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BEAMA's Vision for a Smart, Flexible Energy System

BEAMA response - BEIS Ofgem Smart, Flexible Energy System - A Call For Evidence

12th January 2017

Foreword

BEAMA CEO, Dr Howard Porter

BEAMA fully support the need for a full review of market frameworks and associated policy for a smart flexible energy system and this consultation is a good step in the right direction to establishing a value proposition for all parties involved in a market for flexibility, including the end consumer.

Greg Clark's foreword stated the need to maximise the ability of consumers to play an active role in managing their energy needs, and this we fully support. BEAMA members are already delivering solutions into the market that will empower consumers to manage their energy better and more efficiently but which will also establish them as an integral part of the overall energy system and the maintenance of grid stability.

The innovation I have witnessed in our sector over the past few years has been unprecedented and I have no doubt that we are entering into a period of significant change for the whole energy market. The innovation spend over the past 5 years has ensured momentum in the UK market for smart devices and technologies, and arguably positioned the UK as leading the European and international agenda. However, we need to foster this in robust export support and policy, as well as collaboration and support for standardisation work. This will lead to the development of an integrated energy system, and establish the unique UK IP formed off the back of innovation trials into international standards, thus expanding export potential for UK companies. This is a huge growth area and the BEAMA board fully endorse the support from BEIS and Ofgem to get to grips with this agenda and involve industry in developing a market led approach.

BEAMA is able to provide considerably more detail and contribute further to this work. Due to the time constraints of this consultation we have done our best to submit the full breadth of views our members take but strongly believe there is a need for further follow up. I would therefore like to invite BEIS and Ofgem to contact BEAMA in follow up to this consultation and provide opportunity for further evidence to be submitted. This will allow us to further refine our thinking around the policy and regulatory options we have which are necessary for this market to develop.

Kind regards

Dr Howard porter

BEAMA's Vision for a Smart, Flexible Energy System

Introductions

Domestic consumption makes up a third of overall UK consumption[1], but is responsible for 50% of peak demand, whilst SME peak consumptions contributes 30% making a total of 80%[2]. The Digest of UK Energy Statistics (DUKES) also shows that the combination of energy industry usage and conversion, transmission and distribution costs accounts for 62% of fuel inputs. Issues with both peak demand and minimising losses during conversion transmission and distribution of electricity need to be addressed. This consultation goes some way to open up this discussion but we must maintain the focus on systems and the domestic consumer and SME sectors.

The structure of this consultation doesn't convince industry that the discussion will continue at a system level so from the outset we call for a team to be set up to review the end to end challenges associated with this call for evidence.

The solution lies with the consumer, and understanding the role of the consumer in the context of this debate is key. However, it is not clear that Greg Clark's Foreword statement 'we must maximise the ability of consumers to play an active role in managing their energy needs', has been fully carried through in this consultation.

We need to be working from a vision of how we want consumers to be engaging with the energy system in 2030 and work back from there to develop a plan/ strategy going forward. We outline in this consultation response some of this vision (new build policy and regulation, tariffing etc) and some immediate actions that can be taken but follow up on this point is essential.

To frame our response to this call for evidence BEAMA has outlined here the outputs we hope will develop from this work and our vision for the future smart, flexible energy system. These are based on some core principles on which we have based our response, further outlined herein.

Key outputs

- **A known market framework for domestic Demand Side Response by 2020** – allowing the network operators to adequately plan for the next RIIO price control period starting 2023. We view this as a realistic timescale in line with plans for half hourly settlement and the implementation of smart tariffs for domestic consumers.
- **A clearly quantified value proposition for the flexibility market, from generator to customer**- To establish the market for flexibility services, especially in the domestic sector we need to clearly understand the value

[1] Digest of United Kingdom Energy Statistics, July 2016 para 5.2

[2] GB Electricity Demand – Context and 2010 Baseline Data table 7 and Ofgem Demand Side Response. July 2010. Appendix 2 P. 50

proposition for all parties. This will ensure consumers are sold suitable products and services and the benefits are fully understood.

- **The market must remain open to new entrants to offer a range of service propositions to consumers** – in developing the market design and suitable regulation for aggregators and flexibility providers we should not provide new barriers to future market opportunities.
- **Develop targeted regulation** – here we call for government to review existing regulation before introducing new frameworks into the market. Where appropriate by reframing existing regulation we could make significant progress in developing a market for domestic DSR. A good example would be the Building Regulations and Part L. This is not targeted or integrated with government policy effectively, but if reviewed effectively could help mould homes for the future energy customer. Today Part L is driven by energy efficiency and therefore buildings are evaluated by blunt mechanisms to determine energy conservation. The amount of energy that could be conserved and the carbon intensity of energy potentially avoided by DSR is not evaluated or re-warded. Regulation driven by energy efficiency alone could stifle the DSR market and limit the retention and/or the future deployment of DSR type beneficial technologies. One example that could be introduced through Building Regulations is a minimum thermal storage provision capable of delivering a defined amount of hot water, in all new heat generator installations in single unit residential homes.
- **Develop a whole buildings approach to evaluating flexibility** - this could be through a range of mechanism and ties in with the current direction of EU policy.
- **The UK shouldn't be doing anything in isolation, especially because of emerging new EU relationships**. Creating unique policy and regulatory frameworks for products in the market would be damaging to the UK supply chain and our continued competitiveness and exports in this sector. This is specifically relevant to product regulation and building regulation and assessment procedures. Whatever we develop in the UK should be done so with a view to exports and promote engagement with overseas markets.
- **There is benefit in mapping the timeline for delivery of specific solutions and broader industry transitions i.e. the move to DSO**. This could involve the allocation of deliverables and delivery dates, responsibility, key stakeholders and participants and the points at which their involvement is required. This will better demonstrate the requirements and responsibilities and remove any barriers to participation.
- **Focus needs to be on developing regional market mechanisms** – for pricing to be reflective of network constraints that DSR is best suited to solving, and for market deployment of technologies at scale.

