in setting the broad direction of travel for the energy system across power, heat and transport.

Crucially, the UK's legislative commitment to decarbonisation has remained solid throughout the recent political upheaval. This is demonstrated by the Government's continuous support for the 2008 Climate Change Act and its target of cutting carbon by 80% by 2050, with five-year carbon budgets until then.

The intent of Government energy policy to achieve affordability of energy, security of supply and environmental sustainability has been implicit for decades. It was the 2010-2015 Coalition Government that first adopted the term “energy trilemma” as the organising approach to energy policy, with sustainability focused on “low carbon”.

Joan MacNaughton said the emphasis on each of the trilemma's three elements had always fluctuated. In recent times, there has been a de-emphasis of the low carbon element in favour of affordability and security of supply. This seems to have formed a key fault line between departments in the Coalition Government, with Sir Ed Davey pointing to his difficulties in getting agreements with No. 10, the Treasury and the Communities Department on support for

decarbonisation policies. This was illustrated by then Prime Minister David Cameron, according to reports¹⁴, privately instructing his advisors to “get rid of the green crap”, after the media had focussed in on energy bills and the Labour opposition had committed to an energy price freeze. This led to the removal of funding for energy savings through the Energy Company Obligation.

Since 2015, the Conservative-led administrations have maintained overarching support for decarbonisation and the Climate Change Act in their 2015 and 2017 manifestos, with the current administration now consulting on its proposal to end coal power by 2025. The party has also stated strong support for market-based solutions, particularly demand flexibility. As Charles Hendry put it, the Government's stance is now “low carbon, in the most affordable way”.

Momentum behind the low-carbon transition in the UK has been dented, however, by the recent reductions in policy support and the uncertainty this has created. But the Wise Minds are clear that the increasingly favourable economics, in tandem with digitisation, have overtaken policy in importance. As Steve Holliday said, “energy policy can either speed up or slow down the rise of renewables, storage and electrification of heat and transport, but it cannot stop it.”





Potential **Future Disruptors**

The Wise Minds group noted a growing consensus that the new energy system that emerges in response to these drivers will be smarter, more flexible, more dynamic, and more complex.

It is unlikely to be a straight and smooth road ahead. New technologies and business models continue to appear, and while some will reinforce current trends, others hold the potential to ‘disrupt the disruption’ we are currently seeing. Blockchain proponents promise a world of peer-to-peer energy exchange, for example, which could threaten the new business models that are presently taking market share from the incumbents.

Furthermore, once renewables start to dominate power generation, there is a risk that the mutually reinforcing set of drivers described above will start to break down.

As Joan MacNaughton summed up, “We can’t know precisely where disruption will come from but what we do know is that there will be disruption and it will be fast. Companies need to be flexible if they are to survive”.





How the UK energy system is changing



“ We are at a moment of real change in the energy industry. From an historic perspective, we created energy in big generating organisations that sent power to houses and their businesses. Now we are producing energy in those places – mostly with solar power. ”

NICOLA SHAW, EXECUTIVE DIRECTOR UK, NATIONAL GRID, JULY 2017

“The future energy system will be much more flexible than today’s.”

STEVE HOLLIDAY, APRIL 2017

With decentralisation and democratisation joining decarbonisation and digitisation, not only as drivers of change, but also as characteristics of the new system that is emerging, we can categorise the four factors driving the shift as:



Decentralisation reflects the clear trend towards distributed power generation, ranging from wind farms through to rooftop solar. As Figure 4 shows, from the 1960s to the 2000s, the power system has been dominated by generation fuels – coal, oil, gas and nuclear – that are converted to electricity in around 80 power stations in the UK. The balance between fuel types has shifted over the decades, but the model of centralised power generation remained utterly dominant.

In 2004, electricity use peaked. Since then, demand has fallen due in large part to the increase in energy efficiency within buildings and industry. At the same time, the installation and use of renewables has grown exponentially while the use of coal has fallen drastically. The hidden picture beyond this chart is that the system has gone from around 80 power stations to over 900,000. The new power plants are of renewable technologies and the vast majority are rooftop solar. The result has been a rapid increase in the amount of power that comes from micro-power stations embedded in places near where the power is used, often in the same building.

This has blurred the role of energy consumers who were, until this explosion of decentralised energy generation, just passive end users. As Ian Marchant remarked, there is now a ‘prosumer’ revolution, where ordinary people and businesses are both producing and using energy. And this appears to be a global trend; the grid industry in Australia, for example, is forecasting that by 2050, consumers will generate 50% of electricity used in the country.

