National Grid response to the BEIS and Ofgem 'Call for Evidence on a Smart, Flexible Energy System

January 2017

About National Grid

1. National Grid is the owner of the high-voltage electricity transmission system in England and Wales, and the owner and operator of the national gas transmission system across Great Britain. As the System Operator (SO), for both gas and electricity in Great Britain, we are responsible for balancing supply and demand in the short term for the whole transmission system.
2. We welcome and support the call for evidence. This submission highlights the considerations we believe the Department for Business, Energy and Industrial Strategy (BEIS) and the regulator Ofgem should take account of when producing respective plans for a future energy system.

Executive Summary

3. The UK transition to a low carbon economy is bringing many new challenges to operating the electricity system, with greater flexibility becoming an increasingly valuable characteristic. We are moving away from the historical reliance on large thermal power generation and there is now a greater diversity of supply and demand side response than ever before. The rapid deployment of solar generation and other low carbon sources, such as wind, are connecting to the distribution network and all bring with them less predictable output.
4. The electricity system is already smart and the SO has continually evolved its role to meet the changing requirements of the energy market, while consistently delivering improvements in consumer value. We frequently assess the future energy landscape and the resulting challenges and opportunities both for energy consumers and for future grid operation, exploiting new technology to make our systems even smarter.
5. In a smarter energy future, system operation will continue to become ever more sophisticated and complex, as resources become more distributed and used for shorter periods of time. We are focused on identifying robust, cost effective and innovative solutions to ensure we can continue to support the delivery of a secure, low-carbon future as economically and efficiently as possible. It is clear however that investment in smarter and flexible system operation is needed to ensure we can continue to deliver savings for the end consumer.
6. As the SO, we continue to work closely with industry to deliver the right solutions at the right time, developing technical and commercial solutions to maximise the use of all available assets (network, generation and demand) to benefit the end consumer.
7. The SO have commenced a programme of initiatives to support the delivery of a smarter, flexible energy future, which includes simplifying the suite of system balancing products and services, to incentivise greater participation. In addition, we are also improving the information and market signals we provide, through the creation of our electricity and gas Future Operability Strategy, to enable the delivery of clearer and more precise forward looking assessment of system requirements. This will enable market participants to more effectively create their business cases and therefore increase competition in markets.
8. We believe that the SO has an important role to play in this significant time of transition to a smarter energy future, and is well placed to take a central facilitating role. However, there are important regulatory and policy changes that are needed, including a new regulatory and incentive framework for the SO as an important enabler to delivering the ambitions outlined in the call for evidence.
9. As the energy market continues to evolve and as the SO is being asked to take on additional responsibility, to meet industry and consumer needs, it is important for industry, Government and Ofgem to have confidence in the SO's ability to impartially deliver the transformation to the smarter energy future.

10. We fully recognise the need to provide confidence that any potential conflicts of interest are properly managed and therefore National Grid is advocating for its SO function to take on a more transformative role in the industry through greater independence. We welcome the consultation document on the Future of SO[1] and fully support the outlined model of a more independent SO within the National Grid Group. However, this would need to be accompanied by a clear regulatory and incentive framework which allows the electricity SO to take on this enhanced role.

11. One of the SO's roles is to balance supply and demand in real-time, and this is an area where we believe electricity storage could play a key role, alongside conventional generation, a greater use of demand side response and interconnectors.

12. We support the proposals for greater clarity on the definition of electricity storage and we believe that a separate definition could help to unlock the development of storage, by providing clearer investment signals to all parties. Storage needs to be treated differently to existing assets to reflect its different capabilities. It is unable to provide electricity constantly and therefore a new category is required to provide greater clarity to the market.

13. Evidence of the benefit of additional flexibility to the system has been widely analysed and includes analysis carried out by Imperial College for the National Infrastructure Commission[2] and for the Carbon Trust[3]. The consumer benefit of additional flexibility on the system could be as significant as £3bn to £8bn per annum by 2030 depending on the scenario.

14. We believe that an active demand side will also play an important role in meeting the challenge of delivering energy affordably and sustainably, and will reduce the need for investment both in generation and networks. As the SO, we are at the forefront of enabling greater demand side participation in the energy market, through our Power Responsive Campaign[4].

15. We believe that the full value of a smarter, flexible energy system (including electricity, gas, heat and transport) can only be realised with sufficient investment, innovation and necessary market reforms. This will allow all market participants access to efficient markets which foster competition and facilitate new technologies. We have identified the following enablers we believe need to be examined in this transition towards a smarter energy future:

    a. A market framework which ensures access and a level playing field for all market participants.
    b. A whole system review of transmission and distribution network charging regimes to ensure fit for purpose arrangements, and ensuring that it drives the right interactions between new and existing market participants. Importantly, delivering a fair and equitable treatment of all technologies whether connected to transmission or distribution systems.
    c. A review of the Capacity Mechanism (CM), to deliver necessary changes, such as longer term contracts for demand side response, proportionate with investment made by participants and the delivery of a stronger signal for electricity storage developers; all of which would provide clearer market signals for participants and investors.

16. In order to enable a smarter system, Distribution System Operators (DSO) and SO interfaces should be clearly defined. The SO supports further work and trials to be carried out to deliver a whole system solution. The SO's Regional Development Programme initiatives, in partnership with DNOs, are seeking to test new whole-system approaches to specific regional challenges and to gather experience to support longer-term structural changes.

17. An enhanced regulatory framework is needed to encourage network operators to focus on whole system solutions. It is important not to assume that a 'one size fits all' approach to the DSO transition is appropriate. Different DNO aspirations and network management requirements will drive an ongoing need for national system operation.

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[1] https://www.ofgem.gov.uk/publications-and-updates/future-arrangements-electricity-system-operator-its-role-and-structure

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507256/Future-proof_energy_infrastructure_Imp_Cam_Feb_2016.pdf

[3] https://www.carbontrust.com/media/129310/energy-storage-systems-role-value-strategic-assessment.pdf

[4] http://powerresponsive.com/

18. While this call for evidence focuses on electricity, it is important to consider the flexibility that the gas system offers now and can continue to offer in a low carbon, smarter future. Gas and electricity whole system thinking is a significant enabler of cost effective decarbonisation of heat, electricity and transport. Gas currently provides significant levels of peak demand and the costs and benefits of continuing to use gas in this way should be considered alongside any additional and innovative other sources. With the increase in intermittent renewable generation, gas and electricity are going to be more closely integrated, and it will be important to ensure that the flexibility that gas can provide is valued in the same way as other forms of flexibility.

19. We have recently published our *Future of Gas – A Transmission Perspective*[5] document which highlights the potential value of harnessing the optionality of the gas and electricity systems to support a more flexible energy system at least cost to consumers. Following this, we will be developing analysis on the future role of gas and the gas transmission system over this year and will publish further documents setting out our analysis and recommendations.

20. We believe that a smarter energy system is about using energy in an efficient and affordable way, as well as getting the best end result for consumers through developments such as smart electricity grids, storage and smarter ways to connect the electricity, gas, heating and transport sectors. The only way that these smart energy systems can be developed effectively is through collaboration and co-operation right across the sector; government, regulators, network operators, distribution companies and consumer groups – we all have a contribution to make. It is important however that Government clearly defines the necessary roles and responsibilities of all participants, as a lack of accountability could be perceived as a barrier to a smarter future being realised.

We welcome the opportunity to further discuss the points raised within this response. Should you require any further information or would like clarity on any of the points outlined in this paper then please contact:

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[5] http://futureofgas.uk/wp-content/uploads/2016/11/The-Future-of-Gas-A-Transmission-Perspective-Interactive.pdf

Questions

Removing Policy and Regulatory Barriers

Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry? Please provide evidence to support your views.

Yes in part, you have correctly assessed the main regulatory barriers to the development of storage.