Our Principles

- As a general principle we believe the market for storage and other flexibility services should be assessed not through asset type, but by the effect this has

on the system, and the services they provide. This will ensure technologies and services are rewarded appropriately.

- We support the principle that consumers will become active participants in the energy market. Their contribution will be key and any policy or regulatory decisions made on energy market reform should consider the consumer value and proposition.
- In all discussions associated with developing markets for flexibility a systems approach must always be adopted and considered, therefore testing the implications of decisions on multi-vector applications for the energy sector.

Developing an energy system for the consumer

Following on from one of BEAMA's core principles, we have expanded further on how we can give the consumer an active role and the use cases associated with this.

Over the last few years BEAMA, with our members, have developed a number of smart grid and connected homes demonstrations[3]. These demonstrations have all sought to deliver clear examples of how different use cases for connected homes could operate in the short to near term, based on products already available in today's market.

All of the use cases BEAMA have demonstrated are achievable technically in today's market. However, we have always stated the fundamental barrier to this market is a clear market design for flexibility services, which can enable a consumer to be an active participant in the energy system. What is needed therefore is a clear value proposition. The changes needed to achieve this are fundamental. We feel this call for evidence is tackling some of these fundamental changes, but perhaps this is still being dealt with in silos. The review of this call for evidence and corresponding answers needs to be horizontal and look at the whole market design framework for the UK. This is also in line with the recent announcements in the Winter Package.

A distributed energy system should mean the ability to develop and deploy virtual power plants, micro-grids and private networks. There are a broad range of potential business models suited to specific local needs and customer ownership/engagement models. Ultimately the full range of business models and approaches should be allowed provided they are justified to deliver benefits to the consumer and whole energy system. Any changes made to market frameworks shouldn't block future market options like this, but should enable this type of innovation. We could also see therefore electricity systems in the same vein as district heating systems which have been heavily promoted in recent years.

Demonstrating connected homes- recent case studies

[3] http://www.beama.org.uk/resourceLibrary/demonstrating-a-smart-grid.html BEAMA, July 2015, Demonstrating a smart grid report - following the demonstration at Aberdeen LCNF conference http://www.beama.org.uk/resourceLibrary/the-beama-connected-homes-demonstration---beyond-smart-metering.html BEAMA, 2015, The BEAMA connected homes demonstration - Beyond Smart Metering BEAMA, November 2016 , Demonstrating flexible Hybird Homes and Demonstrating Connected Homes with Smart Metering - two demonstrations exhibited in 1 Victoria Street.

More recently we have produced two demonstrations which are currently being exhibited at 1 Victoria Street. These provide an insight into the capabilities of an ecosystem of smart energy products in the home and the applications of the data available from smart metering. This has helped moved industries thinking forward and can help government in understanding the needs of the future home and how this could be designed from a flexibility perspective.

Connected Homes with Smart Metering

GB energy suppliers are now rolling out smart metering systems for gas and electricity to all 26 million households. By 2020 all domestic customers will have access to their own energy data and therefore can engage directly in improving their energy efficiency and can access energy management solutions and services. Our demonstration unit shows the integration of the Smart Metering Home Area Network (including all mandated equipment under the GB smart meter program) to the Consumer Home Area Network via the Consumer Access Device (CAD). In this demonstration we have applied a 3 tiered tariff structure similar to that trialled in the Low Carbon Network fund projects, as a means to show the applications that customers can access for domestic energy systems. The tariffs applied aim to demonstrate how consumers can reduce peak demand and improve the overall efficiency of primary services (heat, hot water, lighting etc). More detail on how this demo runs is provided in a recently published leaflet[4]. Overall this demonstration gives just a handful of examples of where value can be extracted from smart meter data, putting the consumer in control and at the heart of their own energy management.

Flexible hybrid homes

The second demonstration which has been displayed at 1 Victoria Street provides an insight into the capabilities of an ecosystem of smart energy products in the home, and of vital importance, the value of stored energy (electrical and thermal) to consumers and the energy system overall. This demonstration visually shows two forms of network generation, renewable and conventional fossil fuel power plant. The scenarios demonstrated are based on the ability to manage domestic energy use according to national supply and domestic onsite generation. In doing so we can help balance supply and demand on the system, and utilise as much as possible low carbon energy from national and local generation.

More detail on how this demonstration runs is provided in a recently published leaflet[5]. We have provided some information below on the two scenarios developed for this demonstration, specifically on demand 'Turn Up' and 'Turn Down'. It is felt these have not be adequately understood in this call for evidence (para 51b, 68, 69). We hope the explanation below, relating to our demonstration on flexible hybrid homes can provide some clarification related to the Aggregators section of the call for evidence.

