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**Ofgem's
Future Insights Series**
The Futures of Domestic
Energy Consumption

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The Futures of Domestic Energy Consumption

Abstract

The energy landscape for domestic consumers is changing rapidly. The digital transformations that we have already seen in other retail markets are beginning to affect the energy sector profoundly. Smart technology is entering our homes, companies are using big data to respond better to consumer preferences, and online competition is allowing new business models to proliferate, often provided by third-party intermediaries rather than traditional energy suppliers. Consumers themselves are changing too – with a projected extra 10 million UK residents by 2039, increasing the total population to 74 million people, more than one in 12 of whom will be aged 80 or over.

Energy consumption in 2030 is likely to be very different from how it is today – but we cannot predict the nature of these changes with certainty. We expect to see consumers choosing to manage their energy usage much more actively, taking advantage of technological developments to choose when and how to consume, as well as whether to provide energy to others through domestic generation and storage. We also think we are likely to see the breakdown of the relationship between energy suppliers and consumers, both through increased use of third-party intermediaries and through firms offering more cross-sector bundles of goods such as broadband, transport and water, as well as energy.

As the regulator of the energy sector, we will need to ensure that our approach is responsive to changing consumer needs. This includes facilitating innovations that can benefit consumers and protecting them against emerging risks, while making sure that those who are less able to engage are supported in doing so, or enabled to get a good deal even if they choose not to take up all of the opportunities available.

Many of the dynamics we discuss in this paper are more closely linked to electricity than to gas, while some go beyond specific fuels to consider experiences and energy services. We outlined our thinking on possible changes to the ways in which we heat our homes in our November 2016 paper, [The Decarbonisation of Heat](#). We do not look specifically at non-domestic consumers, but the experiences of smaller businesses may be similar to those of domestic consumers.

This paper is the fourth in our series of “Future Insights” publications. It has developed from our **Insights for Future Regulation project**, launched in [Spring 2016](#).

The views expressed in this paper are emerging thinking from the project, rather than established Ofgem or Gas and Electricity Market Authority positions.

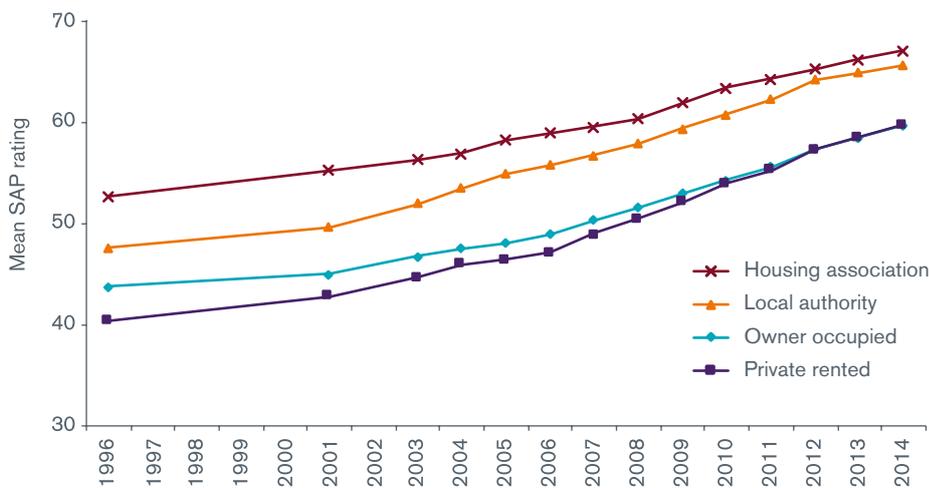
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Context

Technological change

People do not consume energy for its own sake – rather, it is an essential intermediate good, used to heat homes, transport us from A to B and power appliances. The changing nature of goods and services that consume energy is therefore central to our overall energy consumption. Positively, the energy efficiency of our homes, means of transport and appliances continues to increase. Domestic energy demand has fallen by 19% since 2000, despite a 12% increase in the number of households and a 10% increase in population.¹ The UK government estimates that, in 2014, the average SAP² rating of English dwellings was 61 – up from 45 in 1996, implying a 25% fall in modelled energy usage (Figure 1). However, we will need to make significant further progress to achieve the goal of reducing carbon emissions by 80% by 2050 – particularly in decarbonising heating and transport.

