The voice of the energy industry

Roles and Responsibilities in the Provision of Flexibility

Energy industry positions, established by the Energy UK Flexibility Working Group, on tactical decisions to be made to enable the smooth transition to a smart flexible energy system.

Introduction to Energy UK

Energy UK is the trade association for the GB energy industry with a membership of over 100 suppliers, generators and other stakeholders with a business interest in the production and supply of electricity and gas for domestic and business consumers. Our membership covers over 90% of both UK power generation and the energy supply market for UK homes. We represent the diverse nature of the UK's energy industry – from established FTSE 100 companies right through to new, growing suppliers and generators, which now make up over half of our membership.

Our members turn renewable energy sources as well as nuclear, gas and coal into electricity for over 27 million homes and every business in Britain. Energy UK established the Flexibility Working Group in 2016 to coordinate energy industry input into the Ofgem and BEIS Smart Systems and Flexibility Plan.

Vision

As the energy system transitions from a system primarily built upon large, centrally dispatched, typically flexible fossil fuel generation to the delivery of increasing volumes of, often less flexible, low carbon power, new roles and responsibilities are emerging to address the increasing complexity of secure system operation.

This paper highlights some of the tactical decisions required by Industry, Government and Ofgem in the short term, here meaning in the next five years, to enable the continued decarbonisation of the energy system and bolster the strong growth in the surrounding industries. Later this year, Energy UK's *Future of Energy* project will outline a strategic vision for the UK energy system, containing longer-term recommendations for government and industry to achieve that vision across a range of areas[i].

Recommendations

Energy UK believes that action should be taken over the next five years to clarify a number of issues which remain unclear in maintaining a safe and reliable energy system, including:

- Consumer protections should be introduced across energy services in line with existing selling protections[ii] and the developing code of conduct for demand-side response[iii]. Ofgem should be enabled to take punitive action when an aggregator or energy service provider fails to follow this consumer protection framework.

- Relationships, particularly those defining imbalance responsibility, between Aggregators, energy service providers, DSOs, ESOs and Suppliers should be clarified with the support of Ofgem.

- Network monitoring and transparency, particularly on distribution networks, must be improved and standardised across Great Britain. Transparent and timely sharing of pertinent information across all appropriate market actors will enable efficient operation of energy flows.

- Ownership or operation of energy assets, including energy storage and aggregation, should continue to be defined as outside of the licensed activities of existing and future network and system operators at transmission and distribution levels.

Executive Summary

As the decarbonisation and decentralisation of power generation continue, digitisation of networks and assets will enable direct lines of communication across the growing number of stakeholder groups, as set out in the Government's Smart Systems and Flexibility Plan[iv]. As these capabilities begin to counter increasing difficulty in forecasting supply and demand, a range of situations involve roles and responsibilities that have yet to be clarified and codified.

The many forms of flexibility, as set out in our short paper entitled *Definitions of Flexibility*[v], have various requirements for efficient operation, with factors including time, location, frequency (of activation) and communication. Competitive markets will continue to form the basis of efficient delivery of security of supply at lowest cost to consumers, but clarity across a range of system interactions will increase investment, innovation and, therefore, the rate of change across the energy market.

Changing customer behaviours, increased digitisation and infrastructure upgrades, including the roll out of Smart Meters, mean that customers are less predictable, but enables and encourages customers to contribute towards maintaining security of supply. As innovation introduces new technologies and business models, increasing choice for customers, it is important to ensure consumer protections are in place to maintain safe and reliable levels of service regardless of what the consumer requires.

Transparent and timely sharing of pertinent information across networks and market actors is increasingly important to enabling all energy actors to contribute to optimised network and system operation. It is, therefore, essential to establish transparent relationships and processes across ESO, DNO, Suppliers, Generators, Consumers and emerging stakeholders.

This paper addresses important changes occurring across the energy system, setting out short-term recommendations to enable the UK to move forward with confidence. In light of the ongoing work of the Open Networks project, this paper also sets out a potential future energy system. In that model, the ESO retains central responsibility for balancing, Aggregators and Suppliers share information as standard and centralised information enables any actor to see where their services would add value.

Existing Definitions of Energy System Roles

Throughout this paper we refer to a number of actors within the energy system as set out below.

Please note that these definitions are overarching, with a series of more specific energy system actors able to fall under one or more of these categories, and complex subcategories within many roles.

Consumer – An individual who receives energy from the grid.

Prosumer – An individual consumer who has the ability to both receive and supply energy to the grid.

Customer – Any business or consumer connected to the energy system.