[4] BEAMA, November 2016, Demonstrating Connected Homes with Smart Metering
[5] BEAMA, November 2016, Demonstrating flexible Hybrid Homes

- Turn up

When wind farms are generating intelligence in the home, via an integrated home management system, can turn up demand in the house – powering equipment from the grid. Should wind speed increase unexpectedly, under the terms of today's market the grid would curtail the wind farm (turning off some of the turbines). Under the scenario for a flexible hybrid home, this increase in wind generation can be identified as a rise in frequency on the system. This can be the role of an aggregator whereby the integrated home management system can then receive a signal (via the aggregator) informing the home to increase demand. The home therefore starts to draw more load from the grid, using it to heat the water tank, re-charge the battery store and EV. All other equipment keeps running, as does the wind farm. This is a good example of where multiple storage devices as part of a system within a home can provide flexibility services without affecting the customer or requiring the customer to be involved in any actions. We should therefore always be considering the value of combined energy systems in a building not the value of individual appliances in isolation.

- Turn down

Similar to the above an aggregator can monitor wind energy production and, on identifying a decrease in wind speeds through a decrease in frequency, a signal can then be passed to the integrated energy management system informing the home to reduce load. The home can therefore start to draw more load from local batteries and stored energy resources. This avoids using carbon intensive forms of energy, as under today's operational market constraints fossil fuel power plants would be asked to increase production and the house would continue to draw from the grid.

Executive Summary

Here we provide a summary of our answers to each section of the call for evidence.

Enabling Storage

- As a general principle we believe that the market for storage and other flexibility services should be assessed not through asset type, but by the effect this has on the system, and the services they provide.
- BEAMA believe that if we resolve connection and charging methodologies we will alleviate barriers to the market for storage. We need to allow for multiple options for ownership and allow storage operators to bid into the full range of services in order to make the market viable and ensure value can be passed to the customer.
- This section doesn't adequately address the overlap between storage and DSR. There is a real danger in defining things too rigorously around fixed categories in a time of rapid technological change - it risks making it difficult to implement valuable cross-cutting technological services.
- Nothing should be written into network regulation or primary legalisation that will prohibit future business cases, technology applications and the full range of scaled storage applications including LV and building energy storage.
- A definition of storage needs to account for vector substitution.

Aggregators

- Opening access to the Balancing Mechanism for DSR would be welcomed. However, supply licences are expensive and hence a significant barrier to entry for small, new aggregators.
- Aggregation is inherently different to supply and should not be forced to fit itself into the supply bucket in order to access flexibility markets.
- The current settlement system was designed for the capabilities of large, monolithic facilities that were prevalent at the time, not for new, agile equipment which could be installed at grid edge (e.g. in domestic properties)
- The capabilities of modern equipment cannot be fully exploited because the system, although clearly in need of greater flexibility, is not currently set up to exploit that flexibility.
- We need to develop new processes that can sit alongside and augment the main settlement processes, but which operate in nearer to real time for aggregators to be able to deliver energy flexibility.
- Aggregator actions could be steered to help suppliers improve their imbalance positions at the same time as they effect system actions. The possibility of positive impacts by aggregators seems to be overlooked in the Call for Evidence

System Value Pricing

- We expect half-hourly settlement to endure, along with the market structure to support it. We do not anticipate a nationwide change to this structure, whether driven by regulation or markets or both.
- In order to achieve greater energy flexibility, all stakeholders need to determine together what additional processes can sit alongside 30 minutes settlements in the wholesale market to support energy flexibility.
- A clear definition and standardising of flexibility services would permit those providing and using such services to better quantify and compare the merits of competing services and technologies
- To make flexibility of the electricity system easy to access and use, data needs to be available in near-real time. Tariffs and the system that takes advantage of them can be thought of as a multi-level control hierarchy consisting of (in diminishing size) the central monitoring and service despatch; a community energy system and microgrid; a home energy management system; and a smart appliance.
- The Smart Meter communications architecture was not designed for mass real time communications, and is therefore limited to what it can deliver in the context of supporting energy flexibility. Services that respond in near-real time to changing network demand need a supporting real time communications channel.

Smart Tariffs

- Smart tariffs incentivise consumers to use, store and export electricity at times that are most beneficial or least costly to the system. ToU tariffs are the most important and most visible expression of smart energy network management. However, the questions expressed here needs to be considered in the light of Half-Hourly Settlement, and the Government's view that this is an essential foundational and enabling step for smart energy management.

Providing price signals for flexibility

- The existing charging structure does not provide the signals needed to support full DSR, especially in the residential sector.
- The introduction of a capacity charge would be a short term step to encourage DSR.
- In the medium to longer term, a full revision of the charging mechanism is needed to support a fully functional DSR and DG market.
- Work is needed to understand true network costs so that assets can be charged according to their costs and benefits without one-off settlements for each.
- Government policy should as far as possible be technology neutral. A well designed flexibility market should allow all technologies to compete in a transparent fashion.
- The design of such a charging mechanism for the distribution system is not yet understood and urgently needs analysis and trialling. Technical feasibility, commercial viability, consumer acceptance and protection must all be balanced.

