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A smart, flexible energy system: Call for evidence

EDF Energy is one of the UK's largest energy companies with activities throughout the energy chain. Our interests include nuclear, coal and gas-fired electricity generation, renewables, and energy supply to end users. We serve over five million electricity and gas customer accounts in the UK, including residential and business users.

Summary

We welcome the opportunity to contribute to this important and wide ranging Call for Evidence. The energy system is going through a significant transition as the sector decarbonises. The drivers of change include deployment of new technologies, the growth of decentralised generation and the increasing ability of consumers to play an active role.

EDF Energy wants to play a key role in this transition and we are leading the way in innovation. We are investing in electricity storage which is an important source of flexibility. We recently won an Enhanced Frequency Response contract from National Grid to provide 49MW of battery storage from our West Burton site. We have launched a dedicated innovation platform called Blue Lab to accelerate new ideas and solutions. Blue Lab will harness the latest smart technologies at home for the benefit of customers. And we are progressing with the construction of Hinkley Point C to provide the secure, reliable low carbon power that will be needed for decades to come.

We believe that a range of technologies is needed to ensure a low carbon, secure and affordable energy system. This includes new distributed energy resources, demand response, aggregation and community energy schemes which, in themselves, increase the diversity of financing options for this energy transition. These technologies need to be combined with a centralised transmission system and large synchronous generators continuing to play an essential role for system security and operability and for the power they provide.

Government has a role to play in ensuring the market framework supports the development of an efficient generation mix. It must be capable of providing secure, reliable power to customers, 24 hours a day, 365 days a year, at the same time as decarbonising the power sector. It must take account of the whole system costs of different technologies, including the costs they impose on the network and the costs of providing back-up generation to deal with intermittency.

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The market framework put in place by Electricity Market Reform (EMR) – with the key components of the Capacity Market, low carbon Contracts for Difference and the Carbon Price Floor – remains the right framework for making the transition to a low carbon power sector. This framework needs to evolve as the market develops, in particular, to ensure that the costs of developing and operating the network are fairly allocated, and that grid services are procured efficiently.

Network charging reform

Network charging reform is a priority. For decentralised resources to contribute to a smart, flexible energy system in a sustainable way that drives investment in the most efficient generation mix there must be a fair allocation of costs including network charges.

We have identified significant impacts on the capacity and energy markets from distortions created by embedded benefits, particularly from avoidance of transmission network charges. Distributed generators can be overcompensated through network charges and we see increasing evidence of network charging avoidance by installing generation 'behind the meter' and the use of private wire networks.

If market participants rely on having access to the transmission and distribution networks, we believe they should make a fair contribution to their costs. We believe that a move to a more fixed or capacity based system of charges would better achieve this than the current approach.

We support Ofgem leading a review of these issues in early 2017.

Procurement of flexibility services

A smart, flexible energy system relies on procurement of flexibility services. With more intermittent generation on the system, the role of the System Operator (SO) is getting harder and this increases the need for procurement of flexibility services. EDF Energy is working closely with National Grid in the way we deploy our own assets: running our coal assets to provide the flexibility services required by the SO, providing some flexibility from our nuclear stations, and investing in new technologies such as our battery project.

It is really important that there is visibility to the market of the value and transparency in procurement of flexibility. We welcome National Grid's System Operability Framework document and look forward to their "Requirements" publication in Spring 2017. To support flexibility providers, the System Operator needs to better highlight the future market for flexibility services: the expected range and value of these services.

We find the current procurement arrangements segmented, complex and at times opaque. This risks inefficiencies. We agree that some services are not being adequately signalled or valued, such as the provision of inertia which will become increasingly important over the coming decade. National Grid needs to develop a more effective procurement model that is transparent, market-wide and technology neutral. We believe that there is more that the SO can do to procure in ways that better enable market participants to capture a number of flexibility revenue streams enabling innovation and reducing the cost of flexibility.

Coordination between SO and DNOs / DSOs and TOs

We expect distribution systems to become more active and there will be opportunities for DSOs to procure flexibility services to help them manage their networks. In doing so, there is a clear need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning, and reliable and cost effective operation of the system through local/system-wide use of resource. To maintain a robust and secure system during the challenges of transition, there should be an increasingly strong role for the SO. The SO must retain overall responsibility for final balancing of the system.

System for the consumer / Innovation

Mandatory half hourly settlement and the rollout of SMET2 meters to include interoperability are essential enablers to facilitate further involvement of the demand-side in providing flexibility. The market will then be well placed to innovate to develop products and services. Government and Ofgem's role in relation to the adoption of smart tariffs should be one of facilitation through the removal of barriers rather than direct intervention.

We recognise the increasing role that aggregators will play in future. We believe it is important to protect customers and to provide clarity over the rights and obligations of aggregators by introducing suitable licensing arrangements for parties providing aggregation services.

Finally, we strongly support Government's focus on innovation and believe that the four areas in the call for evidence are the right areas to receive funding. Alongside the importance of the electrification of transport, specifically electric vehicles and their integration into the system, we would also highlight the importance of the electrification of heat and the opportunity this brings for flexibility.

Our detailed responses are set out in the attachment to this letter. Should you wish to discuss any of the issues raised in our response or have any queries, please contact Mark Cox on 01452 658415, or myself.

I confirm that this letter and its attachment may be published on BEIS's and Ofgem's website.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Angela Hepworth".

Angela Hepworth
Corporate Policy and Regulation Director

**A SMART, FLEXIBLE ENERGY SYSTEM
RESPONSE TO CALL FOR EVIDENCE**

Removing Policy and Regulatory Barriers – Enabling Storage	
1	<p>Q1: Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by the industry? Please provide evidence to support your views.</p> <p>We agree that you have correctly identified the main policy and regulatory barriers to the development of storage. We agree that storage has an important role to play in a flexible, energy system particularly given the material cost reductions we have seen.</p> <p>We see the primary role of storage in providing very short term flexibility, i.e. frequency response and shifting energy over short periods of time (minutes/hours). We note the recent National Grid tender for exactly this type of flexibility – the Enhanced Frequency Response tender – in which we were successful with a 49MW battery storage project. It is clear that in the near-term battery storage can be economic over these short timescales but it is a long way off being economic to store electricity over days/weeks/ months.</p> <p>We agree that Government’s and Ofgem’s focus should be on removing barriers with the objective to allow all technologies to compete on a level playing field where it is economic. It is important not to directly subsidise specific technologies or for other system users to subsidise indirectly. We have not identified any additional barriers.</p>
2	<p>Q2: Have we identified and correctly assessed the issues regarding network connections for storage? Have we identified the correct areas where more progress is required? Please provide evidence to support your views.</p> <p>The unprecedented growth in distributed energy resources, including storage, PV and reciprocating engines, has challenged the ability of DNOs to respond and make network connection offers. We agree that the right issues have been identified to improve arrangements including greater clarity on treatment of storage (both commercial, e.g. access and charging, and technical, e.g. P2/6, rules) and the development of more flexible contracts for connection and use of the network. It is critical that the DNOs adapt and keep pace with the material changes to the use of their networks.</p>
3	<p>Q3: Have we identified and correctly assessed the issues regarding storage and network charging? Do you agree that flexible connection agreements could help to address issues regarding storage and network charging? 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.</p> <p>The call for evidence asks about network charging for storage. While this is important, there is a broader question about network charging arrangements more generally that is fundamentally important to ensure that a smart, flexible energy system is developed.</p> <p>It is very important that network costs are allocated fairly between customers and also between different generators. Key principles for network charging are to reflect the drivers of network costs, they should be fairly allocated considering use made of the system and social equity issues, and network charges must not distort competition. At the same time charges should be simple and understandable, predictable, enduring and sustainable and consistent</p>

