Department for Business, Energy & Industrial Strategy

ofgem
Making a positive difference for energy consumers

# A SMART, FLEXIBLE ENERGY SYSTEM

## A call for evidence

November 2016

The call for evidence can be found on BEIS and Ofgem's website:
https://www.gov.uk/beis
https://www.ofgem.gov.uk/



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# Foreword

**Ministerial Foreword**

New technology is changing the way that we generate, distribute and consume energy. In particular, the application of information and communication technology is transforming our old passive energy networks into an increasingly smart energy system.

For instance, the Government is committed to rolling out around 53 million smart meters (together with the supporting infrastructure) by the end of 2020. Smart metering on this scale will provide the backbone of a transformed energy system in which we can produce and consume energy more flexibly and efficiently than ever before.

New demands on our energy system – for instance from electric vehicles and the need to manage renewable energy sources – mean that these enhanced capabilities aren't just advantageous, but essential. And, as well as meeting new challenges, we must seize the opportunities enabled by a smart system – including active demand-side response to price incentives, and the use of advanced energy storage technology.

The age of exclusive control by big energy companies and central government is over; we must maximise the ability of consumers to play an active role in managing their energy needs. With a smart system we can go further and faster in breaking down barriers to competition – allowing the widest possible range of innovative products and services to prove themselves in the market place.

To make the most of a smart system we need smart policy and smart regulation. Our ultimate objective – clean, secure and affordable energy – is clear, but a number of possible pathways lie before us. In this Call for Evidence we ask open questions about these strategic choices, which we will make with the best available information and always with current and future energy consumers at the heart of our decisions.

**Greg Clark**

**Secretary of State for Business, Energy and Industrial Strategy**

## Ofgem Foreword

This document is the first major step in making sure consumers benefit from the exciting changes in the energy sector.

It builds on the position paper on Flexibility we published last year. In that, we stated our priorities were the roles of storage and aggregators, demand side response (DSR) for industrial and commercial consumers, network and system operation, and the extent to which distribution network charges need to change.

The document reflects our joint work with Government on how we can make the most of innovation and new technologies in designing the future electricity system. It outlines what we can do now, and how we see the regulated monopolies' roles and responsibilities in the electricity sector evolving now and in the future.

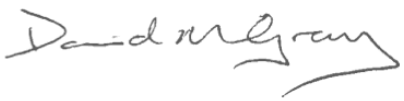
We want your views on how we and Government can create the right environment for consumers to benefit from a smarter, more flexible energy system at its fullest potential.

Today, we are doing this by implementing the CMA's remedies for the retail markets, by putting pressure on network and system costs, by holding the industry to account, and by promoting security of supply.

But this document also asks what we should do tomorrow. We already have a new framework for regulating network companies (RIIO), which incentivises them to respond to their customers' changing needs. We are also changing the way we regulate the retail markets of the future, to ensure suppliers treat their customers fairly. We consulted on the transformative potential of non-traditional business models and the challenges, risks and opportunities they create. In this document, we are now looking at where regulatory change or space for innovation is needed.

The system changes described in this call for evidence are happening across the world. We will continue to engage with others in Europe and elsewhere as we develop our thinking.

We're grateful for the many people who have so far engaged with us on this important work. They include new entrants who are pushing forward. This engagement will continue as we move to a smarter, more flexible system.



**David Gray**
**Chairman**

# Contents

# General information

**Purpose of this consultation:**

BEIS and Ofgem are seeking the views of energy industry players, including new entrants, and consumer groups on questions around how our energy system could be more smart and flexible.

**Issued**: 10 November 2016

**Respond by**: 12 January 2017

**Enquiries to:**


BEIS

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Consultation reference: Plan for a Smart, Flexible Energy System - A call for evidence

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Consultation reference: Plan for a Smart, Flexible Energy System – A call for evidence


**Territorial extent:**

Great Britain

**How to respond:**

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.
Where possible, responses should be submitted electronically via the e-consultation available at https://beisgovuk.citizenspace.com/energy-strategy-networks-markets/call-for-evidence-a-smart-flexible-energy-system/

Responses emailed to smartenergy@beis.gov.uk, flexibility@ofgem.gov.uk and hardcopy responses sent to the BEIS or Ofgem postal address will also be accepted.

**Additional copies:**

You may make copies of this document without seeking permission. An electronic version can be found at https://www.gov.uk/beis and https://www.ofgem.gov.uk

**Confidentiality and data protection:**

Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information legislation (primarily the Freedom of Information Act 2000, the Data Protection Act 1998 and the Environmental Information Regulations 2004). If you want information that you provide to be treated as confidential please say so clearly in writing when you send your response to the consultation. It would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded by us as a confidentiality request.

We intend to publish all responses in full for transparency purposes unless confidentiality is specifically requested. We will also summarise all responses and place this summary on the GOV.UK website and at https://www.ofgem.gov.uk. This summary will include a list of names or organisations that responded but not people's personal names, addresses or other contact details.

**Quality assurance:**

This consultation has been carried out in accordance with the Government's Consultation Principles. If you have any complaints about the consultation process (as opposed to comments about the issues which are the subject of the consultation) please address them to:

BEIS Consultation Co-ordinator
3 Whitehall Place
London SW1A 2AW
Email: consultation.coordinator@beis.gov.uk

# Towards a smart, flexible energy system

1. Government and Ofgem are committed to ensuring the energy system works for people and businesses. A smarter and more flexible system offers significant benefits for consumers and the economy. This can help to ensure the UK has a secure, affordable and clean energy system now and in the future, while helping to enable growth in all parts of the country.

2. Government and Ofgem are publishing this document together because we both recognise that the potential consumer benefits of a smart, more flexible system are significant, and that there is a need for both of us to act to deliver this. To make these changes successfully we will both need to exercise our independent responsibilities in a co-ordinated way.

3. This document is a product of a joint project on smart flexibility undertaken by teams in Government and Ofgem.

4. A smart energy system is one which uses information technology to intelligently integrate the actions of users connected to it, in order to efficiently deliver secure, sustainable and economic electricity supplies. Smart technologies will be an important source of future flexibility. 'Flexibility' refers to the ability to modify generation and/or consumption patterns in reaction to an external signal (such as a change in price, or a message).

5. The approach set out here is aligned with the development of the Government's Industrial Strategy. The proposals set out here can help to put power in the hand of consumers, use our resources efficiently to improve productivity in the UK, and develop expertise in growing sectors of the global economy.

## Why is a smart, flexible system important?

6. **For consumers, smart energy technology and processes have the potential to deliver lower bills and new services.** By integrating smart technology and techniques, generation and network assets can be used more efficiently. This has benefits for consumers as it puts downward pressure on bills and, in a potentially more power-hungry future, could be even more valuable. The transition to a smart energy system could feel as radical for consumers as the changes they have experienced in how they buy and use telecoms. This could mean increased complexity but also far greater consumer choice of new products and services which could benefit the individual and the energy system. We will remain mindful of the need to ensure the overall system reflects the needs of different types of consumers and that vulnerable consumers in particular are appropriately protected.

7. There is a growing body of evidence on the benefits for consumers of a smart and flexible energy system. Ofgem[1] and Government[2] set out our understanding of the benefits last year. The National Infrastructure Commission (NIC) reported on Smart Power in March, drawing on work from the Committee on Climate Change[3], stating that a smart system could provide gross benefits to consumers of £3-8bn a year in 2030, and making a number of recommendations[4]. The Government has already agreed to implement these recommendations[5]. A Government-commissioned study carried out by Imperial College London and the Carbon Trust and published alongside this document found broadly similar benefits, with a combination of flexible solutions in a whole systems approach saving GB consumers £17-40bn cumulative to 2050[6].

8. **For the current and future energy system, greater flexibility will help deliver security of supply**. It gives the System Operator (SO) and potentially other actors, more (and more affordable) options for the essential task of keeping the system in balance. We welcome the SO's efforts in this area including, for example, the Power Responsive campaign[7] aimed at increasing demand-side response (DSR), and the Enhanced Frequency Response[8] tender which procured 201MW of storage for balancing the system. Both storage and DSR can act as turn down (reducing demand from the grid) to avoid peak prices and turn up (increasing demand) to take advantage of plentiful electricity from low carbon generation. In the future, this flexibility could be even more valuable in managing a more complex and locally diverse energy system.

9. **It helps to make it simpler to integrate new, low carbon technologies into the system.** Energy storage allows the shifting of energy delivery from a time when it is less valuable to a time when it is more valuable. DSR can similarly shift demand towards times of plentiful and cost effective low carbon generation. Interconnection can let the UK export excess energy to other countries and import during expensive peak periods. As more inflexible and intermittent energy is deployed, this ability to flex supply and demand will become increasingly important for system stability and to avoid wasting low carbon generation. Similarly, as transport and heat are electrified, these will have the potential to increase peak demand significantly, and so the need for flexibility will increase further. In short, a smart system can help make the future low carbon GB energy system both affordable and secure. This gives the UK the opportunity to export expertise when it comes to integrating these technologies into a stable, secure energy system. UK companies in this field have the potential not only to innovate and grow at home but also to export their expertise in integrating low carbon technologies abroad.

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[1] https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/flexibility_position_paper_final_0.pdf
[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486362/Towards_a_smart_energy_system.pdf
[3] https://www.theccc.org.uk/wp-content/uploads/2015/10/Power-sector-scenarios-for-the-fifth-carbon-budget.pdf
[4] https://www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report
[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf
[6] The difference is largely explained by the NIC study covering gross, not net, benefits and by this analysis assuming an emissions intensity target of 50 g/kWh in 2030 for the high end of the range.
[7] http://www.powerresponsive.com/
[8] http://www2.nationalgrid.com/Enhanced-Frequency-Response.aspx

10. **Efforts to make our energy system smarter are complementary to bringing forward new generation such as gas.** The Government-commissioned research[9] shows that gas powered plants have a long-term role in the GB energy system, even in scenarios with low cost DSR and storage. The different technologies perform different and complementary roles, depending on their cost relative to other kinds of flexibility and system needs for flexibility over minutes, hours, or months in future energy scenarios.

11. **We want to create a system that allows disruptive innovation.** The GB energy system is already getting smarter: smart meters, smart grids, interconnectors and industrial DSR all make it possible for the electricity system to operate more efficiently. Smart technologies and processes are often disruptive and could require changes in the structures of GB's energy system and the roles played by existing industry parties. New business models could challenge incumbents and how they operate. Where these could bring overall benefits to consumers, we should allow them to do so. Government and Ofgem have a role to ensure that this transformation happens in the right way, to make sure new technologies can compete and consumers are both empowered and protected.

12. **The electrification of transport and heat will have significant implications for patterns and levels of power demand locally and nationally.** We need to ensure that the interventions we make are resilient to a wide range of potential demands for power from heat and transport whilst being proportionate and cost-efficient.

13. **We should act sooner rather than later so consumers can benefit now**. A more flexible system, with less redundancy, has the potential to be cheaper only if the investment in unnecessary traditional infrastructure is avoided. Given the pace of change, opportunities to realise these efficiencies are likely to arise in the short term and with the potential to deliver benefits over a longer period. At distribution level, for example, Distribution Network Operators (DNOs) are already considering how flexible solutions can give them optionality by deferring the investment in assets, the need for which might not arise.

## What are we aiming for?

14. **At the centre of our approach is ensuring effective markets and competition.** Markets can allow the best flexible solutions to flourish and deliver a secure, affordable low carbon energy system. We want to see competition that is as far reaching as possible to make sure consumers benefit from a more efficient energy system. This means facilitating competition, based on the outcomes the energy system needs, between:

9 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/554485/An_analysis_of_electricity_system_flexibility_for_Great_Britain.pdf

a) those offering services to consumers and to industry parties;
b) generation and other flexible alternatives (such as shifting demand away from peak periods or to periods of low demand, or greater interconnection with other countries); and
c) traditional infrastructure solutions (such as building network assets) and flexible alternatives (such as storing energy, or shifting demand).

The policy ambition is for flexibility providers to be able to access revenues which reflect the true value of their flexibility. In the current context, this means maximising access to the existing suite of markets (capacity, wholesale, balancing and ancillary services), alongside new markets (perhaps at a distribution network level, or for new services) and being able to stack value across them wherever appropriate. In the future, it could mean new market structures (such as flexibility trading platforms or DSO/SO procurement mechanism) where these better support our aims.

15. **Achieving this increased level of competition and a market-led system will require effective coordination between buyers and sellers of flexibility, and improved visibility and transparency.** The coordination will be needed to guard against conflicts or lost synergies. The increased visibility is needed to give buyers and sellers of flexibility improved lines-of-sight to the markets, and market signals which inform their long and short-term investment and operational decision making.

16. **We want to help energy consumers gain control of their bills and how much energy they use.** Smart technologies have a central role to play in this, and can provide consumers with greater control and choice. We want it to be easy for consumers to access the benefits of a smart system in whatever way works for them. So we want to enable innovative businesses to be able to offer new technologies and new services to consumers, many of which could build upon the smart meter infrastructure. For example, smart appliances can help consumers manage or reduce their bills by shifting some demand automatically to times of day when energy is cheaper, or when it is useful for system stability. The availability and affordability of these appliances could have a significant impact on how much flexible demand will exist. This in turn will affect the scale of benefits for all consumers from a smart energy system.

17. **Security of supply is vital.** A smart system can deliver energy security at a lower cost than would otherwise be the case. As new smart technologies and solutions emerge, the SO and the energy market will have a more diverse range of options for balancing supply and demand. This will need innovation in technologies, business models and consumer offerings. Equally, a smart system could face new risks, because it will be more complex and more driven by data and communication technologies. It is essential that a smart system remains a secure system.

18. **We want to encourage innovation**. A key role for Government and Ofgem is to create the environment for new ideas to flourish by removing barriers to innovation. The GB energy system needs technologies and infrastructure that are both cheap and clean, but it also

needs innovation in processes, transactions and customer offerings. Consumers will benefit most from an energy system and markets that can match the system need with the most cost-effective solution, in both the short and the long-term. This may require innovation in existing markets, or via new market platforms for trading and commissioning flexibility to allow value to flow through to providers of flexibility.

19. **We want to work in partnership with others to deliver change at the required pace**. Other countries around the world are facing similar challenges. We are looking at different approaches, with Government working with other governments and Ofgem working with other regulators. In GB, the SO, Transmission Owners (TOs), DNOs, suppliers, aggregators, tech companies, community energy groups, and consumer groups, amongst others, are already considering the challenges and opportunities smart technologies bring. The development of a smart systems plan is an opportunity to work together on this transition.

## What are the specifics?

20. In line with the plans both Government and Ofgem set out last year, we have considered a range of options to deliver a smart energy system, including:

- removing barriers to storage and DSR;
- improving price signals to allow more flexibility;
- catalysing innovation, so that new solutions can emerge and compete in the market; and
- assessing changes to roles and responsibilities in the energy system.

### Removing barriers

21. **For markets and competition to work effectively, smart technologies and new business models need to be able to compete fairly with more traditional solutions.** Our policy intent is that undue regulatory, commercial and legal barriers do not prevent the deployment of smart technologies and processes, or new service providers competing in markets. In our work so far, we have looked in particular at how storage and aggregators fit in to current arrangements.

22. **We have found that storage faces a number of barriers:**

- **how storage connects to the network.** We have identified that greater clarity is needed on how the connection process works for storage and set out options for achieving this;
- **how storage is charged for using the electricity network.** Charging methodologies applied to storage by network operators may not accurately reflect the value and costs storage imposes on the network. We want to see storage compete on a level playing

field with other forms of flexibility. Ofgem is investigating the extent to which charging arrangements reflect this;

- **the absence of a definition of storage in legislation** can lead to a lack of clarity when storage interacts with other legislation and regulations, including the planning framework**.** We have identified options for addressing this, ranging from creating a licence to lighter touch approaches; and
- **how final consumption levies are charged to storage.** As mentioned above, storage is not explicitly defined in existing legislation, which obliges energy suppliers to fund renewable support schemes[10] and the Climate Change Levy. This means that storage can be charged as an end user of electricity (even when this electricity is exported and used a second time). We are looking to address this double counting and have set out options for doing so.

23. **Aggregators have a role to play in delivering smart technology and processes. They enable consumers to offer flexibility by providing an intermediary role.** Last year, Ofgem committed to clarifying the role of aggregators and their relationships with other parties, and assessing the need for policy intervention and regulatory oversight. This work has identified, through close engagement with stakeholders, a number of reported barriers including challenges in selling services to the SO and accessing the balancing mechanism. There could be some further potential issues including cross-party impacts in the energy market, aggregated actions that impact on the secure operation of a local or national system, and issues in relation to consumer protection risks. We set out options for addressing all these issues and ask for views on the proposed approach.

24. In this document we also ask stakeholders for evidence of more general barriers (i.e. barriers not specific to technologies or business models) experienced by providers of flexibility. This includes difficulties in accessing multiple revenue streams, for example, barriers to providing services to both the SO and the DNO due to lack of visibility.

## Improving price signals

25. The GB energy system already has some well-functioning price signals that shape the profiles of generation and demand. We recognise that to deliver the full benefits of flexibility, these price signals will need to develop to reflect the value to the energy system of smart technologies and processes. We have focused on particular aspects of the system so far, but we welcome views and evidence from stakeholders on overall market design as well as the particular elements we have drawn out.

26. Government has already carried out work on the whole system impacts of different generating technologies. Government's policy intention is for those offering flexibility to be appropriately rewarded for the range of benefits that they can provide, such as shifting load away from peak times. Ofgem is considering whether the costs and benefits are currently

[10] The Renewables Obligation, the Feed In Tariff, and Contracts for Difference.

reflected efficiently in the market to minimise total system costs, and if not, where action is most pressing. This should improve the price signals for flexibility.

27. In the industrial sector, there is already a significant amount of DSR (especially generation-led) and many of the building blocks are already in place for this to expand further. Under its Power Responsive campaign, the SO is working to ensure that balancing services work as well for demand flexibility as they have done historically for generators. The SO aims for 30-50% of balancing services capabilities to come from the demand side by 2020.

28. Government is also considering process changes to the Capacity Market, where these could be made in the short-term to reduce administrative and cost barriers. We are keen to understand any further issues for industrial and commercial customers engaging in DSR, and what more can be done to foster their participation.

29. For domestic consumers and small businesses, these building blocks are not in place. There are limited price signals from which these consumers can benefit. We are committed to making greater participation in DSR possible for domestic consumers and small businesses too.

30. **Smart meters.** Government is committed to ensuring that smart meters are offered to every home and small business by the end of 2020. The programme involves replacing meters that, in some cases, are based on technology that is over 100 years old. Smart meters provide the means for consumers to benefit from more control, cheaper bills and new services. These meters will also be the foundation of a smart system that is accessible to domestic and smaller non-domestic customers.

31. **Half-hourly settlement,** using the functionality provided by smart meters, can help support the move towards a smarter, more flexible energy system. A Balancing and Settlement Code modification (P272) is ensuring the move to half-hourly settlement for larger non-domestic consumers. However, as the Competition & Markets Authority (CMA) has noted, current settlement arrangements for domestic and smaller non-domestic consumers limit suppliers' incentives to encourage their customers to voluntarily change the times at which they consume energy. This means that at present neither consumers nor the energy system can benefit.

32. We consider there is a strong case for half-hourly settlement to be enabled alongside the smart meter roll-out. Ofgem is taking forward work to remove the barriers to suppliers and smaller consumers choosing elective half-hourly settlement by early 2017. This work will also consider the approach for moving to mandatory half-hourly settlement, with a decision to be taken on the timescale and approach in 2018. Government has published draft

legislation that would help Ofgem deliver these reforms more efficiently[11]. A consultation on the plan for mandatory half-hourly settlement will be published very shortly.

33. **Smart tariffs** will play a key role in helping consumers participate in the future smart energy system. There are currently very limited offerings in the domestic and smaller non-domestic sector, primarily due to a lack of smart and advanced metering, and half-hourly settlement. However, we would expect more smart tariffs to become available once these enablers are in place.

## A system for the consumer

34. **The participation of a range of consumers is necessary for the development of an efficient smart energy system**. In addition to receiving a price signal, consumers will need to find it easy and appealing to participate. The option of automation, through technologies such as smart appliances and electric vehicle charging, would help with this and innovative suppliers could develop systems to automatically flex demand to align with prices. Consumers will need to be aware of the opportunities available, be clearly informed about what their participation will entail, and have a clear choice about whether and how they participate. Ensuring that the energy system focuses on the needs of current and future consumers is an on-going priority for Government and Ofgem.

35. **Smart appliances that can automatically respond to signals from the energy system can play an important role** in enabling widespread participation in a smart energy system. Government believes that open standards which ensure the interoperability of smart appliances are essential for enabling the market in these appliances to grow, and so that the appliances work for consumers. Through this document we are seeking views on our approach to supporting the growth of smart appliances and removing the barriers to their wider uptake.

36. **Ultra-low emission vehicles are vital to cutting carbon emissions and tackling air pollution.** Both battery electric and hydrogen fuel cell vehicles are expected to play key roles in the transition towards cleaner road transport. However, these vehicles bring with them new challenges and opportunities for the energy system. Without any intervention, there is a risk that electricity demand to support these vehicles could add to existing demand peaks, triggering expensive network reinforcements and a need for additional peak generation capacity.

37. **Electric vehicles have the potential to shift demand, provide system services or store energy** in ways that make our energy system more efficient. We have an opportunity to help shape norms, expectations and markets so that electric vehicles are integrated into

[11] https://www.gov.uk/government/publications/draft-legislation-on-energy

our energy system in the most cost effective way, taking advantage of the full range of capabilities that they offer. We seek views on what roles Government and industry should play in bringing forward smart charging propositions for consumers, and whether there are particular barriers in the development of this market.[12]

38. **Data access and consumer consent.** The move to a smarter energy system will increase the volume, need for and availability of data. Where this data is personal, including where it relates to detailed consumption patterns, the right consumer safeguards must be in place. We need to ensure that appropriate protections are established to safeguard consumers and provide confidence in the security of smart offerings.

39. **Some consumers will be less able to benefit from a smart energy system than others**, for example because they are less able to move their energy consumption away from peak times. We will therefore need to consider any social impacts, including those on consumers who are vulnerable in different ways, such as ability to access the internet or inability to shift electricity usage, and decide how these are reflected in policy design.

40. **Cyber security and system stability.** A smart energy system has greater interconnectivity and data exchange than a traditional one. Increasing connection to the internet of smart technologies could potentially increase vulnerability if security is not incorporated into frameworks and designs. By designing security in from the outset, we can maximise its effectiveness, while still securing the benefits that a smart interconnected energy system can bring.