Supplier – A supplier of gas or electricity through pipes and wires, as defined in the Electricity Act 1989 and Gas Act 1986, as well as in the 8 roles of a supplier defined in Ofgem's Open Letter on Future Supply Market Arrangements[vi].

Generator – A generator of electricity, under licence or exemption detailed in the Electricity Act 1989, acting in its capacity as a generator in Great Britain (GB) or Offshore, as defined in the Grid Code[vii].

Aggregator – An organisation which collates various energy resources to create a single, larger flexibility asset, as set out in Ofgem's open letter on the design of arrangements to accommodate independent aggregators in energy markets[viii]. Aggregators can be independent organisations or market actors combining roles, such as Prosumers, Suppliers or Generators.

Transmission Operator (TO) – The organisation/organisations responsible for maintaining and monitoring transmission networks (pipes and wires)**.**

Electricity System Operator (ESO) – The body responsible for operating the GB energy system to ensure optimal flow of energy across the network. In GB this role is fulfilled by National Grid.

Distribution Network Operators (DNOs) – The organisations responsible for maintaining and monitoring distribution networks (pipes and wires) as defined by the Distribution Licence.

Distribution System Operators (DSOs) – An organisation that does not yet exist in GB, but is being developed as part of the Smart Systems and Flexibility Plan. These organisations would manage and maintain distribution-level energy systems, addressing local constraints in a way that the Electricity System Operator is currently unable to.

Balancing Services Provider (BSP) - In the European Union Internal Electricity Market, this is a market participant providing Balancing Services to its Connecting ESO or Contracting ESO.

Balancing Responsible Party (BRP) – A market participant, or its chosen representative, which is fiscally responsible for its imbalances.

Additional details of existing and developing roles in the energy system can be found in Annex 1.

Consumer Interactions and Aggregation

Changes to the energy system have resulted in an increasing number of new business models for providing energy services to customers, including the aggregation of customer assets to provide access to additional revenue streams. To maintain simplicity and clarity in contracts, there is a need for definition of some of the related interactions, particularly surrounding liability for imbalance and resolution of double-counting of supply between aggregator and supplier.

Aggregation is certainly not a new role in the energy industry, with Commercial & Industrial customers participating in Distributed Energy Resources (DER) programmes for around two decades, but as uptake of DER continues, the capabilities and business models for aggregation are evolving. DER including demand-side response (DSR) and small-scale energy storage or generation assets continue to gain popularity, complementing existing flexibility capabilities from pumped hydro and peaking plants.

For aggregation and bundled services to maintain market success, surrounding protections and arrangements will need to be established ahead of avoidable problems. As a matter of urgency, established consumer protections from other areas of the energy market should be expanded and adapted to ensure that, regardless of the business model, consumers are protected.

Ensuring Continued Consumer Access, Choice and Protections

To enable continued uptake of energy assets, including low carbon heat and transport, and smart controls, the UK must set out simple frameworks for customers using, generating or reselling energy. Customers should retain the right to refuse to participate in flexibility and still be given acceptable levels of service. Government and regulator are rightly working to ensure that customers are encouraged to participate in flexibility through rewards via reflective price signals[ix].

Across the range of emerging energy services, Energy UK believes that the use of customer assets in aggregation or system management, for example in managed electric vehicle charging, should be a service option to which consumers can *choose* to apply. This makes it important to ensure that processes and obligations surrounding changing customer interactions with energy are accessible and understandable for customers.

A number of existing standards and codes for interactions with customers could be better aligned by central efforts to educate customers. The Each Home Counts review[x] is exploring adapting standards to apply to the increasing number of customer offerings; Smart Energy GB[xi] is educating customers on smart meter benefits; and, Power Responsive[xii] continues to educate new entrants as to what DER could mean for them. These efforts should be coordinated and bolstered by increased governmental support for public engagement.

Uncertainty is apparent when defining a customer able to inject power into the system via energy storage or on-site generation. This type of customer, referred to as a Prosumer when in a domestic or SME setting, should not be held responsible for abiding by generation licence conditions. Once a number of Prosumers are aggregated, they would be seen as a ‘virtual power plant’ and, as such, the Aggregator would be the actor required to follow licencing and codes in their operations.

Further to this, if a local energy community or a community energy scheme is established under existing legislation, organisers may need to set up separate entities to operate the generation, retail and network operation roles within their system. These complexities deserve further examination to ensure it is easy for customers and communities to contribute to the safety and security of the energy system, reducing costs for consumers.