Figure 1: Improvements in SAP Ratings by tenure



Source: DCLG (2016) 'English housing survey 2014 to 2015: headline report'

Note: y-axis does not begin at zero

While energy efficiency is increasing, the range of goods that consume energy is also growing. Twenty years ago, less than a third of households owned a computer. Now, many households own several, often operating day and night. In this context, the way in which we manage our energy consumption is crucial. The government's commitment to roll out 53 million smart meters by the end of 2020 will form the basis for enabling consumers to play an active role in managing their energy needs. Along with other system changes, such as half-hourly settlement, it will also allow domestic consumers themselves to become providers of system services in new ways.

Figure 2: What will smart mean?

- **Real time information on energy usage**
- **Automated use of smart appliances at cheapest times**
- **Billed for actual usage not estimates**
- **Growth of data**
- **Easier switching**
- **Personalised tariffs**
- **Consumer as provider of system services?**



Image courtesy of British Gas

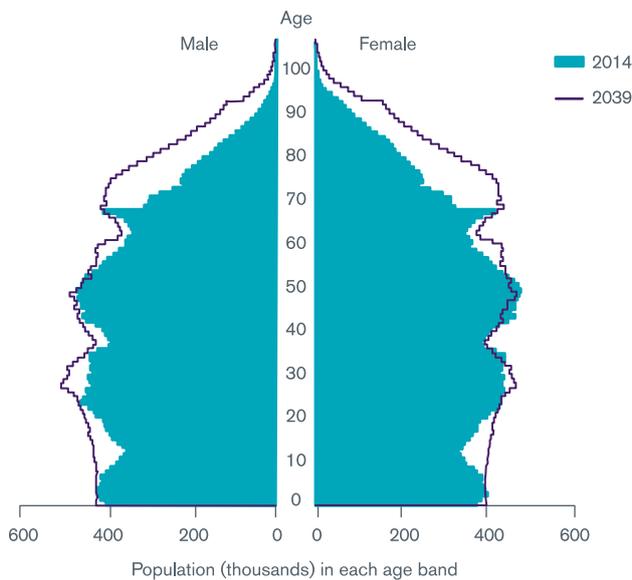
Many consumers have already become energy producers and service providers in their own right by installing micro generation equipment such as solar panels. There are around 900,000 photovoltaic installations across the UK, with a cumulative capacity of over 11GW. Over 90% of these installations are of a small-scale, domestic size (0 to 4kW).ⁱⁱⁱ

The next phase of the ongoing technological revolution will likely take place within our homes – through the appliances and platforms that control our energy services. In the short term, smart tariffs, appliances and battery storage should allow consumers to manage their demand more flexibly. Longer term, big data, accompanied by machine learning, could enable both more personalisation of services and more automation of the relationship between consumers and firms. Developments such as blockchain^v could redefine domestic consumption practices, for instance by enabling consumers to trade with each other on a peer-to-peer basis, without the need for third parties. Achieving the benefits from such technological developments will require a regulatory and policy framework that supports innovation while recognising the need to protect consumer interests. This includes a more flexible and consumer-focussed system for changing the energy industry rulebook where necessary.

Demographic and economic developments

These technological changes must be considered against the backdrop of potential large-scale changes in the nature of energy consumers. Some of these are fairly certain – we can be reasonably hopeful that average longevity will continue to increase, meaning that there will be more elderly consumers, and potentially more demand for tailored living arrangements for them. The Office for National Statistics expects more than one in 12 people to be aged over 80 by 2039; regulators and policymakers will need to ensure that elderly consumers, including those with health problems or restricted mobility, are able to engage fully with energy market developments.