## Network and system operation

41. **We are mindful of the potential for significant changes to the framework of the energy system.** Smart technologies and processes are potentially disruptive and could provoke changes in the structures of GB's energy system and the roles played by existing industry parties. New business models could challenge incumbents and how they operate. Where these could bring overall benefits to consumers, we should enable them to do so.

42. We have been thinking broadly about the need for changes to roles and responsibilities in the current GB energy system, drawing on work by the Energy Systems Catapult and the Institution of Engineering and Technology[13] amongst others. Like them, we are considering how the architecture of the future power system might need to change to respond to advanced technologies and emerging new business models in a way which meets the overall needs of consumers. An early focus area for Government and Ofgem has been the role of regulated monopolies in the energy system. We will continue to consider the work of the Energy Systems Catapult on the new functionalities that the energy system will require

[12] https://www.gov.uk/government/consultations/proposed-ulev-measures-for-inclusion-in-the-modern-transport-bill

[13] https://es.catapult.org.uk/what-we-do/fpsa/

as it transitions to provide smart and more flexible capabilities. The Energy and Climate Change Committee also investigated changes required from today's electricity infrastructure to build a low carbon, flexible and fair network. Their final report makes a number of recommendations in this area.[14]

43. The changing GB energy system is leading to increasing interactions between the electricity transmission and distribution networks, and a greater role for active management of supply and demand on distribution networks than previously. As the system changes, there is a growing need for parties to move away from traditional roles and to explore market based solutions together with the technical, commercial and governance systems needed to facilitate this. A smart, more flexible energy system is likely to require both an evolving role for existing actors and an increasing role for other market participants who have the potential to contribute to system and network operation in new ways.

44. In the immediate term, DNOs need to transition to Distribution System Operator (DSO) roles. This includes making active use of new technologies, providers and solutions in managing distribution networks, as well as having an increased role in delivering an economic, efficient and co-ordinated wider system. DSOs, the electricity SO and TOs also need to significantly increase engagement with one another, and other parties, to deliver the best whole system outcome for consumers.

### How to approach further potential changes to roles & responsibilities

45. When considering the specifics of the system and network operator roles, it is possible that further, more far-reaching, changes to roles and responsibilities in the future could help deliver system requirements and meet the needs of users.

46. As the precise nature of the future system remains uncertain, there is value in market arrangements that are resilient across a broad spectrum of scenarios. With a great amount of research being conducted into aspects of the evolving energy system, the potential for technology disruption is considerable. Indeed, given the proactive approaches of businesses in this space, there is a reasonable possibility that the environment may evolve significantly. However, a way to mitigate so many unknowns is to foster a flexible system that is able to absorb changes. Using competitive approaches wherever possible can help deliver maximum benefit to consumers in this context. In this document, we ask for views and evidence, not just on near-term incremental changes, but also on the possibility and desirability of more fundamental changes – and how the two interact.

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[14] The Energy and Climate Change Committee also investigated changes required from today's electricity infrastructure to build a low carbon, flexible and fair network. Their final report makes a number of recommendations in these areas: http://www.publications.parliament.uk/pa/cm201617/cmselect/cmenergy/267/267.pdf

## Catalysing innovation

47. Government and Ofgem have a key role to play in catalysing innovation in smart technologies and solutions. Innovation support can address "first mover" risks, bring down costs, and demonstrate new technologies and business models. This can generate important lessons for Government and businesses, and support wider uptake.

48. Ofgem's network innovation competitions currently allocate up to £99m of consumer funding a year for network innovation. Ofgem's Low Carbon Network Fund (LCNF) played a key role in helping network operators understand how they will support the transition to a low carbon economy in a secure and value-for-money way. A number of innovative technologies piloted by the LCNF are now being rolled out as business-as-usual across the network (e.g. active network management). The Electricity Network Innovation Competition – successor to the LCNF – is continuing this work.

49. Ofgem will consult later this year, following its evaluation of the LCNF, on how the programme can be improved. One of its aims is to ensure that genuinely innovative projects and technologies which can bring benefits to networks and consumers can be brought forward. In late 2016, Ofgem will launch a new Innovation Link service to promote beneficial innovation in the energy sector and inform how we regulate in the future. Ofgem will also bring forward proposals in due course on providing innovation spaces for experimentation, giving more regulatory certainty for innovative approaches and products to be trialled within the existing regulatory framework.

50. As announced in Budget 2016, the Government has at least £50m of funding to support innovation in DSR, storage and smart technologies. Government has identified a number of potential priority areas over the next 5 years:

(i) **commercial and residential DSR.** In order to catalyse innovative DSR services for residential and SME customers, Government thinks it would be valuable to explore approaches involving intelligent automation of flexible loads e.g. electric vehicles, electric heating/cooling, smart appliances, storage devices, etc;

(ii) **flexibility trading/optimisation platforms.** Government believes there may be a case for further innovation support here. Our objective would be to support optimal use of flexibility to help flexibility providers realise the true value of their resource, and to mitigate prioritisation conflicts between multiple users of flexibility;

(iii) **storage costs.** Government believes there is a good case for further innovation support to catalyse the development of alternative storage technologies, which have the potential to be more cost-effective at grid scale than more mature systems, such as Li-ion batteries or pumped storage. This could be facilitated by demonstrators of large-scale storage technologies, e.g. compressed air or power-to-gas, or support for component level development, manufacturing process, or efficiency improvements; and

(iv) **Vehicle to grid.** As the number of EVs increases, there is potential for them to provide flexibility, including balancing services. Government believes there is a case for innovation to test availability and cost of infrastructure, viability of stacking services, and models that work for both business fleets and private consumers as well as to encourage development of offerings which could incentivise EV owners to shift charging away from the peak loads.

51. We welcome comments on these potential priorities, or suggestions of alternatives in Chapter 6. Subject to responses and further assessment of priorities, we intend to set out detailed plans in the plan.

## Next steps

52. The responses to this document, as well as wider engagement, will help shape the plan that we plan to publish in Spring 2017. This plan will set out the specific actions we plan to take to remove barriers, sharpen price signals and shape roles and responsibilities in the shift to a smart, more flexible energy system which meets the needs of consumers now and in the future.

53. The table below reflects our current thinking on longer-term aims, sequencing of work and how our work will fit with other key milestones. We will update this and provide more details in our plan, but considered that sharing this high level view of next steps would be useful at this stage.

## Table 1: Next Steps

| | Actions under way for 2016/17 | In the final plan we will set out implementation tasks and timelines for: | Current view of aims and selected milestones to 2020 |
|---|---|---|---|
| **Removing barriers** | - Data and Communications Company starts operating<br>- System Operator procurement of Enhanced Frequency Response<br>- Capacity Market transitional arrangements auction for DSR (March 2017)<br>- Assessment of whether flexibility providers can access existing markets on reasonable terms | - Any further measures to make it easier for storage to connect to the network<br>- A decision on regulatory definition for storage and whether a new licence is required<br>- A decision on whether to create a new route for independent aggregators to access the Balancing Mechanism | Our aim: a level playing field for DSR and storage competing with other forms of flexibility and more traditional solutions.<br>- Enhanced Frequency Response providers operating (March 2018)<br>- Ancillary services and other markets accessible to new types of flexibility<br>- Decision on appropriate long term regulatory regime for aggregators and other new flexibility providers including any consumer protection needed. |
| **Improving price signals** | - Elective half hourly settlement streamlined (early 2017)<br>- Ofgem open letter on embedded benefits (published July 2016). Our follow-up work to this including consulting on a targeted charging review.<br>- Technical changes to the Capacity Market with regard to the participation of DSR<br>- Assessment of flexibility providers ability to stack value across potential markets | - Ofgem's view on future distribution charging reform<br>- Proposals for changes to how the charging regime applies to storage<br>- A decision on how final consumption levies should apply to storage | Our aim: right price signals in place for a smarter and more flexible system.<br>- Roll-out of around 53 million smart meters and supporting infrastructure complete (by end 2020)<br>- A decision on move to mandatory half hourly settlement (1st half 2018)<br>- SO has an ambition for 30-50%[15] balancing services capabilities to come from the demand side by 2020<br>- SO ancillary services work as well for the demand side as the supply side, and issues of contract exclusivity addressed<br>- 2019 review of the Capacity Market |

[15] See Q30. http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/energy-and-climate-change-committee/energy-revolution/oral/40839.html

| | | | |
|---|---|---|---|
| **A system for the consumer** | - Government-commissioned study on cyber security and smart<br>- National Cyber Security Centre launched (November 2016)<br>- Government-commissioned study on: Realising the potential of DSR to 2025 – a focus on small energy users<br>- Ofgem-commissioned study on the potential distributional impacts of smart tariffs<br>- Assessment of need for additional consumer protection on potential for mis-selling, data privacy, and social impacts of smart | - A decision on whether additional consumer protections are needed | Our aim: consumers can choose smart tariffs and smart appliances with confidence.<br>- new proposals on smart appliances could enter into force<br>- appropriate consumer protections are place |
| **Assessing roles & responsibilities** | - Improved SO-TO-DSO coordination, including through ENA's Transmission and Distribution Interface (TDI) Group<br>- DNOs are transitioning to DSO roles under RIIO-ED1 framework | - Direction on any further changes to roles and market arrangements to support system coordination and support appropriate valuation of flexibility<br>- Flexibility trading / optimisation platforms identified for Government smart innovation funding | Our aim: roles and market arrangements support efficient, coordinated whole system planning and operations<br>- Ofgem develops strategy for next transmission (from 2021) and distribution (from 2023) price reviews<br>- Review of progress on DNO-DSO transition and SO-TO-DSO coordination (2017) |
| **Catalysing innovation** | - BEIS Innovation Programme set out (end 2016)<br>- Ofgem launches Innovation Link to promote beneficial innovation in the energy sector (end 2016)<br>- Annual Network Innovation Competition decisions from Ofgem (end 2016)<br>- DNOs rolling out innovative solution as business as usual | - Specific Government smart innovation programmes<br>- Proposals for future funding and governance of Ofgem's Network Innovation Competitions | Our aim: a vibrant smart energy market where innovation can flourish<br>- Implementation of BEIS smart innovation programmes, and key findings published |

# 1. Introduction

## 1.1 Flexibility in the energy system

1. To keep the power system stable, supply and demand have to balance in real time. Flexibility refers to the ability to modify generation and/or consumption patterns in reaction to an external signal (such as a change in price, or a message)

2. Flexibility has always been a feature of energy markets. But using new and existing forms of flexibility efficiently is key to making the most of the opportunities and responding to the challenges of a changing system.

3. As traditional sources of flexibility decline, we need new types of flexibility and to take the opportunities offered by information technology to deliver smart, flexible energy systems; simply building high numbers of new power stations and networks will not be efficient.

4. In this document we use ‘smart’ to mean enabled by information technology to intelligently integrate the actions of connected users in order to efficiently deliver secure sustainable and economic electricity supplies. Smart technologies will be an important source of future flexibility.

5. Combining these solutions in a whole system approach would help us achieve the following benefits:
   a) defer or avoid investment in network reinforcement;
   b) reduce the need for a significant increase in reserve generation capacity;
   c) meet binding climate change targets with less low carbon generation;
   d) make the best use of our low carbon generation; and
   e) optimise balancing of our energy system on a minute-by-minute basis.

6. These approaches will allow us to deliver a power system which meets the needs of consumers more cost effectively. There are a range of studies which quantify the benefits of enhanced flexibility.

7. Government has commissioned new modelling from Imperial College and the Carbon Trust which analysed illustrative deployment of specific flexible technologies in different demand scenarios given different technology cost trajectories. The modelling, which is published alongside this document, identified that:
   - combining flexible solutions in a whole system approach could save the UK £17-40bn cumulative to 2050 through building less low carbon generation capacity, reducing peaking plant and fuel spending, and deferring investment in network reinforcement while still meeting carbon targets. The study found net benefits of deploying flexibility

technologies in the range of £1.4-2.4bn/year in 2030. For the National Infrastructure Commission, Imperial College used the same model to estimate gross benefits of £3-8bn/year in 2030, but with a higher penetration of low carbon generation for the high end of the range;[16]

- deploying demand side response (DSR) early (i.e. ~5GW by 2020 based on our best assumptions), but reducing deployment if costs are higher than expected, delivers benefits across all of the illustrative scenarios to 2050; and
- deploying a balanced mix of flexibility technologies delivers benefits across a range of scenarios.

8. Enabling a smarter, more efficient energy system is a priority for both Government and Ofgem. As patterns of energy supply and demand change we need a system that can cope more efficiently. This document builds on work that Government, Ofgem and others have already undertaken to understand and communicate the benefits of such a move and what will need to change to get there.

[16] Imperial College and the Carbon Trust (2016), LWR study (commissioned by BEIS)

## 1.2 Chapters in this document

**Table 2: Document sections**

| Chapter | High level summary |
|---|---|
| **Removing policy and regulatory barriers** | Enabling new and existing forms of flexibility to compete efficiently within the energy market is key to ensuring that we will have a dynamic and responsive energy system which works for consumers and supports low carbon generation.<br><br>We want a policy and regulatory framework that ensures that barriers are not hindering their development. This chapter focuses on storage and aggregators, where a number of challenges have already been identified in line with the recommendations of the National Infrastructure Commission[17]. We discuss the barriers facing each industry, potential solutions, and ask for your views. |
| **Providing price signals for flexibility** | Our energy system already has some well-functioning price signals that shape the profiles of generation and demand. We recognise that to deliver the full benefits of flexibility these price signals will need to develop to reflect the value to our energy system of smart technologies and processes. We have focused on particular aspects of the system which we see as key to enabling flexibility. We welcome evidence on these particular elements, which will inform the plan we will publish later. We also welcome evidence on other price signals which will inform our longer term thinking. |
| **A system for the consumer** | Consumers are at the heart of the development of a smart energy system, which can give them choice and control over how they use electricity, including any that they generate themselves. The participation of a diverse range of consumers can help enable the development of a more efficient smart energy system. Government and Ofgem need to develop policy and regulation that facilitates consumer benefits.<br><br>We welcome views on how to ensure that consumers can participate in a smarter energy system where they may benefit from doing so. We consider the potential for smart appliances and electric vehicles to help in this, and the barriers that may be preventing some users from offering DSR to the system. We also consider how consumer |

[17] In the National Infrastructure Commission's report on Smart Power recommendation 2a) was that "*DECC and Ofgem should review the regulatory and legal status of storage to remove outdated barriers and to enable storage to compete fairly with generation across the various interlinked electricity markets. The reforms should be proposed by Spring 2017 and implemented as soon as possible thereafter.*" https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf

| Chapter | High level summary |
|---|---|
| | protection may need to evolve, and the need for cyber security measures to protect consumers and the system. |
| **The roles of different parties in the system and network operation** | Our changing system is leading to increasing interactions between the transmission and distribution networks, and a greater role for active management of supply and demand on distribution networks than previously. As the system changes, there is a growing need for parties to evolve away from traditional roles, and a need to think about how best to enable both existing and new market participants to support network and system operation.<br><br>This chapter considers how the roles of different parties need to evolve to ensure that networks, and the whole electricity system more broadly, are managed efficiently. |
| **Innovation** | This chapter seeks views and evidence on whether we have identified the right areas for innovation support, and which other areas might warrant support. |

# 2. Removing policy and regulatory barriers

**Enabling new and existing forms of flexibility to compete efficiently within the energy market is key to ensuring that we will have a dynamic and responsive energy system which works for consumers and supports low carbon generation.**

**We want a policy and regulatory framework that ensures that barriers are not hindering their development. This chapter focuses in particular on storage and aggregators where a number of challenges have already been identified in line with the recommendations of the National Infrastructure Commission[18]. We discuss the barriers facing each industry, potential solutions, and ask for views.**

## 2.1 Enabling storage

1. There is increasing interest in energy storage as a potential source of flexibility for our energy system, driven in part because the costs of some storage technologies, especially batteries, are falling fast – on a scale similar to that seen for solar PV. Lithium-ion battery costs fell around 14% pa from 2007-2014 and are forecast to reduce further (albeit at a slower rate)[19] – at around 6% pa reduction for EV batteries from 2015 to 2020[20]. Scaled up battery production (e.g. Tesla's giga-factory) combined with growing demand for EVs and to a lesser extent static storage have been the main drivers of these cost reductions.

2. Falling costs are one element of bringing forward large scale storage projects – the market and its structures must also recognise and reward storage for the value it brings to the energy system. One example of where falling costs and rewarding flexibility have come together is in the System Operator (SO)'s recent tender for Enhanced Frequency Response, which saw 201MW of the service procured from storage providers. Our role in enabling a market for storage is to ensure a level playing field exists so it can compete fairly with other sources of flexibility, including by removing policy and regulatory barriers. This chapter on storage identifies the main barriers:

    - network connections;
    - network charging;
    - final consumption levies;
    - planning; and
    - regulatory clarity.

[18] In the National Infrastructure Commission's report on Smart Power recommendation 2a) was that "*DECC and Ofgem should review the regulatory and legal status of storage to remove outdated barriers and to enable storage to compete fairly with generation across the various interlinked electricity markets. The reforms should be proposed by Spring 2017 and implemented as soon as possible thereafter.*" https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf

[19] US White House report on "Incorporating Renewables into the electric Grid: Expanding Opportunities for Smart Markets and EnergyStorage" *https://www.whitehouse.gov/sites/default/files/page/files/20160616_cea_renewables_electricgrid.pdf*

[20] *Nykvist, B. & Nilsson, M. Rapidly falling costs of battery packs for electric vehicles Nature Climate Change 5, 329–332 (2015)*

3. We are seeking views on solutions; both for individual barriers and whether some solutions could address multiple barriers e.g. regulatory clarity. This section focuses on issues that are most relevant to electricity storage. Other sections of this document, such as the potential alternative market models discussed in chapter 5, as well as smart tariffs and smart distribution tariffs, low emission vehicles in a smart energy system and aggregators, are also relevant for stakeholders with an interest in storage. Section 6 on innovation considers how to promote other forms of energy storage.

### 2.1.1 Network connections for storage

4. Network operators have well established rules and processes for connecting traditional demand and generation customers to the network. Storage connections, on the other hand, are relatively unusual in GB. Unlike typical demand or generation connections, storage connections require both import and export capacity, and the connection characteristics vary depending on the use, size and location of the connection. These requirements and complexities can create uncertainty for the storage connections process, for both network operators and developers. There is also uncertainty for network operators on the impact storage will have on networks. The number and volume of connection applications for storage is increasing rapidly. Around 19GW of storage applications have been made to DNOs in recent months.

5. Getting a timely and fairly priced network connection is important for all customers, and it is important that the connections process also works for storage customers. Ofgem's on-going work on improving connections, including quicker and more efficient connections,[21] has instigated a series of industry actions aimed at reducing the cost and time of connecting by:

    - reducing the need for reinforcement via network management;
    - reducing the need for reinforcement by managing connection offers; and
    - providing more flexible terms for the recovery of connection charges.

6. In Table 3 below we summarise some of these actions and other work being carried out by industry. We also indicate where we think more work is required to specifically address issues facing storage connectees. We expect industry to deliver on these actions and will provide an update on progress and on any outstanding areas in our plan publication.

[21] https://www.ofgem.gov.uk/publications-and-updates/quicker-and-more-efficient-connections-update-industry-progress

### Table 3 Network connections for storage

| Issue | On-going work | Further work required |
|---|---|---|
| **Clarity on connections process – how to connect and where to connect** | | |
| Developers require more clarity on the connections process for storage e.g. clarity on connection types. | The Energy Networks Association (ENA) published a new standardised application form for storage connections. This should ensure DNOs consistently collect information from developers.[22]<br><br>The IET are developing a code of practice for electricity storage systems.<br><br>A grid code working group has been established to consider appropriate technical requirements for storage technologies connecting to the transmission network.[23] | Network operators need to provide more clarity on the process for storage connections (including transmission connected). The work carried out to date is a positive step forward but more work is needed.<br><br>When planning connections, network operators are required to comply with network security of supply standards. It is unclear how storage should be treated for the purposes of these standards[24] as its effects may be positive (deferring reinforcement) or negative (requiring reinforcement), depending on its use. Network operators should carry out further analysis to fully understand this, including in the current review of Engineering Recommendation P2/6.[25] |
| If storage is added to a site with an existing demand or generation connection it is unclear if it should be treated as a material change to the original connection.[26] | The ENA has consulted on what constitutes a material change to a connection for distribution networks.[27] | The ENA and network operators need to work with industry to understand how storage paired with current connections will affect the network and define processes for new or modified connections. |
| Lack of information on where to connect storage, inhibiting full system benefits of storage being realised, and leading to high volume of connection applications. | Some DNOs have developed, or are considering developing, heat maps to include demand. | Network operators need to continue to innovate to provide better information to storage customers. This could be done by providing demand heat maps or commercial opportunities for storage where it could defer, or provide an alternative to traditional network reinforcement. |

[22] http://www.energynetworks.org/electricity/futures/energy-storage/energy-storage-further-information-request.html
[23] GC 00096 Energy Storage
[24] Security and Quality of Supply Standard (SQSS) applies at transmission level and P2/6 applies at distribution level
[25] http://www.dcode.org.uk/dcrp-er-p2-working-group.html
[26] When storage is paired with a pre-existing demand or generation customer's connection, it may alter the impact of the connection on the network, and require a new or modified connection agreement
[27] ENA consultation on Fair and Effective Management of DNO Connection Queues: Treatment of Changes to Connection Applications http://www.energynetworks.org/assets/files/news/consultation-responses/Consultation%20responses%202016/Fair%20and%20Effective%20Management%20of%20DNO%20Connection%20Queues%20Treating%20Changes%20within%20Applications.pdf

| Issue | On-going work | Further work required |
|---|---|---|
| **Cost and time of connecting** | | |
| High cost of connecting.<br><br>Lack of capacity for fully firm connections. | The ENA has consulted on using milestones in connection offers, which will help DNOs free up unused capacity in the future.[28]<br><br>The ENA/DNO-DG steering group is working with DNOs to see how they can release capacity from underutilised connections.<br><br>The ENA has published information on flexible connection agreements available for generation.[29] | Network operators and industry should ensure flexible connections are available for storage. These contracts could set out what services the storage facility will provide with the associated timeframes, which could ensure the connection contracts are better aligned to actual use of the connection and the associated impact on the network.<br><br>Work should be done to better align flexibility products (e.g. Enhanced Frequency Response, network constraint management) between DNOs and the SO to enable whole system value. This concept of shared services is being discussed at the ENA's Transmission Distribution Interface working group, the Shared Services Working Group and the Active Network Management Group, but more progress is required. This is closely linked to discussion on efficient local/system-wide use of resources between the SO and DNOs in Section 6. |
| Storage may need to queue for a long time behind generation for a connection even if it can relieve constraints. | | If a DNO can demonstrate that other customers within the queue can benefit from storage connecting (by enabling quicker and less costly connections through avoided need for reinforcement) then DNOs should promote storage. |

### 2.1.2 Network charging for storage

7. Network charging methodologies were not designed with storage in mind and so applying them to storage can create problems. Following a review of these issues we consider that some comparatively simple changes could be made now to improve the way storage is treated. We have also identified other issues relating to the contribution to network cost recovery which Ofgem will consult on soon as indicated in Ofgem's recent open letter [30]. Other changes may be required in the future if the wider charging structure is amended.