Attributing Imbalance Costs Appropriately

Energy Suppliers are encountering increasing complexity as the potential number of actors able to create an imbalance increases. Suppliers are held responsible for imbalances between supply with demand if they purchase the wrong amount of energy based on forecasts of demand for their customers.

If customers participate in DSR, this activity may change their demand profile from forecasted energy usage and result in an imbalance of supply and demand.

It is important to system security that suppliers are notified when a customer enters a contract with an Aggregator and that aggregation events which affect the customer demand profile are flagged to suppliers as soon as possible, with an understanding of the importance of sharing this ahead of Gate Closure. Energy UK is aware of a general agreement across Suppliers and Aggregators, wherein the body responsible for an imbalance takes ultimate responsibility for imbalance costs. This agreement is currently based on good faith, with the supplier informed of DSR activities where possible and penalties fairly attributed.

This agreement will only go so far and should be codified in a way that enables Aggregators to maximise value for their customers whilst taking on responsibility for costs incurred in that process. The *Code of Conduct for Aggregation* being developed by the Association for Decentralised Energy is a positive step towards market clarity, but should be supported by comprehensive governance to ensure it is followed.

It is possible that a third party will cause an imbalance in other ways, a factor that will need to be addressed as it arises. It will be important to maintain an understanding of how new and existing activities, including those by a DNO or DSO, impact upon balancing costs to ensure that these are attributed appropriately across market actors, whilst ensuring full consideration of consumer interests and the requirements of maintaining secure and safe energy networks.

The Developing Role of Distribution-level Network and System Operators

The Smart Systems and Flexibility Plan has directed the Open Networks project to develop recommendations on processes, market models and system structures to enable market activity and decrease network costs, reducing the impact of those costs on energy bills. A frequent comment across the various workstreams of the project is based on the need for greater provision of information from network and system operators.

In order to enable the most efficient transition to flexibility, DNOs should identify current and future operational needs to enable the development and testing of local arrangements for flexibility services, including how these interact with ESO activities. This work has already begun in trials being undertaken by UK Power Networks[xiii] and Centrica[xiv].

As we transition to incorporate DSOs into the energy system, the future role of the DSO should be to: Aid the ESO is maintaining security of supply; realise the value of flexibility for consumers; enhance information provision; act as neutral facilitator of competitive markets; and, remove barriers to market entry. Additional responsibilities, obligations, and separation of DNO and DSO functions are not yet defined but will need alignment with existing principles and progression via a full industry consultation, to be reflected in future DSO licencing.

Information Provision, Coordination and Collaboration across Network and System Operators

As has been raised by Government's Panel of Technical Experts (PTE), data available to the ESO and wider industry from the distribution level is today relatively poor, requiring urgent remedy[xv]. It is, therefore, important that monitoring capabilities and smart network assets be encouraged as part of the developing RIIO-2 price control in order to ensure capabilities are improved in a timely manner.

As an increasing share of generation connects at distribution level, one major operational challenge for the ESO will be maintaining overall system security. National Grid has taken steps to address this lack of information, but will need increased access to data as time goes on[xvi]. Scarcity of system services may become more acute in future, necessitating new operational arrangements between ESO and DSOs to unlock the capabilities of DER and maintain security on distribution and transmission networks.

Where possible the ESO and DSOs should provide visibility of all flexibility providers connected to their operational region and timely information about market actors' deployment of flexible assets such as energy storage or large-scale generation assets and network operator deployment of smart network assets. Visibility will help the ESO maintain security of supply, lessen demand forecast errors and limit increases in reserve margins increasing the overall cost-efficiency of the system.

Smart network assets should enable greater access and connection for flexible assets and enhance the optimal management of network assets. These assets should not be used to participate in competitive markets, in line with the recommendations of Council of European Energy Regulators (CEER). Greater monitoring and management capabilities should be expected and incentivised across applicable networks where they provide the best outcome for consumers.

As detailed later in the paper, Energy UK believes that the ESO should retain overall responsibility for national system security. Information on the activity of DSO, DNO, market participants and flexibility assets being operated in any local markets should, therefore, be provided to the ESO on a consistent basis, including details of pricing and volumes produced and consumed. This should result in the ESO holding greater ability to provide accurate price signals and efficiently procure appropriate services.

Information Provision and Collaboration between Flexibility Providers and Network Operators

In order to make efficient use of the increasing number of energy resources capable of offering flexibility of supply or demand, levels of transparency of information between flexibility providers and system operators will require significant improvement. It would be beneficial to all energy actors to increase the amount of information available from network operators at distribution and transmission levels in terms of available capacity, areas of potential or existing constraints and pending connections.