- We are supportive of improving network connections for storage. In addition, storage developers are likely to diversify their portfolio of revenues over the lifetime of the asset and having the option for a sufficiently flexible connections contract which allows them to do so would help to unlock additional storage.
- We agree that network charges should deliver a fair and equitable treatment of storage. Review of charging arrangements for storage should be undertaken as part of a broader whole system charging review to ensure that other technologies and other new or existing market models may not be unfairly disadvantaged.
- We fully support the removal of uneven application of consumption levies for storage.
- Storage may provide short run economic network asset deferral options. This outcome depends on a regulatory framework which encourages network operators to potentially use storage as short run solutions and a cost reflective signal for storage assets to be sited in particular locations. It should be noted that network charges do not currently facilitate short run and/or locational cost signals.
- We agree that clarity is needed in the definition of storage to provide clearer signals to developers which will also help with codes evolution. Storage is not a generation asset and should not be treated as such.
- We consider that markets can provide suitable incentives to maintain security of supply in normal market conditions

We believe however that there are additional potential barriers which should also be considered:

- Storage providers should be able to access more than one revenue stream at once (similar to generation and demand side response providers). This requires:
    a. A review of contractual and delivery arrangements to ensure that multiple services can be provided to multiple parties
    b. Development of the capacity market to ensure non BM connected providers can provide balancing services on the same terms (secure, cost effective) as BM connected providers.
- The lack of coherent engagement on storage is a potential barrier. Following on from its successful EFR tender, the SO has set up a Storage Working Group as part of its Power Responsive programme. The aim of a single engagement platform is to pool knowledge, share solutions and so drive forward action to unlock storage at speed.
- Finally, we believe that gas storage can play a useful role in providing flexibility in the operation of the gas network. The GB market is very well supplied with a diverse range of sources, with a large surplus of supply capacity over demand. With so much capacity available it appears that the economic conditions for storage, particularly development of new seasonal storage, are challenging.

There may be a case for operators to develop storage to support their operations, for example to make best use of shale gas, which is expected to be produced at a constant rate throughout the year.

Evidence of the benefit of additional storage technologies to the system has been widely analysed and includes analysis carried out by Imperial College for the National Infrastructure Commission[6] and for the Carbon Trust[7]. The consumer benefit of additional storage on the system could be as significant as £3bn to £8bn per annum by 2030 depending on the scenario.

Note that European development, and in particular the new legislative proposal for the electricity market design foresees a new network code for storage. We agree with the principle of equal treatment of generation, demand response and storage.

Analysis by Oxford Institute for Energy Studies[8] in 2013 suggested that a spread of 20p/therm between winter and summer gas prices was needed for new gas storage facilities to break even. Price spreads in recent years have been nowhere near this level.

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.

Yes, based on the current understanding of the characteristics and potential uses of new storage technologies. However, other issues may emerge as more electricity storage is connected to the system. As such, a framework needs to be created to ensure there is sufficient opportunity to respond when issues are identified whilst still giving investors' confidence on the robustness of the regime.

- Currently the arrangements for generation are mainly applied to storage connections. A blanket application of these arrangements could lead to delays in connection of storage, or potentially even additional costs, as this treatment (like for like with generation) will not recognise that storage may act to complement the adjacent generator connection rather than compete with it. As electricity storage are new technologies, it is important to develop a better understanding of how the storage assets will behave before defining enduring connection arrangements.
- We are therefore working with industry to develop connection requirements, to formulate innovative connections and to define further information required. We are using the arrangements within the Security and Quality of Supply Standards (SQSS), Connection and Use of System Code and Grid Code to align our assumptions with developers' needs. This approach involves use of customer choice for design variations and access arrangements are being developed in bilateral agreements.
- The call for evidence correctly links the connection process with the security standards. We continue to work with other network operators and customers on developing the distribution network planning standards, i.e., P2/6[9] and the SQSS. The SQSS should in turn feed through to access right definition, charging arrangements and connection timing. We therefore believe holistically considering how storage should be treated in all areas of the SQSS is an appropriate approach.
- We consider that once the impacts of storage are correctly identified within SQSS, this will enable storage to connect earlier where it can be shown not to use the same capacity as other users waiting for a connection, or indeed where it can positively impact on capacity available to other users. (E.g. acting to complement the adjacent generator connection).

Additional considerations include:

- Access to storage information (e.g. information on how storage operators will use their assets in line with other market operators) will be of significant importance for market participants to balance their positions and for the SO to support the efficient and effective operation of the

[6] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507256/Future-proof_energy_infrastructure_Imp_Cam_Feb_2016.pdf
[7] https://www.carbontrust.com/media/129310/energy-storage-systems-role-value-strategic-assessment.pdf
[8] https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=oies%20gas%20storage
[9] Engineering Recommendation **P2/6** (ER **P2/6**) is the current distribution network planning standard

system.

- The gas storage market is more mature than the electricity storage market and we do not believe there are any significant barriers to network connection. A new small storage facility may be able to connect using our new low cost connection developed as Project CLoCC.

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.

We have heard from stakeholders and agree that a definition of storage and further clarification around charging of storage are areas that that should be progressed as soon as possible, as part of a holistic charging review. The double charging of storage as both generation and demand is likely to hinder the development of new electricity storage technologies.

Evidence, example 1: Current network charges could dis-incentivise storage connections where they are most needed for the purpose of avoiding network reinforcement – example of storage in Scotland.

The Electricity Ten Year Statement[10] 2016 p32 onwards discusses the need for high potential reinforcement of the transmission network in Scotland across the B0 to B6 boundaries. This is due to the fact that by 2035, the Future Energy Scenarios suggest a total Scottish generating capacity of between 15 and 25GW, primarily driven by new renewable connections - but with Scottish domestic demand of around 4-5GW by 2035.

Generation TNUoS[11] charges are higher in Scotland, reflecting the increased transmission capacity needed to move power from this region to centres of demand. Storage in Scotland could capture excess power at times of high renewable output, reducing flows North to South, and release power when renewable output is low, reducing power import – both of which would reduce necessary network reinforcement. We would recommend that this is considered within a whole system transmission and distribution charging review.

Evidence, example 2: Current network charges could dis-incentivise storage from behaving in a way that will most benefit the network

Under the current TNUoS demand charging methodology, transmission connected storage is incentivised to not import at Triad[12] periods, and distribution connected storage is incentivised to export at Triad. Any user who is not taking power off the network at these times will not pay a TNUoS demand charge, currently an average of £45/kW (based on average use over the 3 Triads). For distribution connected storage, net charging arrangements mean that these projects receive an embedded benefit that is equal to the TNUoS demand charge (locational element plus residual charge) in their location.

From a network operation point of view this signal may not incentivise optimal network use by storage schemes. Increasingly some parts of the network are experiencing peak supply outside of Triads (for example solar generation peaking in summer daylight hours) and other areas (e.g. high renewables) may experience constraints, including over times of peak scarcity. The current network charging regime is therefore unable to temporally / locationally signal to storage schemes what the network most needs at different times and in different locations. In addition, the Triad price signal is

[10] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Electricity-Ten-Year-Statement/

[11] Transmission Network Use of System Charges

[12] The Triads are the three half-hour settlement periods with highest system demand and are used by National Grid to determine charges for demand customers with half-hour metering and payments to licence exempt distributed generation. They can occur in any half-hour on any day between November to February inclusive but are separated from each other by at least ten full days.

currently so strong that it is likely to reduce the effectiveness of other possible revenue streams seeking to incentivise storage to operate in different ways. We would recommend that TRIAD is considered as part of a whole system charging review.

Do you agree with our assessment that network operators could use storage to support their networks? Are there sufficient existing safeguards to enable the development of a competitive market for storage? Please provide evidence to support your views.

Yes, network operators using storage to support their networks as short run asset deferral for transmission and distribution networks is one potential application of storage. In terms of safeguards to enable the development of a competitive market for storage:

- Storage has a large number of applications such as providing balancing and ancillary services to the SO, helping generators/suppliers to balance their positions and helping network operators to support their networks as short term asset deferral.
- Competitive market for SO services already underway with an EFR tender having generated 1.3GW of tender submissions for 201MW of requirement.
- However, there are improvements that could be made to ensure that storage and other similar technologies could maximise the use of their assets. These include:
    - Maximising market access for all technologies and market models (e.g. non-BM access to the Balancing Mechanism and wholesale markets);
    - Providing clear and digestible information such that storage developers can easily understand the opportunities offered to them;
    - A simplified set of SO products and services contributing to the delivery of stronger signals to participants.

These improvements should be delivered as part of the SO's ongoing flexibility initiatives which aim to improve market conditions for new and existing flexibility providers. We are engaging with Ofgem, BEIS and industry as part of this programme of work.