	<p>with Government energy policy. Current charging arrangements do not achieve these principles and allow parties to unfairly avoid paying charges which means others end up paying for them.</p> <p>Our analysis indicates that the majority of network costs are fixed over the long run as they mainly represent the large sunk cost of the invested network and yet are being recovered through either energy/commodity based charges or targeted at specific times, e.g. TRIAD charges and hence varying with use. This creates the ability to avoid these charges by self-generating or contracting with local distributed generation to run at certain times (or utilising behind-the-meter battery storage, once half-hourly (HH) settlement is in place for all customers). The value of this is material – current level of embedded benefits derived from Transmission network use of system charges (TNUoS) alone is valued at £45/kW in 2016 rising to around £75/kW by 2020. National Grid estimate the actual value of the benefit derived to the transmission system from embedded generation should be closer to £2/kW. This leads to inefficiencies and market distortions: one example is the impact on the Capacity Market where there has been a rush of new, small-scale diesel or gas reciprocating engines which have a significant advantage in relation to transmission connected generators. As another example, at domestic level a customer can avoid significant network charges by installing a solar panel and reducing their energy use through the year, and yet when they need the network most (winter peak when it is dark) the network will be fully loaded and under most stress and the customer will not be self-generating. This over-compensation will affect customers’ and developers’ investment decisions. Going “off-grid” is unlikely to be economic from a system perspective in the vast majority of cases. It is important that charging arrangement change to reflect the cost of the network and the different use and benefit that people make of it.</p> <p>In addition to distorting the market and impacting investment decisions, which in the medium term will impact consumers, it also has a direct cost to consumers. National Grid estimates that customers are paying an additional £300m per annum to cover the cost of TNUoS avoidance through embedded benefits.</p> <p>Ofgem has acknowledged these issues through their July 2016 letter and more recently December 2016 letter and intend to consult further. We are pleased that Ofgem has recognised these issues and we support this review – we consider that a Significant Code Review is the right governance approach for Ofgem to lead this reform assuming it can be undertaken in a targeted manner and expedited. We promoted our own targeted CUSC modification to address what we considered the most urgent issue of embedded benefits impacting the Capacity Market. In doing so we were clear about the need for wider reform.</p> <p>We believe that network charges need reform so that they better reflect network costs. A move to a much larger element of fixed capacity based charge, for instance, will better reflect the sunk costs of the network. This will help to address the current over compensation of embedded benefits, ensure a fair allocation of costs between users and better reflect the changing use of the networks. This change to more fixed capacity based changes has happened (and is actively being considered) in other jurisdictions around the world, e.g. Netherlands, Australia, US. Overall, all generation should be treated the same, whether ‘behind-the-meter’ or not which may imply changes to metering arrangements so that all generation output can be measured.</p> <p>Specifically addressing the points raised by the call for evidence, we agree that storage should pay for network charges for both import and export. We note that with charges that are broadly cost reflective (including time of use), it is unlikely that network charges will impose a</p>
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	<p>heavy burden on storage despite it being liable for both export and import due to its operating regime.</p> <p>We agree that clarity on the treatment of storage, e.g. whether it is deemed intermittent or non-intermittent, is important and to the extent that it is controllable then it is reasonable to assume that it is non-intermittent for charging purposes. It is important that there is consistent treatment of storage between network operators.</p> <p>We support the consideration of flexible connection agreements for storage but it is important that these are transparent so that parties, e.g. suppliers, can understand potential impacts.</p> <p>In addition to network costs, the call for evidence raises the question of BSUoS charges. We do not agree that standalone storage (distribution connected) would necessarily pay higher BSUoS charges than large generators. At present distribution connected storage can avoid BSUoS charges when they export. We agree this is an area that is worth including in Ofgem's review to ensure fair allocation of costs.</p> <p>Similarly, as low carbon policy costs are currently recovered on an energy/commodity basis the same questions arise about whether there is a fair allocation of these costs. We agree that some forms of storage (distributed connected) can be charged twice for these policy costs on the same energy depending on their commercial arrangements and this should be addressed. However again the question is broader as some forms of distributed energy resources can currently help customers avoid paying their fair share of these policy costs.</p> <p>Finally, as more storage is installed on the energy system we need to better understand how this will operate in aggregate and how it should be treated. One example of this is the growth of storage in the Capacity Market. Battery storage will play a valuable role in providing capacity but our analysis shows that for a large number of potential stress events, battery storage will not have enough stored energy to contribute fully to the duration of the stress event. With the current levels of storage this is not a security of supply risk but it is likely to become a risk as storage capacity increases; this may happen quite rapidly and it is therefore important that this issue is addressed this year. We support an approach based on derating factors, to reflect the contribution that storage can make to managing stress events as fairly as possible. This approach is analogous to the use of derating factors to assess the capacity contributions from interconnectors and we believe it is preferable to the introduction of arbitrarily enhanced testing requirements, which may stifle the development of storage and which could also impose increased burdens on other capacity providers, such as Demand Side Response.. See also our response to Q26.</p>
4	<p>Q4: Do you agree with our assessment that network operators could use storage to support their networks?</p> <p>Are there sufficient safeguards to enable the development of a competitive market for storage?</p> <p>Are there any circumstances in which network companies should own storage?</p> <p>Please provide evidence to support your views.</p>
	<p>We agree that DNOs should <u>not</u> be allowed to own storage – there are risks of market distortion in doing so, but rather they should be strongly encouraged through regulatory incentives to tender for flexibility services where economic relative to network investment. This will enable them to secure any benefit without the risk of impacting on the competitive development of storage.</p>

	<p>The RIIO framework provides a basis for these trade-offs to be made (through assessment of total expenditure rather than just assessing capex and opex efficiency separately) and this framework should be updated as required in the next price control review effective April 2023 to ensure DNOs adapt and keep pace with the rapid change in the use of their networks.</p>
5	<p>Q5: Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage? Please provide any 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.</p>
	<p>EDF Energy agrees that storage, and other decentralised energy resources, have an important role in a smart, flexible energy system. It is important that the regulatory framework keeps pace with innovative technologies as these technologies play a greater role in future networks in order to ensure that existing rules are not exploited, technologies are deployed based on market fundamentals and that shared costs are allocated fairly.</p> <p>We would support the definition of storage as a new asset class as this would provide clarity and be a precursor to any reform related to the regulatory treatment of energy storage. To this extent EDF Energy would be supportive of the Electricity Storage Network definition of storage although we note the need to test this definition to ensure it can be applied to any existing storage facilities.</p> <p>EDF Energy supports proposals to deliver greater regulatory clarity on storage's role in the energy system by developing a definition for electricity storage and explicitly recognising it within the licensing framework.</p> <p>We note that four regulatory models for storage have been presented within the consultation. EDF Energy's preference is for storage to be defined in primary legislation as a distinct licensed activity. If storage is to become more prevalent on the transmission/distribution system, we believe the clarity and legal certainty that a new licensed activity approach would provide is appropriate and would avoid any potential unintended consequences of treating it as a subset of the existing generation activity.</p> <p>However, we note that the primary legislation needed to implement this regulatory approach may take some time to introduce. Consequently, while we continue to believe that this should be the regulatory model ultimately adopted, if this would take a significant time to implement, defining storage as a subset of generation within a modified generation licence could deliver early benefits and reduce the current uncertainty in the interim period.</p> <p>Planning:</p> <p>EDF Energy agrees that the planning processes detailed in the Call for Evidence have been correctly identified. These currently influence project sizing and delivery timelines for all generation and storage projects and we urge caution with any proposed changes to these rules to ensure that they preserve fair treatment for all types of asset and technologies.</p>
6	<p>Q6: Do you agree with any of the proposed definitions of storage? If applicable, how would you amend any of these definitions? Please provide evidence to support your views.</p>
	<p>As set out in our response to Q5 above, we fully support the proposal to define electricity storage within the regulatory framework and for it to become an explicit licensed activity. In developing an appropriate regulatory framework for storage it is important that the definition is future proof and generic enough to capture all relevant storage facilities/technologies. On</p>