Figure 3. An Ageing and Growing Population



Source: Office for National Statistics - around National Population Projections: 2014-based Statistical Bulletin

The UK population is also likely to continue to increase – though the scale of the increase is dependent upon developments in net migration. The Office for National Statistics expects total UK population to increase by 9.7 million by 2039, to 74.3 million people. The impact of these changes is more speculative. We may see continued growth in the numbers of people living in rented accommodation, and in those living in high-density accommodation. While high-density living tends to be more energy-efficient, people living in rented accommodation currently often have limited choice over their energy supply and their methods of consumption, reducing their engagement with energy usage. The growth of smart metering should, however, help to enhance consumer choice across payment and tenancy types.

Wider economic developments will also affect the energy sector. Real wages have stagnated in recent years, due to disappointing productivity growth and workers receiving a declining share of total economic output. The Institute for Fiscal Studies expects average real wages to be no higher in 2021 than they were in 2008.^v Unless energy bills fall in real terms, continued slow wage growth could lead to increasing numbers of people being at risk of fuel poverty.

An evolving retail market

In the domestic retail market, the number of energy suppliers, tariffs and pricing models has expanded. Between December 2012 and September 2016, the number of active domestic gas or electricity suppliers more than doubled from 20 to 48.^{vi} This expansion requires a more flexible regulatory approach. Through our Future of Retail Regulation work, we have begun the process of relying less on a one-size-fits-all approach, instead using principles to provide good consumer outcomes.

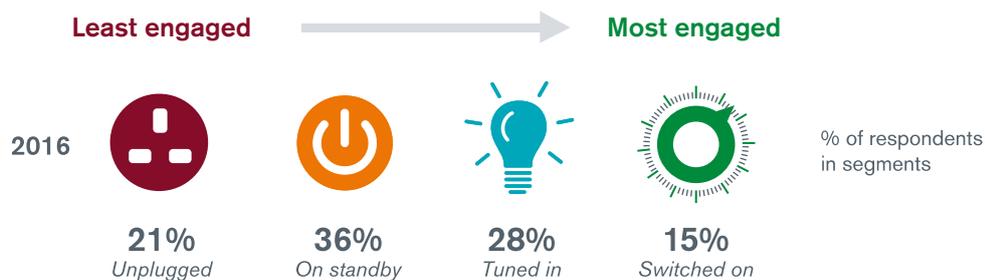
The growth in the number of suppliers has been accompanied by increased switching by consumers, including to smaller suppliers. As of September 2016, 14% of domestic consumers received their electricity from suppliers other than the six large energy firms.^{vii} The corresponding figure for gas was 17%.^{viii} However, 66% of all households are still on relatively expensive standard variable tariffs and 43% of domestic consumers have never switched energy supplier.^{ix} With the growth of suppliers and offers, even those who do switch may not be getting the best deal possible. In 2010, researchers at the University of East Anglia found that at least 17% of electricity consumers who switched suppliers in order to save money ended up with a worse deal as a result.^x For many consumers, it could be that simplicity and a personalised service are more important considerations than financial savings alone; our 2016 consumer survey found that on average, consumers said that a financial saving of around £300 would be needed to encourage a change of supplier or tariff.^{xi}

Continued evolution of the retail market, combined with technological developments, is likely to result in new consumer offers such as the ability to purchase bundles of energy by the day rather than pay for metered usage (indeed, Scottish Power recently introduced a pay as you go package along these lines). We may see consumers choose to pay for different service levels rather than primary fuels, blurring the traditional boundaries between energy and other services. Some energy service contracts already include insulation or appliance upgrades over time, as with mobile phone contracts. Increasingly, payments for such services are likely to happen in real time, via mobile apps or other platforms.