In addition, the use of storage by network operators depends on a regulatory framework which encourages network operators to potentially use storage as short run solutions and a cost reflective signal for storage assets to be sited in particular locations. It should be noted that network charges do not currently facilitate short run and/or locational cost signals.

One example of storage being used by Network Operators is the Smarter Network Storage project where UK Power Networks used a Lithium Ion battery at Leighton Buzzard to defer network reinforcement while at the same help to manage the peak demand curve and providing services to the System Operator. A recommendations report on the trial published by UK Power Networks[13] highlighted that the storage facility was successful in supporting the distribution network and deferring network reinforcement by providing peak shaving.

The gas and electricity networks operate in very different ways. The electricity network has to be balanced instantaneously, while the gas network is balanced over a 24 hour period. Gas storage viewed as a supply is treated no differently to any other supply. Shippers can nominate gas flows from storage, interconnectors, LNG imports or producing fields to balance their portfolios. National Grid as the system operator facilitates the market, but balancing actions are the responsibility of shippers. As such, the system operator cannot use storage directly, but price signals on the day should provide more gas which may come from storage or other sources. Similarly, if there is too much gas in the network the price of gas should fall to the point where shippers might consider buying gas and injecting it into storage.

[13] http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/SDRC+9.7+Successful+Demonstrations+of+Storage+Value+Streams+LoRes+v1.pdf

Are there any circumstances in which network companies should own storage? Please provide evidence to support your views.

The volume of new electricity storage on the system is likely to be higher if all participants are able to own storage including network operators. The benefits which storage brings to the system (e.g. increased competition in markets) are likely to be realised more quickly if all parties can own storage.

There are also specific situations where it beneficial for the distribution or transmission party to own storage if network ownership delivers a more efficient solution to a network problem than other infrastructure. Storage solutions should be taken into account as part of the NOA process.

Where storage is used to defer asset investment, we would expect contractual and operational safeguards that prevent that intent from being undermined.

Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage? Please provide evidence to support your views, including any alternative regulatory approaches that you believe we should consider, and your views on how the capacity of a storage installation should be assessed for planning purposes.

We agree with Option (d), defining storage in primary legislation as a separate activity. Whilst storage is currently treated as a generator, given the broad range of activities it can fulfil, the technology is more akin to a different type of party (for example an interconnector).

The uncertainty around its regulatory status creates additional risk potentially leading to lost opportunity and increased costs. Therefore licencing storage as a distinct activity is most likely to leverage the full benefits for end consumers.

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.

- We agree with Option (d) and treating storage as an asset class in its own right. Storage needs to be treated differently to generation as it can both export and import electricity.
- A new licence category for storage (making it explicit that it is distinct from generation) would be the surest means of bringing clarity to the market, so creating conditions in which developers can be more confident to invest.
- Over the longer term, a new licence category would also enable more flexible ongoing adaptation of codes and charging, so that the regime for storage can be kept up to date.
- An example of recent new definition is the one which applies to interconnectors.

European legislation also defines energy storage in the electricity system as: deferring an amount of the electricity that was generated to the moment of use, either as final energy or converted into another energy carrier. This definition could be considered as part of the other options.

What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on: balancing services; extracting value from the balancing mechanism and wholesale market; other market barriers; and consumer protection.

Barriers on balancing services and value from the BM and wholesale market.

The perceived barriers have been correctly identified in the Call for Evidence. The impact of these barriers is to reduce competition in balancing services, increasing costs to the SO and ultimately consumers. These barriers are likely to impact on how the aggregator model can evolve sustainably

in the longer term.

Through its proposed flexibility programme, the SO is directly tackling the perceived barriers to participation in balancing services. In the next 12 months, we will deliver, amongst other initiatives, a simplified set of products and services as well as new contracting structures and improved information to market participants (e.g. 1-5 year forecast of our operability requirements). This is likely to deliver increased participation in balancing services through providing stronger signals to market participants.

We believe that equitability and transparency are important in resolving access barriers like non-BM access to the BM. Equitability will ensure markets are not distorted, that parties compete on a level playing field and that liquidity is improved.

EU Project TERRE is creating a new market for replacement reserves where all parties (BM and non-BM) will be balance responsible. This balancing responsibility could potentially be extended to non-BM participation in the BM.

Consumer Protection

It is beneficial for there to be a mechanism for protecting consumers (both non-domestic and domestic) when signing up with aggregators. This should focus on whether the consumer is getting a "fair" deal/treatment, rather than a "good" deal (which is subject to competition and commercial business models).

Protection for domestic consumers will require an additional set of considerations and would need to go further than a voluntary code of conduct for aggregators working with non-domestic consumers. Energy UK have recently expressed some interest in looking in to this.

Power Responsive/Customer Feedback

- Anecdotal evidence from Industrial & Commercial businesses (a handful of anecdotes heard over course of 12-18 months) suggests that some businesses have been put off participating in flexibility programmes/markets due to aggregators taking a "hard sell" approach, or misleading the potential benefits, or through the existence of multiple aggregators. The risk is that a bad experience with an aggregator could put off a business from participating in demand side response for an extended period.
- I&C consumers have fed back that they are looking for ways in which to support their decision making when selecting an aggregator partner. Having a list of "accredited" aggregators, as proposed through the ADE Code of Conduct process, would support this.

Note that European development, and in particular the new legislative proposal for the electricity market design will look to review the framework for demand response.

Do you have evidence of the benefits that could accrue to consumers from removing or reducing them?

Evidence of the benefits that could accrue to consumers through increased competition can be found in the recent developments to the static Firm Frequency Response (FFR) market. The increase in competition in the FFR Static market between July 2015 and July 2016 reduced the volume weighted average price of the service by 41%, resulting in an estimated saving to the consumer of between £6m-£8m.

The introduction of FFR bridging which reduced the MW entry barrier from 10MW to 1MW, thereby allowing parties to grow their portfolio with a guaranteed term and price contributed to the creation of the benefit accrued to the end consumer.

What are your views on these different approaches to dealing with the barriers set out above?

The barriers identified have arisen through the emergence of new market models such as aggregators. Aggregators are an important component of the energy system alongside suppliers in delivering value to the end consumer through maximising the use of distributed and other energy resources. Other market models may emerge in the future and any approaches need to consider existing participants as well as future potential market models such as Electric Vehicle operators.

The System Operator firmly believes that it should lead on its product design and procurement practices while engaging and working with industry. The delivery of our flexibility initiatives which includes significant engagement through our Power Responsive campaign should create greater transparency, less complexity and a set of products which are more easily understandable and fit for purpose in this new smart energy world.

The role of the system operator itself is different in a smart energy world. The operation of the system becomes an order of magnitude more complex. The skills needed by the SO will be different; the SO will optimise the utility of all available assets including networks and generation through investments in systems and processes. Much more targeted engagement will also be needed is market participants are contracting across multiple services. Benefits[14] to the end consumer at a whole system level are unlocked through more optimal usage of all assets (existing and new). Investment in smart and flexible system operation will contribute to delivering these savings for the end consumer.

A new regulatory and incentive framework for the SO is therefore a critical enabler to transforming system operations and delivering the benefits above.

In relation to consumer protection, the ADE Code of Conduct is a good start for fair treatment for non-domestic consumers and should be supported. This is the industry led approach. The benefits of such a code of conduct could be lost if there are multiple codes in place. If there is a voluntary code of conduct in place, it should not determine who the System Operator can contract with. There should be the option for businesses to work with aggregators whether they are on a voluntary list or not; this should be a choice for the consumer.

Aggregator access to the balancing mechanism and wholesale market will benefit the system through generating greater competition. The SO aspires to a framework which allows access to the balancing mechanism for aggregators and other future market models while ensuring a level playing field for all parties. Through our flexibility initiatives, we are examining access to BM for new market models. This work is likely to support a predominantly industry led approach while at the same time identifying where regulatory steps are needed. Non-BM participation in the BM will create imbalance costs which the non-BM entities are not exposed to. This is a regulatory distortion which needs to be addressed.

What are your views on the pros and cons of the options outlined in Table 5? Please provide evidence

Aggregators filled a need that other market participants were not; empowering consumers to provide services to the market through their asset/demand base. As such, the regulatory framework needs to reflect this need, the desire for speed and recognise the increasing number of customers interested in controlling their demand. The regulatory response should therefore be proportionate and focused on handing control to consumers.