Smart Appliances

- The industry needs an agreed definition of all elements of 'smart' that contribute to flexibility. Recognising not all appliances can provide all functions of flexibility. We need to define the smart elements of flexibility in order to classify appliances. This would be the basis of any market led label for smart appliances - as defined by their ability to deliver flexibility.
- We need to get the market design right first before we can regulate an offering for consumers through the appliance market. The development of smart appliances should be driven through developing the appropriate value proposition through market design, not by enforcing functionality on consumers before they can extract that value.
- To fully answer the questions being asked in this section considerable work is required to define the market and technical requirements for smart appliances. We have only touched the surface on this topic in our answer and invite Government to work with BEAMA to develop this further.
- Interoperability should not be forced through regulation but driven by the market and standardisation work.
- When this work is complete and the value for consumers understood and defined BEAMA would support the development of labelling for smart appliances ensuring consumers can appropriately engage with the flexibility market.

Ultra-Low Emission Vehicles in a Smart Energy System

- Home EV charging is highly suitable for DSM interventions when coupled with consumer controlled parameters, equipment is commercially available today to perform these functions.

- The difficult part is creating the right market conditions to encourage consumers to install and use smart functionality. Two elements are vital in achieving this in the long term:
    - Ensuring that the systems themselves are part of a unified smart technology sphere developed in conjunction with other products by industry standards bodies for interoperability (i.e. government might set goals but not the specific standards of how to achieve them).
    - EV smart charging must be an integrated part of the domestic DSR market mechanism and not dealt with separately –this would be bad for EVs and harm progress in the rest of the market.
- V2H and V2G are again technically feasible and available today and may in the future serve a useful purpose but may be overtaken but other solutions such as static battery storage. Timely development of such systems would be enhanced by clearer understanding across different industries of the detailed nature of the need and the rewards for meeting it.

A System for the Consumer

- The move to DSO presents several valuable opportunities for DNOs and the effective coordination of key resources, ownership and enabling policy frameworks are an essential aspect of this.
- Generally trigger points for further engagement should be in advance of the points at which the flexibility services and customer participation at domestic level (where appropriate) become necessary from a system perspective. We therefore need to start working on developing the market design and mechanisms to support a market for domestic energy flexibility today.
- There is a continued role for suppliers, aggregators, providers and installers in encouraging customer uptake of innovative solutions and new technologies and in clearly demonstrating the inherent value propositions.

Cyber Protection and Cyber Security

- The market demand for products at a system and consumer level is already driving increased security standards for the market. Standards for communication protocols are already being upgraded for improved security and protection.
- Any DSR system needs to be designed with the above threats in mind. We already have a lot of this protection enshrined in current policy and regulation, including the Data Protection Act. Furthermore, we should be following the precedent set by smart metering for the ownership and storage of customer data.
- BEAMA members are engaging with the standardisation work around this topic at a European and International level and will continue to supply products into the market that meet the existing standards for Cyber protection and security.

The role of different parties in system and Network Operators

- This section identifies some of the perceived barriers of DSO as well as examples of known work in the area. These new ways of operation present considerable benefits but there is also a need to consider the risks and cost implications, particularly the variations arising from the different market models and optionality therein, as well as the participation of the key stakeholders involved in scoping, delivering and harnessing benefits from the proposed changes. The move to DSO presents a number of key benefits to network operators and customers and this section aims to capture some of the most valuable benefits as well as suggesting industry ownership and examples of work undertaken to date or in progress as appropriate. Lastly this section identifies the key initial risks, benefit and cost implications of the presented high level market models and highlights the key requirement for broad stakeholder involvement in shaping and delivering these new approaches.

Innovation

- Sufficient funding should be available for significant demonstration projects in these areas which have high TRL levels (above 5). Furthermore there should be funding available for the capital cost of these demonstrations and not only for research. For priority number 1 (Commercial and Residential automated DSR) there should also be a strong emphasis on research, and funding available for consumer side / consumer behaviour evaluation. Innovation spend should now be targeting trials at scale, aimed at moving into the commercialisation of new business models and technologies.
- Focus now needs to be on driving innovation through to Business As Usual and innovation should be established as a core part a Network operator's business.
- BEAMA members have reported on the limitations the NIC and NIA governance processes may place on innovation and the ability for truly innovative projects to come to the fore.
- Overall collaboration for LCNF, NIA and NIC projects with partners has been positive. BEAMA have reported to Ofgem in the past concerns over the level of risk companies are often forced to take on in delivering a project. This risk in most cases is also not proportionate to the size of the company that could be involved, and therefore favours the involvement of larger companies to partner on projects, likely to also already be active suppliers into the DNOs BAU procurement. This risk is reputational, as well as financial. Alleviating the risk SMEs would have to take on as part of a project would encourage more of the SME community to take leading roles in project delivery under NIA and NIC, benefiting the UK market overall.
- Issues around the treatment of background and foreground IP must be addressed. This is something BEAMA have been reporting on for 3 years and it is a significant barrier for many companies engaging with innovation projects.

Enabling Storage

Summary

- As a general principle we believe the market for storage and other flexibility services should be assessed not through asset type, but by the effect this has on the system, and the services they provide.
- Ultimately BEAMA believe that if we resolve connection and charging methodologies we will alleviate barriers to market for storage. We need to allow for multiple options for ownership and allow storage operators to bid into the full range of services in order to make the market viable and ensure value can be passed to the customer.
- This section doesn't adequately address the overlap between storage and DSR. There is a real danger in defining things too rigorously around fixed categories in a time of rapid technological change - it risks making it difficult to implement valuable cross-cutting technological services.
- Nothing should be written into network regulation or primary legalisation that will prohibit future business cases, technology applications and the full range of scaled storage applications including LV and building energy storage.