A key consideration for the future of the energy market is that the industry and government have chronically and consistently underestimated the uptake of renewables (just as they have failed to foresee the dramatic cost-reduction curves that facilitated this uptake). As referenced earlier in this report, the International Energy Agency forecast in 2002 that the amount of solar power installed globally would double to 10GW by 2020; yet the UK alone exceeded this projection as early as 2016¹⁵, and capacity worldwide now exceeds 300GW.

¹⁵ <https://www.gov.uk/government/statistics/solar-photovoltaics-deployment>

The rise of decentralised power has gone hand-in-hand with a democratisation of the energy system. Across Britain, individuals and small groups have been rallying together to set up community energy projects and take control of their energy needs.

The community energy sector is a relatively new phenomenon in the UK, but already comprises over 200 organisations with renewable energy projects which provide enough power for 130,000 homes. In Germany, citizen energy groups won more than 90% of permits in the latest Government onshore wind auction scheme. Not only do the Wise Minds see the emergence of business models that represent “power from the people, for the people”, some are actively driving the sector forward in a professional capacity. Volker Beckers is a Director of Albion Community Power, and Sir Ed Davey is the Chair of Mongoose Energy.

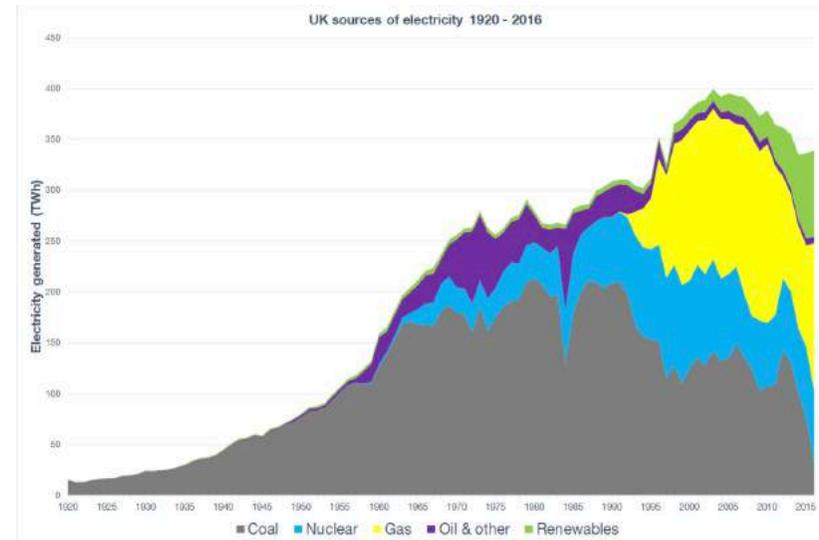


Figure 4 - The primary source of electricity production in the UK from 1920 to 2016 (reproduced with permission from Carbon Brief, and with thanks to their original data providers)

Both of these pioneering companies aim to take the model of community involvement in energy to scale.

Not every aspect of energy is changing as fast as electricity generation, however. While energy efficiency improvements may have led to a fall in demand for power in recent years, there remain many more substantial and cost-effective energy-saving opportunities to be realised in our buildings and in industry. Low-carbon heat technologies are also advancing at a far slower pace. Sir Ed Davey stressed, “Decarbonising urban heat, currently made up of millions of boilers supplied by the gas grid, is a challenge the UK is yet to agree on.” And while there are over 100,000 electric vehicles (including plug-in hybrids) on British roads, the remaining 99.7% are still solely powered by fossil fuels.





Implications for large energy utilities

“The companies that come to dominate the future market don't yet exist or are currently outside the energy sector.”

SIR ED DAVEY, APRIL 2017

Since 2008, European utilities have lost up to 80% of their share market value. While the UK's companies have, in general, not been hit as hard, the impact has still been notable, with the largest energy supplier, Centrica, worst affected with a valuation drop of 50% since 2013.

In a few years, the utility-controlled model of centralised generation sold to far-away passive consumers may no longer generate sustainable profits. As Ian Marchant stated, the incumbents face a choice as to whether they embrace – and play a positive role in – the transition or whether they attempt to block it. Given the multiple forces driving the energy transition, the latter approach appears a fool's errand, no matter how threatening the transition might appear to established players.