Increased transparency at a more granular level will enable market actors to identify where their services or investment would be valuable to the system and hence, aid in identifying commercial viability. In turn, this will enable ESO/DSOs to attract flexibility in an economic manner and increase the overall economics and efficiency of the network business.

The ESO and DSOs will be responsible for providing standardised and timely information and support to market participants regarding their respective network levels. As neutral facilitators, they should ensure that DNOs and TO provide connections in a timely manner, assessing flexibility services and communicating system needs in the connections process. They must act in a transparent and non-discriminatory manner when addressing network constraints, including in terms of user-friendly statement of works on longevity, necessity and type of solution being deployed.

The range of potential DER applications hold differing requirements dependent on their intended outcomes, for example: location may be important; the notice period to initiate the DER may be variable; the duration and frequency of service events will impact availability. Whilst some DER may be better suited to certain uses, others can supply multiple uses; as a result, there may be conflicts or synergies for the ESO in managing their deployment. There is a risk that this will grow in complexity as the future energy system develops, particularly as potential DSOs models are developed.

To avoid conflicts and duplication, DNOs and, in future, DSOs should have visibility of the capabilities of DER on their networks, which will, in part, be enabled by increased communications across network and system operators. When the ESO wishes to access these resources, the DNO / DSO / relevant third party should facilitate the use of these assets in a way that benefits the national system and the flexibility provider.

As smart meter deployment continues and a range of communication technologies are deployed by flexibility providers, it is important that the DNO, TO, ESO and future DSOs are capable of managing, evaluating and reacting appropriately to a much more granular level of information. This being said, it is vital to the protection of consumers' privacy that smart meter data shared outside of the Data Communications Company (DCC) and relevant supplier is anonymised and aggregated.

Neutral Facilitation of Local Energy Markets

A core function of a neutral market facilitator is that, as is the case in existing regulations, it and its subsidiaries neither own or operate market assets nor take any other commercial interest in the market outcome. In order to ensure that neutral market facilitation is a core function of a DSO and not simply a principle, existing licence arrangements preventing DNO, TO or ESO ownership or operation of generation assets, which will soon be inclusive of energy storage, should be extended to the DSO.

Ownership or operation of a 'virtual power plant' in the form of aggregated energy assets should be considered in the same light as equivalent to generation asset ownership, as increasing levels of digitisation will result in similar capabilities. Ongoing innovation trials in this area will should be enabled to continue only where a third party takes on ownership and operation of assets, and where that third party is required to bid the assets into a competitive market for flexibility.