8. The first of the changes which should be addressed is to provide clear guidance in the charging methodologies on whether storage should be classified as intermittent or non-intermittent. The Transmission Network Use of System Charges (TNUoS) and Distribution Use of System Charges (DUoS) can vary significantly depending on whether a generator is classed as intermittent or non-intermittent.[31] This reflects the impact that different types of

[28] ENA consultation on Progression Milestones: http://www.energynetworks.org/assets/files/news/consultation-responses/Consultation%20responses%202016/Queue%20Management%20Milestones%20consultation%20April%202016%20-%20FINAL.pdf

[29] Further information on flexible connections: http://www.energynetworks.org/electricity/futures/flexible-connections.html

[30] Ofgem open letter: Charging arrangements for embedded generation

[31] Detailed analysis of the impact of classification of storage as intermittent or non-intermittent can be found in the Smarter Network Storage report – Electricity Storage in GB: SNS 4.7 Recommendations for regulatory and legal framework: http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/Report+9.5+19Oct_v2.1_(Final+Photos).pdf

generators have on the transmission system and distribution networks. For example, non-intermittent generators connected to the distribution network can be relied on to generate at peak times, allowing network operators to offset distribution network investment. As a result DUoS charges for intermittent generators tend to be greater than for equivalent non-intermittent generators.[32]

9. At present storage tends to be treated as non-intermittent, but as there is no guidance on this in the charging methodologies, it could lead to discrepancies in treatment by different network operators. This could also create difficulties and uncertainty for storage developers in estimating their network charges. We understand that the industry is planning to consider this as part of its review of the Common Distribution Charging Methodology (CDCM). However, we think this issue can be addressed immediately at both transmission and distribution level, and Ofgem will actively engage with industry parties to ensure this happens.

10. The second area for immediate action is to ensure flexible connections are available for storage. The National Infrastructure Commission noted that network charges do not take account of the fact that storage is likely to export power at times of peak load, and import power at times of peak generation, reducing the stresses faced by the network rather than increasing them.[33] We agree that storage can have a positive impact and reduce a network operator's costs; but it could also drive network costs by adding to peak usage, although the incentives for storage generally discourage this behaviour.[34] One way to ensure that network charges better reflect the value and costs of storage is for network operators to provide flexible connection and charging agreements in line with the actual operation of the storage facility. Flexible connections can lower network charges and could be used to provide a revenue stream to storage based on avoided network reinforcement costs for network operators.[35] In Chapter 3, we ask questions about barriers to accessing these sorts of revenue streams.

11. Network charges should represent a cost reflective and fair recovery of network costs. Without this there is risk of competition distortion and a lack of level playing field for those using the network to deliver flexibility. Our view is that while storage should pay network charges for both import and export, as it uses the network for both, there are some instances where storage may pay more towards network cost recovery when compared with other users under the current charging regime.

12. For example, under the current charging methodologies, the cost recovery element of DUoS and TNUoS charges is mainly levied on demand customers who use the network at

[32] Intermittent and non-intermittent generators are also treated differently at a transmission level.
[33] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf
[34] For further discussion of the cross-system impacts associated with the use of distribution connected flexibility resources, and possible ways to manage them, please see chapter 6 on roles and responsibilities of parties in system and network operation.
[35] UKPN's SNS trial demonstrated that, in some scenarios, if a storage operator could offer voluntary interruptible import or export capacity, a payment for the service could be offered.

times of peak demand. As a result, storage users could contribute more towards the cost recovery of the network than an equivalent generator if it imports power during peak periods. This is an issue which we believe could have an impact on the competiveness of storage. It is also closely linked to the discussion in section 3.3 on smart distribution tariffs on the need to ensure network users receive the right price signals and make appropriate contributions to network cost recovery.

13. Balancing Services Use of System (BSUoS) charges could also affect the competiveness of storage. The BSUoS charges for providing services such as frequency response will tend to be higher for standalone storage when compared to the BSUoS charges for generation, demand side response (DSR) or co-located storage providing the same service.

14. Other factors such as embedded benefits may also distort competition between different users, including the competiveness of storage users connecting at different voltage levels. Ofgem has recently set out its thinking on embedded benefits, which notes the relevance of this for storage.[36]

15. The contribution made by storage to network cost recovery and the impact of network charges on the competiveness of storage require further examination to ensure they do not act as a barrier, while not unfairly subsidising storage and other providers of flexibility. We welcome views and proposals from industry on how these issues could be addressed, particularly in relation to the contribution made by storage to network cost recovery and BSUoS charges compared with other network users. Ofgem will shortly set out further thinking on allocation of fixed/sunk cost recovery, including for storage,. This will include identifying where possible actions which can be taken forward in relation to network charging for storage. The views, evidence and proposals which we receive from stakeholders to this call for evidence, will help to inform ongoing considerations on network charging for storage. Ofgem will engage with stakeholders while taking this forward and we will provide an update on this work and any further actions we think are required in our plan.

### 2.1.3 Final consumption levies

16. A number of policy costs are levied on energy suppliers, which they in turn pass on to consumers, outlined in Table 4. Storage ‘consumes’ energy in order to be able to store it, but then passes the majority of the energy to end consumers. This can result in a ‘double counting’ of the supply of electricity to the end consumer and a payment of levies by both the storage provider and the consumer on the same electricity. It can also add to the operational cost of storage projects (which might also be passed on to the end consumer) and make storage less competitive than other flexibility providers.

[36] https://www.ofgem.gov.uk/publications-and-updates/open-letter-charging-arrangements-embedded-generation

**Table 4 Final Consumption levies**

| Levies charged on the volume of energy supplied that could be double counted | |
|---|---|
| The Renewables Obligation (RO)<br><br>Feed in Tariffs (FiTs)<br><br>Contracts for Difference (CfDs) | The cost of these policies (i.e. payment to generators) is paid for by electricity suppliers according to the volume of energy they supply on a per MWh basis. |
| Capacity Market (CM) gross auction cost | The cost of the CM is paid for by electricity suppliers according to the volume of energy they supply during winter peak periods (4-7pm on weekdays between November and February) |
| Climate Change Levy (CCL) | This is a tax on energy delivered to non-domestic users in the United Kingdom. Storage devices could be considered by suppliers to be eligible to pay the tax because they import a large amount of energy. Suppliers add the CCL to industrial and commercial consumers' bills. |

17. This double counting has a different effect, depending on the use of the storage.
    - **For storage that trades on the wholesale market**, there is no impact because operators buy and sell their power without going through electricity suppliers, meaning that no levies are applied.
    - **For storage located behind a single meter (e.g. domestic batteries)**, there is also no impact from the levies because the electricity will only be metered on import once.
    - **For storage that purchases electricity from suppliers and which is not for onsite consumption, there is a significant impact.** This will likely be the case for most distribution-connected storage. Government estimates that final consumption levies (this currently includes CCL, FiTs, RO) could add almost 20% to the cost of electricity for storage operators in 2014, rising to over 40% by 2020 (including the aforementioned levies as well as CfD and CM costs), based on storage operators meeting the definition of large energy users.

18. The uneven application of levies precludes a level playing field for storage developers relative to other flexibility providers. Existing legislation for RO, FiTs and CfDs excludes electricity supplied to licensed generators from supplier volumes. This means that energy suppliers do not pay levies on electricity supplied to holders of generation licences and can pass on these levy savings. However, obtaining and meeting the conditions of a generation licence has downsides for smaller storage developers who would otherwise be exempt from needing a licence.

19. In the longer-term, Government will align the relevant levy legislation and guidance with the regulatory clarity we provide for storage. Amendments may be needed to the applicable legislation, for example, for the purposes of determining suppliers' FiTs scheme obligations. We will also look to ensure clarity is provided to those seeking to co-locate renewable generation and storage assets on sites which benefit from RO or CfD payments.

### 2.1.4 Planning for storage

20. We want to ensure that the planning process does not act as a disincentive or barrier to storage projects where unnecessary uncertainty could affect investor confidence. The planning system has national and decentralised elements, with individual planning systems operating in the devolved administrations.[37] Where storage has yet to be classified and defined, it is unclear how storage fits within the planning framework.

21. Historically, bulk storage was (and still is) delivered by pumped hydro stations which involve mechanical generation of electricity and are big civil engineering works with high potential environmental and social impacts that require scrutiny at a national level. Newer storage projects (>50MW) may also need to go through National Planning.[38] Small storage projects (≤50MW) must seek planning permission under the Town and Country Planning Act. We believe further clarity is needed within the planning framework about how to classify and treat storage projects, given the emerging nature of the market and new technologies.

22. For the time being BEIS, the Scottish Government and the Welsh Government agree that a storage facility is a form of electricity generating station. This means that a storage facility with a capacity of >50MW in England and Wales will need development consent as required by sections 15 and 31 of the Planning Act 2008 or Scottish Ministers' consent under section 36 of the Electricity Act. We believe further clarity is needed within the planning framework about how to classify and treat storage projects, given the emerging nature of the market and new technologies.

23. BEIS will be working closely with other departments across Government and the devolved administrations to explore the options for providing greater clarity in the planning process on storage. Our primary focus will be designing the regulatory framework for storage in a way that helps address the definition and classification issues. We welcome evidence on how the current planning regimes affect storage projects and on what, if any, changes are necessary to best support the market.

### 2.1.5 Use of storage by network operators

24. Storage can be a valuable source of flexibility for network operators, offering an alternative solution which they can use to avoid or defer the need for traditional reinforcement or to support cheaper and faster network connections. We want to see competitive markets for flexibility including storage where possible. Any asset owned or operated by a regulated monopoly has the potential to distort competition or deter entry to new markets. To some extent, this issue is addressed through current rules requiring network operators to

[37] The town and country planning system is a devolved matter with individual planning systems operating in the devolved administrations. This section describes the structure of the planning and consenting arrangements as they currently operate in England. Wales, Scotland and Northern Ireland have their own policy and consenting regimes.
[38] Planning consenting for energy infrastructure is wholly devolved in Scotland and Northern Ireland. In Wales, Developments of National Significance (DNS) for generation 10MW and above are submitted to Welsh Ministers.

'unbundle' (i.e. separate) any non-network business operations. As the operation of storage involves elements of generation and supply, if a network operator intends to own or operate storage, it must comply with unbundling requirements.[39] We would not envisage this requirement to be affected by a new definition or licensing arrangement, because the elements of generation and supply in the operation of storage would not change.

25. The National Infrastructure Commission[40] recently recommended that "network owners should be incentivised by Ofgem to use storage (and other sources of flexibility) to improve the capacity and resilience of their networks as part of a more actively managed system."

26. Elements of the RIIO[41] framework, including the Network Innovation Competition, incentivise network companies to trial new technologies or ways of working and to adopt those which will benefit consumers. This approach provides an incentive to network operators to choose the most economical and efficient way of running their network, be that in the form of capital expenditure or operational expenditure. RIIO is designed to ensure that network companies can procure and use services from storage providers (or other flexibility providers) to efficiently defer or avoid investments, support cheaper and timelier connections, or to better manage issues on their networks.

27. We would welcome your feedback on whether the current arrangements are sufficient to address the National Infrastructure Commission recommendation and our commitment to ensuring a competitive market.

### 2.1.6 Providing regulatory clarity

28. This section identifies ways we could deliver greater regulatory clarity for electricity storage, and asks for views on the different approaches.

29. Regulatory clarity for storage has a number of benefits such as:
    - providing a basis for industry to make changes to industry codes (including connection and charging codes);
    - enabling Government and Ofgem to make necessary changes to guidance documents and/or legislation relating to final consumption levies; and
    - assisting national and town and country planners to understand how storage projects should be treated.

30. A separate definition for electricity storage, and more clarity on how to calculate the relevant capacity for different policy areas (e.g. planning) could help to resolve some of the

[39] Storage is both "generation" and "supply" for the purposes of the Electricity Directive (Directive 2009/72/EC). Therefore, under the Directive's unbundling rules DNOs and TSOs cannot lawfully operate storage facilities on a commercial basis except where they can show that there is no relevant control.
[40] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf
[41] RIIO (Revenue = Incentives + Innovation + Outputs) is Ofgem's framework for setting price controls for network companies. It is a new performance based model which lasts eight years.

barriers we have identified in this chapter. Government and Ofgem are minded to define electricity storage. We list some examples of definitions that either already exist or are newly proposed and which we would like your opinion on.

31. A definition for storage does already exist in legislation, for the Capacity Market,[42] which reads:
"storage facility" means a facility which consists of -

(a) a means of converting imported electricity into a form of energy which can be stored, and of storing the energy which has been so converted; and
(b) a generating unit which is wholly or mainly used to re-convert the stored energy into electrical energy.

32. The Electricity Storage Network (ESN), the UK's main trade body for electricity storage, has also recently published a definition for storage, which reads:

- "Electricity Storage" in the electricity system is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy.
- "Electricity Storage Facility" in the electricity system means a facility where Electricity Storage occurs.

33. The Capacity Market definition was created for use by a particular policy area, rather than for use more widely. We would like to ensure that any future definition for storage can have a broad application across policy areas. As some options for licensing storage (options c and d listed below) would be under the Electricity Act 1989, we will need to ensure that any definition for storage is in keeping with the definitions for other licensable activities.

34. Given the breadth of these types of definitions, further consideration would be needed to specify which storage facilities should be captured for the purposes of the licensing regime. For example, this could include:

- the extent to which exemptions should apply to smaller storage facilities and how the size of a storage facility is determined for planning purposes;
- whether the definition and regulation should only apply to storage facilities which re-export electricity onto the distribution and transmission network; and
- how to ensure network assets such as capacitors and transformers are not caught by the definition.

[42] See http://www.legislation.gov.uk/uksi/2014/2043/contents/made

35. We note that the ESN definition has been developed by industry and, in feedback to us, has received support from a range of stakeholders. We would welcome your views and proposals on how storage should be defined.

36. We have set out below a number of models on how the regulatory framework for storage could be clarified. These range from continuing to treat it as generation or a subset of generation, through to defining a new type of storage licence. We would welcome views on these models. Option a is a continuation of the existing regulatory approach, so would not require any changes to the licensing framework. As option b does not require a legislative change, it could be introduced on a shorter timescale (approximately two years) than option c and d which would require primary legislation.

37. In addition, we would welcome views on whether a more technology neutral flexibility licence model should be considered, which could be more widely applicable to other providers of flexibility within the market, for example aggregators.

38. Approaches for regulatory treatment of storage

    a. Continue to treat storage as generation for licensing purposes**.** While electricity storage is not defined in the Electricity Act 1989, it has to date been considered by Government and Ofgem to be 'generation', requiring either licensing or exempting for the purposes of the Electricity Act. All existing large storage facilities are licensed as generators, and small storage facilities (≤50MW) can use the class exemption[43] for small generators. While continuing with this approach would provide some certainty, it does not explicitly recognise the distinct characteristics of storage (e.g. its demand as well as its generation capabilities).

    b**.** Define storage as a subset of generation in a modified generation licence (no primary legislation required). Ofgem could introduce a modified generation licence specifically for storage facilities (in consultation with industry). Under this option storage could only operate under this modified licence or a licence exemption. A modified generation licence could take account of the non-generation aspects of storage.[44]

    c**.** Define storage in primary legislation[45] as a subset of generation in the Electricity Act, with modified generation licence for storage. This option upholds storage explicitly as a type of generation, requiring a licence or licence exemption. Subsequent to this (or in parallel) a modified generation licence would be developed for storage with industry. This could provide more legal certainty than option b, and as with option b the modified generation licence could take account of the non-generation aspects of storage.

[43] http://www.legislation.gov.uk/uksi/2001/3270/contents/made.
[44] Section 7(1)a of the Electricity Act.
[45] An alternative to primary legislation is available through Section 56A of the Electricity Act, which enables the Secretary of State to create new licensable activities through secondary legislation on an application from the Gas and Electricity Markets Authority. However, we consider that this option is more complicated, with a potentially longer implementation route.

d. Define storage in primary legislation as a new activity with separate storage licence regime**.** Ofgem would have powers to grant licences to authorise the activity (Government, or Ofgem, may also have powers to grant or allow an individual or class exemption). Subsequent to this (or in parallel) a licence would be developed for storage with industry. This would provide the storage industry with its own regulatory regime; but as well as a longer timeline, it could potentially create uncertainty for both incumbent storage operators who are licensed as generators and current storage developers, as this new regulatory framework may need to be adopted by them. The creation of a new asset class for storage would not resolve barriers in itself, and the non-generation aspects of storage can be considered in option b and c.

These approaches are not mutually exclusive, and some could be pursued in parallel.

## Questions: Enabling storage

| | |
|---|---|
| 1. | Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry?<br><br>Please provide evidence to support your views. |
| 2. | Have we identified and correctly assessed the issues regarding network connections for storage?<br><br>Have we identified the correct areas where more progress is required?<br><br>Please provide evidence to support your views. |
| 3. | Have we identified and correctly assessed the issues regarding storage and network charging?<br><br>Do you agree that flexible connection agreements could help to address issues regarding storage and network charging?<br><br>Please provide evidence to support your views, in particular on the impact of network charging on the competitiveness of storage compared to other providers of flexibility. |
| 4. | Do you agree with our assessment that network operators could use storage to support their networks?<br><br>Are there sufficient existing safeguards to enable the development of a competitive market for storage?<br><br>Are there any circumstances in which network companies should own storage?<br><br>Please provide evidence to support your views. |
| 5. | Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage?<br><br>Please provide evidence to support your views, including any alternative regulatory approaches that you believe we should consider, and your views on how the capacity of a storage installation should be assessed for planning purposes. |
| 6. | Do you agree with any of the proposed definitions of storage?<br><br>If applicable, how would you amend any of these definitions?<br><br>Please provide evidence to support your views. |

## 2.2 Clarifying the role of aggregators

39. In this section, we outline issues to aggregators providing greater system flexibility, and describe possible approaches for overcoming them.[46]

40. In our discussions with aggregators and other stakeholders, they have raised the following areas for us to consider:

- balancing services barriers around product design and procurement;
- cross-party impacts;
- barriers to balancing mechanism and wholesale market participation;
- other market barriers; and
- consumer protection

41. We are seeking views on all of these.[47] We want to understand the current and potential future impact of the existing arrangements, and the potential benefits of making changes, in order to set out our future direction in the plan.

42. Aggregators combine and sell flexible load adjustments and on-site generation flows from multiple consumer sites. Aggregators do not need a licence to operate within the GB system. Some aggregators are suppliers, combining their operations with some elements of supply. But they are not required to be licensed if they provide only aggregation services ('independent aggregators').

43. In September 2015 Ofgem committed to clarifying the role of aggregators and their relationships with other parties, and to assessing the need for policy intervention and regulatory oversight.[48] Aggregators have asked us to look in particular at how they access balancing services, and the balancing mechanism. These markets work differently, but in relation to both there is a question relating to payments to (or from) suppliers:

- for balancing services, whether a payment should be made (and how that should be set);
- for the balancing mechanism, whether the payment should be set by bilateral or broader industry negotiations, or by regulation.

44. **Background to balancing services and the balancing mechanism.** The SO uses balancing services, and the balancing mechanism, to ensure the network stays in balance.

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[46] Informed by the report Ofgem commissioned from PA Consulting 'Aggregators – Barriers and Issues' https://www.ofgem.gov.uk/publications-and-updates/aggregators-barriers-and-external-impacts-report-pa-consulting

[47] Respondents will wish to note that barriers related to the Capacity Market are considered under "Other Government Policies"

[48] In their report on Smart Power (4 March 2016), the National Infrastructure Commission emphasise the importance of such a review, including considering the current Balancing and Settlement Code arrangements.

45. Although the generation, transportation, delivery and use of electricity is continuous, for the purposes of trading and settlement it is considered to be generated, transported, delivered and used in half hour segments. For each defined half hour, those with demand for electricity and those who can provide it reach agreements on volume and price. Contracts can be struck up to an hour before the Settlement Period. This cut-off is known as Gate Closure and contracts are not currently struck after this time. In the half hour itself, generators are expected to generate and deliver their contracted volume of electricity and suppliers are expected to use their contracted volume of electricity.

46. In the half hour (in real time) the provision of, and demand for, electricity might not balance. There is a need for real-time management to ensure that supply matches demand, and to address any issues with transportation and delivery. This is the role of the SO.

47. The SO contracts for balancing services from providers which commit to be available for dispatch. Services include frequency response and reserve. All aggregators, including independent aggregators, may sell balancing services directly to the SO.

48. The SO also uses the balancing mechanism to procure (and sell) energy to balance the system in real time, after Gate Closure. Aggregators who hold supply licences can participate in this market on their own behalf. Independent aggregators need to have an agreement with someone who owns energy, most often an energy supplier.

49. **Balancing services barriers – product design and procurement.** Independent aggregators can access balancing services directly. Some, however, have expressed concern about the difficulty of selling flexibility to the SO in the form of balancing services. They are concerned about complexity, a lack of transparency, and the procurement process. They have also argued that product specification, such as duration of response, may disadvantage DSR in competing with other sources of flexibility. Some are concerned that characteristics of balancing services, such as contracts that pre-determine utilisation prices or availability window obligations, do not provide access to balancing value on a level playing field with parties participating in the balancing mechanism.

50. These are cross-cutting issues, affecting not only aggregators but also other parties who may offer DSR directly. The SO is seeking to address many of these issues through its Power Responsive campaign, which we welcome. We plan to assess progress on this as part of our on-going engagement with the SO. Views and evidence from this call for evidence will be fed into Ofgem's future SO incentives work[49].

51. **Cross-party impacts.** Existing market arrangements could potentially distort prices, with knock-on negative effects for dispatch efficiency and competition.