	that basis, the definition developed by The Electricity Storage Network (ESN) would appear to meet such criteria.
Removing Policy and Regulatory Barriers – Aggregators	
7	<p>Q7: What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on:</p> <ul style="list-style-type: none"> • Balancing services; • Extracting value from the balancing mechanism and wholesale market; • Other market barriers; and • Consumer protection <p>Do you have evidence of the benefits that could accrue to customers from removing or reducing them?</p>
	<p>We support the removal of unreasonable and unnecessary barriers to support competition and the development of new business models. To facilitate consumer engagement in providing flexibility the use of greater aggregation will be necessary. We support aggregators having access to the Balancing Mechanism and other flexibility markets as they develop. To ensure consumers and other market participants are protected, it is important that the activity of aggregation falls within the regulatory framework as identified by Government. Aggregators will be affecting consumers' demand and it is important that the necessary safeguards are in place. By affecting the consumer's demand the consumer's supplier will also be impacted – they will be put out of balance. Suppliers should not bear the costs of aggregators' actions.</p>
8	<p>Q8: What are your views on these different approaches to dealing with the barriers set out above?</p>
	<p>We agree that the proposal in table 5 to include aggregators fully within the regulatory framework through licencing is the correct way forward to address potential barriers and issues and we support its implementation. However, we recognise that this will take time and may not be currently appropriate with the size of the market. In the meantime adequate oversight and intervention measures are necessary which may not be achievable with a 'watching brief' approach.</p> <p>We would welcome clarification on timelines to implement each of the options in Table 5 and whether there is a trigger based on the size of the market.</p> <p>The key reasons for regulating aggregators through licencing are:-</p> <ol style="list-style-type: none"> To protect customers To provide a legal basis for them to provide services to the SO and to ensure orderly markets in ancillary services, balancing etc. To manage risks to the security/stability of the system (e.g. co-ordinated cyber-attack on energy consumption)
9	<p>Q9: What are your views on the pros and cons of the options outlined in Table 5? Please provide evidence for your answers.</p>
	See answer to Q8. No further comments.
10	<p>Q10: 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?</p>
	<p>We agree with the assessment of the risks to system stability where aggregators achieve scale. In this situation it is important that their system and processes involved in managing load control are robust and secure. As scale increases the robustness of these systems will need to improve. The relevant thresholds should be driven by impact on network operators and overall system operation. Network operators already plan for the loss of demand and loss of generation at various thresholds (P2/6 and SQSS) and secure for these events. If aggregation is</p>

	<p>at this scale then the wider system implications should be factored into the robustness of aggregator systems, e.g. equivalent to security at a large power station/network substation.</p> <p>In addition further actions could include:</p> <ul style="list-style-type: none"> a) Government creating more incentive for adoption of security in smart devices design b) Educating the consumers in making informed choices on security of smart devices
<p style="text-align: center;">Providing Price Signals for Flexibility – System Value Pricing</p>	
11	<p>Q11: What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?</p> <p>We agree that accessible markets and pricing which reflects the true system value of flexibility will be critical to enable the delivery of a smart, flexible energy system. A smart, flexible energy system will rely on procurement of flexibility services. With more intermittent generation on the system, connected at transmission, distribution and behind the meter, the role of the System Operator (SO) is getting harder and this increases the need for procurement of flexibility services.</p> <p>We have already seen changes to the way we operate our own assets by providing greater flexibility as a system service. Our coal assets due to lack of market value have at times not been running but we have offered them to National Grid to provide flexibility to support the system. This has been a big change over the last couple of years. Similarly we have worked closely with National Grid to provide some limited flexibility from our nuclear stations to support the system.</p> <p>It is really important that there is visibility to the market of the value and transparency in procurement of flexibility services. We welcome National Grid’s System Operability Framework document and look forward to their “Requirements” publication in Spring 2017 which we expect to detail additional commercial flexibility services required for the next five years. To support flexibility providers, the System Operator needs to better highlight the future market for flexibility services: the expected range and value of these services.</p> <p>We also consider the current procurement arrangements to be segmented to certain technologies, complex and at times opaque which risks inefficiencies. We agree that some services are not being adequately signalled or valued, such as the provision of inertia which will become increasingly important over the coming decade. National Grid needs to develop a more effective procurement model that is transparent, market-wide and technology neutral. We believe that there is more that the SO can do to procure in ways that better enable market participants to capture a number of flexibility revenue streams.</p> <p>This would enable new and existing flexibility providers to offer a suite of services that reflects the holistic value of the flexible asset to the system. Combining a number of revenue streams, including flexibility services, is key to forming a business case for new flexible assets, as no single market stream is likely to be of sufficient value to generate sufficient return on investment. This will not remove market risk and uncertainty but will more easily enable developers to invest. Our own experience developing our battery storage project highlighted the need to combine various uncertain revenue streams to determine our Enhanced Frequency Response tender bid – for instance one element was not knowing whether we would be successful in the CM and at what price.</p>

	<p>We recognise that National Grid is reconsidering how they procure system services and this should be a key focus for early 2017. It will be difficult to design an ideal procurement process for this. Some factors which we believe to be important are:</p> <ul style="list-style-type: none"> • Capacity and flexibility are inherently different products and they should not be combined in a single auction • A tender which bundles multiple flexibility services has some theoretical advantages but if this is too complex with too many services it is likely to introduce significant implementation risks and we do not advocate it at this stage. However, aligning procurement of a few flexibility services together is likely to aid the market and drive improved efficiency • The ability to bid to provide flexibility services contingent on, say, success in a capacity auction might have some advantages for the bidder but these could be outweighed by greater uncertainty for the market as a whole • Contract length is another important consideration; longer contracts will help to support new investment but carry the risk of locking in high costs to be borne by customers <p>For consumers and DSR, half hourly settlement and the rollout of SMET2 meters to include interoperability are essential enablers to increase consumer engagement in flexibility services. Alongside this smart appliances will be needed to facilitate this engagement. As we discuss later, once these enablers are in place, sharper price signals are necessary to promote flexibility services for the demand side. However, we recognise that protections must be in place for vulnerable customers who may not be able to respond to flexibility signals.</p> <p>Customers express preference for simple tariff structures and some customer groups may be unable to respond to more complex time of use tariffs. Suppliers should be able to design customer offerings to avoid overly complex pricing whilst promoting innovation and providing signals that coincide with the key periods of industry stress.</p>
12	<p>Q12: 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?</p>
	<p>Historically we have provided, and continue to provide, a wide range of flexibility services to the SO from our existing fleet of nuclear, coal and gas fired plant. These include system services: inertia, frequency response, reserve, reactive power, black start and energy services through the balancing and energy markets. Currently inertia from large synchronous generators is not remunerated.</p> <p>As described in the response to Q11, the current procurement process is a barrier. We have contracted with National Grid to provide EFR from a 49MW battery storage facility at West Burton B and as noted above this required a 4 year EFR contract to provide sufficient investor certainty and relied on many assumptions on other revenue streams that we would be able to stack to determine our EFR bid. There must be opportunities to: 1) better signal future services and their likely value to give greater certainty to market participants and 2) then run more coordinated procurement processes to reduce uncertainty and help increase competition for these services.</p> <p>For DSR we do not find there are barriers to accessing different schemes at different times of the day or the year. What is less clear are the risks of participants offering services to multiple DSR schemes. It is not clear how these schemes and the services being offered interact and</p>

	whether they are compatible with each other. There is scope to reduce confusion and inefficiency.
13	<p>Q13: 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?</p> <p>We agree that inertia should be included as a flexibility service and should be technology neutral with appropriate market signals. Specifically generators, including large synchronous generators, should not be excluded. Currently the true value of this service is not recognised or remunerated through market arrangements – there is no procurement of inertia. With a shift to increasing amounts of asynchronous generation there is an increasing demand for inertia on the system to manage frequency response - while fast frequency products such as Enhanced Frequency Response can substitute to an extent, it is important to establish market value for this service. Currently National Grid is sourcing inertia as a bundled, unremunerated service alongside other flexibility services from synchronous generators.</p>
14	<p>Q14: 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.</p> <p>We agree that encouraging flexibility should be done through more costreflective pricing (network charging) and through more effective procurement of ancillary services. Steps are already being taken to deliver smart meters and half hourly settlement to support further consumer response.</p> <p>We believe that Ofgem should lead reforms to network charging set out in this response by launching a targeted review in early 2017 to address current distortions. We advocate a shift to a greater fixed capacity type charge to better reflect the underlying cost structures of the network companies, the changing use of the networks and create a fairer allocation of costs.</p> <p>Separately the System Operator needs to better highlight the future market for balancing services (flexibility) and develop an effective procurement model (with at the very least greater coordination of procurement to allow providers to capture (stack) multiple revenue streams).</p>
Providing Price Signals for Flexibility – Smart Tariffs	
15	<p>Q15: 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</p> <p>We believe that Government and Ofgem's role in relation to the adoption of smart tariffs should be one of facilitation through the removal of barriers rather than any direct intervention. In particular, we believe that the development of such tariffs, and the awakening of consumer demand for them, is best left to market participants. This will primarily be the energy suppliers, as it is suppliers who set the tariffs. In this context, we note that the CMA, in its recent energy investigation, took steps to facilitate innovation, particularly in anticipation of the rollout of smart meters, by asking Ofgem to reduce the restrictions on energy suppliers imposed by the "simpler choices" part of the Retail Market Review.</p> <p>In terms of facilitation, the primary role that Government and Ofgem should play is to remove barriers to innovation. These barriers have been identified throughout the call for evidence. In our view, the main enablers to smart tariffs are:</p>