Evolving consumer profiles and interactions

The changes we are seeing in the energy system have implications for what it means to be an energy consumer, and how we as a regulator should approach issues of consumer protection, engagement and vulnerability. Consumer surveys show that there are already many different ways of engaging with the energy industry. For instance, our retail market surveys identify four categories of engagement – *Unplugged*, *On standby*, *Tuned in* and *Switched on* – based on factors such as rates of switching between suppliers and changing tariffs.

Figure 4: Consumer Engagement Segments and Social Grades



Social Grade	Unplugged	On standby	Tuned in	Switched on
AB	14%	22%	27%	39%
C1	27%	32%	34%	33%
C2	23%	21%	20%	17%
DE	35%	25%	19%	12%

Source: Ofgem (2016) 'Consumer engagement in the energy market since the Retail Market Review - 2016 survey findings.'

Switched on consumers are more likely to be from higher socio-economic groups - a pattern that has strengthened since 2014. This means that it may be difficult to ensure that the benefits of innovation and decarbonisation are shared by all. Wealthier consumers may find it easier to invest upfront capital costs in battery storage, smart appliances and micro generation.

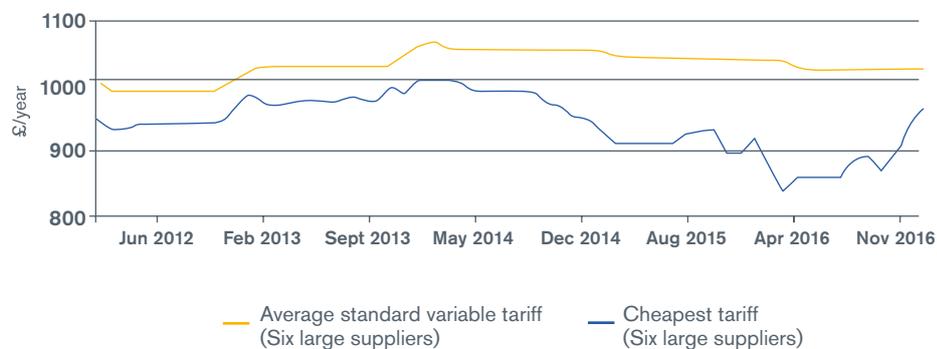
High-level categorisation of consumers can play a useful role in understanding consumer behaviour and developing responses to remedy a lack of engagement and to mitigate the effects of vulnerability. However, the dynamics discussed in this paper hint at new developments within a number of these segments. For example, consumers that we presently consider *Unplugged* may choose to disengage by handing control of their energy supply or usage to a third party. *Switched on* households may no longer be involved in active switching, but could instead be selling their energy directly to local consumers.

Consumer segmentation

The transition to a smarter energy system will lead to energy suppliers receiving vast amounts of data regarding consumer behaviours and preferences. This should permit greater diversity in tariff offerings. Some of these may be more complex – with charges more closely reflecting real-time prices of energy and providing incentives to reduce energy demand at peak times. Tariff structures could incentivise charging of batteries or electric vehicles at times that are most beneficial to the wider system. Alternatively, particularly if the marginal cost of energy falls, suppliers may choose to offer unlimited usage packages to consumers, as we see in telecoms markets. Consumption would then be limited by capacity rather than through pricing incentives.

Such developments could have very different implications for different types of consumers. There is already substantial dispersion of prices among customers (Figure 5), with less engaged consumers tending to pay more on average. As suppliers gather more data on consumer behaviours and preferences, the scope for customer segmentation increases. This could lead to more perceived unfairness or to vulnerable consumers paying higher prices on average.

