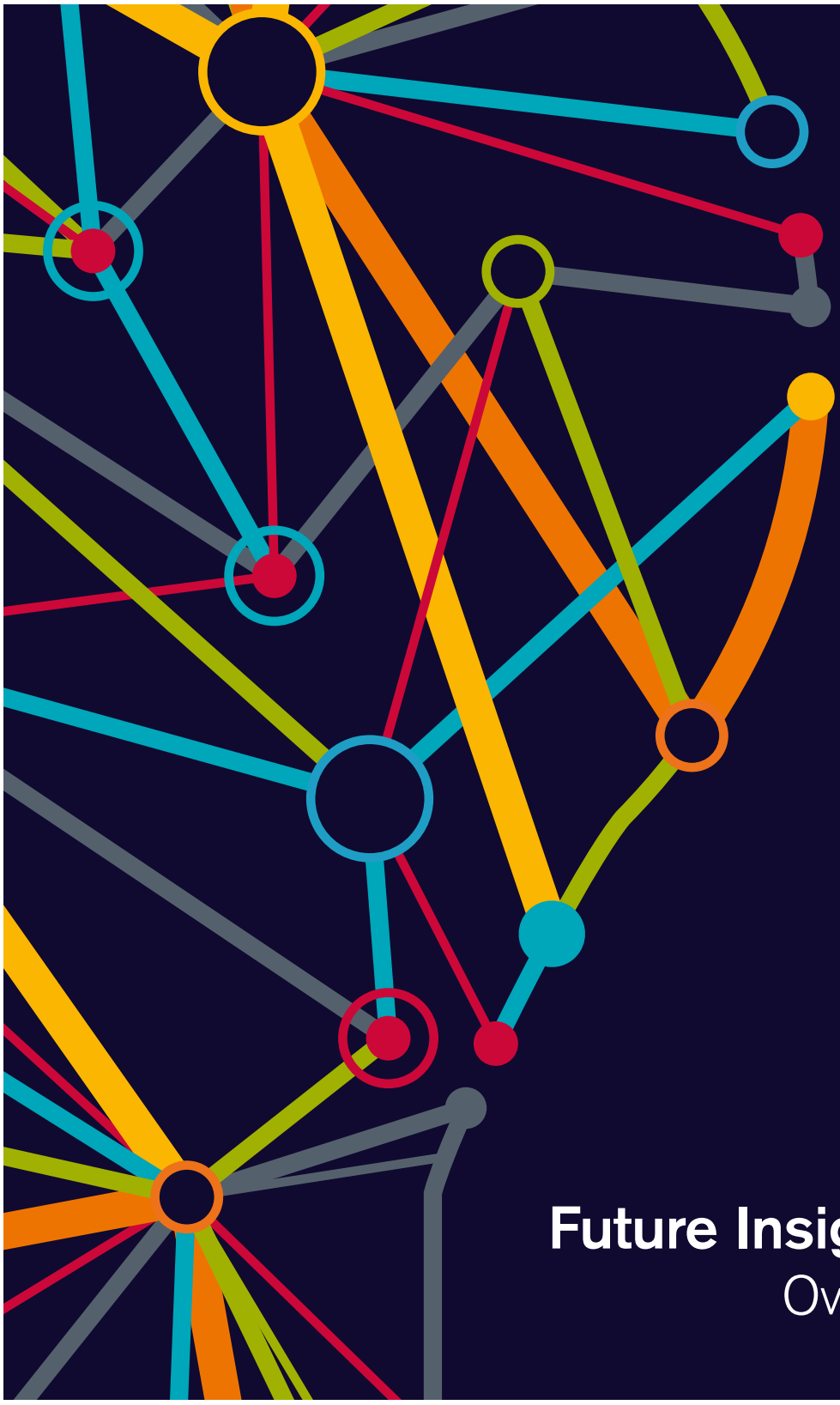
ofgem | future insights



Ofgem's Future Insights Series

Overview Paper

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Overview Paper

Abstract:

The energy sector is undergoing fundamental change. In this paper, we outline some of the main drivers of change and the resulting uncertainty about the future shape of the energy system. We consider the role of consumers in the development of the energy system. Technological changes we are already beginning to see give consumers much greater control over how the energy system evolves to meet their needs. But they also create risks of some groups being left behind.