[49] https://www.ofgem.gov.uk/publications-and-updates/electricity-system-operator-incentives-april-2017

a. Suppliers' imbalance positions will be affected. When an independent aggregator calls a DSR action,[50] it alters the consumption volume of the consumer's Balancing Responsible Party (BRP),[51] usually the consumer's supplier. This could be addressed in various ways. For example, the forthcoming EU Electricity Balancing Guideline may require adjustment of the supplier's imbalance position to ensure it is unaffected.[52] [53] This would mean that the supplier would be 'restored' to the balance position before the DSR action.

b. Suppliers will incur costs for energy not used. Turn-down of the consumer's energy consumption may mean the supplier cannot bill the consumer for the energy already bought. Thus the consumer (or aggregator) may not be directly exposed to the full system cost of the action,[54] that is, the cost of procuring the energy not used. In some jurisdictions, aggregators (or direct DSR providers) are expected to pay the supplier something in respect of the cost of this energy, although not necessarily the actual price that was paid. At present, no such requirement exists in GB. We would welcome evidence and views on this. If you consider that payment should be required in GB, we would also like to know your views on how the price should be set, for example negotiated privately or under a Code. There may be useful lessons to be drawn from work being undertaken by the European Commission and in other jurisdictions (see next section).

52. **Barriers to balancing mechanism and wholesale market participation.** Some independent aggregators have identified lack of direct access to the balancing mechanism as a key barrier preventing them from providing DSR to the electricity system. We are looking for evidence and views on this issue, its materiality, and the best ways of addressing it if necessary.

53. Independent aggregators do not have a defined role within the Balancing and Settlement Code (BSC) that would allow them direct access to the balancing mechanism. This is because they do not own the customers' energy and do not have an 'account' in the balancing mechanism. As such, they could enter into a bilateral agreement with a supplier, under which the supplier bids into the balancing mechanism on behalf of the aggregator, and passes on some of the payments received, subject to negotiation. Such an agreement would likely include some form of payment to the supplier for the energy the supplier has procured, but which is not consumed, as a result of the DSR delivered by the aggregator.

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[50] Note these issues apply to DSR whether aggregated or not. However, as this issue has been at the heart of discussions in European fora on regulation of aggregators, we consider it here in the aggregators section.
[51] Balance Responsible Party is a market-related entity or chosen representative responsible for imbalances.
[52] The EU Balancing Guidline is a draft EU law, still under negotiation, and due to come into effect in 2017. http://www.acer.europa.eu/en/electricity/fg_and_network_codes/pages/balancing.aspx
[53] On 23 June, the EU referendum took place and the people of the United Kingdom voted to leave the European Union. Until exit negotiations are concluded, the UK remains a full member of the European Union and all the rights and obligations of EU membership remain in force. During this period the Government will continue to negotiate, implement and apply EU legislation. The outcome of these negotiations will determine what arrangements apply in relation to EU legislation in future once the UK has left the EU.
[54] The nature of this will vary with the type of DSR – whether peak shifting or back-up generation, turn-up or turn-down.

54. This requirement may deter some independent aggregators from accessing value in the balancing mechanism and the wholesale market and thereby hold back the efficient provision of flexibility. The extent to which needing a prior contract with suppliers is a barrier, and one of material impact for the consumer, will depend on various factors, notably the strength of retail competition[55]. In principle, the stronger competition is, the easier it will be for consumers and independent aggregators to ensure they are efficiently accommodated by suppliers. Intensified retail competition and half-hourly settlement following the CMA's investigations should also provide stronger incentives for suppliers to help their customers make best use of their flexibility.

55. Another important factor is the extent to which the design of balancing services provides an equivalent opportunity for non-BM parties to access balancing value available through other routes. We note here two on-going developments. The first is that the EU Balancing Guideline in its current draft (Article 19) requires that balancing product utilisation prices should not be pre-determined in contracts.[56] The second is that Project TERRE[57] will provide a new route for both BM and non-BM participants to submit sets of bids and offers up to one hour in advance of delivery.

56. Our view is that regulatory arrangements should allow access to markets, including the balancing mechanism, where this supports whole system efficiency. Some aggregators have acquired a supply licence to facilitate direct access.

57. Another approach would entail amending the BSC to allow independent aggregators to submit bids to the balancing mechanism directly.[58] This access would likely require the consumer or aggregator to compensate the supplier for the unused energy. This payment could be negotiated between the aggregator and supplier, or the consumer and supplier. As all contracts struck would be done so voluntarily, they should be efficient. On the other hand, if competition is weak, suppliers might impede the access of independent aggregators. Concerns have been expressed by independent aggregators on this point. Standard arrangements or "universal contract terms" could remove the need for negotiation and determine the price paid to the supplier. Regulatory intervention here might pre-empt any obstacles suppliers may raise, but could have its own unintended effects.

58. More broadly, allowing direct access by independent aggregators would raise other important issues, for instance relating to the SO's requirements for locational visibility of demand reduction or generation in the balancing mechanism. There may also be a need to ensure the relevant suppliers are given visibility of an imminent DSR action, to prevent

[55] Note some independent aggregators point to the administrative burden of striking these contracts as a barrier.
[56] As currently drafted, any exemption proposed by the SO to this would require justification by demonstrating higher economic efficiency.
[57] Project TERRE, the Trans-European Replacement Reserves Exchange, is an early implementation project designed to meet the requirements of the forthcoming European Balancing Guidelines. The participating TERRE SOs will be able to undertake joint balancing of generation and demand using a common set of TERRE bids and offers. Project TERRE is aiming for launch in 2018. http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589936829
[58] On a preliminary and high level scoping, Elexon has suggested a BSC modification to decouple balancing service provider and BRP settlement to accommodate independent aggregated DSR would be relatively substantial compared with historic modifications.

them taking inefficient or unnecessary remedial action to correct perceived imbalance positions due to DSR actions. Faster supplier switching is another relevant area for consideration, as it will introduce more pressing timeframes for remedial action.

59. We hope responses to the call for evidence will shed light on the question of whether consumer benefits from removing the barrier outweigh costs of doing so.[59] We are interested in any evidence that the requirement for independent aggregators to interact with (or become) a supplier to access value from the balancing mechanism, impedes the efficient realisation of flexibility from consumers.

60. Industry could lead on the development of proposals to assist independent aggregator access, to identify and address consequential issues, and to conduct assessments to test viability. There are a number of possible approaches:

- we could ask the BSC Panel to provide a report;
- a modification proposal could be launched by the SO or other BSC party (some aggregators have signed up to the BSC as suppliers or through traders);
- Ofgem could allow a designated third party to launch a modification. This could be for instance an independent aggregator or relevant trade body;[60] and
- the SO's balancing services could be amended to introduce a product that provides access to real time balancing value that more closely resembles the balancing mechanism.[61]

61. The various approaches to this – from keeping a watching brief, through industry-led changes to Codes or market design, to regulatory intervention in commercial terms or requiring aggregators to hold a supply licence – are set out in a table at the end of this section.

62. **Other market barriers.** Some independent aggregators have expressed concerns over perceived market barriers relating to the Capacity Market. The section on 'other government policies' requests views on helpful short term process changes to the Capacity Market to further enable DSR as well as longer term changes. Separately, Ofgem has published recommendations to address concerns with the Capacity Market (CM) rules including those expressed by aggregators.[62] Chapter 5 considers potential DSO/SO models that aggregators could use to access a range of revenue streams.

[59] Respondents may find PA Consulting's review on the qualitative aspects of this matter to be of interest.
[60] Any modification proposal received by Ofgem would be assessed against BSC applicable criteria and Ofgem's wider objectives.
[61] This might require a "C16 change" – a change to Standard Condition C16 of National Grid's Electricity Transmission licence. http://www2.nationalgrid.com/uk/industry-information/electricity-codes/balancing-framework/c16-consultations/
[62] https://www.ofgem.gov.uk/publications-and-updates/statutory-consultation-amendments-capacity-market-rules-0

63. **Consumer protection.** Ofgem currently has limited regulatory tools to protect consumers who contract with independent aggregators.[63] Consumers might therefore be at risk from behaviours or offers that are unfair, misleading, or unclear. Negative perceptions of some independent aggregators could in turn discourage consumer engagement. Ofgem is currently monitoring third party intermediaries (TPIs) to provide an informed view on the appropriate regulatory framework for this part of the market. We will ensure aggregators are considered in the development of this framework.

64. Any consumer protection regulation should be appropriate for the market. As DSR provision is currently dominated by large non-domestic consumers, the potential for consumer harm is currently limited. However, we expect that domestic and smaller non-domestic consumers will become increasingly engaged with DSR, and so it will be important that appropriate consumer protections are in place for this in future.

65. The Association for Decentralised Energy has recently announced an intention to develop a code of conduct and compliance scheme for non-domestic aggregated DSR.[64] We will follow development of the code with close interest.

66. It would also be possible to have a mandatory code of practice, set up as a requirement for access to one or more markets. If more intervention is appropriate, Ofgem could be enabled to introduce a General Authorisation Regime (GAR), or a licence – either a specific aggregator licence or a full or modified supply licence.

67. We are interested in views and evidence on the degree to which the regulator should seek to regulate aggregators' behaviour in order to protect consumers, now and in future. Table 5 sets out the range of possible future developments, from no change at present, through a code of conduct or changes made by industry through the BSC, to regulation by authorisation or licence.

68. **System stability.** If there is high uptake by consumers of DSR, there is an associated risk that more load will be switched simultaneously than the system is able to handle. This risk would likely manifest via large aggregators, as the probability is negligible that enough consumers will switch their loads simultaneously to threaten system stability.

69. This risk has been mitigated to a proportionate level for all signals going through smart meters. However, it is possible for aggregators to directly control consumers' loads, bypassing their smart electricity meters. It will therefore be important for both consumers and the wider system that aggregators' systems and processes for load control are robust and secure. Ensuring that this risk is minimised to an acceptable level will require cross-system thinking and collaboration. Understanding at what point this risk becomes significant

[63] Note however that Contract Law may provide some protection for business consumers, while Consumer Rights Act and Data Protection Act provide protection for individuals.
[64] http://www.theade.co.uk/demand-side-response-code-of-conduct-planned_4012.html?Parent=697

is important. We would like to know how we can establish the tolerances for simultaneous load switching and rate of change of load. We are also interested in potential solutions, such as time randomisation of signals or implementation of standards, and the extent to which market participants are already considering or managing this risk.

70. **Approaches.** Some approaches for addressing the potential barriers and issues outlined in this section are presented in Table 5. In addressing different barriers and issues, there is variation in the degree of intervention that can be applied. We have set out the different degrees of involvement – 'monitor', 'industry-led change', and 'regulator steps in' – against the different barriers, chiefly barriers to market and cross-party impacts, and consumer protection.

71. In terms of barriers to balancing services, Ofgem could either monitor Power Responsive campaign progress, or adopt an 'enhanced involvement' role. Considerations may include how and whether product design and procurement practices can be improved – such as through better data sharing and addressing any generation bias in product specification – and consideration of the number and complexity of services.

**Table 5: Some approaches for addressing potential barriers and issues**

| Approaches | Barriers to Market (in particular balancing mechanism) and Cross-party impacts | Consumer protection |
|---|---|---|
| **Monitor** | **A 'watching brief'**<br><br>Perhaps shared with the SO, to monitor market access barriers and issues. | **A 'watching brief'**<br><br>Monitor consumer concerns, and microbusiness/domestic DSR. |
| **Industry-led change** | **BSC or C16 modifications**<br><br>To support independent market access. This could include:<br><br>• allowing a participation role for independent aggregators in the BSC;<br>• possibly including a financial compensation process.<br><br>A BSC modification proposal could be launched by the SO or other BSC party, or designated third party. Independent aggregator involvement would need to be facilitated.<br><br>Alternatively, balancing services could be amended more closely to mimic the balancing mechanism (C16 changes). | **Voluntary code of practice**<br><br>Note UK ADE commitment here (non-domestic).<br><br>**Mandatory code of practice**<br><br>The SO requires sign-up to accreditation scheme to access balancing services, or a requirement for specific aggregator role in the BSC. Code of practice set out by industry. |

| Approaches | Barriers to Market (in particular balancing mechanism) and Cross-party impacts | Consumer protection |
|---|---|---|
| **Regulator steps in** | **Obligation on suppliers**<br><br>To sign bilateral agreements or standardised frameworks. | **GAR or licence, with code of practice**<br><br>GAR or licence provides general legislative powers over aggregators, or a broader class of entities. Code of practice set out by industry or by Government. |
| | **GAR or licence aggregators**<br><br>Require signing BSC, making them BRPs. BSC potentially modified to address cross-party effects. | **GAR or licence aggregators**<br><br>Aggregator licence conditions or general conditions of a GAR set out consumer protection standards. |
| | **Supply licence**<br><br>Aggregators required to have a supply licence. | **Supply licence**<br><br>Aggregators required to have a supply licence and meet consumer protection standards. |

## Questions: Aggregators

| | |
|---|---|
| 7. | What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on:<br>• balancing services;<br>• extracting value from the balancing mechanism and wholesale market;<br>• other market barriers; and<br>• consumer protection.<br>Do you have evidence of the benefits that could accrue to consumers from removing or reducing them? |
| 8. | What are your views on these different approaches to dealing with the barriers set out above? |
| 9. | What are your views on the pros and cons of the options outlined in Table 5? Please provide evidence for your answers. |
| 10. | Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk? |

# 3. Providing price signals for flexibility

**Our energy system already has some well-functioning price signals that shape the profiles of generation and demand. We recognise that to deliver the full benefits of flexibility these price signals will need to develop to reflect the value to our energy system of smart technologies and processes. We have focused on particular aspects of the system which we see as key to enabling flexibility. We welcome evidence on these particular elements, which will inform the plan. We also welcome evidence on other price signals which will inform our longer term thinking.**

**In this chapter, we consider some specific enablers:**

**i) half-hourly settlement – which will place stronger incentives on suppliers to help customers use electricity when it is cheapest;**

**ii) smart tariffs – retail tariffs that enable consumers to respond to price signals, and receive the financial benefits of doing so; and**

**iii) smart distribution tariffs – which, amongst other tariff objectives, can be designed to send price signals to suppliers related to the costs of provision of the network to meet peak demand or when demand is highest (or lowest) for example. This call for evidence only considers electricity distribution charges, but many of the issues hold for transmission charges too.**

**Finally, other Government policies may affect the ability for flexibility providers to realise the value they could offer to the system. In this chapter, we set out some of these and seek views on how they may help or hinder the development of a smart, flexible system.**

## 3.1 System value pricing

1. To be cost-effective at any given moment, the system should be making best use of the flexibility available. That means all users of flexibility (network and system operators, suppliers, generators and third parties) need to be using flexibility optimally, from all providers (generators, demand side response (DSR) providers, storage and interconnector flows). This requires institutional, governance and market arrangements which enable solutions to compete based on their value to the whole system, and services that are priced accordingly. We call this “system value pricing”.

2. Accessible markets and pricing which reflects the true system value of flexibility will be critical to enable the delivery of a smart, flexible system. We welcome views and evidence on how they can be achieved in specific areas and more generally.

3. We have considered these requirements in relation to two types of flexibility.

    a. **Price flexibility.** This occurs when any party varies their demand or generation in response to the price of energy and network use at a particular time and/or location.

    A number of building blocks can facilitate system value pricing for 'price flexibility'. The provision of appropriate signals in smart tariffs, charging and other industry arrangements such as half-hourly settlement have the potential to signal flexibility needs to consumers and generators. Smart meters and smart appliances will help enable consumers to realise the benefits of smart tariffs.

    If prices reflect full system cost variations, including locationally and over time, the right amount of flexibility should be provided. However, there are limitations on the extent to which flexibility costs and benefits can be signalled. The charging methodology needs to consider other objectives including stability, transparency, non-discrimination, and sufficient certainty on revenue for network companies. The signals that can be sent through tariffs and charges may not always be sufficiently granular, localised, or variable. Parties procuring flexibility may also need greater certainty about users' response, or greater control over contractual terms than could be offered through price signalling.

    We see an important role for price flexibility and in this section we consider how half-hourly settlement, smart tariffs and smart distribution tariffs can contribute to this.

    b. **Contracted flexibility.** This is where parties trade and directly contract with one another to procure flexibility, and for which an agreed payment is made. Parties buying this currently include the System Operator (SO), Distribution Network Operators (DNOs) and suppliers.

    Flexibility is already valued to some extent in existing arrangements, such as procurement of ancillary services, the wholesale market and the Capacity Mechanism. These mechanisms allow sellers to be remunerated for the flexibility they provide. We are considering the extent to which these markets:

    - **operate efficiently for buyers and sellers of flexibility.** For efficient use of assets, any contractual terms should allow flexibility providers to sign up to multiple contracts where possible, thus "stacking" revenue streams and extracting more value from their assets. Ideally, flexibility services should be tradeable to enable the most efficient uses within the system to secure them. While some restrictions are necessary for the purposes of, for example, system security, we believe industry can do more to design flexibility contracts to improve access to more than one revenue stream. Ultimately, an approach which leverages more open competitive mechanisms such as a trading platform, integrating standardised products to meet the needs of a range of users and providers of flexibility, could offer benefits. Chapter 5 on roles and responsibilities provides examples of initial steps industry is taking to improve coordination and considers potential future models that could better support optimal use of flexible resources in the longer term; and

- **capture the costs and benefits of flexibility actions in our energy system at different voltages, locations and times.** Arrangements would also need to reflect the costs associated with flexibility actions on other parts of the system. For instance, price incentives could help to ensure that when one party takes an action which imposes a cost on another (such as putting them out of balance), those costs are internalised by the first party (i.e. they are charged the cost that they impose on the second party). This would discourage actions which have negative effects on others, but it could be complex. Trials or pilot projects will be useful in exploring how such arrangements could work in practice. In Chapter 5 we outline some of the market models that could support more efficient use of flexibility and more integrated and coordinated interaction between different markets.

4. Finally, there are some types of flexible response for which providers are currently not necessarily directly remunerated. These include provision of inertia and reactive power, which have before now mostly been provided by generators, whose main business case has been the sale of energy. Specific payments for inertia or reactive power might in the future form part of the business case for a new flexibility company or asset.

## Questions: System value pricing

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| 11. | What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future? |
| 12. | If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so? |
| 13. | If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits? |
| 14. | Can you provide evidence to support any changes to market and regulatory arrangements that you consider necessary to allow the efficient use of flexibility. What might be the Government's, Ofgem's, and System Operator's roles in making these changes? |

## 3.2 Half-hourly settlement

5. At present most domestic and smaller non-domestic consumers[65] do not have meters capable of recording consumption data on a half-hourly basis. Instead, they are settled using estimates of their usage in each half hour (based on a profile of the average consumer). This has drawbacks from a smart energy perspective. For example, as identified by the Competition and Markets Authority (CMA) in its market investigation,[66] it means there are limited incentives on suppliers to encourage customers to move load to periods when electricity is cheaper (e.g. through Time of Use tariffs) that would deliver benefits both to consumers and the system.

6. The roll-out of smart meters, which can record the amount of energy consumed or exported within every half-hour period and provide this data to energy suppliers remotely, presents an opportunity to settle domestic and smaller non-domestic consumers using their half-hourly consumption data ('half-hourly settlement'). This is a key enabler of the move towards a smarter, more flexible energy system that lowers bills, reduces carbon emissions and enhances security of supply. In particular, we expect that this, through the realignment of incentives on suppliers mentioned earlier, will pave the way for more widespread provision and take-up of smart tariffs.[67]

7. We therefore consider there is a strong case for enabling half-hourly settlement alongside the smart meter roll-out. As announced in December 2015, BEIS and Ofgem are taking forward joint work for delivering this objective.[68] We are approaching the work in two phases:

    a. removing the barriers to suppliers and consumers choosing half-hourly settlement ('elective half-hourly settlement') by early 2017. In May 2016 Ofgem published details of the industry code modifications and other changes needed to enable cost-effective elective half-hourly settlement for domestic and smaller non-domestic consumers;[69] and
    b. considering the move to mandatory half-hourly settlement. After consultation, in June 2016 Ofgem indicated its intention to launch a Significant Code Review (SCR) on mandatory half-hourly settlement once the work has been thoroughly scoped, planned and consulted on.[70] In addition, BEIS has published draft powers that would provide Ofgem with the means to progress these reforms more effectively than through an SCR. The Energy and Climate Change Select Committee conducted pre-legislative scrutiny of these draft powers earlier this

[65] Those non-domestic consumers in profile classes 1-4. Larger non-domestic sites (those in load profile classes 5-8) with advanced meters are required to be settled half-hourly from April 2017, while the largest consumers are already settled using actual half-hourly meter readings.
[66] See: https://assets.publishing.service.gov.uk/media/5773de34e5274a0da3000113/final-report-energy-market-investigation.pdf
[67] It will also help suppliers to forecast demand more accurately, strengthening competition and reducing costs; and make the settlement process itself faster and more efficient, reducing barriers to entry to the energy market.
[68] For details see: https://www.ofgem.gov.uk/sites/default/files/docs/final_open_letter_on_hhs.pdf
[69] See: https://www.ofgem.gov.uk/system/files/docs/2016/05/elective_hhs_conclusions_paper.pdf
[70] See: https://www.ofgem.gov.uk/publications-and-updates/open-letter-mandatory-half-hourly-settlement-intention-launch-significant-code-review

year and the Government responded to the Committee's recommendations in July.[71]

8. The CMA concluded that a move to half-hourly settlement will be a necessary step in achieving the higher end of potential benefits from DSR and recommended BEIS and Ofgem undertake a number of actions in this area, including:
   - the development of a full cost-benefit analysis of the move to mandatory half-hourly settlement;
   - consideration of whether any changes are needed to the smart meter Data Access and Privacy Framework, to deliver the benefits of HHS; and
   - consultation on a plan setting out timescales and responsibilities relating to the introduction of half-hourly settlement.

9. While we consider it is in consumers' interests to be settled half-hourly, there are a number of issues that will need to be considered in more detail to inform the decision on mandatory half-hourly settlement, including:

   - the potential social impacts of the smart tariffs that are enabled by half-hourly settlement, as different types of consumers will be affected in different ways, with some less able to benefit than others;
   - whether consumers' half-hourly consumption data will be available for settlement, due to the requirements of the smart meter data access and privacy framework;
   - the target operating model, setting out how the new arrangements supporting half-hourly settlement will work; and
   - how the transition to mandatory half-hourly settlement will be managed, recognising the volume of IT changes in the sector already planned for the coming years.

10. These issues are covered in a consultation on the plan for settlement reform, which will be published shortly. The decision on the introduction of mandatory half-hourly settlement, including timescales and any transitional arrangements, will be taken in the light of the cost-benefit analysis.

## 3.3 Smart tariffs

11. Smart tariffs incentivise consumers to use, store and export electricity at times that are most beneficial or least costly to the system. They will play a key role in helping consumers to participate in, and realise the benefits from, the future smart energy system. For example, Time of Use (ToU) tariffs which charge different prices at different times of the day can lead to bill savings for consumers if they change behaviour and use energy at

[71] www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/inquiries/parliament-2015/pre-legislative-energy-15-16/

cheaper times. Smart meters and half-hourly settlement are important facilitators of sophisticated smart tariffs such as dynamic ToU[72] and load control tariffs.[73]

12. We want to ensure that consumers can make the right choice for them and are adequately protected. Different consumers will have different needs and will behave in different ways.