Q1. Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage?

The main barriers for large scale electrical storage have been identified.
However, in the context of energy storage solutions which may cover broader applications - e.g. electricity in / heat out - we feel the points outlined in the content of the call for evidence do not adequately reflect the range of storage functions that may be applicable on the system in the future and especially with reference to heat. We therefore provide in this answer a review of the main types of storage technologies we have identified, which should be considered in the context of this assessment. This is not exhaustive but we are confident reflects the breadth in storage technologies available on the market today.

Furthermore behind the meter energy storage is not sufficiently covered in this section. This should not be over looked as services are already developing to offer behind the meter storage for Demand Side Response and Balancing Services. We acknowledge some of this is to be covered in the Smart Appliances chapter of the call for evidence, but in reviewing potential regulatory amendments as we do in this section we must consider all applications for storage, and all levels of the system. We have mentioned where applicable in our answers to the questions in this section, references to LV and building energy storage applications although we have focused on grid connected storage applications assuming this is the intention of this section. We refer further to building energy storage in the smart appliances section of the call for evidence.

We strongly urge BEIS and Ofgem to be conscious that any changes or recommendations made to address the main policy and regulatory barriers for grid

connected storage, also address behind the meter energy storage solutions and do not create any new barriers to enabling building energy storage solutions.

Storage technology overview

1. Chemical

- Hydrogen (H_2)

Hydrogen can be physically stored in a gaseous state (compressed) or in a liquid state. Both technologies are established and used in the car industry for hydrogen vehicles.

Chemical storage of hydrogen, where hydrides are stores is an emerging technology. Currently the only hydrides used are limited to lithium, boron and aluminium based compounds. Hydrides chosen for storage applications provide low reactivity (high safety) and high hydrogen storage densities. The use of hydrides of magnesium is now being developed.

2. Electrochemical

- Batteries

They consist of two or more electrochemical cells which through a chemical reaction create a flow of electrons. An increasing number of chemistries are used for this process but the more familiar ones include lead-acid, nickel-cadmium (NiCad), lithium-ion (Li-ion), sodium/sulphur (Na/S), zinc/bromine (Zn/Br), nickel-metal hydride (Ni-MH) and others.

- Flow batteries

The flow batteries use electrolyte that is stored in a separate container outside of the battery cell container. The advantage is that the storage system's discharge duration can be increased by adding more electrolytes. Vanadium redox and Zn/Br are the two more familiar types.

3. Electrical

- Capacitors/Super-capacitors

Capacitors store electric energy as an electrostatic charge. They are well-suited to being discharged rapidly and to deliver a significant amount of energy over a short period of time.

- Superconducting Magnetic Energy Storage (SMES)

SMES systems store energy in the magnetic field created by the flow of direct current in a superconducting coil which has been cryogenically cooled to a temperature below its superconducting critical temperature. Once the superconducting coil is charged, the current will not decay & the magnetic energy can be stored indefinitely. SMESs are highly efficient > 95%.

4. Mechanical

- Compressed Air Energy Storage (CAES)

CAES involves compressing air (using inexpensive energy) that can be used to generate electricity (when the energy is more expensive). The compressed air is heated and released into a combustion turbine generator system. For larger CAES plants, underground geologic formations (salt, aquifers or gas fields) are used. For smaller CAES plants, tanks or high-pressure natural gas pipelines are suitable.

Adiabatic CAES (ACAES) uses no fuel to convert stored compressed air into peak-electricity power. Cooling of the compressors and the heating of the stored air for power production are achieved with thermal energy storage. Therefore the round-trip efficiency is must higher.

- Flywheel Energy Storage

The principle is to have a cylinder with a shaft that can spin rapidly within a robust enclosure. The shaft is connected to a motor/generator. To limit fictions, a magnet levitates the cylinder. To charge the storage, electric energy is converted via the motor into kinetic energy (rotation speed). The stored energy is converted back to electric energy via the generator, slowing down the speed of the flywheel.

- Hydroelectric

Most hydroelectric power (conventional) comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the volume and on the difference in height ("the head") between the source and the water's outflow. The amount of potential energy in water is proportional to the head.

Key elements of hydroelectric power (pumped-storage) system include turbine/generator equipment, a waterway, an upper and a lower reservoir. This method produces electricity to supply high peak demands by moving water between reservoirs at different elevations. At times of low electrical demand, excess generation capacity is used to pump water into the higher reservoir. When there is higher demand, water is released back into the lower reservoir through a turbine.

5. Thermal

- Ice storage

There are various ways to store thermal energy but the most common way is to make ice when energy prices are low and to use it to reduce cooling needs (especially compressor-based cooling) when energy is expensive or the load of the grid is close to the black out.

- Liquid Air Energy Storage (LAES)

LAES system employs proven cryogenic processes that use liquid air as the energy storage medium. Storing energy in the form of liquid air increases the energy density up to five times as compared with similar Compressed Air Energy Storage (CAES) technologies and can achieve high energy storage efficiencies.

Are there any additional barriers faced by industry?
Please provide evidence to support your views.