	<ul style="list-style-type: none"> • Smart Metering. This is being addressed through the national rollout programme. Foundation/SMETS 1 metering could be a barrier given its interoperability issues and possible lack of functionality post enrolment and adoption into the DCC. We note that the DCC is identifying options for the enrolment and adoption of these meters. EDF Energy is seeking a cost effective and pragmatic solution to adoption and enrolment. • Mandatory half hourly settlement of all premises with smart meters. This is being addressed by Ofgem's mandatory half-hourly settlement programme • Consumer awareness of the benefits of smart metering. This is the focus of work by Smart Energy GB (a body established by energy suppliers which is independent of government) • Consumer protection. The need to ensure that consumers, especially vulnerable consumers, who cannot change their pattern of consumption do not suffer detriment regarding the adoption of smart tariffs/half hourly settlement – which is already part of the Ofgem half hourly settlement programme <p>In addition, we expect the benefits of smart tariffs to be relatively small, particularly in terms of the scale of benefits needed to encourage consumers to engage with the retail energy market (even when savings of £200 plus are available from switching tariff or suppliers, it takes concerted action to engage consumers and the majority remain disengaged).</p> <p>Research by Frontier Economics as part of the Low Carbon Network Fund 'Customer Led Network Revolution' project (June 2012) shows a washing machine may have as little as £2 p.a. value from shifting its load away from peak times. The research showed that the annual value of interrupting hot water heating load at peak could be higher at £15. Combi boilers are replacing hot water tanks but electrification of home heating, may in the longer term reverse this trend.</p> <p>The small size of benefits is likely, in our view, to be a major barrier to the adoption of smart tariffs by consumers. This suggests that for smart tariffs to have the maximum impact on the smart energy system, the facility to automate between tariffs and smart appliances / storage / EVs / heat pumps will be needed to ensure that customer engagement is made as simple and easy as possible.</p> <p>Government can play a strong role in facilitating automation, for example through supporting the development of relevant standards (for products, buildings etc). Interoperability (i.e. between smart devices, communications devices and smart metering systems) is an area where government facilitation could be beneficial, particularly in respect of ensuring that customers do not get trapped into one closed technology, protocol or manufacturer's solution.</p> <p>Avoiding complexity will continue to be an important factor for all actors to be aware of. One of the key challenges for energy suppliers is how to deliver smart tariffs to customers that are easy to understand and respond to. Effective communication with, and education of, consumers in respect of smart tariffs is an area best left to participant innovation.</p>
16	<p>Q16: If deemed appropriate, when would it be most sensible for Government/Ofgem to take any further action to drive the market (ie what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer.</p>
	<p>In our response to question 15 we said that we do not see a direct role for government/Ofgem in relation to the adoption of smart tariffs. Instead we see innovation being led by market participants, particularly energy suppliers. We also noted the key facilitative actions to support smart tariffs, including, critically, mandated half hourly settlement of smart meters.</p> <p>Both the current target for the rollout of smart meters (2020) and that for mandatory half</p>

	hourly settlement suggest that the widespread take-up of smart tariffs will not occur until the end of the decade. This suggests that facilitative action by government and Ofgem should be targeted at consumer adoption from the early 2020s onwards.
17	Q17: What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs?
	<p>The Victoria smart meter rollout in Australia nearly stopped due to the mandated introduction of Time of Use tariffs with smart meters. Some vulnerable customer groups were unable to shift their demand at peak times and so were faced with higher energy bills.</p> <p>A similar issue occurred in 2010 where Oncor in Texas was taken to court as a result of the introduction of Time of Use tariffs using smart meters. Care needs to be given to avoid a customer backlash, not directly caused by the introduction of smart tariffs, but blamed on it.</p>
18	Q18: 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?
	Yes. In recognising the limited value available to larger non-domestic customers in responding to smart tariffs, it is also worth recognising the potential scale of cost/risk to a business's primary processes (such as manufacturing processes) that taking such action may imply.
Providing Price Signals for Flexibility – Smart Distribution Tariffs – Incremental Change	
19	Q19: Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including relevant experiences/case studies where relevant.
	<p>EDF Energy sees a number of areas where distribution charges can act as a barrier to the development of a smart, flexible energy system. These are:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Distribution charges are typically charged on an energy/commodity basis (kWh) despite being set to largely recover fixed costs including sunk network investment. This approach was appropriate in the past as it was simple (aligning with kWh meters) and facilitated supply competition. With increasing amounts of distributed generation, its lack of cost reflectivity is creating market distortions and enabling some consumers to avoid metered consumption, and hence not pay their fair share of network costs. This needs urgent action not least to avoid wasted investment, including in private wires, and we welcome Ofgem's plans to review this issue in early 2017. We consider that a larger fixed capacity element of distribution charge is needed – it is more cost reflective and provides a fairer allocation of costs. <input type="checkbox"/> As the call for evidence highlights, distribution charges will need to evolve to better reflect likely costs on a more active network and highlight flexibility value using the opportunity created by smart meters and half hourly settlement capabilities. More granular and accurate distribution tariffs (location and time of use) will be needed.
20	Q20: What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility?
	<p>As noted above we believe that more cost reflective distribution charges are needed urgently so that they have a much larger fixed capacity element to ensure fair cost allocation and avoid the building of duplicate assets as private networks.</p> <p>With the delivery of smart meters and half hourly settlement further reforms will be needed to</p>