Figure 5: Price dispersion of energy tariffs



Source: Ofgem (2017) [Data portal](#)

Note: y-axis does not begin at zero

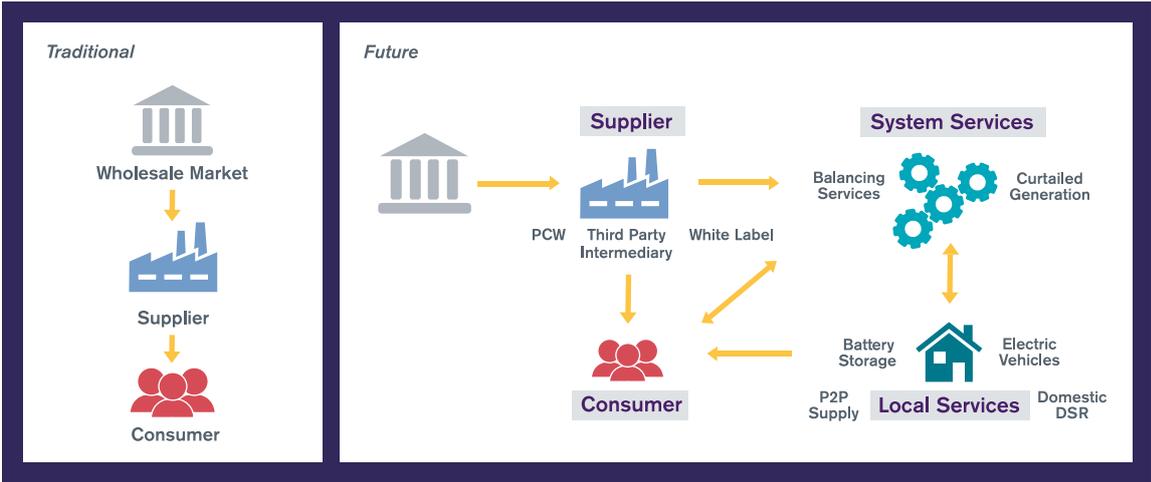
As well as greater diversity in pricing schemes, big data may enable offers to be targeted to specific customers or customer groups on the basis of factors such as age, geography, wealth, behaviour or other factors. The theoretical economic concept of first-degree price discrimination – whereby each consumer is charged an individual price – becomes more practical in a data-rich world. While this could help to open new markets and respond to customer needs, competition could be harmed because of the information advantage of existing suppliers, leading consumers to lose out overall.

The role of consumers in the energy system

The shift away from a centralised, carbon-intensive energy system to one that is increasingly decentralised will see consumers play new roles and engage with the market in different ways. Some consumers will install more micro-generation and battery equipment, and participate fully in demand-side response activities. Others may prefer to hand over responsibility for decision-making to third parties, with energy services automated through smart equipment.

New business models are likely to emerge to provide balancing services or curtailment of generation, allowing better management of demand and supply changes at a system level. This will help the system to respond to trends such as the uptake of electric vehicles and increasing amounts of renewable energy. Consumers may also choose to engage more as members of groups, for instance through collective buying arrangements or local distributed generation projects. Figure 6 shows one possible future role for consumers in a transformed energy system.

Figure 6. What role might the consumer play in a future energy system?



However, there remains a possibility that consumers will not adapt their behaviour or offer flexibility, for instance if they are unaware of the benefits of doing so or are concerned about the perceived loss of control over their energy usage or data. Moreover, there will inevitably remain consumers who lack the time or motivation to engage actively with the energy system. We and government need to ensure that their interests are still protected, and that decarbonisation and other objectives can be achieved.

What does this mean for consumers?

For many consumers, familiarity with a gas boiler and minimal switching of energy suppliers have meant that their broad interactions with the energy system have remained unchanged for decades. However, the pace of change is gathering momentum – from smart metering through to new heating systems and visible signs of change such as public electric vehicle charging stations. We see active trialling of new technologies and business models, while building understanding of consumer behaviours, concerns and preferences, as crucial both to reducing carbon emissions and building an energy system that responds better to consumer needs.

Whom do consumers engage with?