[14] Analysis carried out by Imperial College for the National Infrastructure Commission shows that the benefit of increased competition and more optimal usage of flexibility available in the electricity system is likely to deliver £3 to £8bn/annum of consumer benefit in a Green Scenario.

Monitor – a watching brief on market access barriers and issues

Pros

- Least cost option
- Further evidence to support any case for change can be gathered
- Avoids market and investment uncertainty

Cons

- Disenfranchise and slow DSR/Non-Traditional Business Model growth
- Lower competition in balancing services and BM
- Greater levels of flexible generation build required
- Increased consumer cost

Industry-led change to support independent market access

Pros

- Industry ownership creates engagement
- Industry can provide evidence of its own case for change
- Avoids market and investment uncertainty if process is transparent
- Can be delivered in a holistic way
- Lower administrative burden through avoiding new aggregator licence

Cons

- Interactions between different code developments can be difficult to address
- Risk of unintended consequences / missing interactions

Regulator steps in to licence aggregators and standardise frameworks

Pros

- Holistic approach
- Ensures interactions are addressed
- Objective assessment of market impacts
- Smaller parties' views can be more fully considered

Cons

- Pace of change is slower
- Increased administrative burden on smaller parties may deter smaller aggregators.

Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk?

- We agree with the risks outlined. We also agree that there could be a risk of 'herding' around market Price Flexibility signals by very fast assets such as demand and storage, creating system instability. The most obvious signal is a settlement period price change and a step change in demand or generation on the half hour.
- These risks could be more significant with the combination of behind the meter storage and dynamic time of use tariffs. The volume of forecasting error for the System Operator could be much more significant.
- The size of this risk is currently unknown. How parties design the technologies and control software will determine the materiality of this issue. This is an area which the System Operator will be investigating in the next few years.
- There are already some solutions being considered within the smart meter roll out including time randomising[15] at the end of a settlement period which could help with this issue.

[15] A settlement period is not the same for all meters

Providing Price Signals for Flexibility

What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?

SO vision is a market framework which delivers access to all parties; new and existing technologies as well as new and existing market models.

Whether we are considering price or contracted flexibility, transparency and equitability in the price paid for services is a significant enabler of the right investment and operational behaviours. This is particularly important as the new energy system delivers different sets of interactions between supply, demand and networks.

A number of initiatives are needed across all markets to deliver greater access to flexibility. In relation to balancing and ancillary services changes, SO is delivering on the following initiatives:

- Simplified suite of products and services as well as changes to contracting structures and processes to improve market signals and transparency. This could include the emergence of new markets such as RoCoF and Voltage Support to ensure that all services which providers deliver are suitably remunerated.
- Improving the information and market signals we provide to market participants (e.g. how our requirements change over time, future requirements in a 1-5 year timeframe)
- Where appropriate, ensuring that providers can access revenue streams across SO services and across multiple market participants (e.g. providers able to offer services to both SO and DNO or SO and Supplier) through establishing shared services frameworks which allow participants to minimise conflicts in the use of resources and maximise synergies.
- Reviewing access to the balancing mechanism (e.g. non-BM access to BM)

There are some trials which should also be considered including innovative market design structures (e.g. trial of alternative procurement methods such as auctions, trial of regional market structures including pricing arrangements) to deliver the future market vision.

In addition, there is a lack of confidence in the way the wholesale market and capacity mechanism currently co-exist in that the growth in renewable generation is reducing the effectiveness of the wholesale market for other providers[16]. There are a number of broad structural market changes which could be considered by industry:

- Review how capacity mechanism could more effectively incentivise new investments (e.g. longer term contracts for DSR proportionate with the investment they incur)
- Further obligations on parties to balance their positions (e.g. reflecting regional scarcity). A less socialised imbalance regime and a better reflection of local congestion costs is likely to strongly signal the need for flexibility and inject additional liquidity in markets.
- Options for how wholesale market could evolve over time (e.g. all parties enter an intraday market, changes to gate closure, limited day ahead physical hedges etc.)

On a whole system basis, the charging arrangements and the regulatory frameworks governing the network operators and the SO need to align to capture all the benefits of flexibility actions across all voltages. Charging arrangements should be reviewed holistically to better reflect the whole system and flexibility needs of the system.

[16] Survey carried out by the SO in October 2016 and received 112 respondents.

A new regulatory framework for the SO is needed to deliver the savings from smart operation for the end consumer[17]. An enhanced RIIO is needed to encourage Network Operators to take on a more whole system approach.
The interactions between the gas and electricity control rooms in a world with more price and contracted flexibility need to be considered particularly in relation to risk allocation between the Gas and Electricity SO.

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?

Whilst National Grid is not a provider of flexibility, our stakeholder engagement indicates that the key barriers to participation are: market transparency; information provision; complexity of product suite; lack of investment signals whether market based products or long term contracts.

Our providers have also discussed the difficulty in accessing and combining different revenue streams as well as providing services to multiple market participants. We propose to tackle this issue by reviewing our contracting structures as part of our review of SO products and services. In addition, we are actively working with DNOs and other market participants to determine how we can open up the provision of multiple services to multiple market participants.

The SO may engage in pilots to speed up the process of establishing how DERs may provide multiple services to multiple market participants.

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?

While NGET is not a provider of flexibility, our stakeholders have raised the issue of NGET not needing to pay for certain services such as inertia which is currently a by-product of having large conventional plants on the system.

The SO recognises the need to firstly provide strong commercial signals, secondly to avoid distorting markets and thirdly to pay the market price for services provided. Our SO What of SOF (future operability strategy), to be published in March 2017 will provide a view of the SO's requirements in the 1-5 year timeframe. This will help to provide strong commercial signals to participants for all our requirements including those which may be currently undervalued.

Can you provide evidence to support any changes to market and regulatory arrangements that you consider necessary to allow the efficient use of flexibility. What might be the Government's, Ofgem's, and System Operator's roles in making these changes?

There are a number of reports which have been published in the last few months including the National Infrastructure Commission's (NIC) smart power report which highlight the consumer benefit of additional flexibility and more efficient use of system flexibility. The consumer benefit of additional

[17] £3 to £8bn savings by 2030 in scenarios with 100 g/kWh and 50g/KWh carbon content respectively. https://www.theccc.org.uk/wp-content/uploads/2015/10/CCC_Externalities_report_Imperial_Final_21Oct20151.pdf

storage and DSR on the system could be as significant as £3bn to £8bn per annum by 2030 depending on the scenario according to analysis carried out by Imperial College for the NIC[18].
Our own equivalent internal analysis shows a benefit to the end consumer of ~£2bn/annum in a Gone Green scenario by 2030.

In addition to quantitative analysis, many reports published to date as well as our own engagement with stakeholders have highlighted the need for the market and regulatory changes which we have highlighted in our response to question 11 above.

Regarding new European legislation, the Government, Ofgem, SO and industry should align on the approach to ensure the best outcome for UK customer.

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.

Government/Ofgem role should be focussed on providing the right arrangements to enable Smart tariffs to be created rather than directing what those tariffs are. This fosters competition between those offering such tariffs. This includes allowing suppliers to define smart tariffs with freedom as put forward in the CMA investigation recommendations.

We also see a role for Government and Ofgem to ensure responsibilities are clearly allocated to industry participants and to monitor delivery. This will be through allocating appropriate licence responsibilities and incentives. There may be commercial risks that could preclude timely implementation. These may occur due to interaction with other regimes, such as the Capacity Market. In these cases, it is for Ofgem / Government to decide whether to change these regimes or introduce separate mitigating measures.

Without competitive pressure, customers will be disadvantaged, however, without some form of incentive there is a risk the full spectrum of potential options will not be explored.

Consumers will need appropriate (e.g. web portals, In House Display) to understand the impact of new tariffs on their energy bills. Consumers who are not flexible and those who are vulnerable will also need to be protected.

If deemed appropriate, when would it be most sensible for Government/Ofgem to take any further action to drive the market (i.e. what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer.

The proposed CMA reforms to the industry governance arrangements should introduce improved project management of major industry reforms. These will support the introduction of an enabling framework around smart metering and settlement. Through market monitoring Ofgem can identify whether broader policy goals are being achieved in a timely manner. It is important not to be over prescriptive on how the markets should evolve, but rather reduce regulation and remove barriers so that innovation naturally deliver the most efficient solutions.