- **Domestic and smaller non-domestic consumers**. There may be a lag between suppliers offering smart tariffs, and domestic and smaller non-domestic consumers adopting them at scale. In particular, until domestic consumers are able to automate their responses to smart tariffs (e.g. through smart appliances) they may have limited appetite for them. Research commissioned by Smart Energy GB shows that nearly one in three (30%) of consumers would be in favour of switching to a smart tariff,[74] while Government's recent research into consumer attitudes found that 50% of respondents would take up a smart tariff if their supplier offered one to them now and that for a third of respondents, automation would encourage them to take up a smart tariff.[75] While some suppliers have started to offer load control tariffs to particular groups of domestic consumers, these are currently not widespread.
- **Larger non-domestic consumers**. We expect more smart tariffs to become available in the non-domestic sector once half-hourly settlement is fully enabled, with greater levels of consumer awareness and engagement, and with potential stimulation of the aggregator market. In the larger non-domestic sector,[76] there appear to be additional barriers, because the majority of consumers are also on single rate electricity tariffs or bundled billing.[77] This is despite these sites generally having meters capable of recording data half-hourly and being in the process of moving to mandatory half-hourly settlement.[78] Based on discussions with stakeholders, we believe that this is due to:
  - consumer and intermediary preferences for simpler tariffs, which are easier to understand and compare;
  - a perception among suppliers and intermediaries that the value created through consumer response to smart tariffs is insufficient to be worth pursuing for consumers other than the largest users e.g. due to limited wholesale price differentials; and
  - trade-offs between reducing the cost-to-serve and raising suppliers' costs of bill administration (standardised products are likely to be cheaper to administer).

[72] Where the timing of peak and off-peak periods may differ from day to day.
[73] Where the supplier or third party can control certain loads within the home within parameter set by the customer.
[74] https://www.smartenergygb.org/en/resources/press-centre/press-releases-folder/ucl-tou-research
[75] DECC Smart Energy Research: Summary Report (2016), TNS BMRB, TNS April 2016.
[76] Load profile classes 5-8.
[77] With the exception of very large, electricity intensive users, who are on tariffs with components that vary with time.
[78] https://www.elexon.co.uk/mod-proposal/p272-mandatory-half-hourly-settlement-for-profile-classes-5-8

13. We think the market can and will deliver smart tariffs once the necessary building blocks are in place. Therefore, we intend to monitor the market and focus on delivering the following key enablers:

    - the roll-out of smart meters;
    - enabling half-hourly settlement for domestic and smaller non-domestic consumers and the move towards half-hourly settlement for larger non-domestic consumers; and
    - removing restrictions on tariff types to better enable suppliers to innovate and provide new offerings to consumers. The CMA has recommended the removal of elements of the 'simpler' Retail Market Review rules, to promote greater tariff competition and innovation.[79]

14. Together these changes will remove the most significant barriers to smart tariff availability and enable innovation in the market. Additionally, we will consider supporting further pilots of tariff structures and domestic consumer responsiveness[80] and opportunities to raise consumer awareness, engagement and understanding.

## Questions: Smart tariffs

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| 15. | To what extent do you believe Government and Ofgem should play a role in promoting smart tariffs or enabling new business models in this area? Please provide a rationale for your answer, and, if you feel Government and Ofgem should play a role, examples of the sort of interventions which might be helpful. |
| 16. | If deemed appropriate, when would it be most sensible for Government/Ofgem to take any further action to drive the market (i.e. what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer. |
| 17. | What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs? |
| 18. | Do you recognise the reasons we have identified for why suppliers may not offer or why larger non-domestic consumers may not take up, smart tariffs? If so, please provide details, especially if you have experienced them. Have we missed any? |

[79] https://www.gov.uk/government/news/cma-publishes-energy-proposals-in-full
[80] Chapter 6 on innovation.

## 3.4 Smart distribution tariffs

15. DNOs charge network users for transporting electricity through their networks. Currently this is done via Distribution Use of Service (DUoS) charges. The charges are set to recover the costs of building, maintaining and operating electricity distribution networks. At present the vast majority of distribution connected users pay DUoS on a flat-rate volumetric (p/kWh) basis. This is problematic as a long term arrangement because it neither reflects the costs associated with the network being built and reinforced for peak demand nor does it send a signal as to when demand is highest (or lowest).

16. We foresee a number of significant changes that either enable or drive broader consideration of distribution tariff design in the medium to longer term. These include the rapid growth of distributed generation and, in future, storage, half-hourly settlement, the transition to Distribution System Operator (DSO) roles, and broader changes to the roles of parties. Important reforms have already occurred in this area. In particular, as soon as customers are half-hourly settled they will automatically be placed on a pre-determined Time of Use (ToU) DUoS tariff with very different p/kWh charges between different time periods.

17. We think it is helpful to consider changes to network charging through the lens of whether incremental changes should be made to the current system, or whether more fundamental changes are needed. We welcome views on different ways for recovering different elements of distribution network costs. Where possible please indicate in your answers possible developments and dependencies with which proposed changes should align. Any discussion on the timing and urgency of reforms is also welcomed.

18. **Current distribution network charging arrangements**. Requirements for charging methodologies are set out in the network companies' licences and also in the relevant industry codes. The industry code for electricity DNOs (DCUSA) has two main objectives: to facilitate competition and cost reflectivity (i.e. the creation of charges which as far as possible reflect the costs incurred by the DNO). Ofgem considers that charging methodologies should meet broader requirements. Facilitating competition is likely to be achieved through ensuring a level playing field and also through tariff stability, transparency and simplicity. If consumers are being asked to respond manually to price signals it is particularly important that tariffs are easy to understand. It is unavoidable that network tariff objectives conflict. For example, whilst greater distribution tariff complexity may enable more cost reflectivity it also may mean less simplicity and stability.

19. We have identified what we think are important considerations in the design of distribution tariffs as we move to a smart energy system:

    - forward looking network access price signals have different (but interrelated) time horizons. Charges can be constructed to send price signals on a half-hour by half-hour basis to reflect prevailing network conditions, for example whether or not there is very

high demand or generation which may be causing congestion. Network charges are then combined with the electricity power price to send market signals on whether to produce, store or consume. However, charges also send price signals which can incentivise efficient longer term decisions about where and what energy infrastructure is built (by both network companies and users). This longer term signal has important linkages to other areas like connections. These operational and longer term investment based price signals, whilst not entirely distinct, are also different;

- ensuring all network users make appropriate contributions to DNO cost recovery given increasingly varied network usage patterns. Distribution networks have significant sunk and fixed costs. In a smart, decentralised energy world, some network users, for example households with solar panels, heat pumps and storage, may use the distribution network much less than they did in the past. Flexibility also means some periods of time can be avoided all together. In this context it is important to ensure there is an appropriate contribution to the recovery of a network's costs from everyone who benefits from it. Ofgem noted in their July 2016 'Open letter: Charging arrangements for embedded generation' that fixed/sunk network costs recovery merited further consideration. Ofgem intends to consult on a targeted charging review, which includes this issue, in the near future.

- how distribution charges should be configured so that they send the right signals to network users in the context of new DSO roles and any new market arrangements. In Chapter 5, we consider a range of potential operational models which could support more coordinated access to flexibility providers. The extent to which new market or system arrangements may need to do this could depend on the degree to which price signals are able to drive response in future (reducing the need for it to be procured as a contracted service).

20. **The range of options for distribution network charging.** There are many possible DUoS charge tariff options in a half-hourly settled world. These tend to be either ToU volumetric charges or capacity based (i.e. kWh or kW based). As many have noted, hybrids of these may be best. Ofgem has been exploring these issues through the Distribution Systems working group (DS WG) of the Council of European Energy Regulators (CEER). The DS WG is developing 'best practice guidelines for distribution tariffs' which will consider the trade-offs between different distribution tariff methodologies and how certain types of network behaviour are best incentivised.

21. There are different mechanisms to recover revenues from network users. ToU volumetric charges send a price signal to avoid network usage at certain times. However, where these times are fixed in advance (as they are currently, specifically for winter peak), they risk not necessarily being correctly aligned with true times of network pressure. This is particularly the case if DNO costs now, or in the future, are no longer just linked to winter demand peak provision but are increasingly variable and location specific. ToU volumetric network tariffs can be dynamic. They could change daily, or even more frequently, to reflect network

stress. Whilst a highly variable, localised, dynamic ToU tariff may have the benefit of sending a more accurate short term behavioural signal regarding network conditions, it may also be less transparent (because of its complexity), predictable/stable (for investment decisions either by users or the DNO), or mean less revenue stability for DNOs (depending on what costs it was set to recover). The extent to which a dynamic tariff of this kind could be suitable would also be impacted by the type of users it is targeted at and the technological capability of users to respond, for instance, smart appliances could mitigate the risks associated with tariff complexity.

22. Much network reinforcement is decided according to forecast peak load, which is dependent on the likelihood of network capacity being used at the same (peak) time. Capacity based charges are a more cost reflective way to fund network expansion than flat rate volumetric charges. Capacity charges can be set in different ways. They can be pre-determined or based on 'utilised capacity' only known after the event. Where pre-determined they can be based on either subscribed or connection capacity e.g. fuse size. Pre-determined capacity charges have the benefit of ensuring all distribution network users make a contribution to the recovery of a DNO's allowed revenue. They are stable, but do not provide an incentive to reduce consumption below the agreed subscribed or connection capacity level. They can be set at different levels depending on time and the amount of connection sought.

23. Whilst changes could be possible to the structure of DUoS charges as described above, we note there is also the potential to consider whether new additional or alternative types of charges could help to support the efficient provision of signals and recovery of costs at a distribution level, particularly in the context of future models for network and system operation discussed further in Chapter 5.

## Questions: Smart distribution tariffs: Incremental change

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| 19. | Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including experiences/case studies where relevant. |
| 20. | What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility? |
| 21. | How problematic and urgent are any disparities between the treatment of different types of distribution connected users? An example could be that in the Common Distribution Charging Methodology generators are paid 'charges' which would suggest they add no network cost and only net demand. |

24. **Further changes.** The scale of change in the energy sector may give rise to a need for more fundamental changes to the structure of charges. With changes in the roles of the transmission and distribution networks and the SO, there will be an increasing need to consider how the structure of distribution and transmission charges fit together. As flagged above, Ofgem is already looking at network charging for storage, fixed/sunk network cost recovery, and examining issues related to embedded benefits for generators[81].

## Questions: Smart distribution tariffs: Fundamental change

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| 22. | Do you anticipate that underlying network cost drivers are likely to substantively change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result? |
| 23. | Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how? |
| 24. | In the context of the DSO transition and the models set out in Chapter 5 we would be interested to understand your views of the interaction between potential distribution charges and this thinking. |

### 3.5 Other Government policies

25. **Support for renewable energy generation.** There are clear synergies between our approach to supporting renewable generation and the transition to a smart energy system. The Government is committed to supporting deployment of renewable generation. Distributed electricity generation has seen a rapid increase over recent years. As costs continue to fall, we expect deployment to continue. However, without the correct framework, unconstrained deployment of variable decentralised generation could put additional pressures on local networks and system operation.

26. We are interested in understanding how Government can support distributed generation whilst reducing the system impacts that could result through other policies:

[81] https://www.ofgem.gov.uk/publications-and-updates/open-letter-charging-arrangements-embedded-generation

- in the Feed-in-Tariff (FiT) scheme, generators up to 30kW without an export meter have the option of a deemed tariff, based on an assumption about the level of export. It has been clear since the introduction of FiTs that deemed export was intended as a temporary measure to be in place until smart meters are available. Moving to metered export helps support the move to a smart energy system and delivers a number of consumer and system benefits. It helps pave the way for 'time of export' tariffs whereby a FiTs consumer who installs a domestic battery can respond to price signals to store energy during cheap periods for use (or discharge to the grid) at more expensive times (or when it is most beneficial to the system);

- in Contracts for Difference (CfD), generators wishing to co-locate storage with their generation[82] must ensure that imported electricity is not included in the meter readings used to calculate CfD payments. We have proposed putting the storage units in a separate Balancing Mechanism Unit (BMU)[83] to the CfD facility. The consultation on changes to the CfD contract and CfD regulations[84] sought views on this approach; and

- under the Renewables Obligation (RO), the integration of storage and onsite electricity generation can be permitted, although similar issues can arise as under the CfD policy. However, implementation structures differ between both schemes, so a solution for one will not translate to the other. Government is currently exploring these issues further for the RO with relevant stakeholders.

27. **The Capacity Market (CM).** The CM exists to ensure security of electricity supply by providing a payment for reliable sources of capacity. We have seen a growth in DSR participation in the CM over the first two auctions for delivery four years ahead, and we expect this to continue. The current application and testing processes have been put in place to ensure that DSR capacity in particular is real, identifiable and measurable. This is intended to mitigate the risk that consumers pay for capacity that cannot be robustly identified and verified. However, it is important that the right balance is struck, and that these processes do not create unnecessary barriers to the ability of DSR and other forms of flexibility to participate in the CM.

28. The National Infrastructure Commission (NIC), in its 'Smart Power' report[85], stated that 'as the Capacity Market evolves, the clear goal must be to ensure that demand flexibility participates fully in the main Capacity Market', ensuring that there is 'a level playing field for the diverse technologies that can participate.' The NIC recommended that a number of

[82] A CfD is a private law contract between a low carbon electricity generator and the Low Carbon Contracts Company (LCCC), a Government-owned company – the CfD Counterparty. The CfD gives greater price stability to electricity generators by reducing their exposure to volatile wholesale prices, whilst protecting consumers from paying for higher support costs when electricity prices are high. In this way, CfDs provide efficient long-term support for all forms of low carbon generation. See: https://www.gov.uk/government/publications/electricity-market-reform-contracts-for-difference.
[83] BMUs are units of trade within the balancing mechanism. Each BMU accounts for a collection of plant and/or apparatus. Most contain either a generating unit or a collection of consumption meters. https://www.elexon.co.uk/reference/technical-operations/balancing-mechanism-units/
[84] See https://www.gov.uk/government/consultations/consultation-on-amending-the-cfd-contract-and-regulations
[85] See https://www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report

small changes should be made as soon as possible which will make it easier for demand side solutions to participate. In particular, the NIC recommended that Government 'consider whether any administration of this regime, such as the rules around testing and the makeup of portfolios of capacity, unintentionally precludes the participation of demand flexibility and storage'.

29. Government is clear that the fundamentals of the CM design are sound at present. They include the auctioning of a standard capacity obligation at a single price for all types of capacity, and the ability for all participants to compete annually for one year agreements – except in the case of new generation projects which require longer term certainty in order to secure finance to meet capital expenditure above a specified threshold.

30. Government's consideration of responses to this call for evidence will inform potential near-term changes to address process barriers to DSR participation in the CM, in line with the National Infrastructure Commission's suggestion[86]. We particularly welcome views on improvements to CM processes that address barriers to true DSR[87] and flexibility participation specifically. In the longer-term, the CM legislation requires the Secretary of State to carry out a review of the CM after five years, reporting in 2019. This review will provide an opportunity to consider some of these interactions in detail, at a point when there is greater clarity regarding wider developments to the electricity system.

## Questions: Other Government policies

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| 25. | Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future? |
| 26. | What changes to CM application/verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions within/alongside the CM might be needed to enable newer forms of flexibility (such as storage and DSR) to contribute in light of future smart system developments? |
| 27. | Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on a smart system? |

[86] Respondents may wish to note annex A, which provides information on existing measures that have been developed, following engagement with stakeholders, to help increase the participation of DSR and storage in the CM.
[87] In particular, DSR that is achieved by reducing electricity demand via changes to a process. This would move away from the status quo where the large majority of DSR currently active in GB is achieved by running backup or distributed generators – which may be CHP, gas or in many cases diesel.

# 4. A System for the Consumer

**Consumers are at the heart of the development of a smart energy system, which can give them choice and control over how they use electricity, including any that they generate themselves. The participation of a diverse range of consumers can help enable the development of a more efficient, smart, and flexible energy system.**

**Chapter 3 set out options for ensuring the right signals are in place for flexibility, including signals received directly by the consumer. In addition to a price (or other) signal, consumers will need to find it easy and appealing to realise the benefits of flexibility for themselves and, in doing so, provide greater flexibility to the system. We welcome views on how to ensure that consumers can participate in a smarter energy system where they may benefit from doing so. We consider the potential for smart appliances and electric vehicles to help in this regard, and the barriers that may be preventing some users from offering demand side response (DSR) to the system. We also consider how consumer protection may need to evolve, and the need for cyber security measures to protect consumers and the system.**

## 4.1 Smart Appliances

1. Smart appliances (e.g. demand response enabled white goods, heating, ventilation, and air conditioning units, and battery storage systems) can support demand side flexibility because they can be set up to respond to signals, such as price information (e.g. received from the smart meter) or direct control signals. For example, a dishwasher could be programmed to run when energy is cheapest and be finished by the consumer's chosen time, saving them money. Some smart tariffs, particularly more complex ones which offer potentially greater system benefits, will require an automated response from smart appliances for consumers to fully realise the benefits. Studies have shown that smart tariffs with automation and/or direct control can deliver peak energy demand reductions of between 60-200% greater than smart tariffs without.[88]

2. For the consumer, smart appliances offer an additional means by which to optimise their energy use, providing both potential lifestyle benefits and cost savings. In order to maximise the benefits that smart appliances offer them, consumers are likely to need to be able to sign up to a smart tariff. Additionally, consumers will need to have clear information available to them regarding smart appliances and how to use them, in order to build consumer confidence in this new type of product.

[88] Frontier Economics, "Future potential for DSR in GB", October 2015. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/467024/rpt-frontier-DECC_DSR_phase_2_report-rev3-PDF-021015.pdf

3. Government's early estimates show that smart appliances could be more cost-effective than using new reciprocating engines (an alternative technology for meeting peak demand).

4. Smart appliances allow a wider range of consumers to participate in flexibility offers, and increase the volume of flexible load per consumer. However, there are a number of barriers and risks associated with smart appliances, including:

    a. limited financial incentives in a world where consumers do not already have smart tariffs;

    b. risks for consumers of becoming locked into a specific technology/manufacturer (if devices are not interoperable), which may limit their access to a full range of smart tariff offerings; and

    c. consumer concerns around price, autonomy, performance or privacy.

5. These could hamper the development and deployment of smart appliances. Additionally, wet and cold appliances have long replacement cycles,[89] meaning that penetration of new appliances into homes and businesses will take time. Government therefore considers that it is sensible to take action to promote smart appliances, and address the barriers to their deployment, sooner rather than later. Any action must ensure that innovation is enabled and promoted, without putting consumers at risk and while ensuring system stability.

6. Government envisages that appliances with high potential for DSR should have the capability to respond to signals to alter how and when they consume energy. This may be achieved in a number of ways, some involving cloud services (e.g. over the internet) and some without (e.g. self-contained hardware and software in the home which receives price signals from the smart meter). Government wants to ensure that there are no barriers to smart appliances being used in any model. Therefore, we consider that the following principles should be met by high potential smart appliances:

    a. **interoperability**: we believe that open standards will facilitate the interoperability of smart appliances and are essential for enabling a competitive market;

    b. **data privacy**: consumers must be in control of any data exchanged with third parties arising from the appliances with clear consent procedures that will ensure they are able to make informed decisions regarding data sharing;

    c. **grid security**: consideration should be given to the security of the electricity system, to ensure that smart appliances would not represent a risk to its stability (e.g. in the case of simultaneous activation of loads following price signals); and

[89] White goods (washing machines, dishwashers, refrigerators, etc.) have an average lifespan of 13-15 years.

d. **energy consumption:** we would expect the additional energy consumption of the appliance arising from the ability to respond to signals to be negligible (including additional energy consumption of any associated hardware in the premises).

7. There are a range of options that could be pursued, through regulation or voluntary agreements, to encourage the uptake of smart appliances by consumers and incentivise/ensure that the above principles are followed. The three main options we have identified are set out below. We should also be mindful of the direction of travel of the European Ecodesign framework, which is considering actions to increase uptake of smart appliances and principles similar to those outlined above. Additionally, the following section, on ultra low emission vehicles, sets out government action on electric vehicles and their integration into the electricity system, including consultation on taking powers for regulation for smart functionality.

    a. **Smart appliance labelling**: appliances which meet certain functional requirements (e.g. use open communication protocols) can use a particular label. Both smart and non-smart versions of appliances would be available for purchase.

    b. **Regulation of smart appliances**: any communications-enabled device (i.e. any device with the capability of receiving and/or sending signals) must meet certain criteria, focused around interoperability and demand response capability. Both smart (complying with the criteria) and non-smart versions of appliances would be available for purchase.

    c. **Requirements for appliances to be smart**: high-potential appliances are required to be ‘smart’ and interoperable (i.e. meeting a certain set of criteria, for example having a connectivity function and using open communication protocols); non-smart versions of these appliances are not available for sale.

## Questions: Smart appliances

| | |
|---|---|
| 28. | Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)?<br>• Yes<br>• No (please explain) |
| 29. | What evidence do you have in favour of or against any of the options set out to incentivise/ensure that these principles are followed? Please select below which options you would like to submit evidence for, specify if these relate to a particular sector(s), and use the text box/attachments to provide your evidence.<br>• Option A: Smart appliance labelling<br>• Option B: Regulate smart appliances<br>• Option C: Require appliances to be smart<br>• Other/none of the above (please explain why) |
| 30. | Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence:<br>• Wet appliances (dishwashers, washing machines, washer-dryers, tumble dryers)<br>• Cold appliances (refrigeration units, freezers)<br>• Heating, ventilation and air conditioning<br>• Battery storage systems<br>• Others (please specify) |
| 31. | Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified? |
| 32. | Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers? |

### 4.2 Ultra Low Emission Vehicles in a Smart Energy System

8. The Government is committed to the UK being a global leader in the transition to cleaner and more efficient vehicles, with an aim of ensuring nearly all cars and vans are zero emission by 2050. Both battery electric and hydrogen fuel cell vehicles are likely to play important roles in this transition. Take up of these vehicles will bring opportunities and challenges to the electricity system and we welcome views and evidence to support policy development in this area.

9. With Government support, the market for electric vehicles in the UK has grown rapidly, with total electric vehicle (EV) registrations now reaching over 75,000. The shift towards electric vehicles will see demand for traditional road transport fossil fuels replaced with demand for electricity. This will have implications for electricity generators and suppliers, who may stand to gain from this transition, and network operators, who will need to ensure their networks can manage these new loads. With the market poised to move out of the 'early adopters' phase, there is a window of opportunity to shape norms, expectations and markets so that electric vehicles can meet the needs of both consumers and the electricity system, before electric vehicles become truly mass market.