	better reflect network costs and to better value flexibility. Consideration should be given over the next two years to develop granular distribution charges recognising the increasing complexity, less transparency, and potentially less stability/predictability this will bring.
21	Q21: How problematic and urgent are any discrepancies 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.
	We are concerned about ensuring that parties are treated fairly and with equivalence. It is important in this context that all generation is treated as generation, whether behind a meter or not, or whether connected at transmission or distribution. In practice we recognise that it is not always possible to achieve this as charging models are simplified representations. The approach to charging generation in the Common Distribution Charging Methodology (CDCM) is a simplification which no longer is sustainable with the continued growth of distributed generation. As noted above this needs to be reviewed and made more cost reflective.
Providing Price Signals for Flexibility – Smart Distribution Tariffs – Fundamental Change	
22	Q22: Do you anticipate that underlying network cost drivers are likely to substantially change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result?
	<p>As highlighted above the continued growth in distributed energy resources including intermittent generation means that the distribution networks are already changing and in some areas materially. This creates significant challenges to network operators to plan and invest in their networks. We believe that reforms are needed to distribution charging now to ensure that investment is efficient and not stranded – specifically to better reflect the sunk cost nature of the network. Further reforms are needed to facilitate greater consumer engagement with the energy system via smart tariffs and settlement and better reflect costs and benefits that different users may bring.</p> <p>With time (in the 2020s) there will be a further step change with the impact of electrification of heat and transport. This will reinforce the need for more cost reflective charges both by location and time but the complexity and cost of implementation could outweigh the benefits.</p> <p>We have concerns that it may not be possible for some vulnerable customers to respond to more complex time of use tariffs, in particular concerns about the elderly, vulnerable and fuel poor. As a supplier we want to retain the option to send through price signals to avoid overly complex pricing when customers express a preference for simple tariff structures.</p>
23	Q23: 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 and long term signals at the same time effectively? Should they do so? And if so, how?
	<p>Stable and predictable DUoS charges should send efficient longer term signals so consumers, generators and suppliers can make appropriate investment decisions. Volatility and uncertainty of DUoS charges are likely to make investment decisions more difficult.</p> <p>It may be appropriate to consider short term price signals to the extent that these are material but this doesn’t appear to be priority given issues highlighted above.</p>
24	Q24: 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.
	<p>Distribution charges may be one appropriate mechanism to help meet emerging system requirements but there are other mechanisms that we consider more appropriate. Electricity transmission currently splits longer term cost signals into TNUoS while short term system management/balancing is recovered through BSUoS. A similar split seems unnecessary and over complex in the near future but some aspects, such as DNO/DSO's contracting with distribution connected consumers and generators for services that enable efficient use of network resources, seems a good way forward. The cost for these could then be recovered in DUoS as a "normal" network cost, enabling continued stability and predictability of charges during the transition to something more complex at an appropriate future point.</p>
Providing Price Signals for Flexibility – Other Government Policies	
25	<p>Q25: Can you provide evidence to show how existing Government policies can help, or hinder the transition to a smart energy future?</p> <p>Electricity Market Reform (EMR) drives low-carbon investment and ensures there is an adequate amount of reliable capacity, all at lowest cost to customers. EMR is the framework which, complemented with a fair network charging methodology, effective ancillary services procurement and efficient energy market, will ensure the UK's energy mix moves to a low-carbon future and will deliver a smart energy system.</p> <p>Contracts for Difference (CfD), strong carbon pricing and the Capacity Market (CM) are the best way to drive towards this future.</p> <p>Government has a role in delivering a cost-effective generation mix and it is right for CfD and CM mechanisms to focus on providing this at lowest cost to customers. However, it is important that Government ensures that whole system costs are considered, for example the increasing impact from solar on managing the system.</p> <p>Encouraging flexibility should be done through appropriate price signals and ancillary services, not through the aforementioned government policies. The system operator must transparently procure these services and better enable revenue stacking of services. Ofgem's recent cashout reform has helped provide a more cost-reflective scarcity price to encourage smarter and more flexible behaviours.</p> <p>The Capacity Market brings forward the lowest cost capacity to ensure security of supply. As this is a market-wide technology-neutral mechanism, all assets are able to compete on an equal basis, bringing forward the lowest cost capacity. We believe that the Capacity Market is a successful and well-established mechanism and has delivered adequate capacity from a diverse range of technologies. BEIS and Ofgem must continue to ensure that there are no distortions in this mechanism and that changes to rules are made where required. In the Capacity Market auction in December 2016, a diverse range of technologies gained capacity agreements for delivery in 2020/21, such as battery storage, demand side response and small reciprocating gas engines. A diverse energy mix is welcomed, but the rules must ensure that these technologies are competing on an equal basis (for example by reform of embedded benefits) and that each technology's de-rated capacity is accurate.</p> <p>Contracts for Difference are the right mechanism to bring forward low-carbon generation at lowest cost to customers. However, we believe there may be some long-term changes that would better incentivise and encourage better system operability, by incorporating the system integration costs of different technologies within the CfD allocation framework. This is</p>

	<p>covered in more detail in question 27.</p> <p>In the long-term, EDF Energy strongly believes that a strong carbon price, coupled with Contracts for Difference and a technology-neutral capacity mechanism, and with appropriately valued ancillary services will drive an energy mix that is low-carbon and lowest cost. We believe that the Carbon Price Floor has already demonstrated this, with marked coal-to-gas switching since its introduction.</p>
26	<p>Q26: 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?</p> <p>EDF Energy believes that the CM should remain technology neutral providing everyone the same £/kW capacity figure, which is de-rated according to a technology's availability and reliability. This mechanism will, so long as market distortions are avoided, ensure that there is sufficient capacity to meet peak demand; the weighting of this mix should not be determined by its ability to be flexible, but by the lowest cost capacity that can meet demand. The value of flexibility should be driven through ancillary services, wholesale and balancing prices to appropriately value the services it provides to the system.</p> <p>As it is technology neutral, storage can compete in the Capacity Market; we have seen 500 MW of successful battery storage projects in the December 2016 T-4 auction, including a 49 MW battery owned by EDF Energy, showing that battery storage projects are able to be competitive with other technologies. However, we are concerned that short-duration batteries are over-rewarded in terms of their de-rating factors when considering the potential length of stress events.</p> <p>We expect the amount of battery storage on the system to increase over the next few years. This may lead to an increased risk to security of supply if generation assets are replaced with batteries with the same nameplate capacity but which are only able to deliver for a relatively short duration. This risk is not material with the 500MW of battery storage that won agreements in the recent auction but could become very significant in a few years.</p> <p>We believe that stress events could last for a range of durations. (Our modelling suggests that half of all stress events are likely to last for less than an hour but that some stress events could last for several hours.) Therefore, we do not agree with the imposition of a testing requirement for an arbitrary duration (as proposed by other members of industry); there is no single point at which the value of a storage asset should switch in a binary way from zero to being fully equivalent to firm generation capacity.</p> <p>We have instead proposed an alternative de-rating approach to Ofgem which we believe will provide a fairer and more realistic means to value the capacity contribution of battery storage to ensuring security of supply.</p> <p>Demand-side response (DSR) has been actively encouraged through the Capacity Market, with two specific transitional arrangements auction, in advance of the first T-4 auction delivery period. We accepted the arrangements to help promote this technology on a transitional basis, but we agree that DSR-specific transitional arrangements should end by October 2018. This is especially justified as we have seen 1.4 GW of Unproven DSR successful in the December 2016 T-4 auction, showcasing that it does not require specific support and can successfully compete against other established technologies.</p>

	<p>We believe that BEIS should ensure that Demand Side Response is defined as true load shifting or reduction. It is not appropriate to define behind-the-meter generation as Demand Side Response and we are concerned that a lot of procured DSR capacity in the CM is in fact generation. Technologies should be accurately defined and the example of behind-the-meter generation being classed as a 'smart' new technology is unhelpful when targeting a low-carbon future.</p>
27	<p>Q27: 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?</p>
	<p>We believe that Contracts for Difference (CfD) and an appropriate carbon price are the best mechanisms to bring forward low-carbon generation, by providing an investible scheme as well as appropriately valuing carbon emissions.</p> <p>We believe that any distortions in distribution and transmission charging should be resolved within the network charging arrangements and should not attempt to be addressed within the CfD and FiT frameworks.</p> <p>EDF Energy believes the CfD is the right mechanism to bring forward low-carbon investment, but we believe that the Government should carefully consider the whole system cost of bringing forward large amounts of low load factor and intermittent generation (such as solar PV) and the potential impacts that this will have on the system as a whole. By incorporating such considerations in to the procurement process, the mechanism will bring forward the lowest cost low-carbon capacity for the system as a whole.</p> <p>We believe there are changes that BEIS should consider for future allocation rounds to ensure that the allocation round brings forward the overall lowest-cost low-carbon capacity for the whole system, accounting for system integration costs. Potential changes to the CfD process could include:</p> <ul style="list-style-type: none"> • At present, CfD payments do not net-off changes in output due to the balancing mechanism or contracted ancillary services (i.e. CfD payments are based on delivered output as opposed to actual output prior to balancing actions), meaning balancing actions or ancillary services are potentially priced at a higher level than is cost-reflective. Reflecting changes due to balancing actions in output to CfD payments would help ensure that CfD contracted generation could bid in to ancillary services and balancing mechanism at a cost-reflective price. This would encourage greater flexibility from CfD contracted generation • At present, CfD payments for intermittent technologies are paid against a day-ahead reference price (the 'Intermittent Market Reference Price'). We believe that the Government should consider changing the reference price to a season-ahead reference price ('Baseload Market Reference Price'). This will incentivise the generator to reduce output at times of low prices and to schedule maintenance and other outages during periods of low prices, which will reduce total costs to the consumer. Such a change would ensure that CfD contracted generation is accounting for a proportion of integration costs within the allocation round.