[18] https://www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report

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, some smaller businesses interviewed for the FES workshops believed that administration costs of a more complex pricing structure makes them un-worthwhile. However this did depend on the price differential.
- In addition to limited wholesale price differentials there are not consistent signals of system impact from balancing services. Recognising these in a more locational and temporal manner would provide signals in terms of the specific effects consumption or generation has on the system at a specific time and in a particular region.
- From a complexity standpoint we consider that until there is sufficient commercial reward (through competition or other means) suppliers would see this as complex with no great return which makes investment unreliable and therefore unattractive.

Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including experiences/case studies where relevant.

- Yes in the sense that the distribution charging models (Common Distribution Charging Methodology and EHV Distribution Charging Methodology) do not value flexibility but provide a cost at peak demand for the network. Current arrangements were established for an energy system with a large number of consumers. These are not necessarily appropriate for a regime with an increasing number of prosumers and appropriate mechanisms for the targeted recovery of DSO costs would need to be established to ensure effective price signals are delivered.
- We recognise that current charging arrangements do not align between transmission and distribution and that further consideration of these in a holistic manner may result in more appropriate outcomes.

https://www.ofgem.gov.uk/ofgem-publications/44179/cdcm-decision-doc-201109-2.pdf[19] states the importance of cost reflectivity.

What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility?

- Wider engagement across industry through a holistic review of charging arrangements would enable discussion of 2-3 year topics across both distribution and transmission. This forum could consider flexibility as a key deliverable in assessing all network costs and their treatment.
- This could expand to consider further fundamental changes and how costs of networks and costs of system management are recovered in future.

How problematic and urgent are any disparities between the treatment of different types of distribution connected users? An example could be that in the Common Distribution Charging Methodology generators are paid 'charges' which would suggest they add no network cost and only net demand.

- Our experience in transmission charging suggests that disparities in treatment are likely to increase as the distinction between the transmission and distribution networks blurs and the network moves to a fundamentally different usage model. In this context, differences in the

[19] Executive summary paragraph 2

transmission and distribution commercial arrangements can lead to unintended consequences. A review of charges that takes this into account as well as exploring all other areas of distortion and recommends a whole system solution is in our view the best way forward.

Do you anticipate that underlying network cost drivers are likely to substantively change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result?

- This principle is a key element of our support for a whole system investigation into network costs. The issues currently faced by transmission charging are likely to be faced by DNOs as more active network participation takes place.
- In particular the right balance between reference sunk costs of the transmission network and promotion of innovative solutions will be needed in a manner that is fair and equitable for all participants and delivers positive outcomes for consumers.
- This is particularly important as the underlying changes to fundamentals include distributed and transmission connected entities being used to solve both network and balancing issues across all voltages.
- The resulting changes in cost drivers need to be considered in a holistic way to ensure a successful outcome for the end consumer.

Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how?

- DUoS prices in their current form cannot send these signals. A dynamic charging methodology would be needed to assign the real time costs of the network in the short term.
- This could be combined with a longer term cost recovery signal to create an immediate price based on consequential system effects.
- An infrastructure charge should not send short term pricing signals as the risk for distortion is great.
- Future DSOs and the SO will need to establish a common cost recovery mechanism for balancing that takes into account future DSO models and future requirements for more cost reflective and potentially regional signals. We believe that a common balancing cost recovery mechanism is in the best interests of the end consumer.

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.

- Markets (whether national or regional) need to deliver sufficient resources for the SO and DSOs to be able to manage their networks. Liquidity should be focused in as few markets as possible.
- Future DSOs and the SO will need to establish a common cost recovery mechanism for balancing that takes into account future DSO models and future requirements for more cost reflective and potentially regional signals. We believe that a common balancing cost recovery mechanism is in the best interests of the end consumer.

Question 25 – Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future?

FIT measurement below 30kW

We agree that facilitating the ability for Renewable Generation up to 30kW to respond to time of use energy drivers will stimulate greater levels of flexibility and drive efficiency.

CfD collocating storage with generation

Stimulating flexibility or storage connected at the same facilities as renewable generation can help alleviate network congestion and energy over supply and we agree that separate BMUs for storage is a sensible approach.

Capacity Mechanism

We believe the suite of Electricity Market Reforms represents a sensible set of policies to support decarbonisation and the transition to a smart energy future:

- Incentivising lower carbon production through a carbon floor price;
- Discouraging pollution through emissions performance standards;
- Supporting renewable generation through efficient price discovery; and
- Certainty of remuneration for generation / DSR that provides security of supply

It is important that these policies do not give rise to uncertainty or distortions. For example, it is important to get the balance right between encouraging renewable generation output and ensuring that the market as a whole is responsive to supply and demand signals. In this context, it is essential to have a level playing field for all conventional and non-conventional generation technologies that allows for the delivery of flexibility at least cost to consumers.

Smart Meters and Half Hourly Settlement

Smart meters and Half Hourly settlement represent enormous opportunities to help in the transition to a smart energy future by allowing a significant proportion of demand, hitherto unable to access reward for flexibility, to respond to price signals or other drivers. Furthermore, greater levels of information and control, where consented, allow all participants in the supply chain to tailor services and investment to deliver consumer needs.

We note the desire for simplification of tariffs to facilitate comparisons by consumers, however there needs to be a careful balance between simplification and tailoring of tariffs to stimulate demand side responses to market conditions.

Question 26 – What changes to CM application / verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions with / 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?

The EMR programme has included two “transitional arrangements” (TA) auctions, aimed at helping DSR providers prepare for entry into the enduring programme of year-ahead capacity auctions; the intention of the TA auctions was to address any perceived barriers to participation by these providers. National Grid, in its role as EMR Delivery Body, undertakes an extensive programme of engagement with CM stakeholders in order to identify potential improvements, and would be pleased to hear from any stakeholders who have improvement proposals

Longer term evolutions to the CM: In addition to the flexibility initiatives being delivered by the SO to optimise the signals from our balancing and ancillary services markets (e.g. simplification of products and services), the capacity mechanism and the wholesale market are important components of flexibility providers’ business cases. The Capacity Mechanism was designed to incentivise lowest cost capacity, whilst the wholesale cashout arrangements are intended to

encourage a market response to market and system imbalance. A holistic consideration of the Capacity Mechanism and the electricity market in which it operates is necessary including a review of charging arrangements. This review should aim to deliver a level playing field for all new and existing technologies and market models. There are a number of potential changes to the CM which should be examined:

- longer term contracts for DSR proportionate with the investment made by parties.
- The delivery of a strong signal for storage developers through the capacity mechanism (see response to question 1)
- designate all Balancing services as "Relevant Balancing Services" so that parties are clear about their eligibility for both CM contracts and participation in the provision of Balancing Services to the SO.
- introduce a locational element to the CM (potentially sitting alongside a locational element to the wholesale market) – this would not act as a "blanket" incentive to flexible services, but would provide some clearer market signals to investors.

Question 27 – Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on smart system?

We note Ofgem's recent considerations of embedded benefits which will better allow the costs and benefits of distributed generation to be fully accounted.

We believe that further market signalling could be achieved through further obligations on parties to balance their positions (e.g. reflecting regional scarcity). A less socialised imbalance regime and a better reflection of local congestion costs is likely to strongly signal the need for flexibility and inject additional liquidity in markets.

Evidence that supports how successful the government policies have been include:

- First and second rounds for Contract for Difference awards achieved prices that were lower than anticipated.
- Offshore wind costs successfully reduced over the subsidy period.

A System for the Consumer

Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)? □ Yes □ No (please explain)

Yes

- An additional principle should be added and that is consumer priority i.e. manual override of the smart functionality.
- We also assume that there is open competition for the services supplied by smart devices.

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.

- **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)**

Other: In order to realise the benefits of smart appliances, there needs to be common communication (how smart appliances communicate) and operational (what smart appliances can communicate) protocols, which will allow the appliances to efficiently respond to market / third party (including potentially SO) signals.