10. Studies undertaken as part of Ofgem's Low Carbon Networks Fund have looked in detail at the challenges and opportunities that electric vehicle charging could pose for DNOs. The "My Electric Avenue" project found that increasing penetration of electric vehicles on low voltage feeders can cause both thermal and voltage problems. The project suggested that 32% of UK low voltage feeders could require intervention to protect against problems when electric vehicle penetration levels exceed 40%.[90]

11. Electric vehicles tend to spend a considerable amount of their time stationary and plugged in, largely either at home, or a workplace. From a user's perspective, once plugged in, precisely when a vehicle begins and ends its charging is not necessarily their main concern. Their interest will be that the battery is charged sufficiently for the vehicle to be ready for the next trip. There is therefore considerable potential to modulate when a vehicle receives its charge, for the benefit of the electricity system and the consumer.

12. Some of this potential is already available, and more could be done to promote its take up. We will be considering ways to ensure that electric vehicle owners are better informed and empowered to take control over when their vehicle receives its charge. For example, this may include working with industry to promote the use of existing charging scheduling functionality to take advantage of off-peak electricity, and improving awareness and availability of static Time of Use tariffs, which could save electric vehicle owners money.

13. Through managed "smart" charging, and the use of two way vehicle to grid technology, customers with electric vehicles could not only take advantage of off-peak pricing, but also provide other functions, such as energy storage and DSR. Customers could potentially offer their car's functionality to various energy system parties, including the System Operator (SO), network operators and energy suppliers, in exchange for lower bills. This could not only ensure charging is efficient from a system perspective, but also unlock valuable services, such as frequency response, and take advantage of surplus renewable generation.

[90] http://myelectricavenue.info/

14. Ensuring the right market structures and price signals are in place, as explored in this document, will help support the development of smart charging offers to consumers. However more could be done. For example, ensuring the necessary minimum technical functionality to underpin smart charging is incorporated as standard to electric vehicle infrastructure would avoid costly infrastructure retrofits or replacements, which is why government is currently consulting on taking powers in this area under the Modern Transport Bill[91] and supporting the RIIO Network Innovation Allowance (NIA) funded "Smart EV" project[92] in seeking views on the functionalities DNOs may wish to see from charging infrastructure[93]. There will also likely need to be on-going cross-sector collaboration, with stakeholders from the transport and energy sectors brought closer together. To help facilitate this, the Government has helped establish the EV Network Group, as a forum of representative groups to share views, identify knowledge gaps and coordinate activities.

15. While some trial evidence suggests electric vehicle owners are broadly comfortable in having their vehicle's charging managed by a third party[94], more evidence is needed on the perspectives of different kinds of consumer, and how smart charging can best be constructed to meet different needs. The Government is involved in a number of projects looking into this issue which will help to inform government and industry approaches: The Energy Technologies Institute's "Consumers, Vehicles and Energy Integration" project[95] will test mainstream driver responses to EVs and test a smart charging solution; and the NIA funded "Electric Nation" project[96] will investigate EV owner consumer acceptance of smart charging, and vehicle to grid services. Ensuring that consumers can access the benefits from smart charging will be essential to its success, and government welcomes evidence and views on how this might best be done.

16. While currently the fuel cell market is much smaller than the battery electric market, hydrogen refuelling station sizes are projected to increase over time with 1000 kg/day capacity stations being viable by the end of the 2020s. Stations of this size with on-site electrolysis would have electrolysers of 2.5MW capacity, or higher if being used aggressively to capture off-peak renewable generation, and an energy storage capacity of 33-100MWh (based on 1-3 days storage). There is significant potential for fuel cell energy storage opportunities, with hydrogen production a commercial activity, readily influenced by market signals, and we intend to work with industry to ensure that this potential can be realised.

[91] https://www.gov.uk/government/consultations/proposed-ulev-measures-for-inclusion-in-the-modern-transport-bill
[92] http://www.smarternetworks.org/Project.aspx?ProjectID=1883
[93] https://www.eatechnology.com/products-and-services/create-smarter-grids/electric-vehicles/smart-ev
[94] http://myelectricavenue.info/about-project
[95] http://www.eti.co.uk/project/consumer-vehicles-and-energy-integration-cvei/
[96] http://www.smarternetworks.org/Project.aspx?ProjectID=1905

## Questions: Ultra Low emission vehicles

| | |
|---|---|
| 33. | How might Government and industry best engage electric vehicle users to promote smart charging for system benefits? |
| 34. | What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, network and system operators) to develop consumer propositions for the:<br>• control or shift of electricity consumption during vehicle charging; or<br>• utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network? |
| 35. | What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium? |

### 4.3 Consumer engagement with Demand Side Response (DSR)

17. **Large non-domestic consumers** have a natural commercial incentive to participate in DSR, and the potential to make a significant contribution to system flexibility. Very large consumers have traditionally provided some DSR to the system, both through the SO's Balancing Services contracts and through the avoidance of peak network charges. In exchange they are compensated. However, although many flexibility enablers are in place,[97] often these providers do not offer their full flexibility to the system because they are unaware of the opportunities or are wary of the risks.

18. As part of our stakeholder engagement, Ofgem has conducted a survey of large non-domestic DSR, seeking views of both large consumers and those that procure DSR (suppliers, networks and aggregators). The results of our engagement reveal a high level of interest in DSR, but barriers remain, which we have split into four categories[98]:

[97] The enablers include meters capable of recoding and submitting half-hourly consumption data, half-hourly settlement with the associated supplier and central IT systems, and time of use network charges.
[98] Some barriers, relating to the role of aggregators, and to the Capacity Market, are covered elsewhere in this document.

**Table 6: Barriers to large non-domestic demand side response**

| Category | Barrier |
|---|---|
| Cultural | Difficulties gathering information on the flexibility products/programmes available and how to participate in them; or awareness that the opportunities exist at all. |
| | Difficult to understand the monetary value of flexibility given the plethora of options available. |
| | A perception that business processes are not suitable for DSR, may preclude consideration of schemes. |
| Regulatory (role of parties) | The process for getting an export connection to the distribution network for on-site back-up generation can be relatively protracted and expensive. |
| | The relationship between DSR opportunities for different uses (e.g. DNO- rather than System Operator-procured) may be unclear to consumers. |
| Commercial (incentives) | Technical and commercial requirements of flexibility products may not fit with the characteristics of the consumers |
| | Providing flexibility is not the core business for consumers so the monetary value may not justify the effort required to sign a contract and provide the service. |
| | DSR may conflict with existing corporate environmental schemes/commitments. |
| Structural (costs) | Concerns about the disruption and the impact on business performance may preclude consideration of DSR. |
| | Even if considered, the on-going perceived risk and perceived associated costs of providing flexibility may be too high compared with perceived benefits. |

19. Consumers may cite multiple reasons for not participating in (more) DSR. To help overcome these barriers and address the concerns raised, there are a range of existing engagement opportunities. The best established fora are for those already participating in DSR, with more limited opportunities for those either not involved or currently unaware of the opportunities. The SO's Power Responsive campaign seeks to increase participation of DSR by 2020.[99] Its first year focused on the SO's balancing schemes rather than the wider opportunities for engaging in DSR, such as contracting directly with DNOs, which it is now looking to address in its ongoing programme. In areas such as this, more may need to be done to engage consumers and overcome barriers to their participation in a more flexible electricity system.

20. We are keen to avoid duplicating existing work given the momentum already behind this area, in particular the Power Responsive campaign. However, we see a need to consider ways to engage with harder to reach groups and increase awareness of the full range of DSR opportunities available, to help identify the options most appropriate to each individual consumer, utilising existing initiatives where possible.

[99] http://www.powerresponsive.com/

21. Ofgem has recently published its initial analysis of the results of its survey, which will inform our future work in this area and that of Power Responsive.[100] We plan to undertake more analysis of the survey responses alongside the evidence provided in response to this document.

*Domestic and smaller non-domestic consumers*

22. The domestic and smaller non-domestic sector offers significant potential for flexibility over the longer term, particularly with the electrification of transport and heating. There are currently low levels of flexibility offered to the system by domestic and smaller non-domestic consumers[101] because many of the building blocks that would enable them to participate are not yet in place.[102] Once these building blocks are in place there is still a risk that these consumers will not offer their flexibility to the system because they are unaware of the opportunities or wary of the risks.

23. It is harder to assess specific barriers to these consumers offering flexibility to the system, compared to larger non-domestics, as the opportunities are currently limited. However, for the domestic sector, Government's recent research[103] found that 50% of respondents would take up a smart tariff if their supplier offered one to them now. For those who were not interested, scepticism and uncertainty over the impact of a smart tariff on energy costs was the most common reason for a lack of interest. Respondents also said they would need more information before taking up a smart tariff, and were concerned about loss of control and that it would not fit their lifestyle.

24. Additionally, we can learn from evidence about smart metering[104], which highlights the likely importance of:

- both supplier and public consumer engagement;
- the role of energy services companies;
- the quality of design solutions (e.g. consumer interfaces); and
- the development of energy tariffs and services which facilitate behaviour change.

25. We believe our focus for engaging domestic and smaller non-domestic consumers should be on information provision, with a particular emphasis on how we might best empower and protect those vulnerable consumers who are most likely to have difficulty participating in a smarter energy system.

[100] https://www.ofgem.gov.uk/publications-and-updates/industrial-commercial-demand-side-response-gb-barriers-and-potential
[101] Exceptions being those customers on economy 7 and 10 tariffs who shift load into the overnight period through the use of storage heating.
[102] E.g. smart meters, half hourly settlement, smart appliances and smart tariffs.
[103] DECC Smart Energy Research: Summary Report (2016), TNS BMRB, TNS April 2016.
[104] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/276656/smart_meter_roll_out_for_the_domestic_and_small_and_medium_and_non_domestic_sectors.pdf p46; see also BEIS's Early Learning Project https://www.gov.uk/government/publications/smart-metering-early-learning-project-and-small-scale-behaviour-trials

## Questions: Consumer engagement with Demand Side Response

| | |
|---|---|
| 36. | Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services? |
| 37. | Do you recognise the barriers we have identified to large non-domestic customers providing DSR? Can you provide evidence of additional barriers that we have not identified? |
| 38. | Do you think that existing initiatives are the best way to engage large non-domestic consumers with DSR? If not, what else do you think we should be doing? |
| 39. | When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)? |

### 4.4 Consumer Protection

26. While the move to a smart energy system is expected to deliver benefits to consumers as a whole, some consumers may be less able to fully realise these benefits. Although the decision to take up a smart tariff is voluntary, certain types of consumer may be less able to change the time at which they use energy, meaning they may be less able to realise the benefits associated with smart tariffs. Action may be needed to help ensure the most vulnerable consumers are afforded suitable protections to ensure they are not made worse off by a more flexible electricity system.

27. We need to consider how to provide proportionate access to data in a way that safeguards consumers' privacy, whilst enabling innovations in the market e.g. the development of new smart tariffs and new business models that require consumers' consent to access their data. We also need to consider what type of information is available to help inform consumers' decisions e.g. information from suppliers and/or price comparison websites explaining the benefits of smart tariffs and how they compare to 'standard' tariffs.

28. We will need to strike the right balance between allowing innovators to emerge and flourish, while ensuring appropriate consumer protections are in place to prevent market abuse. We would also want to ensure a level playing field that does not favour one business model over another, to ensure that all types of flexibility provider can participate at this stage.

29. Within the context of a smart, more flexible system, we have considered consumer protection issues as follows:

a. **social impacts**. Moving to a smart energy system should bring benefits for all consumers, for example by avoiding unnecessary costs. Achieving these benefits is likely to require measures that deliver clearer price signals to consumers, such as smart tariffs. Certain types of consumer will be less able to realise the potential benefits these tariffs could provide, for example, those who are less able to shift their energy consumption away from peak hours or those who face higher barriers to switching. While some studies have explored this area,[105] more evidence is required. Ofgem is working to assess how any impacts differ by consumer group, their potential materiality in the context of work on half-hourly settlement and what needs to be done to mitigate potential consumer detriment;
b. **data and privacy**. The move to a smart energy system is expected to lead to a step-change in the amount of data that will be available to energy suppliers, networks and other parties. Some of this data will be personal, for example where it relates to an individual's pattern of energy use and is therefore subject to the Data Protection Act which provides the overall framework in which organisations are required to operate. We consider it fundamental that appropriate privacy safeguards are in place for handling personal data. The smart metering data access and privacy framework provides an example in this space, by ensuring consumers have control over who has access to their energy consumption data from smart meters and for which purposes[106];
c. **informed consumers**. As we move to a smart, more flexible electricity system, there may be particular information needed to help consumers understand the benefits available to them. This information could be provided from various sources, including energy suppliers and intermediaries such as price comparison websites or aggregators; and
d. **preventing abuses**. There are also issues to consider regarding what regulatory oversight of new market entities, such as third party intermediaries (TPIs) and aggregators, may be necessary. Ofgem wants to adopt a proportionate approach to regulation and a range of different options exist. For example, while TPIs are unregulated, Ofgem can apply for injunctions to prevent breaches in business protection under the Misleading Marketing Regulations. Further measures were discussed in Chapter 2.

## 4.5 Cyber security

30. In a smart energy system, critical national infrastructure will be connected to the Internet of Things through technologies such as advanced network management systems and remote control of smart appliances. A system can be more connected and retain its resilience to cyber-attack, but this requires forward planning.

[105] For example, see: https://www.ofgem.gov.uk/publications-and-updates/investigating-potential-impacts-time-use-tariffs-domestic-electricity-customers-smarter-markets-programme
[106] Except where it is required for regulated purposes. See: www.gov.uk/government/uploads/system/uploads/attachment_data/file/43046/7225-gov-resp-sm-data-access-privacy.pdf

31. Cyber attacks can be categorised as:

- data theft from government, utilities, financial institutions or individuals;
- attacks on IT systems leading to disruption of services; and
- attacks on physical infrastructure through SCADA[107] systems or domestic controllers.

32. The Government has already invested £860 million in its National Cyber Security Programme, successfully improving cyber security and resilience over the period 2011 – 2016. As part of the new five-year strategy launched on 1 November 2016, there will be further investment of £1.9 billion and a National Cyber Security Centre has been opened. The Government is working with cyber security experts to understand how the specific risks associated with smart grids can be mitigated and where the responsibility lies, building on expertise within Government and other organisations.

33. Areas of particular interest are domestic smart technologies and industrial control systems. For domestic smart technologies, individuals or organisations that can control electrical load or access consumers' data must use secure systems, which may require mandated security standards. Industrial users of legacy SCADA systems, many of which were designed before the Internet of Things existed, must ensure that they are appropriately secure for modern levels of connectivity. This requires ongoing risk management to ensure system security.

34. We will use the responses from this document to assess the level of risk associated with smart grids and where the responsibilities best lie for the different areas of cyber security within the electricity system.

[107] Supervisory Control and Data Acquisition

## Questions: Consumer protection and cyber security

| | |
|---|---|
| 40. | Please provide views on what interventions might be necessary to ensure consumer protection in the following areas:<br>• Social impacts<br>• Data and privacy<br>• Informed consumers<br>• Preventing abuses<br>• Other |
| 41. | Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely this is? |
| 42. | What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact. |

# 5. The roles of different parties in system and network operation

**Our changing system is leading to increasing interactions between the transmission and distribution networks, and a greater role for active management of supply and demand on distribution networks than previously. As the system changes, there is a growing need for parties to evolve away from traditional roles, and a need to think about how best to enable both existing and new market participants to support network and system operation.**

**This chapter considers how the roles of different parties need to evolve to ensure that networks, and the whole electricity system more broadly, are managed efficiently.**

**We cover changes to parties' roles in both the short- and longer-term:**

- **i) immediate action is necessary to address emerging system needs and to deliver benefits and savings for consumers. Distribution Network Operators (DNOs) need to transition to Distribution System Operator (DSO) roles and DSOs, the System Operator and Transmission Owners need to significantly increase engagement with one another, and other parties, to deliver the best whole system outcome for consumers. We are seeking to test our understanding of the short term changes needed, and whether there are any barriers to them;**
- **ii) additional changes to parties' roles could be necessary in future. Further thinking and trials are needed to determine whether this might be necessary, and what the changes might be. Debates around changing system needs and the roles of parties have already begun in GB[108] and internationally.[109] In addition there are many case studies and trials taking place. We are seeking to draw on and build on this work through this call for evidence, and are seeking views and evidence on the range of potential options that we set out.**

**The topic is closely linked to a range of other workstreams set out in this call for evidence, and also has strong linkages with other work in Ofgem, Government and more widely.[110]**

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[108] For instance via the Future Power Systems Architecture project, National Grid's SOF, and the Smart Grid Forum (SGF) amongst others. The SGF included a range of relevant work streams including work stream 6 which undertook early thinking on the DSO role and potential stages in a transition and work stream 7, which has assessed how smart solutions will operate in future distribution systems incorporating new LCT connections.

[109] For example the Council of European Energy Regulators (CEER) recently published a position paper on 'The future DSO and TSO relationship', building in part on the 2015 conclusions document, the 'Future Role of the DSO'. We note that the European Commission is undertaking thinking on related issues and its Smart Grid Task Force published its Expert Group 3 Report on Regulatory Recommendations for the Deployment of Flexibility in 2015.

[110] Including BEIS's work considering the case for greater independence of the System Operator, recommendations made by the National Infrastructure Commission, Ofgem's work on network constraints and RIIO, and the CMA's proposals on code governance.

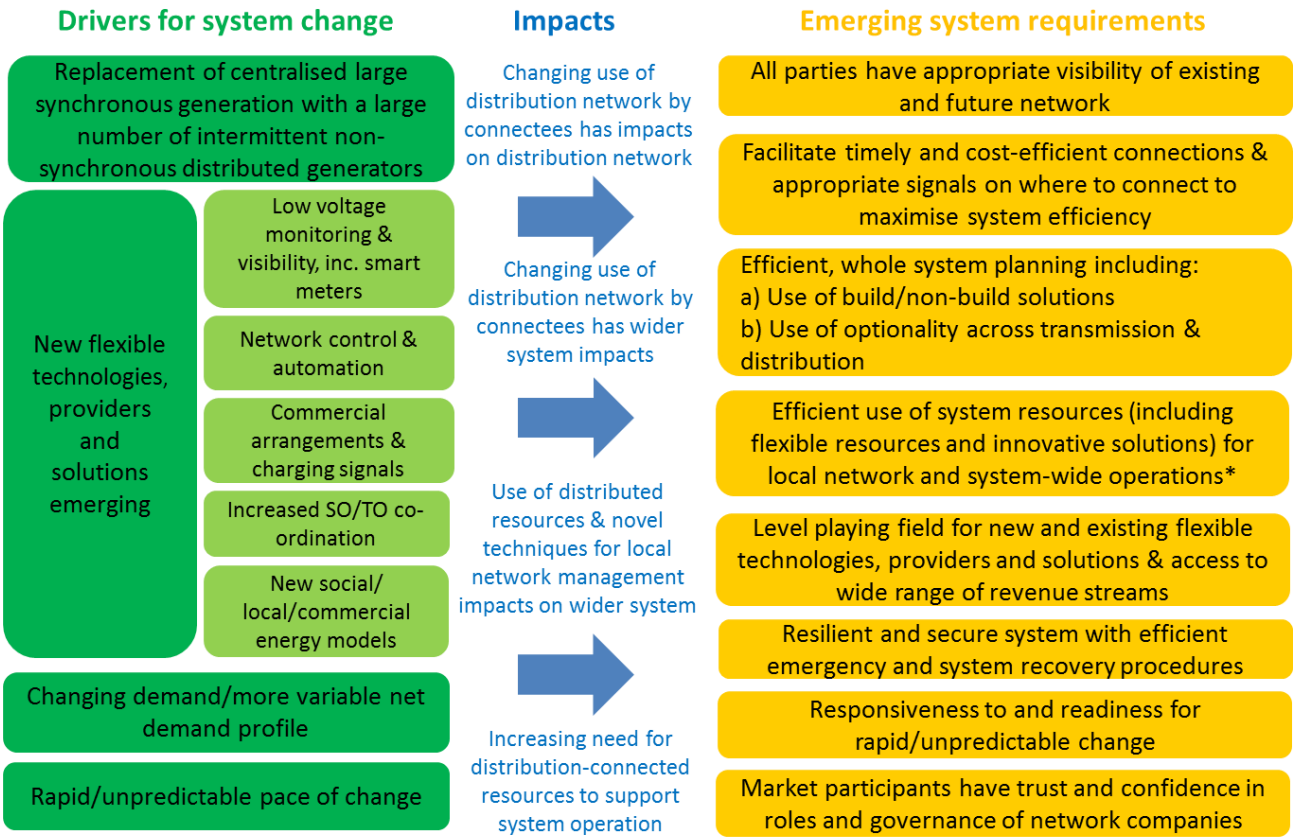
## 5.1 The impact of system changes

1. Our electricity network is split into the high voltage transmission network and lower voltage distribution networks. Responsibility for the transmission network is split between Transmission Owners (TOs) and the System Operator (SO). TOs own, build and maintain the transmission network, while the SO interacts with market participants to coordinate and direct flows across the system and ensures that supply can meet demand, such that system frequency remains stable. Distribution Network Operators (DNOs) own, build, maintain and operate the distribution networks.

2. These arrangements need to evolve to reflect how the system is changing. Figure 1 describes the key drivers of system change, the ways in which these drivers affect the system, and the implications for what the system (and role of parties) needs to deliver now and in the future. We have termed the latter 'emerging system requirements'. These are not exhaustive; they focus on those requirements most relevant to optimising electricity system and network operation in the context of the changes.

3. Whilst the focus is on the electricity system, there will also be a need to consider how any reforms can support an integrated approach with the gas, heat and transport sectors.

**Figure 1: Drivers for change and system requirements**




* Flexible resources (e.g. DSR) and innovative network solutions (e.g. dynamic asset rating) can be used by DNOs, TOs and the SO for a range of purposes: to manage network constraints (e.g. thermal/voltage limits, connections), to manage losses and to maintain frequency. Operational co-ordination is needed to ensure these resources and solutions can be used optimally system-wide.