Traditionally, contact with an energy supplier has been the key way in which domestic consumers have engaged with the energy market. However, the prevalence of price comparison websites (PCWs), white labels,^{xii} third parties offering energy services and even peer-to-peer trading of energy, are all on the rise. Our 2016 consumer survey showed that 51% of those who had switched supplier, changed tariff, or compared tariffs in the last 12 months used a PCW to find out about available deals (up from 46% in 2015 and 40% in 2014).^{xiii} In general, the use of PCWs should support price transparency and competition between suppliers.

Some consumers may prefer to go further and use a concierge model to switch suppliers regularly or hand over some control of their energy to third parties. This could take the form of an energy service contract or – in the extreme – delegating authority to a third party to control how and when home appliances are used. 'Active disengagement' could be a popular choice if consumers trust those to whom they hand over control of their energy decisions. Such trends challenge the premise of the 'Supplier Hub' as the primary basis for both consumer engagement with the energy system and our regulatory approach.

Realising the potential of smart technology

The growth of smart meters and appliances within our homes will provide the basis for greater control over domestic energy consumption. Examples from other industries, such as the recent popularity of personal fitness bands, show how information-based services can help to achieve behaviour change.

But in order to achieve the full potential of smart technology, the infrastructure around it will need to satisfy three key conditions:

- **Ease of use and simplicity.** These principles have been at the heart of the success of items such as tablets and mobile phones. We have already witnessed a digital transformation in other retail markets such as payments, travel and food, which has set expectations for the choice, standards of service and regulation that energy customers will want to see.
- **Interoperability between different devices,** where feasible. This should support effective competition between technologies and suppliers.
- **Robust data handling procedures and cyber security** will be important to ensuring consumers are confident in allowing firms to use their personal data. Some demand-side response activities may enable third parties to control appliances remotely. Secure systems will be needed to mitigate harm to individual consumers and potential adverse impacts on the wider energy system.

Even with these conditions in place, some early trials suggest that consumer demand patterns will only shift substantially through automated responses, rather than through behaviour change alone.^{xiv} If the behaviour change necessary for a flexible energy system is not realised, restrictions on choice and activity could in some cases be justified – for example with regards to charging times for electric vehicles.

From units to services

Gas and electricity have long been fundamental to the ways in which we heat and power our homes. This has been reflected in a utility model that sells kWh of gas and electricity. However, technological developments mean that we now often see fuels embedded within practices and services – heating systems controlled by smart thermostats, security systems and internet-connected televisions. For heating, consumers might just as easily pay to have their thermostat maintain temperatures within pre-defined parameters, with the supplier having the freedom to choose the most efficient way of doing so.

More broadly, smart appliances permit a range of new services that are more easily characterised by the service they provide than units of input. In 2016, a Deloitte consumer survey found that more than half of consumers owned some form of connected device for their home.^{xv} Further, 57% of respondents said that they would like their heating to turn off automatically when they leave the house and 54% would like to be able to control their heating remotely.

This shift from talking about units towards providing services for energy customers has implications for our current licensing regime. The services and experiences that gas and electricity permit take place in presently unregulated spaces beyond the meter. If business models based on providing energy services become the key customer-facing dynamic in the retail market, the nature of the current supply license may need to evolve. Consumers may also choose to buy their energy in a bundle along with other services such as telecommunications, a topic we return to in the next section.

Consumption on the go

The success of the sharing economy in sectors such as transport and accommodation has changed the ways in which we buy goods and services. Rather than linking payment for services to physical possessions such as cars and homes, services such as Uber, Zipcar and Airbnb allow individuals to share infrastructure. For electric vehicles, Ubitricity has developed a mobile charging system that ensures the costs of charging a vehicle are linked to the owner, regardless of the charging location. We might see a similar approach emerging with, for instance, heating of rented properties. Rather than being tied to a physical meter, energy services would be tied to individuals, with costs allocated and payments made through smart technology.