- In order to reach the full potential of demand reductions (and therefore cost savings) a large roll out of smart appliances will be required. How this large roll out can realistically be achieved requires a balancing act between creating long term saving to consumers (through peak demand reduction costs savings) and short term appliance costs (additional cost of appliances to add smart functionality).
- Our FES workshop feedback indicated that automation of DSR processes will be more successful than individual changes in habits. There have been precedents of mandating such changes e.g. the removal of incandescent light bulbs from sale across the EU. However, this route needs to be considered alongside "cyber security"/privacy concerns (see responses to questions 40-42) as well as potential affordability considerations

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Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence:

- **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)**

- The majority of feedback from FES workshops indicated that reductions in demand usage were more likely to occur as a result of automation rather than individuals' changing their behaviour.
- National Grid's Future energy Scenario workshops: Most attendees believed that there is much potential for residential response via background automation of appliances particularly those with latent impact. Consensus on applicability in descending order was 1) wet appliances, 2) cold appliances 3) heating. It was not believed that cooking, lighting and home entertainment would be moved.

- In terms of battery storage systems, avoiding dumb charging is a significant enabler of maximising the use of storage assets.
- Consumers are becoming comfortable with signing up to background automated services particularly with appliances that had "hidden" effects (e.g. freezers).

Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified?

A potential barrier to the uptake of smart appliances could be consumer trust and perception, particularly in relation to data transfers.

Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers?

The following options could be considered:

- There may be room for a "kill" all communications switch which reverts the unit to a basic non-smart model. This may provide comfort and confidence to the end consumer in terms of their ability to control how the appliance is used.
- Limiting which appliances can be called upon to be turned off; for example for vulnerable customers maybe only freezers.
- Installation of smart enabled battery units in vulnerable consumers' homes to provide them with greater flexibility in relation to their consumption patterns.

How might Government and industry best engage electric vehicle users to promote smart charging for system benefits?

The consumer-led desire for fast-charging (~350kW/350A for a 12min charge agreed in the Ultra-E alliance recently in Europe) could increase demand on DNO networks, increase system-wide power flow requirements to accommodate, thus increasing the need for transmission reinforcements.

Unless additional dynamic pricing/tariffs are in place, which incentivise consumer charging behaviours, there is some uncertainty on the capability of the networks to absorb either fast charging or overnight trickle charging. This may not be problematic at low penetration levels but could become so if deep penetration of EVs happens quickly (as per the expansion in solar farms).

The Government could educate consumers on the benefits of smart charging:

- Deferring significant network reinforcement and investment in new power stations (in addition to reduced carbon footprint).
- Potential benefit of using EVs to maximise the use of intermittent renewable generation such as wind twinning.
- Cheaper tariffs in return for managed charging.

Government could also consider subsidising smart chargers. Other quick wins include requiring all public car parks to fit *n*% of smart enabled chargers; same with business premises with more than *n* car parking spaces.

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:

- **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?**

We have identified the following barriers for vehicle participation in the electricity systems:

- Infrastructure constraints: Smart charging is needed to mitigate the impact on electricity networks of significant Electric Vehicle (EV) penetration.
- Lack of clear market structure and regulation around EVs i.e. storage defined as generation under existing market rules.

In relation to Vehicle to Grid (V2G): There are 2 major barriers identified. Firstly battery warranty and secondly charging infrastructure.

What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium?

- High costs associated with hydrogen production and storage.
- A 100MWh hydrogen production would likely require a substantial electrical substation; the proximity of this to the fuel filling station may be a concern.

Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services?

- Power Responsive engagement suggests that many businesses find out about providing DSR service through an industry source, whether that be an aggregator, SO, supplier, consultant or through a trade association that is flagging opportunities.
- Energyst survey[20] suggests that this year more businesses are being informed about DSR services from a supplier and/or aggregator than last year. Of surveyed who don't currently a DSR service:
    - In 2015 26% said they'd been informed about opportunities by supplier/aggregator,
- In 2016 this had risen to 49%

Power Responsive/Customer Feedback

Some statistics to support from survey of I&C customers by the Energyst in relation to how businesses take part in DSR services.

- 212 businesses surveyed, 23% do provide DSR (48 organisations). Of these:
    - 79% participate via an aggregator
    - 23% direct with National Grid
- Businesses looking in to DSR services are focussed on potential returns, period of payback and then the cost/risks of participating. When working with aggregators a key factor is the margin taken by the aggregator/supplier in return for their service offered. Anecdotally this is mentioned often amongst business audiences as a consideration in the business case. The perceived benefit of working with an aggregator is that they provide a simplified offering, take a share of the risk of tendered service offerings and open up a market for businesses whose load does not meet minimum requirements.

It is important to understand that businesses will weigh up the benefits and costs as per above to decide whether to provide a DSR service, and if working with an aggregator works for them. This process typically takes (based on anecdotal feedback) between 6 and 18 months, from first discussion to entering a contract. In some cases a <6 months onboarding time has been seen but this is with a business that has prior experience of participating in a DSR service directly with National Grid.

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?

The barriers covered in the document do cover the majority of barriers that we have heard raised from I&C businesses. An additional barrier to be considered:

- Difficulties in identifying long-term signals & clarity to support business cases. This doesn't necessarily mean longer term contracts, (although these have been mentioned), rather that

[2020] http://theenergyst.com/dsr/

clarity over flexibility incentives is missing at the moment, which does not provide a consistent signal to investors. Recent examples are:

- DUoS charging change (DCP228) to level out red/amber/green rates has reduced the incentive to shift away from red zones.
- Consultation on embedded benefits is giving signal that triad avoidance mechanism incentive may be changed/removed.

When forming a business case for participating in DSR services, non-domestic customers look for signals that incentives will continue, and if there is uncertainty in the markets, it is more difficult to justify the upfront cost (i.e., resource & time spent outside of normal business process)of investigating participating in DSR.

Do you think that existing initiatives are the best way to engage large non-domestic consumers with DSR? If not, what else do you think we should be doing?

Complexity of existing products and services provides a challenge to participation. Our SO Flexibility programme which aims to simplify our suite of products and services as well as provide stronger investment signals to market participants (e.g. through publication of its future operability strategy in March 2017) is part of the process of encouraging new participants including DSR.

In the capacity mechanism, large non-domestic consumers are looking for the option to sign longer capacity mechanism contracts, a position which the System Operator supports.

Power Responsive/Customer Feedback

- Direct feedback from recent Power Responsive Steering Group and non-domestic consumers has been that there needs to be a clear attractive proposition in order to participate in DSR services. Two pieces of feedback came through strongly from the session and wider anecdotal feedback:
  - Certainty of revenue is extremely important when looking to gain investment to participate in DSR services. The upfront investment for a non-domestic customer would be to carve out a proportion of employee time to investigate feasibility and build a business case; which can be at a significant cost.
  - In existing markets, DSR requires some level of support to compete and grow. This has been fed back from a number of providers of user-led demand side response, with the feedback that it is distributed generation technologies and incumbent players which are currently winning in the markets. A suggestion was for some specific mechanisms to support user-led DSR (load shifting and/or using onsite back-up).

When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)?

Trigger points in relation to consumers being exposed to system costs and therefore being able to potentially capitalise on opportunity through providing DSR service. Both factors would need to be in place:

- Half-hourly metering
- Time of use supply tariff

Please provide views on what interventions might be necessary to ensure consumer protection in the following areas:

- **Social impacts**
- **Data and privacy**
- **Informed consumers**
- **Preventing abuses**
- **Other**

- In relation to informed customers, experience from non-domestic customers is that access to clear information of benefits and risks is important.
- Consumers willingly and unknowingly surrender rights and data via smart phone apps, etc. Consumers should be protected from similar consequences in a smart energy world – or at least consumers should be clear on what they are signing up to.
- Resale of consumer data should require specific protection and be anonymised unless specific agreements on exposure have been made.
- Clarity is needed on the commercial exposure of data holders in the event of misuse or breach – rights of redress/consequential losses etc. That should include the obligations associated with any subsequent sale or sharing of data with other parties.

Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely this is?