Embracing and supporting the transition nevertheless poses the fundamental question of whether utilities can own their own disruption. In other words, can they adapt and find a new role in the emerging energy system? The evidence – in the UK and globally – shows they can, at least, in part. E.ON, for example, separated out and sold its fossil-fuelled generation assets to focus on its supply, renewable generation and energy services

“The large utilities must decide whether to block or embrace the disruptive forces they are facing.”

IAN MARCHANT, APRIL 2017

businesses. Meanwhile, Centrica is investing in new energy service technology companies, and EDF Energy is working with a community energy group and blockchain technology company to trial peer-to-peer trading. Volker Beckers' view is that switching from product to service companies will be key to the future success of energy companies.

There are further opportunities for utilities to use their strengths and assets to provide valuable services. They could aggregate household and community generation and storage with accompanying services, or they could use data analytics and demand management services. Both at transmission and distribution levels, grid operators face questions about how they will continue to create revenues from, and enable investment in, changing patterns of grid power flows – from a radial flow out from the centre to edge-to-edge flows – and infrastructure.

The utilities will need to take these opportunities to the heart of their business, rather than the fringes. Whether they survive the inevitable transformation of the energy market will depend, in large part, on whether they can shrug off their inertia after relying on a model that has worked for decades, and transform themselves at scale through innovation.

From our research, we have identified three important ways the energy system is changing:

- 1 **The falling demand for power coupled with the falling market share of the large incumbents;**
- 2 **The disruption in the traditional business model of large, integrated utilities;**
- 3 **A shift in governing power away from a consolidated set of large utilities to hundreds of new entrants from infrastructure, digital and other sectors.**



Falling demand, falling market share

Much has been made about the rise in suppliers that have recently entered the market. The combined market share of the Big 6 – the six large energy suppliers that have dominated the UK energy market since privatisation and introduction of competition in the 1990s – has fallen from 99% in 2013 to 85% in 2016. Ian Marchant sees this combining with the overall fall in demand for power as a “double whammy for the incumbents”, who find themselves in a shrinking pond with fast-growing minnows. The rapidly rising proportion of electricity that is generated and used by prosumers is a new threat to the market share of big and small power suppliers alike.

As we have seen, the fall in power demand has been driven largely by a reduction in the amount of energy the UK needs for economic activity due to increased energy efficiency. However, if heat and transport are to become more or even fully electrified, then this decline in demand will likely be reversed. Joan MacNaughton raised the rather sobering question of whether electricity generation could even reach the

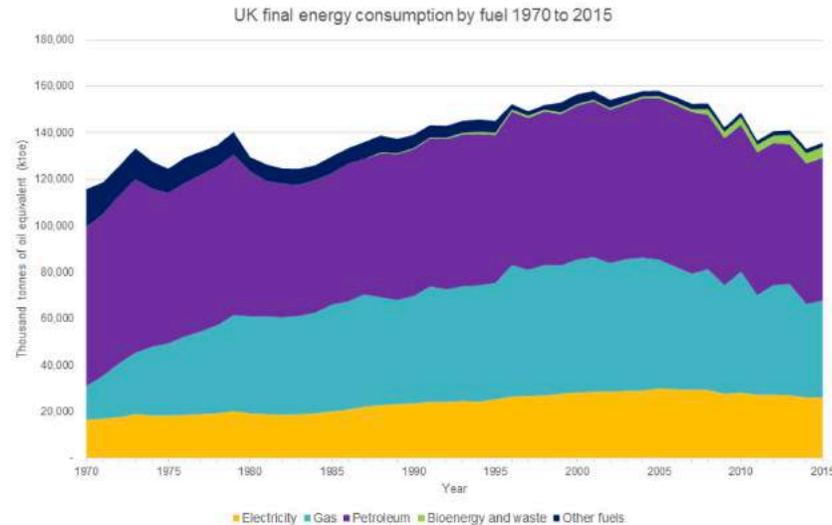


Figure 5 - The end fuel used for energy in the UK since 1970. While electricity has increased its share, gas and oil still dominate¹⁶

scale sufficient to power both these sectors in full. The scale of that challenge is shown starkly in Figure 5: petroleum is used almost entirely for transport, while gas mostly fuels heating. Both continue to dwarf electricity, despite the latter rising steadily in its relative contribution.

National Grid's Future Energy Scenarios covers the potential impacts of 100% of cars and vans being electric in 2050. They show that digitally enabled flexible charging would limit the additional load at peak

times to around six gigawatts (GW). This is equivalent to 10% of the current 60GW peak demand on a cold winter's day. Without such smart management of battery charging, the additional peak load could be as much as 18GW, as drivers plug in to start charging as they get home from work in the evening and turn on other devices.¹⁷ This would be a much more significant challenge, reinforcing the benefits of smart, digital control of energy to reducing the costs.