As mentioned above, behind the meter energy storage solutions should not be over looked in policy / legislation. In particular, we would like to highlight the area of power to heat and small scale thermal storage solutions which we believe is a solution which is currently not given as much attention as it deserves. There are 2.4M electrically heated homes in GB of which 1.8M have electric night storage heaters installed. These have been installed over several decades and many are now approaching the end of their useful life. Assuming a 20-year replacement cycle yields between 90 – 120K homes per year which are replacing existing electric storage heating systems, often with direct electric heating systems. If these systems were to be replaced with the new generation of electric storage heating i.e. Smart Electric Thermal Storage ('SETS') they can be linked to the grid and used for demand side management. SETS can be used to provide decentralised space heating and hot water, and can act as an energy storage system to provide distributed flexibility to the electricity grid. It can drive down energy bills as a result of up to 20% efficiency gains compared to current night storage heaters. Its demand side management functionality also brings flexibility to the energy system by storing heat from renewable electricity generated at times of high supply and low demand. SETS is fully controllable and designed for integration into smart grid control systems. It can contribute to accommodating the increasing penetration of renewable resources in GB.

Technology such as Heat Pumps, and in particular AWHPs can make additional energy and carbon savings of up to 66%. In addition when used with underfloor heating and hot water cylinders, heat pumps can form the heat generator for a demand side energy management system.

Furthermore, there is a legacy of properties that have water cylinders (in airing cupboards) and boilers (in kitchens), and the move towards installing combi boilers means that the simple water cylinder that could have been independently heated, by adding a direct element linked to a smart tariff, is disappearing from the market. This means that a huge potential 'battery' of water that needs heating 365 days of the year is being made less accessible.

In answer to the questions above and expanding slightly to look at all potential operators of storage and the assessment carried out in this section then overall BEAMA feels that this section doesn't adequately address the overlap between storage and DSR. There is a real danger in defining things too rigorously around fixed categories in a time of rapid technological change - it risks making it difficult to implement valuable cross-cutting technological services.

Ultimately BEAMA believe that if we resolve connection and charging methodologies we will alleviate barriers to market for storage. We need to allow for multiple options for ownership and allow storage operators to bid into the full range of services in order to make the market viable and ensure value can be passed to the customer.

Q2. Have we identified and correctly assessed the issues regarding network connections for storage?
Have we identified the correct areas where more progress is required?

Considering the treatment of an existing generation connection (e.g. residential PV panel and inverter), when a home owner is adding a battery store or considering installing an EV charge point, the overall installation process and experience may become much more complicated. Taken together such "generation" equipment configuration could easily exceed the 16A per phase export current limitation in the G83 Distributed Generation Connection Code. This would have knock on implications for both the consumer and network operator in relation to planning and approvals, increased connection costs and extended timescales for installations. Lack of clarity on these matters has already been identified as a barrier to market for the installation of building energy storage. But any change to the rules here would probably require a change to primary legalisation. Either we pursue this route, or we look to agree a process that simplifies the approval and installation procedure with the ENA and their members. If changes are to be made to the Electricity Act (options 1-d in point 38), this could open further opportunities for changes in this primary legislation in the context of building energy storage. This would be significant action and may take some time, therefore in this short term we should pursue clarity on the process with ENA to enable the market for building energy storage to develop.

Further to this, it may be feasible to agree a process of notification and installation with the network companies that ensures the 16A per phase limit is not exceeded. This could involve some form of load limitation, or functional requirements. But we believe there may be options worth considering for storage providers to ensure they are not faced with unnecessary barriers. This is especially true if a storage device is seen to benefit the local network. This therefore refers to a key principle in our overall response - that regulation and policy should not focus on the assessment of asset type, but the effect and potential benefit this asset may have to the overall system, and therefore the services they provide.

Referring to Para 10 in this section. Providing flexible connections and charging is a start, but to achieve most value the network operators also need to open up real time visibility into network conditions, e.g. identifying actual operational conditions of overload and underload as they occur. This will allow operators of distributed storage & DSR networks to dynamically flex their response so as to add maximum value to the system, and to the storage/DSR owner. This dynamic aspect to management of distributed resources is essential to maximising value: if you try to do everything at planning stage, you have to overdesign for the worst case and hence leave value on the table. Reliability can be achieved by stochastic management of the response portfolio, rather than by upfront overdesign.

Q3. Have we identified and correctly assessed the issues regarding storage and network charging?

Referring to one of our key principles, BEAMA believe overall BEIS and Ofgem should be assessing regulatory and policy needs not based on asset type, but their effects on the overall system. An asset, whether generation, load or storage, should be handled according to the effect it has on the system - e.g. if it requires network reinforcement, then it should pay for that reinforcement, if it enables the network to operate more efficiently, it should be rewarded.

Do you agree that flexible connection agreements could help to address issues regarding storage and network charging?

Flexible connection agreements are a good start, but they currently provide only limited support for energy system flexibility. DNOs need to open up their systems to provide dynamic, realtime data on constraints for some assets to fully realise their inherent flexibility value.

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.

Referring to one of our key principles, we suggest that the issue here is not 'the impact of network charging on the competitiveness of storage', but rather a fairly blunt network charging methodology. A well designed charging methodology, which weights its charges according to network impact, should have little impact on storage which is located and used in support of network issues, and in fact the charges could be deemed to be negative in this instance.