The sharing economy highlights some of the potential limits to energy tariffs that are linked to a fixed location. It also raises interesting questions for how we think about shared infrastructure with regards to traditional domestic and non-domestic categories.

Possible regulatory implications

Bundled regulation?

Convergence of technologies and ownership across industries means that energy consumption is likely to be bundled with other products such as water, telecoms and transport. This raises important practical questions for us as the GB energy regulator, including how to determine whether consumers are receiving value for money from the energy-related components of their bills, and how to report and investigate allegations of mis-selling or other consumer protection breaches. Clearly, consumers and firms are unlikely to be well served by multiple concurrent investigations of a single alleged offence. Sector regulators, ombudsmen and consumer protection bodies will need to show that they can work together to facilitate developments that benefit consumers rather than standing in their way. To do so, they may need to align their regulatory approaches and requirements more closely, in order to provide a more seamless experience for consumers and firms.

With the growth of third party intermediaries such as price comparison websites, not licensed by sector regulators, we also see a blurring of the boundaries between regulation and general consumer protection law. Crucially, are there gaps between the two that could lead to detriment for consumers? Should we play a more formal role in setting and enforcing standards of behaviour for third party intermediaries when consumers may in practice see them as identical to licensed energy suppliers? Alternatively, should sector-specific regulation become more limited in scope, with a greater role for generic consumer protection arrangements across sectors? More generally, our conditions for licensing firms are likely to need to evolve in line with the changing energy landscape. We will continue to monitor closely how consumers interact with different parts of the energy sector in light of the technological and business model changes we have discussed in this paper.

Protecting less-engaged and vulnerable consumers

At the heart of the issues discussed in this paper is the notion that energy services in the future will be increasingly personalised to consumers. It is likely that a data-rich environment will permit segmentation of consumers in different ways. If greater segmentation is possible, then is it desirable? This is a fundamental question that cuts to the heart of the current requirement for licensed suppliers to offer terms to all domestic consumers. Allowing energy suppliers to choose 'desirable' customers is unlikely to be in the interest of consumers as a whole if it restricts competition to particular market sub-groups. However, in certain circumstances, characteristics such as location or demand profile could be used to offer a tariff that benefits both the consumer and the energy system.

Many of the changes we are witnessing with regards to new business models and products are potentially positive. But it is important that the less engaged and those in vulnerable situations are also able to benefit. With a greater diversity of service offerings and levels of engagement, our regulatory role could become more focussed on those who are less engaged or more vulnerable. Questions of fairness could become more prominent, with an expectation that we ensure that the benefits of innovation are shared across consumers.

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. We and government will need to be able to use large real-time datasets to allow us to respond quickly and effectively to issues such as vulnerability and fuel poverty – or we will need to ensure that companies are doing so. For example, data on heating profiles for a home could be used to determine the more cost-effective approach to cutting costs – switching fuels or improving energy efficiency.

Vulnerability could also manifest itself in different ways. We define vulnerability as occurring when consumers' personal circumstances and characteristics combine with aspects of the market to mean that they are significantly less able than typical consumers to protect their interests in the energy market, or significantly more likely to suffer detriment.^{xvi} As the energy system develops, we might find that, for instance, middle-income families with limited time or assets find it harder to get a reasonable deal. Not all consumers may want to or be able to participate in an energy system based on real-time transactions and active management of energy usage and generation. Some may choose to hand over control to third parties but others could be at risk of being left behind. Social enterprises and local authorities could play a crucial role in spreading the benefits of energy system innovation more widely across society.

Enabling change

In a rapidly-changing energy system, one of our key regulatory roles will be helping to enable firms to make changes that benefit consumers, through our rule-making, guidance and thought leadership. This will require greater understanding of the nature and extent of possible technological developments – while we cannot predict the future with certainty, we must be able to react quickly as possibilities begin to become more concrete. We will also need to continue to adapt to a changing landscape of energy suppliers, which is likely to include engagement with a wider range of firms and business models.