The scale of uncertainty presents big challenges for policymakers and regulators. Our approach to the regulation of the energy market needs to remain relevant and responsive in the face of rapid energy system change. As we can't know the future, we need to rely more on learning and be flexible in our approach. Flexibility is one of the strengths of market-based solutions compared to other approaches. But, to function effectively, energy markets need a robust and responsive regulatory and policy framework that protects and empowers consumers and encourages beneficial innovation.

This paper is the first in our series of "Future Insights" publications and provides an overview of the possible implications for regulation and consumers from changes in the energy system. Future papers will consider particular issues in more depth, such as the decarbonisation of heat and the prospects for local energy systems. The papers are based on our **Insights for Future Regulation** project, launched in Spring 2016.

In this paper, we outline emerging thinking on the types of changes we may see in the energy sector and the potential challenges for Ofgem. The views expressed in this paper do not represent established Ofgem or Gas and Electricity Market Authority positions.

Context

The energy system is undergoing fundamental change.

Since privatisation of electricity and gas markets in the 1990s, the sector has seen changes in ownership, introduction of competition, market reforms and the growth of renewable energy. But the basic structure has remained largely static. This is likely to change; the Electric Power Research Institute expects that "we will see as much innovation in the next eight years as we've seen in the last 25".[1] As well as technical innovation, we are seeing the development of a wider range of business models and approaches. Between December 2012 and March 2016, the number of active domestic gas or electricity suppliers more than doubled from 20 to 43.

Change and continuity

As we look to the future, some elements can be foreseen, such as demographic trends. There are specific targets to cut greenhouse gas emissions and maintain security of supply in electricity. While legislation could change these targets,[2] they provide a reasonable basis for planning.

We also know that key challenges will endure regardless of the transformation that we are going to see. We will need to continue to manage the energy trilemma of balancing security of supply, decarbonisation and cost. And we know that improvements in the energy efficiency of our buildings, businesses, products and behaviours will be required if we are to decarbonise our economy successfully.

The ways in which the sectors will change within these constraints are very uncertain however. We expect continued technological change to affect both how energy is produced and used and how supply and demand are balanced through the grid and ancillary services. Substantial investment will be needed. This will put pressure on consumers' bills. But market forces will push down other costs, perhaps very materially as we have already seen with the cost of renewable energy and storage.

Despite the uncertainty about what the future will look like, some key changes look likely, including:

- the development of a smarter and more flexible system with greater responsiveness of demand to price changes;
- more decentralisation of the energy sector (with more distributed generation and more suppliers operating locally rather than nationally);
- increasing interdependence of services;
- a more diverse commercial environment, at least in the medium term; and
- better service for consumers enabled by new and smarter technology.

These changes could begin to blur the boundaries of the energy system as we know it and challenge the way that we operate as a regulator.

At the heart of the sector
Consumers

Increasing interdependency

We can already see that the way in which gas and electricity is used has become even more integral to our everyday lives. It is fundamental to the way we socialise, work, heat our homes, run our businesses, shop and engage with goods and services. It is not just an essential service in itself, but is also integral to other essential services, as the impact of flooding in Lancaster last December brings home.[3] With the 'internet of things', this interdependence between energy and other essential services is likely to increase. The type and scale of consumer interactions with the market will be driven by this interdependence and further technological advancements. These will also depend on how consumer behaviours develop and the degree to which consumers take advantage of the opportunities offered by new technologies such as apps that allow you to control your heating remotely or switch supplier with a swipe of a screen. Businesses and domestic consumers of all types (from highly engaged to disengaged or vulnerable consumers) will have many more ways to engage with the energy system. These interactions will bring both challenges and opportunities for consumers.