Rather than focussing on the relative impacts of charging on different types of flexibility, and artificially adjusting to balance competitiveness, it would be more helpful generally to redesign network charging methodologies, as addressed in questions 19 to 24 and our responses to these. This is hinted at in clause 11 of chapter 2 of the consultation document. We believe there are some areas of charging methodologies that could be reformed without significant amendments to current rules, allowing constrained networks to be better managed and to promote applications for ALL types of storage. We are aware that the ENA are hosting a series of workshops with stakeholders to consult on the TSO and DSO transition programme. Within this work we see scope to discuss some of this and work through the details of what reform is required to create a level playing field and reform existing charging methodologies. BEAMA will therefore ensure we engage with this work and contribute with our members. We fully support the need for this to be carefully reviewed in a forum such as this, as this call for evidence does not allow sufficient time or scope to provide all the answers. This is also a complex matter that needs reviewing at a systems level.

Referring to Para 13 in this section. BSUoS charges need a full review and potentially some adjustment to suit the market. The real cost drivers to BSUoS need to be identified

and used to drive charging, rather than attempts to differentiate between, or create a "level playing field" for, different modes of service delivery. For example, it's quite possible that co-located storage and DSR (which are often very similar actions) are inherently cheaper for any single service type than dedicated storage facilities, as they are making greater overall utilisation of a common network resource (by using it to provide multiple service types). In this case, a "level playing field" actually provides an incentive to dedicated facilities and hence a disincentive for DSR and domestic storage. Charging should therefore be tied into actual impacts on the network, if putting in place equipment (whatever it is)creates added costs for the network both when its charged and when its discharged, then it should be charged for this impact. Alternatively if it helps reduce costs on the network, then it should be credited accordingly.

One area of reform BEAMA feel could be delivered quickly is the removal of double charging for consumption levies associated with grid connected storage. This should be done as soon as possible.

Q4. Do you agree with our assessment that network operators could use storage to support their networks?

Yes we fully support the assessment that Network Operators could use storage to support their networks. However, we need to ensure that they don't exploit their monopoly position to artificially favour assets they own over other assets on the network.

Are there sufficient existing safeguards to enable the development of a competitive market for storage?

BEAMA cannot comment on this fully, but we do provide more information in our answer on how Network Operator storage ownership should work in practice, and the requirements/safeguards to ensure this remains a competitive market. There are risks with NO ownership of storage for the market that will need to be managed.

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

This question asks 'why should network operators own storage?', but perhaps this should be phrased as 'why shouldn't network operators own storage'? The most commonly cited reason for this is unfairness of competition, but perhaps the problem needs further breakdown into 'ownership of the storage equipment', 'operation of the storage equipment' and 'trading and ownership of the stored energy'.

For network-connected storage an approach which could be taken would be for the system to own and trade the energy, on behalf of the users of the system, in much the same way that the balancing mechanism currently operates. The distribution operator would make the calls on behalf of the system. If the storage is owned by the distribution operator it is treated as a regulated asset, and revenue is recovered in the same way as if it was owned by a third party who charged for the use of the service.

DNOs might reasonably own storage where a) it is the most effective solution and b) it needs to be managed as a monopoly to be effective and economic. In other cases we believe it makes more economic sense for storage to be owned elsewhere and made available to the network operator as a service. A system that facilitates both options avoids the risk of freezing out one or other asset owners and business models.

It is important that the market for storage remains competitive, to the benefit of the consumer. The regulated entity will need to show that a market-based service procurement is not feasible, and therefore their ownership of the asset is required – this should be subject to periodic review. We expect the market will emerge to allow for a combination of options as this allows complete flexibility for the varied nature of network constraints and the tailored mechanisms that may be required to alleviate stress on a given network.

It is also important to consider under what circumstances the DNO may have unfair advantage. This arises where the DNO has control over whether storage is connected, the DNO has privileged access to the best connection points and privileged control over the operation of different storage units, some owned by the DNO, some owned by third parties.

The same also applies for the DSO and TSO. As DNOs develop a DSO role we acknowledge that changes will need to made regarding the rules for the operation of assets, including storage. It has been accepted by BEIS and OFGEM that, for the transmission system, there is a conflict of interest between the system operational role and the network ownership role. There is no reason to believe that this conflict will not also apply at the distribution level and there must be clear separation between the DSO and DNO roles. This would also allow the DSO to open connection points to both the DNO and third parties and argues for a separated planning role for the DSO.
If DNOS are allowed to own storage it will be important to ensure that the operation of local storage is based on market principals whereby third parties can compete on an equal basis with the DNO. The TSO DSO transition work the ENA is leading could provide a useful platform to review this.

When looking at ownership of storage at smaller scale and in particular for buildings, the cost of storage needs to reduce to a level where a consumer can purchase and see a payback within 5-7years. For this to happen we need market demand. This demand is most likely to start with the DNOs who would benefit from operating saving. This operational saving may never reach the consumer. Consumer engagement with storage and DSR will create a market value for smart products and therefore there is a need to stimulate demand at the consumer level.

Q5. 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.

BEAMA are not able to support one particular regulatory approach at this time. We set out in our answer below the arguments for and against different options. Specifically we outline why we need to be cautious in our approach within the regulatory context, so as to avoid locking out future business models and technologies. BEIS and Ofgem should undertake a comprehensive review of the risks we outline below and consult on these before deciding on whether an amendment to primary legislation is required. If it is, then the definition and approach needs careful consultation with industry, considering our points outlined below and in answer to Q6. We therefore expect follow up to Q5 and 6 with industry after the deadline of the 12th of January. This deadline did not provide us with sufficient time to confidently support one specific approach.