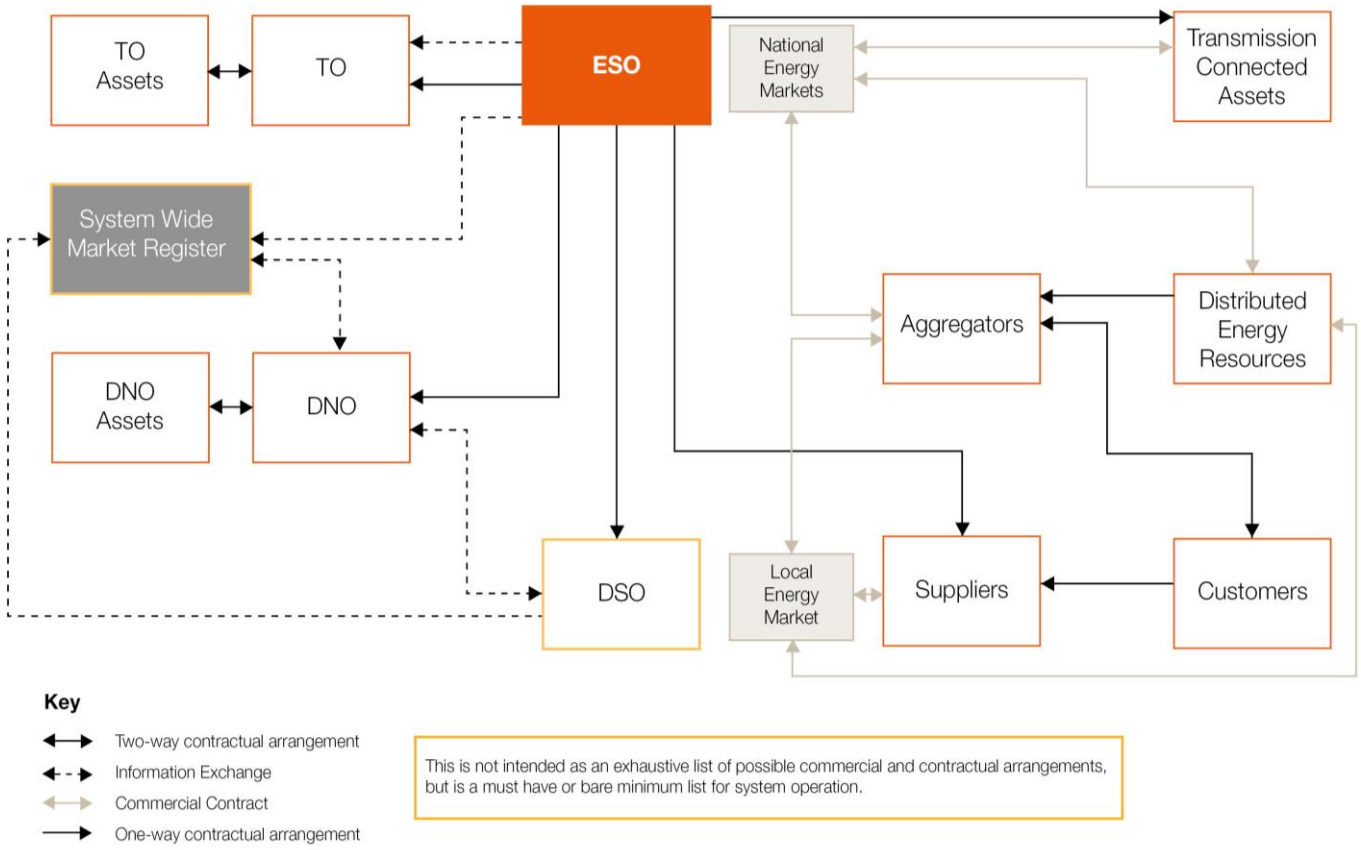
As was set out by the CEER in recent guidance to regulators on flexibility use at distribution level[xvii] neither the ESO, nor DSOs should be active as commercial service providers. As set out in existing Energy UK positions on this topic[xviii, xix], to ensure the development of successful competitive markets addressing localised constraints, clarity is required on what commercial activities DNO and DSO are able to participate in. The separation of commercial activities must be approached in a manner that ensures the best outcomes for consumers, with full consideration of efficient delivery of system security at lowest cost.

To ensure that markets are coordinated across the country, the ESO will need to act as a coordinator of system operators. It is important that DNOs and DSOs reflect the independence and neutrality at the core of the ongoing evolution of the ESO. These defining aspects of the transition should be reflected for system and network operators across distribution and transmission networks going forwards.

Many of the surrounding requirements of neutral market facilitation are established under principles of full transparency and non-discrimination for National Grid as the ESO. The current arrangement is set out in *Electricity Transmission Licence Standard Condition C16 - ESO Balancing Services* and this will need to be adapted for DSOs.

The need for a whole electricity system approach to continue, as defined in National Grid's *Facilitating Whole Electricity System Outcomes*, means that the ESO will need to retain the ability to coordinate the entire system, including crossing over the border to resolve distribution impacts. The same principles are core to National Grid's Product Strategy, which is updating and improving available services to reflect changing needs of the entire system. ESO services and processes need to be reflected in any markets established by DSOs and prioritised in practice to avoid additional complexity.

Future Roles & Responsibilities in the GB Energy System



When examining the future energy system, Energy UK believes:

- A Whole System Approach is vital to a successful model, reflective of the need for ESO coordination of actions to maintain system security at lowest cost to UK consumers;
- Incorporating simplicity, transparency and technology neutrality across the design of a future system are core to continued competition, efficiency and market participation;
- Evolving existing arrangements, rather than pursuing fundamental reforms, is the most sensible approach to developing models for system operation.

The above outline sets out a potential system operation model based on Energy UK member opinions, established in the discourse initiated by the Open Networks project. The Open Networks project provides a useful forum for exploration of a number of options for the future of distribution-level activities. The *Future Worlds* Consultation[xx] has further explored the interactions across potential future systems, initiating broader discourse across the energy industry.

The above model, Model X, draws upon a number of Future Worlds models, some of which are directly referenced below, whilst emphasising the importance of the retaining centralised responsibility for whole system coordination. This makes the model closer in approach to *Model D: ESO Coordinates*.