Intermediaries and tailored offers

For individual consumers, we will not necessarily see more direct engagement in energy but we might see greater use of intermediaries, perhaps replacing some current market participants. The potential emergence of services where consumers can hand over control of their energy purchases to a third party may provide the opportunity for consumers to disengage from the energy market while becoming highly active in demand response or as switchers between suppliers.

At the same time, the growth of big data and more automation should allow better value offers. Offers could be designed to target specific consumer groups in a more tailored way. We are already seeing the emergence of offers where consumers buy in bundles of days rather than on the basis of metered usage.[4]

Bundled services

We may also see more bundling of energy with other products, potentially through marketing of bundles of services (such as energy and broadband) and through buying services with embedded energy. For instance, car drivers might rent electric cars by the mile or hour, with energy already included. We may see a move away from the sale of commodities to the sale of services (where consumers pay for "comfort" levels rather than units of gas and electricity), challenging the very concept of an `energy consumer'.

As the environment becomes more diverse and complex, providing an appropriate level of service for those not able to navigate the market could become more challenging. Automation and moves to services with embedded energy may be helpful, and could be particularly valuable for more vulnerable consumers, but this will need careful attention from a regulatory perspective.

A more decentralised system

Consumers are showing a greater desire to have control over how their energy is generated and distributed. Many domestic consumers are now both producers and consumers of electricity, for instance through rooftop solar panels or wind turbines. They are motivated by financial and environmental concerns, as well as low levels of trust in large energy suppliers. This has led to local energy schemes such as community-owned small-scale wind farms or combined heat and power plants and even to local authorities entering the supply market. We could see more consumers move away from the traditional utility model and adopt community schemes or peer to peer trading arrangements to provide their energy needs instead. The scale and pace at which these trends develop will be influenced by how prepared consumers are to trust new offerings.

Varying levels of disruption

Other changes could be more disruptive to consumers, for good or ill. For example, decarbonisation of heat could involve significant change to how people heat their homes – moving away from natural gas or oil heating to electrification, district heating or hydrogen. We will explore this issue in more depth in a subsequent paper. It is also possible that some consumers will come off the electricity grid, if the costs of connecting distributed generation to the national grid are deemed too high and the costs of storage continue to fall. While the drivers for these trends may be technological and social, the economics of the sector will play a key role in determining how they develop and when they arise.

The economics of the energy sector
Winners and Losers

It's impossible to say what the energy system will look like in 2030 or 2050. Decarbonisation of energy could follow several very different pathways. The composition of the energy system will depend on social, technological and economic developments. Recent history shows that these do not follow smooth and predictable trends.

Technology costs

As we have already noted, the pace of change has accelerated, as demonstrated by rapidly falling costs in some renewable energy sources. Even in the last few months, there have been astonishing developments: solar power in Chile was priced at £25/MWh in August, and then quickly overtaken in Dubai by a price of £17/MWh set in September.[5] Offshore wind in Denmark was priced at £51/MWh in September.[6]

These costs do not translate directly to Great Britain, as they depend on other factors such as resource availability, payment for network connections and development costs, but they do point to dramatic reductions in the costs of deploying solar and offshore wind. Even if GB costs remain higher, the costs of energy produced by our international competitors are falling fast. The GB target is to reduce offshore wind costs below £100/MWh by 2020.[7] Battery storage costs have fallen by up to 20% a year recently, stimulating increased deployment and more research into how battery storage could be integrated into energy systems.[8] Most studies of future trends assume much lower rates of cost reduction in future,[9] but we should still expect some technological developments to surprise us. At present both solar and battery costs show significant economies of scale. This means that deployment at larger scale is likely to be better value for the energy system than mass deployment at a residential scale.