A System for the Consumer – Smart Appliances	
28	<p>Q28: Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)?</p> <ul style="list-style-type: none"> • Yes • No (please explain)
	<p>Yes, we agree with the four principles, although we believe two further principles could be added:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Customer-centric perspective – i.e. an overriding principle that considers how the customer experience will be enhanced by smart appliances (e.g. in terms of the ability to monitor/control appliances remotely etc). <input type="checkbox"/> Health and safety - given the issues seen with some smart technologies recently (smart phone chargers and smart phone batteries for smart devices), as well as issues with conventional devices (like some tumble dryer models,) it is important this area is also covered in the Government principles. For example, running wet appliances (with large motors) at night (when electricity prices are expected to be lower) may legitimately create concerns around fire. If customers do not trust devices as they believe them to be potentially dangerous, they will not be purchased. <p>In terms of grid security, smart appliances can provide more than remote shifting of energy based on electricity prices, as they can be used on an automated basis to manage frequency response. The cost of adding this functionality to a smart appliance is very low (£1 to £2 per appliance). The call for evidence does not recognise this opportunity, but it is one that needs further investigation given the potential value it could provide to the wider energy system.</p> <p>Lastly, we note that the increasing volume of SMETS1 meters is a risk to interoperability, particularly in regards to connectivity to smart appliances. This may exclude many consumers from the advantages of a smarter energy system. The main issues with SMETS1 meters are how long meter manufacturers will support them, create the consumer access devices (CAD – which enables a smart metering system to access a local Wi-Fi router) or develop the load control functions needed to connect smart appliances. With DCC enrolment and adoption there are also risks that only a limited set of commands will be able to be sent to and via SMETS1 meters.</p>
29	<p>Q29: 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.</p> <ul style="list-style-type: none"> • Option A: Smart appliance labelling • Option B: Regulate smart appliances • Option C: Require appliances to be smart • Other/none of the above (please explain why)
	<p>We do not have any evidence to submit, but make the following observations on the options set out.</p> <p>Option A (Smart appliance labeling) is our favoured approach and labeling has shown to help increase customer awareness in other areas such as energy efficiency (for white goods) and food labeling. Labeling will help customers make more informed choices when deciding between which appliances to buy. However, as far as possible, we recommend that the information is based on ‘real-life’ (as opposed to factory) conditions reflecting how consumers actually use different appliances and believe that labeling should also give better</p>

	<p>approximations of running costs so that customers are not misled.</p> <p>We believe that some regulation/mandatory requirements (i.e. Options B and C) should be considered further if the market does not mature as expected. Given the limited value of responding to smart tariffs noted in the call for evidence there may be little consumer pull for smart appliances. However, given the cumulative impact of such response (on overall energy costs, security etc) it is appropriate to encourage smart/smart enable appliances, particularly where the incremental cost of doing so is relatively small.</p> <p>If there are Europe-wide initiatives that create standardisation, security and interoperability compatible with our Smart Metering Systems, then this should be explored. We agree the government should be mindful of the direction of travel of the European Frameworks that will support the uptake of smart appliances.</p>
30	<p>Q30: Do you have any evidence to support actions focussed 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:</p> <ul style="list-style-type: none"> • Wet appliances (dishwashers, washing machines, washer-dryers, tumble dryers) • Cold appliances (refrigeration units, freezers) • Heating, ventilation and air conditioning • Battery storage systems • Others (please specify)
	<p>The Energy Technology Institute's Smart Systems & Heat Programme, which we part funded, provides evidence that smart control of heat pumps and electric vehicles is a prerequisite for efficient deployment of low carbon heating and transport, with smart appliances of second order.</p> <p>http://www.eti.co.uk/insights/uk-network-transition-challenges-electricity</p> <p>The Energy Technology Institute has also examined consumer challenges for low carbon heat, highlighting issues to address if the UK is to change how it heats the vast majority of buildings.</p> <p>In EDF Energy's view battery storage, micro-generation, heat pumps and electric vehicles have the potential to be at the heart of a heart flexible energy system. For this reason, consideration should be given to making them Type 1 devices with 2 way communications connected to the Smart Metering System. Treating them in this way would maximise their visibility to the energy system, as they would effectively become an integral part of the smart metering system (even if they were under the control of aggregators).</p>
31	<p>Q31: Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified?</p>
	<p>Yes.</p> <p>There is a risk that consumers could be put off by the complexity of smart systems, including fears that their appliance will not be available should interconnectivity be lost.</p> <p>It is also possible/likely that consumers will not have suitable reference points to be able to judge what is on offer to them, resulting in a bad experience, and potentially a wider loss of confidence among consumers generally. For example, consumers are unlikely to have a feel for the value that could be unlocked by a complex mix of smart tariffs, smart appliances/demand side response, and aggregation. This asymmetry of information may significantly favour the provider resulting in a loss of confidence by consumers.</p>

	<p>EDF Energy has been calling for the licensing of intermediaries (eg a currently unlicensed aggregator) for some time. The need of a smart flexible energy system adds further impetus in our view.</p> <p>Lastly, the importance of customer preferences need to be adequately considered by the manufacturers of the appliances e.g. aesthetics, noise, and security otherwise there is a risk that customers will not buy such products.</p>
32	<p>Q32: Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable customers?</p>
	<p>EDF Energy sees the main risks to vulnerable customers as:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Not having a smart appliance or not understanding how to derive value from it, and so being excluded from the value it creates as part of the Smart, Flexible Energy System. It is important that vulnerable customers' overall needs are taken into account (which extends beyond energy) and that strong support networks (e.g. Citizens Advice) are available to such customers. <input type="checkbox"/> Increase cost of appliances should GB specific regulation be adopted. Working within international frameworks will help keep the costs of smart appliances down. <input type="checkbox"/> Being locked in to a technology or manufacturer, which requires a balance between providing incentives for innovation and any requirement to permit interconnectivity (e.g. by requiring the use of open-source frameworks) <input type="checkbox"/> Aggressive/mis-selling by unlicensed intermediaries. EDF Energy has been calling for the licensing of intermediaries for some time. <p>Government and Local Authorities could have a key role in promoting smart appliances amongst vulnerable customers by, for example, mandating certain appliances such as smart thermostats (which can help save customers money) in local authority owned properties, as well as in new build properties in order to build a critical mass.</p>
<p style="text-align: center;">A System for the Consumer – Ultra Low Emission Vehicles</p>	
33	<p>How might Government and industry best engage electric vehicle users to promote smart charging for system benefit?</p>
	<p>Tackling carbon emissions from transport is an essential part of meeting our carbon budgets; small passenger vehicles account for a significant fraction of these. EDF Energy supports a shift to electric vehicles as a cost-effective decarbonisation measure and, equally importantly, as an attractive consumer proposition that furthermore contributes to improved urban air quality.</p> <p>The Government should plan on a long term basis for the replacement of the revenue it raises from fuel duty in a way that will not impede the adoption of ultra-low emission vehicles. The added cost of decarbonising the transport sector must be shared broadly across society, and not imposed on electricity consumers, as this would be socially regressive.</p> <p>It is important to consider further the opportunity that electric vehicles bring to the energy system. As discussed above, the building blocks of half hourly settlement and smart meters are key enablers for providing smart charging to encourage the efficient integration of small passenger vehicles into the market. Government should support further trials to better understand market integration opportunities and implications, e.g. distributional aspects</p>

	which are particularly important as EV ownership is likely initially to be concentrated (eg geographical locations, certain socio-economic groups).
34	<p>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:</p> <ul style="list-style-type: none"> • Control or shift of electricity consumption during vehicle charging ; or • Utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network?
	<p>There is highly likely to be an opportunity to use the flexibility inherent in the battery storage of electric vehicles to avoid incurring costs in reinforcing distribution and transmission networks, and in building and operating peaking generation but mass adoption of electric vehicles would most likely have a materially negative impact on the efficiency of the wider electricity system without changes to today's electricity market arrangements. Since cars are parked 95% of the time, there is a huge potential to shift the period over which they are charged up.</p> <p>There are three conceivable ways to mitigate the financial impact of EV ownership on the wider electricity system:</p> <ul style="list-style-type: none"> - Direct subsidies from general taxation, e.g. by paying for reinforcement of the distribution network - Cost-reflective charges for network use and electricity consumption would ensure that EV owners paid their fair share of wider system costs - Mandatory managed control of EV battery charging operation by either suppliers or network operators <p>EDF Energy finds the arguments for and against these differing approaches to be finely balanced. The mix of economics, human behaviours, and technology development makes it difficult to assess their future effectiveness.</p> <p>We see further investigation of the practicalities of managed charging as an important area for research and trials to evaluate consumer acceptability and overall system benefit. In the longer term, the direction of travel ought to be towards cost-reflective price signals.</p>
35	What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium?
	We are not aware of any barriers to the use of electrolysis, but we would emphasise that to provide hydrogen on the scale required to fuel cars and other vehicles will require a much larger scale supply than 'off-peak' renewable generation, and alternative means of hydrogen production such as using high temperature nuclear reactors will be needed.
A System for the Consumer – Consumer Engagement with DSR	
36	Q36: Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services?
	<p>Only the largest and most engaged I&C customers are participating in the market at present, overall it is immature. We find no fixed approach on how customers find out about DSR services or start the process of service provision. Routes for engaging with customers include;</p> <ul style="list-style-type: none"> <input type="checkbox"/> Energy supplier account managers. Either the account manager raising DSR services with the customer or the customer approaching the account manager. The larger the