Whole Electricity System Coordination

It is the opinion of Energy UK that the ESO should retain overall responsibility for national system security to ensure no operational conflicts. More specifically, the ESO should hold responsibility for national balancing, frequency control and system restoration across the whole network. DSOs may take a more active role in congestion and voltage management across their operational areas. Model X, therefore, pulls upon *Model B: Joint Procurement*, offering DSO and ESO direct access to relevant markets for the provision of flexibility.

The ESO in this world must continue to hold the ability to call upon DNO and TO assets to address a national balancing issue, but the surrounding communications capability will need to be further developed to ensure that any DSO actions are not in conflict with national balancing activity. DSOs will act as an extension of the ESO in the role of neutral market facilitator, operating technology neutral markets reflective of the needs in their respective region of operation.

Both ESO and DSO activities should consider the entire range of options available to meet network requirements through a coordinated approach. This can range across network investment, distributed energy resources and small, medium or large-scale generation services. It is important to ensure that regional requirements and resulting investment and procurement processes are assessed holistically throughout the entire network. The Open Networks Project, expansion of the Network Options Assessment process and ongoing development of the RIIO 2 Price Control are critical to this.

It is still uncertain what approach to DSO relationships would be the most beneficial to consumers, in terms of independence from and interactions with DNO and ESO. It may be that the most efficient way to ensure overall system security is to extend the remit of the ESO to distribution level to remove the need to coordinate activities across a range of DSOs. Alternatively, it may be more efficient for the ESO to contract out responsibility for specific areas of third-party system operation. If DSOs are separate entities, wholly independent from the ESO, there will need to be a comprehensive set of requirements governing the relationship between system operators.

Incorporating Simplicity and Transparency

Future Worlds' *Model E: Flexibility Coordinators* also contributes to this model in the form of a central platform for accessing information on markets, which will be vital to ease of access and enabling revenue stacking for market actors.

The Open Networks Project is examining the best methods of disseminating information on the state of the network as part of *Workstream 1, Product 8: System Wide Resource Register and a Reinforcement Register*. For optimal market operation, an additional interface will be needed to present market information and coordinate ease of access to transparent information. This will become increasingly important as reflective price signals result in a wider potential range of services.

As markets develop to address local constraints it would be beneficial for a System Wide Market Register to contain information on where each market operates, what services are included and where to access tenders. This will allow for DSOs to use their own market platforms whilst ensuring that all markets conform to a minimum standard of accessibility and transparency. The efficiency of this platform will directly impact on the ability of market actors to navigate markets with ease.

Evolution Over Revolution

As set out in *Energy UK Positions Regarding the Move to DSOs*[xxi], evolving existing arrangements, rather than pursuing fundamental reforms, is the most sensible approach to developing models for system operation. As we transition to a smart flexible energy system, existing responsibilities found in the Grid Code and Distribution Code will need to be maintained and expanded upon.

This approach allows for the model to 1) align with the increased independence of the ESO seen at Transmission level; and 2) allow for an examination of a range of options for DSO governance,

enhancing the ability to find the best solution for consumers. A core difference of this approach is that a DSO role is not automatically assumed to be an extension of existing DNO functions or organisations.

The Future Energy System will hold an increasing number of new market actors including local energy communities, Electric Vehicle Fleet Operators and other as-yet-undefined participants. This democratisation of energy and broader market access should be enabled where appropriate, as long as these actors are held to the same standards of service and connection requirements as others. Local energy communities would, for example, be expected to meet existing requirements for Suppliers, DER and Aggregators where relevant.

To be effective, modelling future system operations and the further development of distribution-level system management by Ofgem should be underpinned with principles that align with the ESO forward plan and with recommendations from CEER. Ensuring that ESO, TO, DNO and DSO alike are contributing to national efforts to run a secure and low-cost energy system by facilitating and not participating in markets will be core to continued investment across the system.

For local markets to be incorporated effectively, these will need to be aligned with National Grid services. Further to this, the ideal arrangement would see all contracted services displayed in a publicly accessible centralised interface displaying a range of system information including existing capacity and constraints, reinforcement plans and developing connections. This type of system will enhance market accessibility, as well as sending clear signals to investors about where there is value in the GB market.

Conclusion

The existing advantages of the GB energy system and its competitive markets afford us the unique opportunity to create an accessible, flexible and secure model of system and market operation at lowest cost for the consumer. Prioritising the integration of information technology will enable far greater coordination of assets and efforts. Providing clear price signals via technology neutral markets will then enable the future energy system to develop in ways which deliver the greatest value to consumers.