Dramatic cost reductions are, of course, potentially good news for consumers. They might be seen as a sign of the success of renewables policies. But they also highlight the hangover of funding costs for investments made before costs fell, where these are guaranteed. In most markets, such costs could be written off, but, where they are underwritten through government-backed contracts, future system users will need to pay. In the extreme, this risks consumers being incentivised to defect from the main energy system to avoid sunk costs. Energy policy and regulation will need to ensure that previous commitments are honoured, while promoting efficient decisions about, for instance, which networks to use and how. We should only continue to use existing networks if they are the best way of meeting future needs, not because a lot of money has been spent on them in the past.

In our view, typically the best way to get the best deal for consumers (and competitiveness for industry) is likely to be to tackle key externalities (such as carbon pollution, learning and coordination) and let market dynamics drive decisions where possible. This won't be possible in all circumstances – particularly where there are characteristics of natural monopoly or strong network effects. For example, conversion of heating to either district heat or hydrogen will require coordination and restrictions on choice – it will probably not be possible for individual households to choose whether or not to join the new network.

A particular issue with technological uncertainty is learning. Support for trialling and even scale deployment of new technologies may be justified to learn more about their future costs. We would not have solar PV deployments at today's costs were it not for the large-scale deployment funded in large part by some EU member states, including latterly by GB. Looking forward many experts think now that carbon capture and

storage (CSS) is a significant part of efficient pathways to achieve decarbonisation of energy by 2050[10] and that the future of gas as part of our energy mix depends on the success of CCS deployment.[11] There seems to be enough justification to invest in trials – to prompt learning and understand how costs could be reduced. But we should treat with caution arguments about needing to invest early in building supply chain and locking-in the roll-out a long way into the future. There are substantial potential benefits from agility, from learning over time before making decisions and from commercial decision-making in competition with other options. We should also recognise that learning is not usually limited to national boundaries – the costs of solar PV have fallen in GB in light of German and Italian deployment for example.

There is also a very broad range of scenarios for how retail, network and system operation issues will develop. We expect to see some of the boundaries between parts of the sector blur over time, as information and technology unlock more solutions to specific challenges. For example, it is widely expected that flexibility (demand and supply side) will be increasingly needed to help balance the system so it can deal with more intermittent generation. But it is also quite possible that sources of flexibility will be much more available in the future energy system, just needing the market and regulatory frameworks to unlock them. As with energy and capacity, the value of flexibility will vary by location and across time. These variations in value need to be effectively signalled to potential providers of flexibility.

Nature of innovation

The prospect of a wider variety of business models is broadly positive. It seems unlikely that the commercial arrangements existing today will be unchanged. Our current regulatory model is built around the idea that suppliers should be the main point of contact for consumers (the "supplier hub"). The advent of new business models built on third party intermediaries and bundling of services could not only move away from suppliers being the hub but even invalidate the model of regulated suppliers. The nature of innovation means that some new business models will succeed and others fail. We need a market and regulatory framework that allows this to happen without causing undue damage to end consumers, rather than one which tries to pick winners and then ensure their stability. Our market and regulatory framework should also be one where businesses are successful because they genuinely add value, rather than because they arbitrage regulatory rules or find loopholes sometimes to the detriment of the energy system or to consumers. As far as possible, this means streamlining the rules and ensuring they reflect real costs or benefits and minimise distortions.

An important part of facilitating innovation will be to seek to keep barriers to market entry and exit as low as practicable. It is often in the interests of existing market participants to "draw up the ladder after themselves". The IT systems and change control processes (such as industry codes) we have in parts of the industry today are a significant impediment and will need to change.