	<p>customer the more likely they are to be informed about DSR services and they also more likely to have a specialist energy manager.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Third party intermediaries (TPI). This tends to be the TPI being approached by the customer, who then refers the customer to us, but occasionally the TPI will approach the customer on our behalf. <input type="checkbox"/> The National Grid website has a list of aggregators with contact addresses and we have customers contacting us through this route asking for more information.
37	<p>Q37: 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?</p>
	<p>We recognise the barriers identified.</p> <p>Regarding the “cultural” category we find a common worry for our customers is the belief that they may lose control of their assets if they participate in a scheme. There is often a perception with customers that DSR is all or nothing and there is a lack of awareness of the options available to them, such as tailoring the offering to their needs or finding another service that fits better with the flexibility available.</p>
38	<p>Q38; Do you think that existing initiatives are the best way to engage with DSR? If not, what else do you think we should be doing?</p>
	<p>The current initiatives are providing a good starting point for DSR offerings, however a potential barrier is the lack of readily available information on how these different initiatives interact. This can make it difficult for participants to understand the full landscape of options available or to easily understand the risks of exploring multiple options. For example can two services be contracted simultaneously and what penalties would be incurred if one contract could not be met due to conflicting demands.</p>
39	<p>Q39: When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (ie in terms of trigger points)?</p>
	<p>The primary enablers are Mandated Half-Hourly Settlements, and SMETS meters (ideally SMETS2) being rolled out in volume. These are the two main foundations needed for mass engagement with customers which will occur by early 2020s.</p> <p>Industrial and commercial sites are nearly always going to be more effective to target with DSR offerings. Larger sites on contract can provide many megawatts of energy through one contract, and the introduction of a limited number of hardware and software interventions on a single site can provide a cost effective solution. To get the same level of energy from smaller sites would mean many more customer engagements and contracts needing to be signed, and enough suitable demand to be present in each location.</p> <p>The main drivers of flexibility from domestic properties and smaller business sites are likely to be storage, heat pumps and electric vehicles, as these can provide high levels of shiftable demand. Internal work by EDF Energy has backed up the Low Carbon Network Fund Customer Led Network Revolution work by Frontier Economics in finding that the prevalence of smart appliances is less of a driver, though in volume they will be a factor. Therefore engagement will be a priority as these sources of flexibility become more prevalent.</p>
<p>A System for the Consumer – Consumer Protection and Cyber Security</p>	
40	<p>Q40: Please provide views on what interventions might be necessary to ensure consumer</p>

	<p>protection in the following areas:</p> <ul style="list-style-type: none"> • Social impacts • Data and privacy • Informed consumers • Preventing abuses • Other
	<p><u>General comments</u></p> <p>Social impacts</p> <p>We agree with Ofgem that some consumers may be less able to shift consumption away from peak hours and that this is an issue that needs further study, particularly where this involves vulnerable customers. If vulnerable customers do not make use of the smart aspects of the future system, they cause extra costs to suppliers which may result in less choice for these customers. It seems possible that many such consumers will be in the current disengaged group who do not access the competitive market to reduce their bills. Measures to increase engagement for such customers, including those recommended by the CMA, could be of relevance to the engagement needed to take up of smart tariffs. Ofgem's work on extending principles based regulation to marketing activities should ensure that smart tariffs are not miss-sold.</p> <p>Data and Privacy</p> <p>This is a key issue relevant to the success of the smart meter rollout. All participants will need to abide by:</p> <ul style="list-style-type: none"> i) the Data Protection Act (DPA) 1998 (and in particular comply with the data protection principles set out in Schedule 1) ii) The EU General Data Protection Regulation (GDPR) that will come into effect from May 2018 following a two-year transition period <p>Both sets of legislation are overseen by the Information Commissioner's Office (ICO). It is not clear to EDF Energy that any further intervention is required at this stage.</p> <p>However, the DPA or the GDPR do not create a framework for the energy industry to co-ordinate in order to protect consumers against cyber threats which we look at later in the response.</p> <p>Within the smart meter rollout specific interpretations of the DPA have been put in place to give customers confidence about their data and privacy. The Smart, Flexible Energy System goes beyond the meter and it would be reasonable to see if an interpretation of the DPA is needed for energy related products within the home and how this can be regulated with non-licensed entities.</p> <p>Informed consumers</p> <p>Suppliers and intermediaries should provide information within the framework of principles based regulation that Ofgem is developing. Prescriptive regulation should be a last resort, particularly in view of the need for parties to innovate.</p>

	<p>Preventing abuses</p> <p>Suppliers and intermediaries (such as Price Comparison Websites and aggregators) should be subject to equivalence of regulation, meaning that in relation to energy, intermediaries should be subject to a licensing (and associated penalty) regime.</p> <p><u>Cyber security</u></p> <p>The call for evidence rightly highlights the key issue of cyber security. More advanced attackers could target these smart technologies for mass attacks, which could have an extensive effect on specific energy consumers (impacting their own homes but also personal data risks if breached) but also on the energy grid if smart devices are activated simultaneously.</p> <p>Considering the potential impacts on so many aspects of resilience of our modern society, we believe that the government should act rapidly to identify in which way those scenarios can be prevented by encouraging the adoption of sound security practices by Smart Devices manufacturers, including setting manufacturing standards.</p> <p>EDF Energy has already expressed those views in specialist security forums attended by government agencies (NCSC, BEIS, OFGEM). We believe that the subject needs to be reflected in the national cyber security strategy as the incentive measures currently promoted in the strategy are unlikely to reach foreign goods manufacturers and a stronger policy on security of goods commercialised in the UK should be set.</p>
41	<p>Q41: Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely is this?</p> <p>Customer trust is an area of risk. If there is even one instance where the energy system is compromised, customers will lose confidence in smart devices and they will not buy the devices or use them as expected. Such trust issues would also impact the rollout of smart meters and other initiatives that customers think are related to smart technologies. It is therefore critical that smart technologies are secure.</p> <p>As highlighted above we believe that further work is needed to ensure that smart technologies and systems are resilient to cyber-attack particularly where this can be done simultaneously to a large number of customers increasing risks to the overall system. The extensive work on the design of end-to-end security solution for Smart Metering means that this risk is low. However, as noted before aggregators systems once they reach scale need to be robust alongside smart appliances. For instance large sudden changes to demand across the system following a cyber-attack could create system instability – for instance simultaneously switching on or off certain larger appliances, e.g. kettles or immersion heaters. While the System Operator plans for unexpected events, such as loss of transmission equipment disconnecting demand, these standards do not consider this new threat.</p> <p>Smart Appliances are already being compromised and being used in attacks: https://www.ncsc.gov.uk/report/weekly-threat-report-24-october-2016 : IoT botnets take down US DNS services</p> <p>Distributed and coordinated events have the potential for far reaching effects at national scale destabilising the electricity transport grid.</p>
42	<p>Q42: What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact.</p>
	<p>We believe the key risks of securing the smart, flexible energy system are around cyber-</p>