¹⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586245/ECUK_Tables_2016.xlsx

¹⁷ <https://www.carbonbrief.org/factcheck-how-much-power-will-uk-electric-vehicles-need>



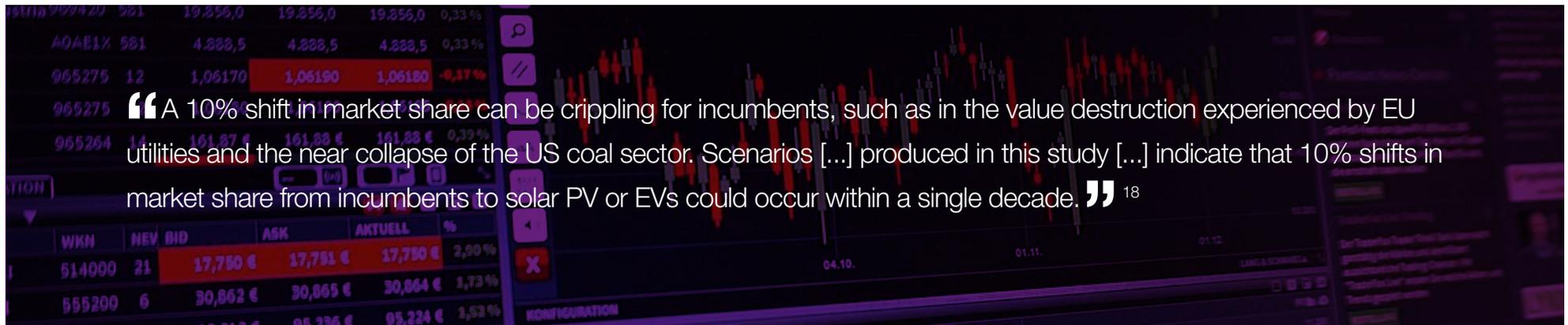
Business model **disruption**

The Big 6 have historically made a profit by generating power from their own power stations, or buying from other generators and selling it for a higher price. They are most profitable when the market price for power spikes, which happens when demand is high and it is hard to maintain supply. However, the trends and changes identified by the Wise Minds and Forum's own research threaten this traditional model. In Europe, this has led to energy utilities writing down over €100 billion in

value, mostly power station assets that are no longer competitive. Volker Beckers illustrated this with the example of a highly efficient gas power station in southern Germany that, since its commissioning in 2011, had become uneconomical to run. Due to unanticipated lack of demand, the power station was fired up far less frequently than its design had intended.

Digitisation and decentralisation are the reasons this traditional model no longer works. In Germany, for example, solar power

matches well with the daytime demand profile of industry. As more and more households get power from their own renewables, and as demand flexibility and storage smoothes out the spikes in demand, there are fewer opportunities for gas and coal generators to make profits at times of supply constraints. A surprisingly small market share of renewables can be disruptive to this profit model, as Carbon Tracker and the Grantham Institute of Imperial College note:



¹⁸ http://www.carbontracker.org/wp-content/uploads/2017/02/Expect-the-Unexpected_CTI_Imperial.pdf



Business model **disruption**

Volker Beckers highlighted the importance of a further shift in the B2B segment of the power market where industrial users with on-site generation are moving from a comprehensive supply contract to a strategic reserve contract (from all power to residual power only). He forecast that with increasing numbers of prosumers, further penetration into the UK and German retail supply markets would happen, adding that the first business models for this were already live in the market.

For power grid owners, decentralisation and digitally enabled flexibility pose both threats and opportunities. Grid operators' business models currently rely on charging for the transportation of power across their network, but both decentralisation and digitisation reduce the use of grid infrastructure by shortening the distance that power flows to get from the place of generation to where it is used. Demand can be controlled to use surplus power from

renewables locally, further reducing the flow of power over the grid. Across the globe, and particularly in sparsely populated regions, households are defecting completely from the grid and becoming self-reliant, using solar, wind and storage batteries.

The Wise Minds think it unlikely that the UK grid will become redundant, even in the long term. Nevertheless, they believe that it will be used less and less, becoming more a backup source of power. Ian Marchant compared the future of grid companies to that of telecoms businesses, where the reduced use of landlines has been met with increased line rental charges.