Implications for regulation and analysis

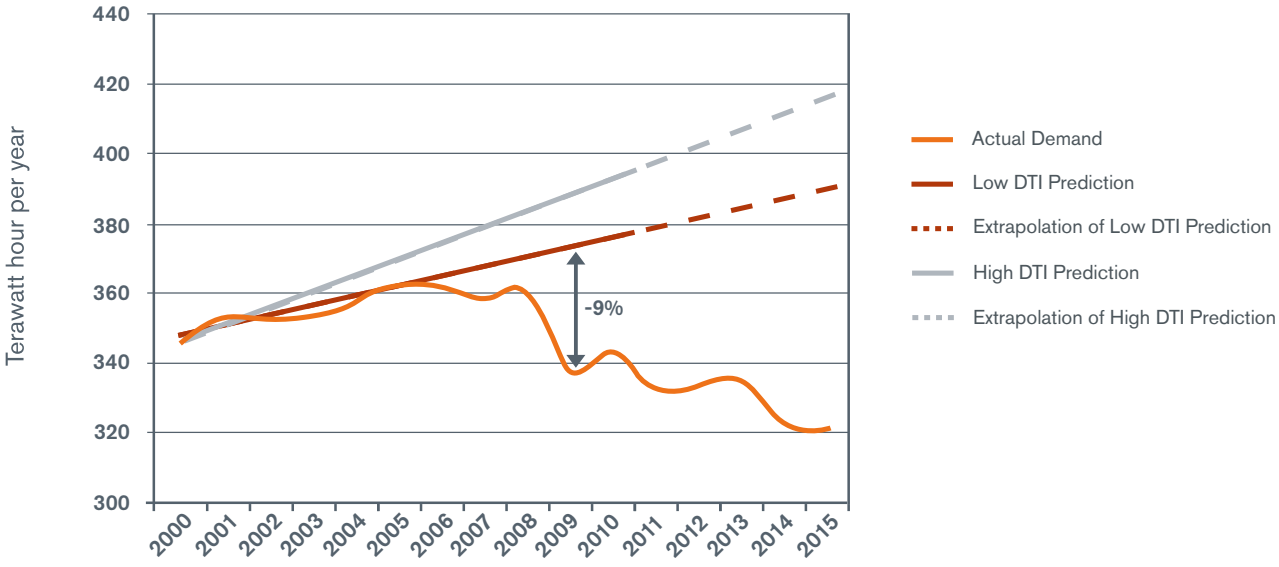
All these changes and uncertainties present big challenges for policymakers and regulators. From our engagement with stakeholders, we heard a strong call for government and the regulator to decide now on our preferred pathway and inform stakeholders. This is unrealistic in the face of the uncertainty described above – it would almost inevitably lead to higher costs and bills than necessary and more disruptive step changes later. But there is clear value in making some – potentially large – investments (some of which would likely require underwriting) to generate learning, provided explicit review points are built in to the policy.

Scenarios and uncertainty

Traditionally, we attempt to characterise the uncertainty we face through scenario analysis, perhaps by setting out a small number of future visions. Typically this comes with caveats that these visions of the future are not themselves predictions but instead form a plausible range in which the future is likely to lie. This can however be misleading – it is often the case that key aspects of the future will lie outside the range, perhaps on dimensions not even imagined yet. Perhaps the best developed scenarios in the energy sector are National Grid's Future Energy Scenarios (FES).[12] In creating these scenarios, National Grid uses stakeholder engagement and analysis to produce four models of the future energy system, based on a range of sensitivities. Inevitably, when trying to model the entirety of the energy system in just four scenarios the number and range of assumptions used is limited. The FES projections of electricity demand in 2025 differ by only 2% across scenarios. This dramatically understates demand uncertainty which has in the past been much higher, in a 10-20% range over a decade.

For example, the graph below, comparing government projections from 2000 with actual electricity consumption illustrates the difficulty of predicting demand.