Ongoing trials of markets for flexibility are testing the requirements of the necessary levels of transparency and accessibility required for successful markets, and will need to be integrated with a coordinated national system that ensures ease of access. There should be a coordinated approach to the level of information, terminology and type of services set out on each of these markets to allow simple integration with a centralised information hub.

As set out in this paper, to ensure safe and secure operation of the energy system, we must ensure that robust competitive markets are enabled by greater levels of transparency and cooperation across a range of networks actors. These principles are core to recent changes made to the role of National Grid as the ESO and should further drive the development the GB energy system.

Energy UK will continue to engage with a range of industry workstreams pursuing changes set out in this paper and will build upon these positions in the *Future of Energy* papers set to be released at the end of 2018[xxii]. Those papers will examine the changing energy system and set out the key decisions that need to be made towards 2030 to ensure the best outcome for consumers.

[i] https://www.energy-uk.org.uk/press-releases/412-2018/6646-creating-a-consumer-centric-future-of-energy.html
[ii] https://www.recc.org.uk/scheme/consumer-code
[iii] https://www.theade.co.uk/news/ade-news/ade-demand-side-response-code-of-conduct-consultation
[iv] https://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[v] https://www.energy-uk.org.uk/publication.html?task=file.download&id=6625
[vi] https://www.ofgem.gov.uk/system/files/docs/2017/11/future_supply_market_arrangements_-_call_for_evidence.pdf
[vii] https://www.nationalgrid.com/uk/electricity/codes/grid-code?code-documents
[viii] https://www.ofgem.gov.uk/system/files/docs/2017/07/ofgem_s_views_on_the_design_of_arrangements_to_accomodate_independent_aggregators_in_energy_markets.pdf
[ix] https://www.ofgem.gov.uk/publications-and-updates/reform-electricity-network-access-and-forward-looking-charges-working-paper
[x] http://www.eachhomecounts.com/
[xi] https://www.smartenergygb.org/en
[xii] http://powerresponsive.com/
[xiii] https://www.ukpowernetworks.co.uk/internet/en/news-and-press/press-releases/UK-Power-Networks-gives-major-boost-to-flexible-renewable-energy.html
[xiv] https://www.centrica.com/innovation/cornwall-local-energy-market
[xv] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/625885/PTE_Report_2017.pdf
[xvi] https://www.electralink.co.uk/2018/08/dataset-will-help-national-grid-join-dots/
[xvii] https://www.ceer.eu/1519
[xviii] https://www.energy-uk.org.uk/publication.html?task=file.download&id=6626
[xix] https://www.energy-uk.org.uk/publication/409-discussion-papers-and-letters/discussion-papers-and-letters-2018.html
[xx] http://www.energynetworks.org/electricity/futures/open-networks-project/future-worlds/future-worlds-consultation.html
[xxi] https://www.energy-uk.org.uk/publication.html?task=file.download&id=6626
[xxii] https://www.energy-uk.org.uk/press-releases/412-2018/6646-creating-a-consumer-centric-future-of-energy.html

ANNEX 1: Existing Energy System Relationships

The energy system has a series of defined interactions with clear responsibilities that need to be understood in order to examine how these are changing. Each of the actors in the existing system have a role to play in ensuring that the energy we generate is able to reach the end user when it is needed.

Consumer
Arguably the most important actors in the energy system are the consumers, for whom access to electricity has become an expectation and a right over the past 100 years. There are approximately 65 million consumers in the UK and 27 million households, each of which add to demand on the system in their own way. Consumers have different patterns, different needs and different preferences based on a large range of variables, but as long as their needs are reasonable they must be met by the system.

Customer
Any business or consumer connected to the energy system can be classed as a customer, but this group includes a wider range of actors than consumers. Some customers require a specific connection to the network due to increased demand, including businesses expecting a high requirement for energy. Other customers are able to feed into the grid thanks to onsite generation, altering their demand pattern and their needs from the system. The variety within customers is broader than within consumers, resulting in a number of subcategories, including but not limited to Industrial & Commercial, Small to Medium Enterprises and prosumers.

Prosumers are becoming more common as increasing numbers of people invest in domestic energy assets like rooftop Solar PV, electric vehicles, energy storage and low carbon heating assets. As uptake continues, it is important that the energy system adapts to integrate these assets and reflect the changing needs of users.

Industrial & Commercial (I&C) customers have begun to offer DSR to the system, typically via an aggregator, thanks to their size and ability to shift some of their activity to other times. This time-based flexibility is complemented by the addition of on-site generation and storage, which can be used to either power the processes of the business or feed into the grid at times of stress. Offering services such as these is reducing the energy bills of an increasing number of businesses in the UK, as well as reducing the cost of maintaining and reinforcing energy networks by lowering peaks in demand.