“ The future energy company will be a service company utilising the benefits of digitisation. ”

VOLKER BECKERS, APRIL 2017

A shift in **governing power**

Energy suppliers have gone from being one of six in dialogue with Government and Ofgem, the energy regulator, to one of many. As their market share has been diluted, their access to – and role in – political and regulatory decision-making have also been increasingly challenged.

Ofgem itself has recognised the need to update its regulatory approach in response to rapid innovations in the market. In 2015, the regulator published a discussion paper on supporting the transformative change in the energy market of non-traditional business models (NTBMs) that admitted “some NTBMs could challenge the fundamentals of current regulatory arrangements.” Ofgem highlighted flexibility and local energy models as those of most interest and innovation activity and priorities for ensuring that the regulation of energy markets reflects the opportunities these offer consumers.

New entrants are often critical of the lobbying power and access to legislators, regulators and in particular the panels that set the industry codes. This power could break down rapidly if there is a reorientation around the new entrants. This poses a further threat to traditional utilities; not only would their market share be reduced but they would no longer have the regulatory access to block the models that are hurting them. The way forward has to be to work with, not against, these new models.





Implications for **investors and government**

The UK energy system is changing more rapidly – and fundamentally – than at any time since the Industrial Revolution.

This poses critical questions for investors in the energy system, as well as for current and future governments and regulators. Each has a vital interest in avoiding dangerous climate change and the loss in economic value this would entail. Doing so requires a complete and rapid decarbonisation of energy systems in the UK and globally. Clearly, that transition is underway and accelerating, at least in electricity. That change is now driven at least as much by the economics of energy technologies and the pace of digital and business model innovation, as it is by climate-driven energy policy and regulation.

For investors

Investors who aim to reach a safe climate outcome need to further accelerate the transition to decarbonised energy systems.

Doing so requires a smooth and just transition that maintains the value of companies, as well as the jobs and communities that depend on them. The utility sector is at a crossroads, with decisions now being made that are of critical importance to the medium-term value of companies. These decisions pose risks of stranded assets and systemic shocks in the wider energy sector and economy. **Now is therefore the opportune moment for investor engagement to increase the likelihood of a positive outcome.**

Utility companies in the UK have already lost market share, and this trend is likely to accelerate. Although there will be losers in the disruption of the market, those that embrace the transition to a decarbonised energy system through innovation of technology and

business models will be better placed to survive and thrive.

The research and analysis here shows that for investors, passive non-engagement is no longer an option. Investors face questions about whether the big utility companies are readying themselves or trying to block the transition, whether investee utility companies are capable of adapting to the new market environment, and whether returning value to shareholders is the best option.

If the big utility companies are to have a viable future, investors need to engage with the sector to develop business models that are resilient to current and future disruptions to the energy markets. Such engagement should include models that entail transitioning to low or zero-carbon generation, supporting flexible and distributed energy and storage, and innovating as part of the changing relationship with traditional customers.

For current and future regulators and governments

Like the energy sector itself, governments have been caught off-guard by the pace and scale of the energy transition.

Official projections and forecasts have repeatedly – and significantly – underplayed the potential for substantive change. New technologies and innovations have often been viewed defensively, as a threat to security of supply, rather than an opportunity to build a better energy system for the country. This, we believe, represents a missed opportunity.

Yet the energy transition is by no means complete, and new technologies and business models are emerging all the time. These will not only continue to challenge established players, but also potentially disrupt the current set of disruptors. It is not enough for governments and regulators to passively wait and see what happens. Policy, and indeed the broader regulatory environment and governance structures that oversee the energy sector, must not only keep pace with the transition, but also encourage further innovation.

Two developments show forward thinking. The first is the work detailed above to understand and enable non-traditional business models. The second is the establishment of Ofgem's Innovation Link to support organisations with new ideas to understand the often complex regulations and to set up 'sandboxes' that allow innovators to trial ideas without incurring all of the usual regulatory requirements. This is already benefiting flexibility providers and community energy groups. The Innovation Link is also intended to identify where regulation may need to adapt to sustain innovation.

These welcome developments enable the transition, but they are not sufficient to maximise its benefits. The innovation we are seeing is still largely happening in spite of, not because of, policy and regulation. Change and distributed energy and storage, and innovating as part of the changing relationship with traditional customers will need to be at scale, including changing the market 'codes', reducing the power of the large utilities in their control, improving access to system data, and enabling local balancing and markets.

Rapid change will disrupt communities, not just markets, and there will be winners and losers on both sides. We therefore encourage the Government to explore options to ensure a just and managed transition.





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