Forecasts of electricity demand from the year 2000 compared with actual demand*

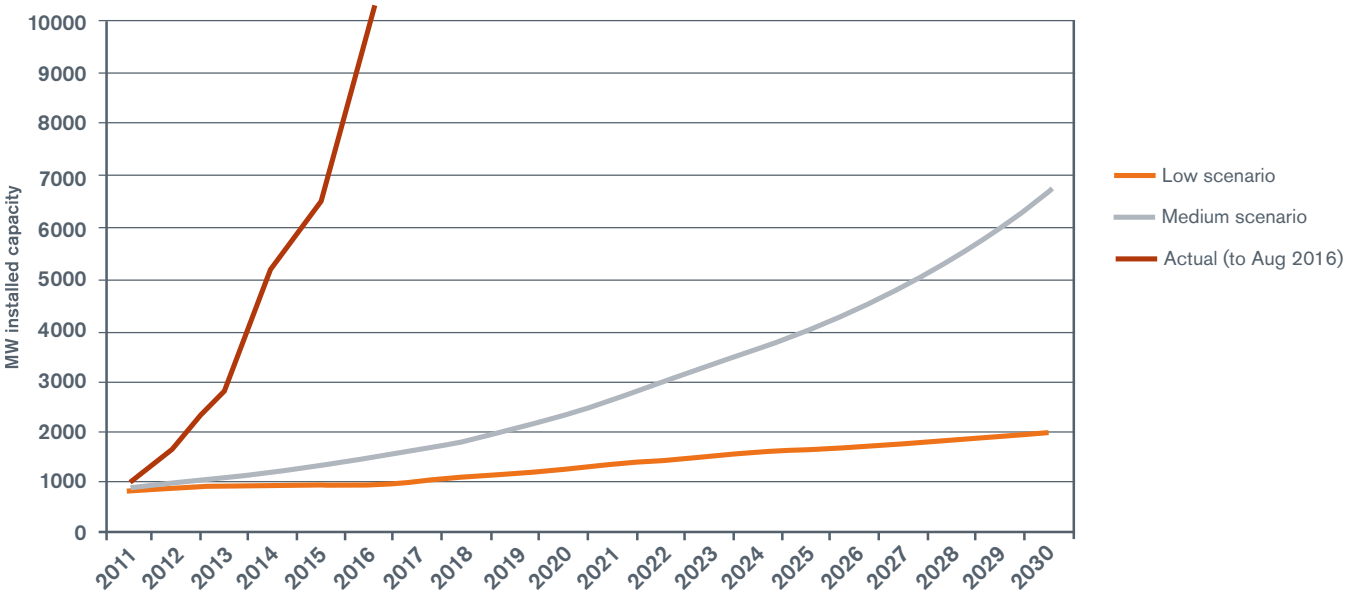


* UK Demand predictions are from the DTI Energy Paper 68. Forecasts from 2010 onwards are an extrapolation of the trend presented from 2000 – 2010. Demand is transmission level demand and has been updated using DUKES data.

In 2015, the divergence between the 2000 low DTI extrapolation and actual demand in 2015 is around 20%.

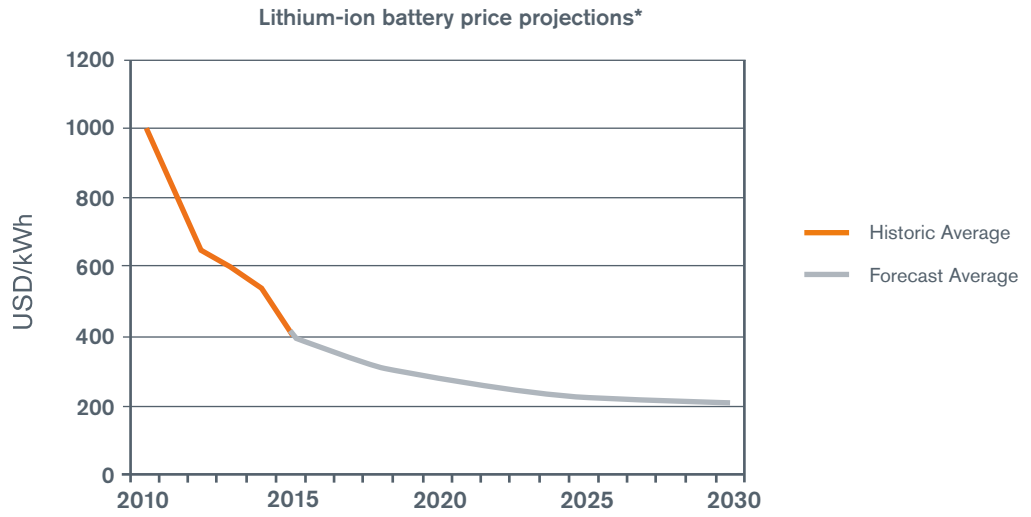
The pace of technology take-up and cost changes is also unpredictable. Projections of solar photovoltaic uptake made in 2012 estimated that it would take 18 years to reach 6 GW of generation capacity on the system. It took only 4 years to reach 10 GW.