Sometimes, the best thing we can do will be to get out of the way and leave firms to innovate in ways that benefit both them and consumers. Through our Future of Retail Regulation project, we aim to establish broad principles that we expect energy companies to follow – without setting detailed rules as to how they should do so. But the extent of possible market or coordination failures in the energy sector means that we will sometimes have to intervene more actively, for instance to remove barriers to innovation (as in our recently-launched [Innovation Link](#)) or to achieve system-wide changes such as those needed to support domestic customer half-hourly settlement in electricity markets.

Many of the changes we hope to see will require consumers to change how they engage with the energy sector to achieve their full potential. Developments such as smart meter rollout and potential future changes to the appliances that heat our homes are examples of physical change that will enable, and in some instances require, consumers to behave in different ways. Communicating this message to energy consumers and active experimentation with business models and technologies that work with preferences will be key to the successful transition to a low-carbon economy.

If we do need to intervene to help consumers to engage more effectively, we must take heed of the lessons from previous interventions, summarised in Amelia Fletcher's recent report on behalf of Which?, "The Role of Demand-Side Remedies in Driving Effective Competition." These include looking to work with the grain of commercial approaches, and considering how firms' pricing strategies are likely to respond to regulatory interventions. In terms of process, the pace of change means that we will need to be able to test the effectiveness of proposed changes quickly, and adapt to the lessons learned. We are developing our approach to testing potential remedies to help us understand better how to implement them to benefit consumers.

End notes

- ⁱ DECC (2015) Energy Consumption in the UK
- ⁱⁱ The government's Standard Assessment Procedure (SAP) is used to monitor the energy efficiency of homes. It is an index based on calculating annual space and water heating costs for a standard heating regime and is expressed on a scale of 1 (highly inefficient) to 100 (zero net energy cost).
- ⁱⁱⁱ BEIS (January 2017) Solar Photovoltaics Deployment in the UK
- ^{iv} A blockchain is a distributed digital database that automatically tracks transactions across a network. It is the basis of the Bitcoin digital payment system.
- ^v Institute for Fiscal Studies, 'Maintaining pay in the modern era has become an unequal struggle' - <https://www.ifs.org.uk/publications/8783>
- ^{vi} Ofgem Data Portal (September 2016) Number of active domestic suppliers by fuel type (GB)
- ^{vii} Ofgem Data Portal (September 2016) Electricity supply market shares by company: Domestic (GB)
- ^{viii} Ofgem Data Portal (September 2016) Gas supply market shares by company: Domestic (GB)
- ^{viii} Ofgem Energy Plans (2016) What is a 'standard variable' rate and how does it compare?
- ^x Wilson and Waddams Price (2010) Do consumers switch to the best supplier?

Note: Data were gathered between 2000 and 2005, so do not reflect the substantial changes to the energy market since then.

- ^{xi} Report prepared for Ofgem by TNS BMRB (2016) Consumer engagement in the energy market since the Retail Market Review - 2016 Survey Findings
- ^{xii} A white label is an organisation that does not hold a supply license, but partners with a licensed supplier to offer energy using its own brand.
- ^{xiii} Ofgem (2016) Retail Energy Markets in 2016 - https://www.ofgem.gov.uk/system/files/docs/2016/08/retail_energy_markets_in_2016.pdf
- ^{xiv} Western Power Distribution (2017) Sunshine tariffs – the consumer response - <https://www.regensw.co.uk/sunshine-tariff>
- ^{xv} Deloitte (2016) Switch on to the connected home <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/consumer-business/deloitte-uk-consumer-review-16.pdf>
- ^{xvi} Ofgem (2013) Consumer vulnerability strategy <https://www.ofgem.gov.uk/ofgem-publications/75550/consumer-vulnerability-strategy-pdf>

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