System security could be compromised by:

- The failure to deliver expected system response when signalled i.e. the "contracted" demand side responses fail to materialise.
- The triggering of a spurious system response when not required/requested by the DSO/SO. i.e. an unexpected demand side response when not needed. This would be a more sophisticated type attack that is falsely stimulating services into action

These events could be as a consequence of:

- A successful attack on the smart meter network, that causes large scale fluctuations in electricity demand.
- A successful cyber-attack upon the increasing number of smart devices connected to the power grid, this includes as examples the following:
    - Internet applications controlling large numbers of smart appliances, cars or micro generation
    - Smart operational devices connected to the power grid by TSO's or DNO's are compromised, affecting the integrity of the information required to operate the grid.
    - The potential vulnerabilities of the interim smart metering deployments by energy providers.
- Evidence is available of intrusion events on a limited or individual basis to date but these events imply the potential for a more widespread attack in the future as services become more prevalent.

The above would be influenced by:

- The diversity of technologies being used for smart network response actions which spreads the risk.
- The diversity of providers (aggregators/big industrials) that spreads the risk
- How much autonomy there is in the response actions i.e. is it all centrally instructed in "real time" or is it downloaded and preset into provider premises and will respond without any further instruction (i.e. time/frequency triggered..)
- The speed of response required - how closed loop/real time are the mechanisms
- The extent to which the power system is holding reserves

What risks would you highlight in the context of the securing the energy system? Please provide evidence on the current likelihood of impact.
The broader risks around securing the energy system include: • A regulatory regime that is not orientated to the agility required to respond to changes in the cyber threat landscape. • A regulatory regime that does not encourage organisations to establish the appropriate provisions for responding to the increased threat of cyber-attack and its rapidly evolving nature. • A supply chain for Industrial Control Systems (SCADA[21]) / Operational Technology systems or assets that does not provide cyber security as a clear requirement. The cyber security maturity of the energy sector in general is low. Information about technologies widely used across the energy sector and how to affect its operation is now available on the internet. This is compounded with a lack of an appropriate IT asset management strategy or process across the energy sector to ensure up to date protection levels. Increased connectivity, the size of energy networks and their associated telemetry networks does not allow for a traditional secure perimeter to be maintained. The IOT is another attack vector to add to the increasing number of attack vectors e.g. USB, WIFI, and Smartphones.

Roles of Different Parties

Do you agree with the emerging system requirements we have identified (set out in Figure 1)? Are any missing?
The list of emerging system requirements for the electricity system appears comprehensive. However, the optionality which gas offers has not been considered. Whole system and network planning for flexibility should include consideration of the roles that gas can play to provide cost effective, reliable alternatives to electricity system options. Gas options can provide fast, flexible and reliable power generation to complement intermittent renewable generation and as well as offer a cost-effective option for energy storage and meeting peak winter heat and electricity demand.[22]. Gas can be stored much more easily, cheaply and for far longer periods of time than electricity; it is three times cheaper than electricity per unit for consumers (5p/kwh vs 15p/kwh); and, in winter, gas currently delivers around five times more peak demand than electricity,
Do you have any data which illustrates: a) the current scale and cost of the system impacts described in table 7, and how these might change in the future?
National Grid's recently-published System Operability Framework 2016[23] includes analysis of the consequences of the changing use of distribution networks on the wider system in terms of visibility of DER (pages 146-153) and the wider system impacts of use of novel techniques for distribution network management such as ANM (pages 154-160).

[21] Supervisory Control And Data Acquisition

[22] http://futureofgas.uk/wp-content/uploads/2016/11/The-Future-of-Gas-A-Transmission-Perspective-Interactive.pdf

[23] http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589937803

National Grid and UKPN's TDI2.0 Bid Document to Ofgem[24] includes analysis of the impact of increasing DER volumes on the cost of managing constraints on the transmission network and the benefits that can be achieved by more active use of DER resources (Appendix 10, pages 91-96)

b) The potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts?

National Grid and UKPN's TDI2.0 Bid Document to Ofgem[25] includes analysis of the impact of increasing DER volumes on the cost of managing constraints on the transmission network and the benefits that can be achieved by more active use of DER resources (Appendix 10, pages 91-96).

With regard to the need for immediate action:
a) Do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources?

Yes – DSOs need to retain responsibility for the safe and secure operation of their networks. By doing this more actively they will have the scope to assist in wider system operation activities – sharing services with the SO, offering controllability and visibility of DER; and optimising the use of available distribution network capacity.

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?

- Through our ongoing whole system SO initiatives, we are seeking to test new whole-system approaches to current challenges and 'design by doing' a range of solutions for discussion with industry. We are partnering with DNOs through Regional Development Programmes to address specific regional challenges and to gather experience to support longer-term structural changes.
- The use of targeted NIC projects offers a way to fund the testing out of new concepts.
- We are intending to make further progress in this area 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.

- A new regulatory framework is needed to provide the right tools and necessary funding for the SO to operate in a smart energy environment.
- The mechanisms available within RIIO-T1/ED1 need to be leveraged to deliver whole system solutions in the short- to mid-term. Similarly, RIIO-T2/ED2 need to be flexible enough to accommodate efficient whole system solutions.
- Relevant information needs to flow freely around the industry as necessary.
- Actions taken will need to be mindful of the direction of travel of relevant EU legislation so as to minimise future impacts.

[24] https://www.ofgem.gov.uk/system/files/docs/2016/11/final_submission_tdi_2.0.pdf
[25] https://www.ofgem.gov.uk/system/files/docs/2016/11/final_submission_tdi_2.0.pdf

With regard to further future changes to arrangements:
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?

While the development and trialling of whole system solutions is possible today, the wide spread adoption requires a change to the regulatory framework. Our Regional Development programmes are there to address specific regional challenges and to gather experience to support longer-term structural changes.

The operation of the system becomes an order of magnitude more complex in a smart energy world particularly as resources are more distributed and used for shorter periods of time[26]. The skills needed by the SO will be different; the SO will optimise the utility of all available assets including networks and generation (within the parameters of their technical design ratings and capabilities, or the purchase of risk-based enhancements from the asset owner) through investments in systems and processes. Much more targeted engagement will also be needed as market participants are contracting across multiple services. The above is likely to reduce the volume of new capital investment, primarily in generation by increasing the use of the demand side.

Benefits[27] to the end consumer at a whole system level are unlocked through more optimal usage of all assets (existing and new). Investment in smart and flexible system operation will contribute to delivering these savings for the end consumer. In order to facilitate a smart energy world, fundamental change is needed on a number of fronts:

- ***a market framework which is accessible*** to all parties and delivers value for the end consumer***;***
- ***a charging and pricing regime which is cost reflective*** and drives the right relationships between supply, demand and networks;
- ***clear agreed DSO/SO model*** with accompanying roles and responsibilities for market participants (TO, DNO, SO);
- an enhanced regulatory regime which ***sufficiently incentivises more complex system operation***;

In relation to gas and electricity interactions, the following should be taken into consideration:

- The potential need for new interfaces between the SO and the DSO and their impacts on gas SO systems and processes
- The extent to which the creation of regional markets and associated regional pricing signals (wholesale and network) impact on gas demand and Transmission and Distribution forecasts.

b**) What are your views on the different models, including:**
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?

- The models presented offer a reasonable range of approaches to tackling the 'whole system' challenge. We consider it important that an evolutionary approach be adopted, so as to strike a balance between the need for change and the need to maintain system security.
- In the immediate term, the SO needs to be able to access sufficient Balancing Services to carry out its duties. This will require greater visibility of, and access to, distributed energy resources – in

[26] Parties build assets and use more complex contracting strategies to realise their business cases. Multiple revenue streams are needed (e.g. capacity payment with TRIAD and Frequency Management). A significant potential source of revenue (wholesale market) is not deemed to deliver sufficient value.

[27] Analysis carried out by Imperial College for the National Infrastructure Commission shows that the benefit of increased competition and more optimal usage of flexibility available in the electricity system is likely to deliver £3 to £8bn/annum of consumer benefit in a Green Scenario.

addition to those it currently has access to.

- Alongside this, DNOs need to develop their own means of utilising DER for their own network management purposes – this can present opportunities for sharing of services and development of commercial mechanisms that support the transition to a DSO model.
- As regional markets develop, the interaction between them and national markets needs to be clearly defined
- The development of regional markets and clear means of interaction with active markets sits alongside a review of the roles and responsibilities (and reach as well as regulatory frameworks) of the SO versus DSOs – to achieve an efficient approach that delivers value to consumers
- The models presented offer the scope to give thorough consideration to the issues, but shouldn't prevent other options being pursued if required. Given that the issues faced by distribution networks across GB can – and do - vary, it should be noted that a 'one size fits all' approach might not deliver the best outcome for consumers.