4. The system impacts described above are being felt now. Below we set out some current examples:

**Table 7: System impacts**

| Impacts | Current example |
|---|---|
| Changing use of the distribution network by connectees has impacts on distribution network | Volumes of distributed generation have grown significantly, with the ENA estimating 27.8GW having now connected.[111] This, and further growth of technologies such as heat pumps or electric vehicles, can lead to reduced network capacity and new constraints, which can in turn impact timeliness and cost of new connections.[112] These impacts need to be managed appropriately, including through the use of active management approaches and innovative solutions (e.g. co-location of demand and generation). |
| Changing use of the distribution network by connectees has wider system impacts | Historically, electricity has flowed from transmission to distribution networks. The growth of distributed generation has reduced the need for distribution networks to import energy, and has even led to a sharp increase in cases of distribution networks exporting electricity to the transmission system.[113] This can create pressures on the transmission system, which may require investment to address. Evolving generation and demand patterns can also make it harder for network operators to predict where future investment will be needed, including whether it is best from a whole system perspective to invest at transmission or distribution level. It is critical that there are appropriate data flows and coordination of investment planning between parties to mitigate this where possible. |
| Use of distributed resources and novel techniques for local network management can have impacts on the wider system | DNOs are increasingly using innovative solutions to manage their networks, and in doing so are delivering benefits to consumers. However, if not managed properly, the use of some solutions can also pose challenges. For instance, Active Network Management may, in some cases, result in DNOs counteracting actions taken by the SO. Effective coordination is needed to avoid this and ensure the most efficient overall outcome. |
| Increasing need for distribution-connected resources to support system operation | The changing generation mix has led the SO to project a 30-40% increase in frequency response requirements in the next five years.[114] Distribution-connected providers could contribute significantly. However, use of these resources to support system operation can affect distribution networks. Co-ordination is needed to improve visibility and make optimal use of these resources, given they can provide services to multiple parties. |

5. The system impacts are likely to get more pronounced as the system undergoes further change. This demonstrates the need for a whole system approach (considering how customer needs can best be met across all voltage levels) now and in the future to support delivery of the requirements. Commercial, technical, and regulatory arrangements will need to facilitate this.

[111] http://www.energynetworks.org/assets/files/news/publications/Reports/TDI%20Report%20v1.0.pdf
[112] For more information please see Ofgem's work on quicker and more efficient distribution connections.
[113] 116 GSPs were exporting in 2014/2015. In 2015, National Grid consulted on potential charging arrangements at exporting GSPs and is now following this up with a broader review of transmission charging arrangements.
[114] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/System-Operability-Framework/

## 5.2 The need for immediate action

6. While the precise long-term roles of parties have yet to be determined, parties need to act together now to optimise outcomes for consumers. DNOs need to transition to new roles, which we have termed 'Distribution System Operator' (DSO) roles.[115] We believe that at a high level, and building on existing responsibilities, DSOs should:

    a. continue to be responsible for operating efficient, coordinated and economical distribution networks, including making active use of new technologies, providers and solutions; and
    b. have an increased role in delivering an efficient, co-ordinated and economical wider system.

7. In delivering (a), DNOs are expected to more actively manage their networks, a recommendation also made by the National Infrastructure Commission. Leading on from (b), DSOs, the SO and TOs will need to significantly increase engagement with one another, and other parties, to deliver the best whole system outcome for consumers.

8. **Progress to date and next steps.** In both these areas, the transition is underway and parties are making progress:

- DNOs are beginning to use new technologies, providers and solutions, including active network management, flexible contracts, demand side response (DSR), dynamic asset management, or services like CLASS,[116] as part of their business as usual processes. RIIO was designed to support this.[117] There are a number of published summaries of LCNF learning which provide more information.[118] Work is also on-going to refine commercial practices and address emerging issues; and
- DNOs, the SO and TOs are engaging more to solve emerging cross-system issues. One forum making progress is the Energy Networks Association Transmission and Distribution Interface Steering Group, and the groups which sit below this.[119] There are also examples of relevant trials, for instance the SO's South East Smart Grids trial[120] and the

[115] Independent Distribution Network Operators (IDNOs) will also need to consider what steps they can take in this context to deliver benefits for consumers.
[116] Customer Load Active System Services (CLASS) are distribution network voltage control and network management services that can support system operation. We recognise that such services need to operate on a level playing field with other flexibility sources and will continue to monitor arrangements to ensure they work in the interests of consumers.
[117] When DNOs identify new approaches that allow them to make savings, a sharing factor is applied which allows both DNOs and consumers to benefit, incentivising the adoption of the most efficient solution. The RIIO framework uses a totex approach so that companies are incentivised to adopt the most efficient solution from both opex and capex alternatives. The RIIO framework also includes a range of innovation funding mechanisms to drive learning and roll-out. It is important that we remain vigilant to any further regulatory or commercial changes that could be needed to better support DSO roles.
[118] EA technology's summary of learning, undertaken on behalf of Ofgem: https://www.ofgem.gov.uk/publications-and-updates/ea-technology-s-summary-low-carbon-network-fund-learning and the review undertaken by the University of Strathclyde, funded by UKERC and HubNet: http://www.ukerc.ac.uk/publications/a-review-and-synthesis-of-the-outcomes-from-low-carbon-networks-fund-projects.html
[119] The TDI steering group is examining issues at the transmission and distribution interface. An update report is published here: http://www.energynetworks.org/assets/files/news/publications/Reports/TDI%20Report%20v1.0.pdf. One relevant group which sits underneath it is the shared services framework for DSR which is looking at how to co-ordinate flexibility services.
[120] For further detail please see: http://www.smarternetworks.org/NIA_PEA_PDF/NIA_NGET0167_1521.pdf

Demand Turn Up trial between National Grid and Western Power Distribution. The aim of this trial has been for National Grid to procure and despatch a demand side service on behalf of both the SO and DNO in order to develop best practice in meeting transmission and distribution network requirements in an efficient manner.[121]

9. However, more needs to be done. DNOs need to demonstrate that active network management solutions and other options that do not involve building new infrastructure[122] are a fully integrated part of their business as usual decision making and culture more broadly. DNOs also need to improve visibility of what is happening on their network, making efficient use of the information that smart meters and other technology can provide as well as improved data sharing with relevant parties. We expect DNOs, working with the SO, TOs and other stakeholders, to make real progress in these areas and be transparent in their approach.[123]

10. More co-ordination between all parties is also necessary. Among the system requirements set out in the previous section, we consider that coordination over both short term and long term network planning and efficient use of resources for local and system-wide operations, are the areas where most immediate progress is necessary. For some requirements, there is good understanding within industry of the progress needed to fulfil them in the future system, while in these areas there is less clarity within industry about the nature of progress required. These are also the areas where more fundamental changes could be needed in the future. We consider progress should be possible in the near term on specific aspects of these two requirements:

    - **network planning.** DSOs, TOs and the SO need to develop formalised frameworks to ensure the network planning process takes into account the requirements of the whole system and the needs of stakeholders.[124] The process should consider all relevant options, including distribution and transmission solutions and alternatives to infrastructure build. Clear coordination processes and common methodologies are likely to be necessary. We consider there would also be value in the addition to the System Operability Framework (SOF)[125] of a role for DSOs to consider future operability issues on their networks in a co-ordinated way; and
    - **efficient local/system-wide use of resources.** There is a need for improved visibility, notification and coordination processes between DSOs, the SO and TOs when using system resources. Parties should build a common understanding of where their actions will have cross-system impacts and develop ways to ensure the best outcome for the system as a whole. This includes better coordination of access to flexible resources so

[121] Please see publications from National Grid and Western Power Distribution for further detail
[122] Including considering energy efficiency measures and other 'behind the meter' approaches
[123] For instance through their environmental reporting and Incentive for Connections Engagement reporting requirements.
[124] In developing their business plans, DNOs must engage to understand the requirements of their stakeholders, including traditional generators and demand customers, as well as local authorities, community groups and other interested parties.
[125] National Grid's System Operability Framework (SOF).

they can be used optimally across the system, and identifying where network management options in one part of a system can help in other areas.

11. In general, we think there is significant scope for these and other system requirements to be addressed through market-based approaches. In particular, we see value in transparent and integrated markets. We expect to see such approaches used wherever it is most efficient to do so.

12. We think the onus is on industry to address these requirements in the first instance, and that further progress is necessary over the coming year. We envisage a progress review will be needed by the end of 2017 at the latest. In starting to undertake new roles, network companies may need to act in new ways and deliver new solutions. We recognise that parties may encounter regulatory or commercial barriers. Industry parties are working together to consider ways to overcome these barriers and we want to work with them to discuss how solutions could be developed. We recognise that these changes will involve a greater role for the SO than previously in its interaction with distribution networks.

## 5.3 Further future changes to arrangements

13. The precise nature of the future system, and the associated future roles of parties in delivering the system requirements, are still uncertain.

14. While there is an important role for understanding how the system could change[126] and making sure roles and market arrangements are appropriate for those changes, there is also value in market arrangements that are resilient across a broad spectrum of scenarios. They must be able to address system challenges, irrespective of how demand, supply and new technologies and providers evolve. Using competitive approaches wherever possible can help deliver maximum benefit to consumers in this context.

15. In determining our longer term approach to changing roles in the system, we will need to monitor the progress parties make in responding to emerging challenges and opportunities. At the same time, we will need to think about what benefits other models of future roles and responsibilities could potentially offer. This will inform an assessment of the need for, and nature of, any more fundamental changes to roles and arrangements.

16. **Potential future arrangements.** There are a wide range of different models for how system and network operation could function in future, to deliver system requirements and meet the needs of users. We have reviewed a sample of existing thinking and identified some illustrative models which consider how different aspects of arrangements could

[126] Ofgem's work on insights for future regulation will improve our understanding of the key sensitivities to consider for future system arrangements

change to support system requirements. Across these models, varying emphasis may be placed on the roles of the SO, DNO and other parties.[127]

17. As in the previous sections, we have focused on identifying models which could support the system requirements for coordination in network planning and the efficient use of local/system-wide resources. The models are intended to act as a starting point for further thinking and illustrate a wide spectrum of possible change rather than a preferred list of options.

    a. **Network planning.** Coordinated and efficient network planning could be supported through:
        i. SO recommendations on the most economic solution. Under this model, the SO could have a role in assessing different options (both at transmission and distribution level) and providing recommendations to relevant parties on which option is likely to most economically meet system needs. This process would be similar to the new Network Options Assessment process for transmission. DSOs would retain responsibility for investment decisions on their network and be required to consider the SO's assessment of potential solutions. The SO could also support TOs and DSOs in ensuring that their RIIO business plans take full account of cross-system issues. DSOs would provide the SO with data to enable it to produce a SOF for the whole system, aiming to achieve a more coordinated, integrated approach to planning; or
        ii. Single party planning. Under this approach, a single party would be responsible for planning the system. This could be applied across the whole system, at certain voltage levels only, or in certain areas (e.g. DSOs could plan both the distribution and transmission system in a region).

    In each model, there is scope to consider how third parties input into planning. For example, SSEN tender for flexibility alternatives to reinforcement in 'constraint managed zones' [128] where demand is forecast to increase, while in Australia projects involving the build of new infrastructure above a certain size are automatically put out to tender[129], to test whether there are better non-build alternatives.

    b. **Efficient local/system-wide use of resources.** Further changes to different aspects of system arrangements could help support optimal system-wide use of connected resources and network management approaches, in operational timeframes:

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[127] Other parties could include consumers, community energy groups, aggregators or independent platform operators, among others. We note that whilst the division of responsibility between these parties will be a function of regulatory arrangements, the role of other parties may also be a function of their appetite to contribute to system or network operation. As such, the models described could be delivered in different ways.
[128] http://news.ssepd.co.uk/news/all-articles/2015/06/constrained-managed-zone/
[129] https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/regulatory-investment-test-for-distribution-rit-d-and-application-guidelines

i. DSO/SO procurement mechanism.[130] A mechanism could be designed to better enable DSOs and the SO to access flexible resources in a co-ordinated way. For example, DSOs or independent local market platform operator(s) could collect bids and offers for flexibility actions from distribution-connected providers in local areas (including from third parties such as aggregators or community energy providers). These bids and offers would then be used at a local level to manage constraint and system requirements within the distribution zone. At the same time, each local unit would be linked to the national balancing mechanism, so that bids and offers from distributed providers could be accepted by the local DSO and/or the SO to maximise their value to the system. This model would capitalise on DSOs' local network visibility while minimising duplicated effort or conflicting actions. It would allow resource to be used where it would be most efficient via the link between local units and the national balancing mechanism;[131]

ii. changes to market signals and arrangements.[132] There is the potential for market platforms to evolve, and market rules and arrangements could be adjusted so that the energy price in local areas reflects key system/network characteristics (based on information provided by the SO and DSOs), such as network congestion. For example, if there were constraints on exporting energy from a particular area of the network, then this would mean the price in that local market would fall, creating a signal for flexible resource that could turn up demand to help match generation in that local area. Alternatively, changes could be made to system access arrangements, such that pricing for a given level of access more dynamically reflects system constraints, and to give consumers greater choice over their preferred level of access. Another alternative could potentially be to send improved signals through network charging arrangements, discussed in more detail in chapter 4. Other changes to market arrangements, such as shortening settlement periods for electricity trading, could also provide better price signals for flexibility. Changes of these kinds could reduce the extent to which DSOs or the SO need to explicitly 'buy' flexibility response themselves after gate closure, as market participants would react in response to the price signals instead;

[130] Relevant models for DSO/SO procurement mechanisms include: Baringa and Smarter Grid Solutions' work for Elexon to identify potential future approaches for active management of DG and interactions with the Balancing and Settlement Code, a factsheet drawing on this analysis can be found here; thinking by Prof. Keith Bell at the University of Strathclyde on hierarchical operation of distribution networks and cell models, drawing on, among other things, work in the FENIX project and the IET's 'Power Networks Joint Vision' initiative; project TERRE, developing cross-border balancing platforms which may have parallels, and implications for platform arrangements; additionally, there are parallels with recent positive experiences in transmission-level regional security coordinators (CORESO and TSC); the approach outlined in SPEN's EVOLUTION project, and New York's 'Reforming the Energy Vision' strategy which includes a distribution platform provider role.

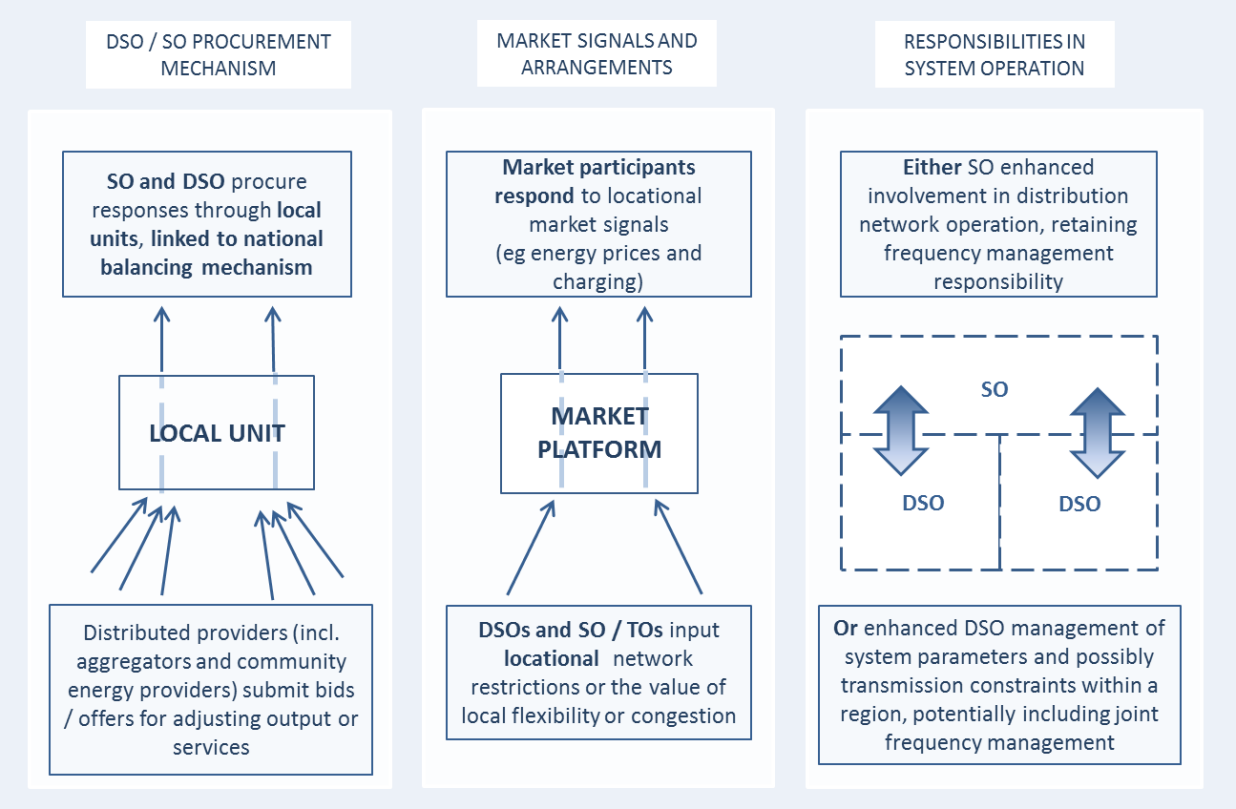
[131] Please note that some models of this type are commonly referred to as 'local balancing'. 'Balancing' is understood by some to refer only to the management of system frequency, whilst others understand it to also include the management of constraints. The models we describe here are intended to co-ordinate DSO/SO access to flexible resources for all network and system management purposes.

[132] Relevant models for changes to market signals and arrangements include Frontier's work for Elexon outlining an example of a platform arrangement supporting coordination of access to DSR, across wholesale market and balancing mechanism timescales; ENERA in Germany, looking at expansion of the intraday market with regionalized products to benefit the distribution grid; Futurewave, which links consumers, suppliers and investors in energy projects; Piclo, a renewable energy marketplace; and Vcharge, a power management platform for distributed transactive load. New York's 'Reforming the Energy Vision' strategy is also of interest, looking at market platforms for flexible technologies and how the uptake of renewables can be supported. Also, the USEF framework describes processes and interaction between different roles and contractual arrangements required to facilitate this, including a market structure, tools and coordination mechanisms.

iii. changing roles and responsibilities in system operation.[133] Responsibility for network operation and managing system parameters, potentially including frequency, could be further aligned within a single party. This would enable both system and network impacts and requirements to be considered jointly when taking operational decisions. It could involve enhanced SO involvement in distribution network operation (across all the distribution network, or potentially just at higher voltage levels) or DSOs jointly managing frequency and/or transmission constraints alongside distribution constraints. In the latter case, some central coordination or responsibility for transmission-connected resources would likely be required. It could also be that such changes relate only to particular voltage levels (for example, with DSOs becoming responsible for just lower voltage transmission asset operation, or the SO becoming responsible for higher voltage distribution asset operation only).

18. The key features of each of these operational models are illustrated in Figure 2.

**Figure 2: Illustrative range of potential models for further changes to arrangements to support efficient use of local/system-wide resources**




[133] In an AC network, like mainland GB, the system frequency is the same everywhere. Under the operational model on Shetland, which has no link to the mainland system, the DNO currently has responsibility for managing system frequency, acting as the system operator. Adopting this approach on the mainland would involve further complexity.

19. In addition to the range of models described above, there is growing interest in 'local energy'[134] and a range of trials of new tools and approaches are in development or underway. A number of these trials contain elements similar to the models discussed above. We will be seeking to monitor the developments in local energy so as to feed them into our thinking.

20. These models are not exhaustive or mutually exclusive. There are strong interdependencies between the models, and with other arrangements, which would need to be considered. These could include regulatory incentives, network charging and access, or wider commercial arrangements. Any changes would need to be considered holistically, and a model adopted in one aspect of the system could drive a different approach in another. There could also be scope to improve the extent to which ancillary services are procured through a more integrated and open platform approach across models (as discussed in Section 3.1).

21. There could also be interactions between network planning and operational models. For example, price differentials under a new market arrangements model could support network planning by providing useful information to guide where new network capacity is needed.

22. **Considerations in further thinking.** We have not yet assessed these models in detail or formed a view of their desirability. In taking forward our thinking on future roles and responsibilities, we will be looking more closely at the models, as well as potentially developing others. We will draw together evidence from this consultation as well as wider stakeholder engagement.

23. We will be considering whether further changes could help maximise consumer benefit, taking into account sustainability, competition and system security impacts and also considering distributional effects. It will be important to make the most of synergies in determining future roles, whilst using competitive approaches wherever possible to maximise consumer benefit.

24. We will also consider implementation costs and timelines of any changes, recognising that deliverability is likely to be a key question for some of these models. Linked to this, we will be seeking to understand what nature and sequence of change could deliver the best outcome for consumers in an evolving system.

25. Finally, we will look to draw on stakeholder expertise by building on the wide range of related current and future work, trials and models.[135] It is important that progress is co-ordinated and not duplicated, and that it is prioritised and targeted appropriately. We see this as a key part of our on-going work.

[134] We use 'local energy' here to refer to arrangements for matching electricity generation and demand at a local level, for a range of reasons

[135] Several projects in this year's NIC initial screening process submissions also have the potential to look at issues relevant to future roles.

## Questions: Roles and responsibilities

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|---|---|
| 43. | Do you agree with the emerging system requirements we have identified (set out in Figure 1)? Are any missing? |
| 44. | Do you have any data which illustrates:<br>a) the current scale and cost of the system impacts described in table 7, and how these might change in the future?<br>b) the potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts? |
| 45. | With regard to the need for immediate action:<br>a) Do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources?<br>b) How could industry best carry these activities forward? Do you agree the further progress we describe is both necessary and possible over the coming year?<br>c) Are there any legal or regulatory barriers (e.g. including appropriate incentives), to the immediate actions we identify as necessary? If so, please state and prioritise them. |
| 46. | With regard to further future changes to arrangements:<br>a) Do you consider that further changes to roles and arrangements are likely to be necessary? Please provide reasons. If so, when do you consider they would be needed? Why?<br>b) What are your views on the different models, including:<br>i. whether the models presented illustrate the right range of potential arrangements to act as a basis for further thinking and analysis? Are there any other models/trials we should be aware of?<br>ii. which other changes or arrangements might be needed to support the adoption of different models?<br>iii. do you have any initial thoughts on the potential benefits, costs and risks of the models? |

# 6. Innovation

**This chapter seeks views and evidence on whether we have identified the right areas for innovation support, and which other areas might warrant support.**

1. As the energy sector continues to respond to new challenges and changing demands, new technologies, processes and business models will play a crucial role in improving the security and affordability of our future energy system.

2. Ofgem encourages innovation in the competitive and monopoly markets and uses competition as a way to encourage industry to experiment and innovate where it offers benefits to consumers. Ofgem has also recently initiated a horizon scanning process to help it inform its future priorities.[136]

3. The Electricity Network Innovation Competition makes funding available to network licencees for large scale development and demonstration projects. It is an annual competitive process (currently worth up to £81m each year) and the innovation it funds can contribute to addressing the challenges set out in this document.