Supplier
Suppliers of gas and / or electricity are defined in the Electricity Act 1989 and Gas Act 1986, as well as in the 8 roles of a supplier defined in Ofgem's Open Letter on Future Supply Market Arrangements. Suppliers are the retail face of the energy industry, holding the relationship with end consumers and more often than not being mistaken as representing the entire industry.

Suppliers contract for energy ahead of time based on the expected demand patterns of their customer base and are held responsible for imbalances if they don't buy enough, or buy too much, power at any given time. Competition in the supply market continues to grow, with over 65 suppliers active in the market as of writing, from the small and new to the long-established and nationwide.

Generator
Generators are those organisations in the energy system who actually produce the power to be transported across the network. These actors inject energy into the network system as defined by the Electricity Act 1989 and Gas Act 1986, as well as the Generation Licence, which covers actors capable of generating over 5MW. Generators historically had a relationship with the TO, as this was where most generation was connected to the network. This is changing as DER investment increases, resulting in more generation assets feeding directly into distribution networks, requiring connection agreements and relationships with the relevant DNO.

Aggregator
An Aggregator often acts as a gateway between customers and the energy system, organising a range of energy resources to create a single flexibility asset. Aggregators navigate the complexities of energy markets on behalf of their customers, identifying ways to add value to the grid and open up revenue streams for their customers. Those I&C customers offering flexibility to the system are often unable to offer enough resource to be of value to the ESO on their own due to the complexity of requesting a

service from a high number of small assets. The Aggregator simplifies the role of the ESO by collating a group of these customers' capabilities and enabling the ESO to call upon a wide range of resources with a single request.

There are a range of subcategories within aggregation as there are a range of possible business models, including independent operation and aggregation by an energy supplier. There is an established and growing market for aggregation for I&C customers, but we are yet to see markets for aggregation at small to medium enterprise or domestic levels. This is expected to emerge as low carbon energy assets become more common, including electric vehicles and energy storage.

It is worth noting that aggregation could be performed by any market actor with control over a number of energy resources, resulting in a wide range of organisations examining business models for aggregation. Energy suppliers, generators, commercial & industrial businesses and even vehicle manufacturers who recognise the potential of electric vehicles.

Transmission Operator
There are 3 TO organisations responsible for maintaining and monitoring transmission networks (pipes and wires) across mainland GB. National Grid Electricity Transmission plc (NGET), Scottish Power Transmission Limited and Scottish Hydro Electric Transmission plc operate the national networks which pull together the segmented distribution networks and transmission-connected generation assets. TOs own and maintain the network assets but play no role in balancing, as this sits with the ESO.

Electricity System Operator
The ESO is responsible for operating the entire GB energy system to ensure optimal flow of energy across the network. In GB this role is fulfilled by a part of National Grid Group and there are a large number of aspects to that role including efficient planning and delivery of transmission investment and acting in the role of the Electricity Market Reform (EMR) delivery body. In their own words, National Grid manages "the flow, security, and quality of electricity to Britain's homes and businesses – managing the network on a real-time basis, making sure supply and demand are perfectly matched from one second to the next".

Distribution Network Operators
These organisations are responsible for maintaining and monitoring distribution networks (pipes and wires) as defined by the Distribution Licence. There are 14 distribution network areas operated by seven DNOs across GB. DNOs are responsible for ensuring that distribution networks are able to deliver for the needs of those in their respective geographical area. DNOs are responsible for investment and innovation across their networks and coordinate with Ofgem and National Grid in those areas.

Balancing Responsible Party
The BRP role is typically taken on by energy suppliers, who hold responsibility for ensuring they have purchased enough energy to provide for the demand created by their customers. Failure to accurately predict the amount and timing of their customers' energy usage can result in imbalances on the system as supply and demand fall out of alignment. If resolving this issue requires action from the ESO, the supplier is held responsible for the cost of resolving the issue.

The ESO establishes contracts with a number of parties ahead of time to ensure that they have a range of options suited to their situational needs. This enables them to act quickly to resolve the imbalance, leaving resolving the costs of their actions until the situation has passed.

Balancing Services Provider
A range of balancing services are offered through existing markets in GB, with each body signed up to offer a service counted as a Balancing Services Provider. At current, BSPs have relationships with National Grid, as the ESO, and the third parties contracted by the ESO as part of the management of those markets. The typical format of the relationship is a contracted service being establishes, which the ESO then calls upon for balancing the system to operate at optimal levels.