Actual solar PV installed capacity against forecast growth*



Battery costs are similarly unpredictable but only one battery cost projection is used across all four FES scenarios. The FES forecasts expect the rate of cost reduction to slow, with lithium ion battery costs falling to $210/kWh only in 2030[13]. But if the approximately 16% annual cost reduction seen between 2010 and 2015 were to continue, costs would fall below $200/kWh by 2019.

* Low and Medium Scenarios come from the EA Technology 2012 report "Assessing the Impact of Low Carbon Technologies on Great Britain's Power Distribution Networks". Actual installed capacity is from DECC solar photovoltaics deployment data.



That is not to say the scenarios don't provide valuable insights – they do – but just that they cannot be used as a plausible range for policy or regulatory decisions. Good regulatory decisions must be designed on the assumption that more dramatic change is possible. We can facilitate good decision-making by providing more information about developments and using a wider range of possible scenarios to stress-test ideas.

Managing uncertainty

We will continue to focus on protecting current and future consumers, including more vulnerable consumers who may find it hard to engage with energy sector developments. But the potential fundamental changes in energy markets mean that we can best protect consumers through a flexible approach that relies more on learning over time. Flexibility and learning are key strengths of market-based solutions compared to other approaches. But in the energy sector, markets cannot operate in isolation to the regulatory and policy framework. We cannot know exactly how the energy system will evolve but we do have a clear vision of the components needed to help us to achieve our objectives both now and in the future.[13]

Given the pace of change and uncertainty, we can no longer rely on three to four year projects to develop regulation that will set policy for the next decade but rather need to set clear principles and a direction of travel for regulation. This will provide a signal of predictability while still allowing us to be flexible to wider changes. This does not mean we cannot conduct broad reviews of market arrangements but we need to acknowledge these are more difficult in an uncertain world. Where we can move away from telling companies how to achieve objectives, without losing clear standards for interoperability for example, to a regulatory framework based on outcomes and principles, this seems likely to be more robust to future developments. Energy remains an essential service and we will need to remain vigilant to ensure minimum standards are maintained for all consumers.[14]

* Source: National Grid's 2016 Future Energy Scenarios.

What next?

This paper is the first in a new series of "Future Insights" publications from Ofgem. Future papers will take a more in-depth look at some of the key issues we have identified here, including the decarbonisation of heat and the prospects for local energy markets.

End notes

1 EPRI "News spotlight" September 2015

2 Current targets include an 80% reduction in greenhouse gases by 2050, while the Reliability Standard is set at three hours loss of load expectation per year. Targets could be tightened or loosened through future legislation. Further information is available at: https://www.gov.uk/guidance/carbon-budgets and https://www.ofgem.gov.uk/electricity/wholesale-market/electricity-security-supply

3 RAENG "Living without electricity"

4 BBC "ScottishPower to offer bundles of energy to customers"

5 SeeNews "Abu Dhabi's solar tender brings bids below USD 25/MWh – report"

6 The Telegraph "New record for cheapest offshore wind farm"

7 DECC UK Renewable Energy Roadmap

8 Utility Week "UK sees first Tesla grid-scale storage installation in Europe"

9 National Grid Future Energy Scenarios

10 Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage (CCS)

11 UKERC "Role of gas as 'bridge' to a low carbon future in the UK is limited, new research finds"

12 National Grid Future Energy Scenarios

13 We will be publishing our regulatory stances later this year.

14 Or at least all that do not make informed choices to move away from such standards.

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