4. Much of the evidence to inform our work on smart/flexibility stems from the predecessor to the Network Innovation Competition, the Low Carbon Networks Fund (LCNF). The LCNF allowed up to £500m of support for projects sponsored by DNOs to try out new technology, operating and commercial arrangements. Ofgem has recently published an independent summary of learning from the LCNF.[137] Ofgem has also commissioned an independent evaluation of the LCNF and is conducting a detailed review to consider whether substantive changes to the innovation arrangements are required from 2017.[138]

   In late 2016, Ofgem will launch a new Innovation Link[139] service to promote beneficial innovation in the energy sector and inform how we regulate in the future. It will be a point of contact for energy innovators to bring new ideas to receive fast, frank and useful (but ultimately non-binding) feedback on the regulatory implications.

5. Ofgem will also bring forward proposals on providing innovation spaces for experimentation, giving more regulatory certainty for innovative approaches and products to be trialled within the existing regulatory framework.

6. As announced in the Budget, BEIS will allocate at least £50m to innovation in smart technologies and processes over the next five years. This section focuses on how BEIS's

[136] Ofgem 'Open Letter - call for engagement on insights for future regulation': https://www.ofgem.gov.uk/publications-and-updates/open-letter-call-engagement-insights-future-regulation
[137] https://www.ofgem.gov.uk/system/files/docs/2016/04/summary_of_low_carbon_networks_fund_learning_1.0.pdf
[138] https://www.ofgem.gov.uk/system/files/docs/2016/04/decision_update_letter.pdf
[139] Parties with an innovative or significantly different business proposition for the energy sector can contact the Link at innovationlink@ofgem.gov.uk

funding can help to catalyse further innovation[140] in the smart energy sector in a way that maximises system benefits of flexibility. Initial decisions on the allocation of this funding will be made shortly.

7. BEIS has identified the following potential areas for innovation funding support through engagement with a range of stakeholders, including other funders, e.g. the Low Carbon Innovation Coordination Group, and evidence gaps identified as part of our policy development process. We are seeking evidence on whether these are the right areas to receive innovation funding.

8. **Commercial and residential automated Demand Side Response (DSR) trials**. A range of surveys and trials in the UK have looked at how consumers respond to smart tariffs and contracts which encourage them to adjust their consumption at certain times. These provide an evidence base on the potential value of DSR to the energy system.

9. However, there has been limited commercialisation of new DSR approaches, particularly in the residential and Small and Medium Enterprise (SME) sectors. Suppliers and others (such as aggregators) face a number of barriers to testing and implementing new products and market services in advance of the smart meter roll-out. These include the complexity and cost of developing innovative DSR products and services, and uncertainties over consumer appeal and financial return. Conversely, in the industrial and commercial sector many flexibility enablers are already in place and the largest of these consumers have traditionally provided some DSR to the system.[141]

10. Trials could help us learn lessons from early adopters and then support faster and wider take-up of market solutions. In order to catalyse innovative DSR services for residential and SME customers, it may be valuable to explore approaches involving intelligent automation of flexible loads e.g. electric vehicles, electric heating/cooling, smart appliances, storage devices etc.

11. **Flexibility trading/optimisation platforms.** Flexibility providers typically access a limited number of revenue streams, often through direct procurement rather than open platforms. This creates barriers to flexibility being used where it adds most value to the system and can inhibit market entry if there is insufficient transparency about revenue opportunities. Both BEIS and Ofgem think this would be a useful area to test further.

12. There has been limited innovation and piloting in this area in the UK, although BEIS has funded projects such as a 'virtual energy store' and we are aware of other companies considering propositions that could achieve similar objectives. In addition, there are several

[140] 'Innovation' is used in this context to describe perspectives, technologies and approaches within the energy sector which seek to change and improve the way systems and operations function by considering improved and novel ways forward.
[141] As shown in the recent Power Responsive DSR market snapshot: http://www.powerresponsive.com/media/1142/power-responsive-dsr-market-snapshot.pdf

recently-funded trials as part of the Local Energy Challenge Fund, and the ACCESS project[142], which build on flexible platform arrangements.

13. BEIS believes there may be a case for further innovation support here. Our objectives would be to support optimal use of flexibility, to help flexibility providers realise the true value of their resource, and to mitigate prioritisation conflicts between multiple users of flexibility. As part of this, BEIS thinks innovation activity should support platforms that:
    a. facilitate coordination across the energy system, e.g. wholesale markets and balancing markets;
    b. enable flexibility providers to realise value by bringing them together with potential flexibility users;
    c. reduce transaction costs for flexibility; and
    d. direct flexibility resources to where they add most value to the system as a whole e.g. mitigating conflicts between potential users of flexibility through marketplaces where optimal dispatch is determined through efficient pricing.

14. **Storage costs.** While costs for some storage technologies are dropping, e.g. lithium-ion (Li-ion) batteries, there are some novel technologies which could benefit from innovation support and might be able to provide cost-effective grid-scale energy system services in the medium to long term.

15. There have been a number of storage demonstrations and pilots over the past few years, predominantly in battery-based distribution level storage[143] and behind-the-meter battery applications.[144] There have also been some smaller grid-level storage demonstrations, and feasibility studies looking at the potential for larger scale energy system storage.

16. BEIS believes there may be a case for further innovation support to catalyse the development of grid-scale storage technologies which have the potential to be more cost-effective than existing, more mature technologies such as Li-ion batteries or pumped storage. This could be facilitated by demonstrations of large-scale, or even inter-seasonal, storage technologies, e.g. compressed air, power-to-gas or thermal. This could also include support for component level development, manufacturing process, or efficiency improvements.

17. **Vehicle to grid demonstrations**. As the number of electric vehicles increases, there is potential for them to support the electricity network through frequency management, load shifting and storing excess energy. To date, exploration of the potential for these services has been limited in the UK. A number of small-scale academic studies and trials have taken place with more substantial trials taking place in other countries such as Denmark and Japan.

[142] accessproject.org.uk
[143] http://www.innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/
[144] http://www.moixatechnology.com/press-release/moixa-wins-share-of-decc-5m-contracts-for-energy-storage.php

18. Key challenges can include: availability and cost of infrastructure, viability of stacking services, and finding models that work for both business fleets and private vehicle owners.

19. In order to understand the potential for vehicle battery capacity to be used flexibly, we think the priority should be on demonstration projects that: pilot suitable commercial models to support the uptake of vehicle to grid capabilities; test acceptance amongst electric vehicle owners of their vehicles being used for vehicle to grid purposes; and work with equipment manufacturers to ensure infrastructure is set up for bi-directional charging.

## Questions: Innovation

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| 47. | Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas? |
| 48. | Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer. |

# 7. Catalogue of questions

| No | Section | Question |
|---|---|---|
| **1** | Removing policy and regulatory barriers<br><br>*Enabling Storage* | Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry?<br><br>Please provide evidence to support your views. |
| **2** | Removing policy and regulatory barriers<br><br>*Enabling Storage* | Have we identified and correctly assessed the issues regarding network connections for storage?<br><br>Have we identified the correct areas where more progress is required?<br><br>Please provide evidence to support your views. |
| **3** | Removing policy and regulatory barriers<br><br>*Enabling Storage* | Have we identified and correctly assessed the issues regarding storage and network charging?<br><br>Do you agree that flexible connection agreements could help to address issues regarding storage and network charging?<br><br>Please provide evidence to support your views, in particular on the impact of network charging on the competitiveness of storage compared to other providers of flexibility. |
| **4** | Removing policy and regulatory barriers<br><br>*Enabling Storage* | Do you agree with our assessment that network operators could use storage to support their networks?<br><br>Are there sufficient existing safeguards to enable the development of a competitive market for storage?<br><br>Are there any circumstances in which network companies should own storage?<br><br>Please provide evidence to support your views. |

| | | |
|---|---|---|
| **5** | Removing policy and regulatory barriers<br><br>*Enabling Storage* | Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage?<br><br>Please provide evidence to support your views, including any alternative regulatory approaches that you believe we should consider, and your views on how the capacity of a storage installation should be assessed for planning purposes. |
| **6** | Removing policy and regulatory barriers<br><br>*Enabling Storage* | Do you agree with any of the proposed definitions of storage?<br><br>If applicable, how would you amend any of these definitions?<br><br>Please provide evidence to support your views. |
| **7** | Removing policy and regulatory barriers<br><br>*Aggregators* | What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on:<br><br>• balancing services;<br>• extracting value from the balancing mechanism and wholesale market;<br>• other market barriers; and<br>• consumer protection.<br><br>Do you have evidence of the benefits that could accrue to consumers from removing or reducing them? |
| **8** | Removing policy and regulatory barriers<br><br>*Aggregators* | What are your views on these different approaches to dealing with the barriers set out above? |
| **9** | Removing policy and regulatory barriers<br><br>*Aggregators* | What are your views on the pros and cons of the options outlined in Table 5?<br><br>Please provide evidence for your answers. |
| **10** | Removing policy and regulatory barriers<br><br>*Aggregators* | Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk? |

| | | |
|---|---|---|
| **11** | Providing price signals for flexibility<br><br>*System Value Pricing* | What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future? |
| **12** | Providing price signals for flexibility<br><br>*System Value Pricing* | If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so? |
| **13** | Providing price signals for flexibility<br><br>*System Value Pricing* | If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits? |
| **14** | Providing price signals for flexibility<br><br>*System Value Pricing* | Can you provide evidence to support changes to market and regulatory arrangements that would allow the efficient use of flexibility and what might be the Government's, Ofgem's, and System Operator's role in making these changes? |
| **15** | Providing price signals for flexibility<br><br>*Smart Tariffs* | To what extent do you believe Government and Ofgem should play a role in promoting smart tariffs or enabling new business models in this area? Please provide a rationale for your answer, and, if you feel Government and Ofgem should play a role, examples of the sort of interventions which might be helpful. |
| **16** | Providing price signals for flexibility<br><br>*Smart Tariffs* | If deemed appropriate, when would it be most sensible for Government/Ofgem to take any further action to drive the market (i.e. what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer. |
| **17** | Providing price signals for flexibility<br><br>*Smart Tariffs* | What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs? |

| | | |
|---|---|---|
| **18** | Providing price signals for flexibility<br><br>*Smart Tariffs* | Do you recognise the reasons we have identified for why suppliers may not offer or why larger non-domestic consumers may not take up, smart tariffs? If so, please provide details, especially if you have experienced them. Have we missed any? |
| **19** | Providing price signals for flexibility<br><br>*Smart Distribution Tariffs - Incremental Change* | Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including experiences/case studies where relevant. |
| **20** | Providing price signals for flexibility<br><br>*Smart Distribution Tariffs - Incremental Change* | What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility? |
| **21** | Providing price signals for flexibility<br><br>*Smart Distribution Tariffs - Incremental Change* | How problematic and urgent are any disparities between the treatment of different types of distribution connected users? An example could be that that in the Common Distribution Charging Methodology generators are paid 'charges' which would suggest they add no network cost and only net demand. |
| **22** | Providing price signals for flexibility<br><br>*Smart Distribution Tariffs – Fundamental Change* | Do you anticipate that underlying network cost drivers are likely to substantively change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result? |
| **23** | Providing price signals for flexibility<br><br>*Smart Distribution Tariffs – Fundamental Change* | Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how? |

| | | |
|---|---|---|
| **24** | Providing price signals for flexibility<br><br>*Smart Distribution Tariffs – Fundamental Change* | In the context of the DSO transition and the models set out in Chapter 5 we would be interested to understand your views of the interaction between potential distribution charges and this thinking. |
| **25** | Providing price signals for flexibility<br><br>*Other Government Policies* | Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future? |
| **26** | Providing price signals for flexibility<br><br>*Other Government Policies* | What changes to CM application/verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions within/alongside the CM might be needed to enable newer forms of flexibility (such as storage and DSR) to contribute in light of future smart system developments? |
| **27** | Providing price signals for flexibility<br><br>*Other Government Policies* | Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on a smart system? |
| **28** | A system for the consumer<br><br>*Smart Appliances* | Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)?<br>• Yes<br>• No (please explain) |
| **29** | A system for the consumer<br><br>*Smart Appliances* | What evidence do you have in favour of or against any of the options set out to incentivise/ensure that these principles are followed? Please select below which options you would like to submit evidence for, specify if these relate to a particular sector(s), and use the text box/attachments to provide your evidence.<br>• Option A: Smart appliance labelling<br>• Option B: Regulate smart appliances<br>• Option C: Require appliances to be smart<br>• Other/none of the above (please explain why) |

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| **30** | A system for the consumer<br><br>*Smart Appliances* | Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence:<br>• Wet appliances (dishwashers, washing machines, washer-dryers, tumble dryers)<br>• Cold appliances (refrigeration units, freezers)<br>• Heating, ventilation and air conditioning<br>• Battery storage systems<br>• Others (please specify) |
| **31** | A system for the consumer<br><br>*Smart Appliances* | Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified? |
| **32** | A system for the consumer<br><br>*Smart Appliances* | Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers? |
| **33** | A system for the consumer<br><br>*Ultra Low Emission Vehicles* | How might Government and industry best engage electric vehicle users to promote smart charging for system benefit? |
| **34** | A system for the consumer<br><br>*Ultra Low Emission Vehicles* | What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, network and system operators) to develop consumer propositions for the:<br>• control or shift of electricity consumption during vehicle charging; or<br>• utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network? |

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| **35** | A system for the consumer<br><br>*Ultra Low Emission Vehicles* | What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium? |
| **36** | A system for the consumer<br><br>*Consumer Engagement with DSR* | Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services? |
| **37** | A system for the consumer<br><br>*Consumer Engagement with DSR* | Do you recognise the barriers we have identified to large non-domestic customers providing DSR? Can you provide evidence of additional barriers that we have not identified? |
| **38** | A system for the consumer<br><br>*Consumer Engagement with DSR* | Do you think that existing initiatives are the best way to engage large non-domestic consumers with DSR? If not, what else do you think we should be doing? |
| **39** | A system for the consumer<br><br>*Consumer Engagement with DSR* | When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)? |
| **40** | A system for the consumer<br><br>*Consumer Protection and Cyber Security* | Please provide views on what interventions might be necessary to ensure consumer protection in the following areas:<br>• Social impacts<br>• Data and privacy<br>• Informed consumers<br>• Preventing abuses<br>• Other |
| **41** | A system for the consumer<br><br>*Consumer Protection and Cyber Security* | Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely this is? |

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| **42** | A system for the consumer<br><br>*Consumer Protection and Cyber Security* | What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact. |
| **43** | The roles of different parties in the system and network operation | Do you agree with the emerging system requirements we have identified (set out in Figure 1)? Are any missing? |
| **44** | The roles of different parties in the system and network operation | Do you have any data which illustrates:<br>a) the current scale and cost of the system impacts described in table 7, and how these might change in the future?<br>b) the potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts? |
| **45** | The roles of different parties in the system and network operation | With regard to the need for immediate action:<br>a) Do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources?<br>b) How could industry best carry these activities forward? Do you agree the further progress we describe is both necessary and possible over the coming year?<br>c) Are there any legal or regulatory barriers (e.g. including appropriate incentives), to the immediate actions we identify as necessary? If so, please state and prioritise them. |

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| **46** | The roles of different parties in the system and network operation | With regard to further future changes to arrangements:<br>a) Do you consider that further changes to roles and arrangements are likely to be necessary? Please provide reasons. If so, when do you consider they would be needed? Why?<br>b) What are your views on the different models, including:<br>i. whether the models presented illustrate the right range of potential arrangements to act as a basis for further thinking and analysis? Are there any other models/trials we should be aware of?<br>ii. which other changes or arrangements might be needed to support the adoption of different models?<br>iii. do you have any initial thoughts on the potential benefits, costs and risks of the models? |
| **47** | Innovation | Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas? |
| **48** | Innovation | Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer. |

# 8. Use of terms

## 8.1 Terms

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| **Smart:** | something enabled by new technology or new uses of technology, in particular technology (often communications) that enables automatic control |
| **Smart Energy System:** | a system which intelligently integrates the actions of all users connected to it, including new parties, in order to efficiently deliver secure, sustainable and economic electricity supplies |
| **Flexibility:** | the ability to modify generation and/or consumption patterns in reaction to an external signal (such as a change in price, or a message) |

## 8.2 List of acronyms

| | |
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| **ADE:** | Association for Decentralised Energy |
| **BEIS:** | Department for Business, Energy and Industrial Strategy |
| **BRP:** | Balancing Responsible Party |
| **BSC:** | Balancing and Settlement Code |
| **BSUoS:** | Balancing Services  Use of System charges |
| **C16:** | Condition C16 of National Grid's Transmission Licence lays down the framework for National Grid's procurement of Balancing Services. |
| **CCL:** | Climate Change Levy |
| **CDCM:** | Common Distribution Charging Methodology |
| **CEER:** | Council of European Energy Regulators |
| **CLASS:** | Customer Load Active System Services |

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| **CM:** | Capacity Market |
| **CMA:** | Competition and Markets Authority |
| **DNO:** | Distribution Network Operator |
| **DSO:** | Distribution System Operator |
| **DSR:** | Demand Side Response |
| **DS WG:** | Distribution Systems Working Group |
| **DUoS:** | Distribution Use of System charges |
| **ENA:** | Energy Networks Association |
| **ESN:** | Electricity Storage Network |
| **EV:** | Electric Vehicle |
| **FiTs:** | Feed-in Tariffs |
| **GAR:** | General Authorisation Regime |
| **LCNF:** | Low Carbon Networks Fund |
| **NIA:** | Network Innovation Allowance |
| **NIC:** | National Infrastructure Commission |
| **Ofgem:** | Office of Gas and Electricity Markets |
| **PV:** | Photovoltaic |
| **RIIO:** | Revenue = Incentives + Innovation + Outputs |
| **RO:** | Renewables Obligation |
| **SCADA:** | Supervisory Control And Data Acquisition |
| **SCR:** | Significant Code Review |
| **SO:** | System Operator |
| **TNUoS:** | Transmission Network Use of System charges |
| **TO:** | Transmission Owner |
| **ToU:** | Time of Use (tariffs) |

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| **TPI:** | Third Party Intermediary |
| **TSO:** | Transmission System Operator |
| **SME:** | Small and Medium Enterprise |
| **SOF:** | System Operability Framework |
| **SSEN:** | Scottish and Southern Electricity Networks |

# Annex A – Demand Side Response and Storage in the Capacity Market

1. Since the early design phase of the Capacity Market (CM) the Government has benefited from regular engagement with and input from stakeholders, including companies and representative bodies from the Demand Side Response (DSR) sector. That engagement has helped inform a number of specific design features for DSR and storage. Most obviously, and despite the fact that the CM is in most respects strictly technology-neutral, this has included the provision of a ring-fenced auction, the Transitional Arrangements (TA) auction, reserved exclusively for the DSR sector. But other features in the more general design of the CM process were also implemented with a view to facilitating and simplifying participation by the sector, for example:

    - a low de-minimis threshold of 2MW to encourage smaller providers, and the ability with those even under 2MW to participate on an aggregated basis;
    - DSR is automatically a "price maker" in CM auctions, enabling DSR providers to be free to bid up to the auction price cap;
    - the choice of three metering options to allow for wider participation of resources that are not party to the Balancing and Settlement Code;
    - storage providers can deliver their capacity obligation during a system stress event through a mixture of generation and reducing demand;
    - the opportunity for DSR Capacity Market units (CMUs) to reduce their bidding capacity prior to the auction, and also to reduce their capacity obligation following a DSR Test, demonstrating a lower evidenced capacity to provide flexibility and to reflect any changes in their portfolio;

2. The above list is not exhaustive and there are many features of the CM that support all types of resources, but which could be of particular interest for smaller providers such as DSR. For example secondary trading, including volume reallocation, enables all CMUs with the opportunity to trade their obligation (or part of their obligation) for maintenance, a customer site closing down, or following an unexpected shortfall in capacity during a system stress event, therefore providing safeguards against penalty exposure. Another feature is that all CMUs that deliver against a relevant 145 Balancing Service despatch request during a system stress event will have their load following capacity obligation adjusted. This enables providers to benefit from other revenues.

[145] Relevant balancing services are set out in schedule 4 of the Capacity Market Rules: https://www.ofgem.gov.uk/electricity/wholesale-market/market-efficiency-review-and-reform/electricity-market-reform/capacity-market-cm-rules

3. We have continued to listen to stakeholders and have amended CM rules and regulations where possible to enable greater participation. We have seen levels of DSR and storage participation in the CM increase year on year, and we are keen to see these sectors continue to grow. Government is encouraged by the high levels of provisionally prequalified DSR in the three upcoming auctions: 668MW in the second TA auction, over 1GW in the Early Auction, and over 2GW in the four-year ahead auction. This shows that DSR is beginning to take its place as a significant resource in both the short and longer term. Storage volumes in the CM have also increased from 2.6GW securing agreements in the 2015 T-4 auction, to 4.7GW prequalified in the 2016 T-4 auction, including around 2GW of new battery storage.

4. Many of the incremental changes made since the CM was first put in place have been small and technical, but they have improved the operability of the CM for smaller providers. For example, credit cover requirements have been eased by allowing Unproven DSR CMUs to lodge cover only once where the units will compete in more than one auction. DSR can now benefit from adjustments to their output for line loss factors. Moreover, we have amended DSR's approach to demonstrating their satisfactory performance days from ex-ante to ex-post, in line with other types of CMUs. Ofgem have also introduced a Joint DSR Test to the CM Rules, which allows DSR portfolios to be tested collectively, rather than at a CMU-level. Ultimately this means a greater volume of DSR de-rated capacity can be included in the CM, benefitting the consumer and the aggregator.

5. Of course, any changes to the CM design must support the core aim of delivering security of electricity supply at the lowest cost to consumers, without creating unfair disparity between resources. In the context of these overriding objectives, we will continue to explore proposed amendments. For example, BEIS plan to consult shortly and seek industry views on whether the level of credit cover for DSR should be increased to the same level as new build CMUs, maintained or lowered, and whether, given the evidence that some providers have struggled with the DSR Test and Metering Test processes this year, the requirements could be simplified whilst maintaining confidence in output and metering set-ups.

6. It should be noted that DSR providers often raise the issue of agreement length in the CM and as part of this Call for Evidence, any new evidence supporting why longer term agreements are necessary for DSR is welcome.

7. Both BEIS and Ofgem (who are responsible for changes to the rules of the CM schemes, as BEIS is responsible for the regulations) will continue to engage closely with DSR and storage stakeholders going forward. We are greatly appreciative of the time and commitment demonstrated by DSR and storage providers in responding to our consultations and partaking in our events, particularly as we acknowledge that smaller providers often have limited resources to delegate this duty, and we look forward to our continued dialogue.


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