	attacks as set out in Q.41
The Role of Different Parties in the System and Network Operation	
43	<p>Do you agree with the emerging system requirements we have identified (set out in Figure 1)? Are any missing?</p> <p>Yes, we broadly agree with the emerging system requirements identified.</p> <p>As we have set out above we believe that a smart, flexible energy system is one that includes a balanced mix including new distributed energy resources, demand response through supplier innovation, aggregation and community energy schemes combined with a centralised transmission system and large synchronous generators continuing to play an essential role for system security and operability. It is not a total replacement of large synchronous generation as set out in figure 1.</p> <p>Figure 1 refers to “new flexible technologies” – it would be good to acknowledge that existing technologies can also be operated flexibly. For example, we are operating our coal stations more flexibly and they are providing system services, to help manage the changing requirements of the system. We also have experience of offering some flexibility to National Grid in the operation of our nuclear stations, and this is being developed further.</p> <p>Figure 1 also highlights changing demand as a key driver – while underlying demand is changing in nature it is worth recognising that in large part this is driven by hidden embedded generation and it is important to distinguish the two to ensure effective design of the system. And while demand has reduced over recent years it will be important to consider future electricity demand with electrification of transport and heating in the coming decade.</p> <p>We believe that greater visibility to the market of future flexibility services and their value is needed. This could be made explicit in figure 1.</p> <p>Finally we fully support the need for efficient, whole system planning – this is important for Government, Ofgem and National Grid. The implications to the whole system with the changing generation mix need to be understood including the operability challenges and this should be set out more thoroughly through scenario modelling. Figure 1 refers to the “rapid and unpredictable pace of change” there is an important role for Government and National Grid in scenario planning to take account of some of these uncertainties. For example, we believe National Grid could have done more to anticipate the requirement to procure black start services from a wider range of market participants, given the known closure of coal stations albeit with uncertain timing.</p>
44	<p>Do you have any data which illustrates:</p> <p>a) The current scale and cost of the system impacts described in table 7, and how these might change in future?</p> <p>b) The potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts?</p> <p>The Transform model (financial model) and DS2030 (powerflow model) developed by the industry within the Smart Grid Forum (SGF) and used for RIIO ED1, illustrate the impact EV, Heat Pumps, Storage and Microgeneration will have on the system. They show that we do get to a point in the future where the powerflows at a local level will be such that they exceed capacity (including the extra headroom smart solutions will provide) and DNOs will have to add capacity to the system in the traditional manner (larger sub-stations and cables in</p>

	<p>conjunction with smart innovations) that will have bill impacts and customer disruption (directly with their energy supplier or via inconvenience like road works). Whilst we were fully supportive of the SGF work it did highlight as table 7 says that coordination / re-scoping of roles is needed to ensure the best outcome for the whole system rather than concentrating on one area of the system at a time. We do not have data to illustrate the potential saving of greater coordination and planning, but the need for it is clear. We are concerned about the impacts that connections at DNO-level are having on the management of both the distribution and transmission networks, and the costs incurred by National Grid to manage the transmission network which are ultimately passed on to customers. A recent example is the growth of PV through subsidy schemes which has exceeded its aims in terms of uptake but it has caused issues during the summer to the TO, SO and DNO which have led to restrictions (for example, network capacity in the south west and frequency control issues for the SO) and additional costs for the customer.</p>
45	<p>With regard to the need for immediate action:</p> <ul style="list-style-type: none"> a) Do you agree with the propose roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wider use of resources? 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? 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.
	<p>We agree that the role of the DNO needs to evolve to better manage a more active network – much of the innovation trials and RIIO framework should facilitate this but further assessment will needed at RIIO ED2 review to ensure DNOs adapt to the smart, flexible energy system.</p> <p>We strongly agree that there is a need for increased coordination between DSOs, the SO and TOs to deliver efficient network planning and local/system-wide use of resources. Again there are existing routes to achieve this through industry frameworks but it is vital that these are developed further to provide greater information flow and understanding of operability issues. For instance the recent growth in PV (all embedded within the distribution networks) has created significant operability challenges for the System Operator due to lack of visibility and control. While ultimately the growth has been largely down to support mechanisms, greater information exchange between the network companies and connection arrangements could have mitigated this effect.</p> <p>In the short term we believe that National Grid needs to develop their approach to procurement of balancing / flexibility services. It is really important that there is visibility to the market of the value and transparency in procurement of flexibility. We welcome National Grid’s System Operability Framework document and look forward to their “Requirements” publication in Spring 2017 which we expect to detail additional commercial flexibility services required for the next five years. To support flexibility providers, the System Operator needs to better highlight the future market for flexibility services: the expected range and value of these services.</p> <p>We also consider the current procurement arrangements to be segmented to certain technologies, complex and at times opaque which risks inefficiencies. We agree that some services are not being adequately signalled or valued, such as the provision of inertia which will become increasingly important over the coming decade. National Grid needs to develop a</p>

	<p>more effective procurement model that is transparent, market-wide and technology neutral and we believe that there is more that the SO can do to procure in ways that better enable market participants to stack value streams. As DNOs develop their own procurement of flexibility services (and indeed Europe through project TERRE and similar) it will be important that these are co-ordinated effectively.</p> <p>We believe that National Grid's SO incentive framework is a key enabler to ensure that these developments are taken forward and needs material reform.</p> <p>Evolution of the ENSG and SGF to a Smart System Forum as proposed by BEIS is an opportunity for industry input, oversight and leadership over these developments over the coming year.</p>
46	<p>With regard to future changes to arrangements:</p> <p>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?</p> <p>b) What are your views on the different models, including:</p> <p>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?</p> <p>ii which other changes or arrangements might be needed to support the adoption of different models?</p> <p>iii do you have any initial thoughts on the potential benefits, costs and risks of the models?</p>
	<p>Given the pace of change, we believe that there is a need for the rules, processes and arrangements to catch up as highlighted above particularly around information exchange, and better signalling and procurement of flexibility needs. However, once these more urgent and immediate issues are addressed it will be necessary for the roles and responsibilities to evolve as the market changes.</p> <p>In this changing system, clear roles and accountabilities are needed. We recognise that DNO systems will become more active and potentially unpredictable with local flexibility service procurement but, as it is now, it will be important that the System Operator retains overall responsibility for final balancing of the system.</p> <p>At this stage we do not see the case for a radical change in operational model which is likely to drive material costs but rather we support drawing on some of the aspects highlighted by the call for evidence, e.g. a co-ordinated procurement platform and an enhanced role for the SO.</p>
Innovation	
47	<p>Q47: can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?</p>
	<p>The new UKRI body should be tasked with ensuring sufficient support is given to the focus areas highlighted in the call for evidence (subject to our comments in Q48) both through existing channels, such as Innovate UK (and subsequent Catapults), and through industry led initiatives (e.g. generators, SO, TSO, DNO, Suppliers).</p> <p>It is important though that this approach allows industry participants to help shape the detail of the scope and approach to funding and for industry to play an active role within the trials to accelerate learning and development.</p>

	<p>When undertaking trials Government and Ofgem have a role in considering to what extent existing regulation and rules are a barrier to innovation within these areas. To maximise value and learning it may be necessary for existing rules to be relaxed (with appropriate consumer protections) to provide an “incubator” environment in such trials. This will require an active role of the regulator which we believe is similar to innovation trials through the Low Carbon Network Fund under RII framework. For instance regulation doesn’t currently allow for true peer to peer trading of energy.</p>
48	<p>Q48: Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer</p>
	<p>One additional area that Government should consider is heat. With the electrification of heat this may well provide another important source of flexibility and further research and innovation on the role that heat can play in a smart, flexible energy system would be valuable.</p> <p>We support funding of all four proposed areas as well. We would focus strongly on the need to develop the market design, integration and conditions for innovation. Addressing these issues will advance the onset of the smart, flexible energy system. With this in mind we would put less weight on the area of storage costs. We consider that innovation in the proposed technologies is likely to bring value over the longer term while the other three areas are likely to bring benefits sooner. We have seen with solar growth, once the market opportunity is clear there is significant growth and cost of the technology itself has fallen sharply. Similarly for EVs to Grid, the technology to connect and use battery storage from EVs is available today. The more challenging question is the interaction with the market and how best to facilitate significant growth in EVs onto the system at least cost.</p> <p>Finally we recognise that there are other existing innovation funding routes, e.g. improved renewable generation and demand forecasting and Small Modular Reactors, which are likely to provide an important source of longer term flexibility to the system and this is not highlighted within the call for evidence.</p>