DSO/SO Procurement Mechanism

Short-Term: The SO should remain the sole counter-party in the national Balancing Mechanism. Participation should be required by a defined group of Parties – this should be linked to the need to manage networks at Transmission and Distribution level (i.e. include sufficient DER to support network management at T and D). DER participation could be enabled by the technical capability of distribution Active Network Management schemes (taking care to ensure their participation is not inhibited by those same schemes, for example to allow provision of balancing services) – engagement by Parties via this technical means should be on a competitive basis and link in with current market structures. This would suggest a 'DNO-technical'/'market-commercial' approach. Essentially, the DNO's ANM would be a technical 'gatekeeper' to DER control, and the DNO would operate the generation within that ANM scheme to another's commercial stimulus – either to manage their own local system issues or to provide bids and offers into the Balancing Mechanism. This would, in effect, be a new role when compared with the status quo.

Longer-term: Markets (whether national or regional) need to deliver sufficient resources for the SO and DSOs to be able to manage their networks. Liquidity should be focused in as few markets as possible – a single national balancing mechanism and some means of accommodating GSP/regional balancing in a manner that complements this. Market prices could reflect regional value and parties should be required to participate. Strong links should be made with markets for ancillary services.

Market Signals and Arrangements

Short-Term: Regional price signals should be derived at a resolution sufficient to (a) focus decision making on both operational and investment-based solutions; (b) support appropriate wholesale pricing and (c) drive network investment signals and in a manner linked to a consistent T/D approach to network charging. Parties should respond by pricing services accordingly. Regional price signals could then feed into the needs case for additional transmission and distribution infrastructure.

Longer-Term: Those regional price signals should continue to be developed to an appropriate level of detail/granularity (underpinned by system requirements).

Responsibilities in System Operation

Short-Term: The SO should develop its ability to manage the National Electricity Transmission System by augmenting its visibility of and access to DER, using it alongside transmission-connected resources to ensure overall system balance and severe operation (including managing system frequency, reserves, voltage and black start requirements). To assist DNOs in the transition to DSO the SO should share services and call-off/settlement mechanisms as required to promote more active distribution network management.

Longer-term: The interface between the SO and DSOs should be set at the GSP – the SO managing transmission and the DSOs managing their own distribution networks within operating envelopes per Grid Supply Point, with the SO retaining responsibility for key system-wide tasks, such as managing system frequency response, reserves and taking a national approach to more locational tasks such as voltage and black start requirements. Regional Balancing Mechanisms should mesh effectively with

the national Balancing Mechanism and ancillary services markets to allow robust price signals to support locational system operation needs; and investment in transmission and distribution assets and infrastructure.

It should not be assumed that a 'one size fits all' approach to the DSO transition is appropriate. Different DNO aspirations and network management requirements will drive an ongoing need for national system operation oversight.

ii. which other changes or arrangements might be needed to support the adoption of different models?

The model chosen will determine the magnitude of change, from amendment to existing frameworks through to, a complete review of the Electricity Act, taking account of EU legislation.

iii. do you have any initial thoughts on the potential benefits, costs and risks of the models?

- Benefits:
  - Clear responsibilities at the Transmission/Distribution boundary – TSO manages Transmission, DSOs manage Distribution
  - Clarity for customers (Transmission -connectees deal with the TSO, Distribution-connectees deal with the DSO)
  - Liquid markets at Transmission and Distribution, with the TSO able to utilise Distribution resources and vice versa.
  - Consistent charging approach across Transmission and Distribution
  - Consistent incentives across Transmission and Distribution
  - Investment and operability processes consider Transmission and Distribution solutions appropriately
- Costs:
  - New regulatory frameworks
  - New roles and responsibilities would need resource capability changes within businesses
  - Significant IS, legal and consultancy cost
- Risks:
  - Maintaining security of supply
  - Delivering value for consumers
  - Cost risk
  - Delivery risk
  - Compatibility with relevant EU legislation

Innovation

Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?

Ofgem plans to launch a new Innovation Link in late 2016 as a point of contact for energy innovators to bring new ideas to receive fast and useful feedback on the regulatory implications. The System Operator is looking into a more efficient and effective channel/platform for energy innovators to originate and finance projects and ventures. We see potential for collaboration and coordination between these two initiatives.

We believe that all innovation support should take the following points into consideration:

- Prioritisation and allocation of support should be linked to the value case for the whole system
- This should include supporting both gas and electricity flexibility options.
- Support timeframes should allow time and space to fail/succeed. Funding periods need to commit

funding for a length of time that allows projects to run to completion. Currently the RIIO price control periods incentivises Network Operators to initiate projects with an increasingly shorter term horizon as the end of the funding period approaches. We suggest a rolling timeframe that provides support for an appropriate period from the origination of a project.

- Whenever possible, baselines should be identified and documented; clear change markers should then be tracked in order to link system improvements and savings to the innovation projects that originated them.

Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer

Commercial and residential automated Demand Side Response (DSR) trials

- In line with Ofgem's CfE, the SO also believes that it will be valuable to explore approaches involving intelligent automation of flexible loads (e.g. electric vehicles, electric heating/cooling, smart appliances, storage devices) in order to overcome identified barriers to residential and SME DSR (e.g. the complexity and cost of developing innovative DSR products and services, and uncertainties over consumer appeal and financial return)
- In order to best follow up on the effectiveness of DSR, given the difficulties resulting in tracking and measuring scattered loads, smart meter/smart tech solutions linked to the High Voltage grid (not just to distributed network) should also be explored.

Flexibility trading/optimisation platforms

We agree with Ofgem that the objectives of innovation support in this area would be to support optimal use of flexibility, to help flexibility providers realise the true value of their resource, and to mitigate prioritisation conflicts between multiple users of flexibility. In turn, we agree that innovation activity should support platforms that:

- facilitate coordination across the energy system, e.g. network requirements, portfolio needs (wholesale) and balancing markets;
- enable flexibility providers to realise value by bringing them together with potential flexibility users;
- reduce transaction costs for flexibility;
- direct flexibility resources to where they add most value to the system as a whole e.g. mitigating conflicts between potential users of flexibility through marketplaces where optimal dispatch is determined through efficient and cost reflective pricing.
- Create the space and the conditions to allow for new sources of flexibility to enter the market without being outcompeted by other parties.

We support Ofgem's position that innovation funding linked to storage costs is necessary. Specifically:

- novel technologies which could benefit from innovation support and might be able to provide cost-effective grid-scale energy system services in the medium to long term
- there is a clear case for further innovation support to catalyse the development of grid-scale storage technologies which have the potential to be more cost-effective than existing, more mature technologies such as Li-ion batteries or pumped storage. This could be facilitated by demonstrations of large-scale, or even inter-seasonal, storage technologies, e.g. compressed air, power-to-gas or thermal.
- In order to create the right market conditions for storage, it is important before allowing such practices, to test the ability of technologies to deliver multiple services in parallel (i.e. what is currently referred to as "application stacking").
- This could also include support for component level development, manufacturing process, or efficiency improvements, as well as provide indications to industry on aspects of the technologies which merit further development.

Vehicle to grid demonstrations is an area of innovation which the SO is particularly interested in exploring, and welcomes support in this area. All three areas outlined in the Call for Evidence are being investigated by the SO, and support would be required to progress these in timeframes which would be optimal for system development:

- pilot suitable commercial models to support the uptake of vehicle to grid capabilities;
- test acceptance amongst electric vehicle owners of their vehicles being used for vehicle to grid purposes; and
- work with equipment manufacturers to ensure infrastructure is set up for bi-directional charging.

In addition to the above areas outlined in the CfE, we suggest including the following areas for innovation support:

Cyber security

- We should examine potential future market models and in particular for the eventuality and possibility of distributed market platforms. In this scenario we would be potentially subjected to millions of more intelligent, connected and automated systems, which would result in a higher risk of cyber-attacks. Novel and innovative tools and platforms such as those used in bitcoin (block-chain) could be explored and tested.

Big data analytics

- Prediction / integration of intermittent generation
- Supporting forecasting of increasingly distributed assets on the network
- Harnessing increasing amounts of information available in order to operate networks at a lower cost for consumers
- Harvesting new information from the study and tracking of past and present nodes.