The problem with defining storage and creating a special use case for it is that it is almost certain this will create an anomaly in the future, as new applications/business models and technologies arise. For example, there are technologies under development which can store energy, import and export electrical energy, and import and export heat. Electrical energy may be used to "charge up" the storage but the export could be as electricity, or as heat. Conversely, heat may charge up the storage and it could be exported as electricity. (Please refer to the technology overview we have provided in answer to Q1 in this section. Here we provide a review of the main types of storage available on today's market, and therefore all those to be considered in the assessment of regulatory approaches).

These units may well meet the criteria for any given definition of storage, but could then be seen as an abuse of the intent of the definition. Arguably it could be more beneficial to the market to not change the regulatory approach (of treating storage as generation and load) but rather to address any deficiencies in the charging methodology.

Another example, as outlined within chapter 4, would be ULEVs with vehicle-to-grid (V2G) capability where the point of export to the grid may be different to the original point of import from the grid. It seems more straightforward to treat storage as separate generation and load, but to produce an appropriate charging methodology.

The challenge today is we don't fully understand the potential impacts of storage (and associated DSR). We have various studies and trials to suggest the effects and value of storage, but we haven't yet fully tested these models in the field, and hence seen all their potential intended and unintended consequences. This suggests we shouldn't freeze too much into legislation or regulatory frameworks at this point, but allow for a period of experimentation with careful monitoring and target specific interventions where warranted. This would require some flexibility from Ofgem to allow for projects to come to fruition at scale, in order to fully test the system effects of storage. Reference to NG's System Operability Framework (reproduced below) shows that storage can provide flexibility at several timescales; rapid response, post fault and longer term. Each of these forms of flexibility will have different values and requirements across the network. The market arrangements to reward storage for these different services has not been explored in any detail and must be developed and trialled.

Referring again to our key principles, in a lot of cases the discussion being had is based on assets rather than effects. Charging methodologies should not therefore be defined based on whether an asset is load, generation or storage. It should depend on whether integrating the asset into the system creates additional costs (or reduces them), regardless of what type of asset it is. Currently, there is no mechanism for rewarding an asset that might reduce overall system costs, e.g. by reducing the need for reinforcement. This is an important comment for grid connected storage and building energy storage where stores are just accounted for as additional potential load, even though they may never operate in this way and will only reduce strain on the system - this can form a barrier to market.

If government is to go down the route of amending primary legislation, the legal process in doing so would need to consider the points above and ensure those amendments were future proof. Our point is this may be difficult to do. Furthermore, amendments to primary legislation will take time. The longer this process may take the further the market for energy storage may be stifled. Nothing should be written into Network Regulation or primary legalisation that will prohibit future business cases, technology applications and the full range of scaled storage applications including LV and building energy storage.

Q6. Do you agree with any of the proposed definitions of storage? If applicable how would you amend any of these definitions.

BEAMA agree with the definition set out by the Energy Storage Network so far as it provides a suitable definition for electrical energy storage. We do not support the use of this as it stands for primary legislation. We feel the full spectrum of storage applications and technologies need to be considered here (Please refer to the technology overview we have provided in answer to Q1 in this section. Here we provide a review of the main types of storage available on today's market, and therefore all those to be considered in the assessment of regulatory approaches.).

As per our answer to Q5 we feel these questions require further follow up with industry in order to ensure we are not going to implement something into primary legislation or secondary legislation which will prohibit future technologies, or even technologies available on the market today.

Key to any definition will be the inclusion of Vector Substitution. Referring for example to the case we outlined in answer to Q5, there are technologies under development which can store energy, import and export electrical energy, and import and export heat. Electrical energy may be used to "charge up" the storage but the export could be as electricity or as heat. Conversely, heat may charge up the storage and it could be exported as electricity.

Either we are defining very specific detailed rules for electrical storage only (which BEAMA are unlikely to support),, or we need to determine categories for storage on a

sliding scale of applications including electricity and heat and for all DSR and Balancing Services.

The recent Winter Package includes an amendment to the 'Directive on common rules for the internal market in electricity' and refers to a revised definition of storage in Article 2 as:

'Energy storage means, in the electricity system, 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 does take into account vector substitution and foresees future technological development in storage applications as it is not limited to electricity in and electricity out. This is also an approach that is supported by EASE because it encompasses 'power –to-X' and thermal heat energy storage.

BEAMA has discussed this position with a number of other organisations, including the Energy Systems Catapult who agree with the need to ensure the definition does not preclude applications, and can allow for vector substitution. Furthermore, this is more conducive of a systems approach where multi vector services and applications are more integrated.

Aggregators

Summary

- Opening access to the Balancing Mechanism for DSR would be welcomed. However, supply licences are expensive and hence a significant barrier to entry for small, new aggregators.
- Aggregation is inherently different to supply and should not be forced to fit itself into the supply bucket in order to access flexibility markets.
- The current settlement system was designed for the capabilities of large, monolithic facilities that were prevalent at the time, not for new, agile equipment which could be installed at grid edge (e.g. in domestic properties)
- The capabilities of modern equipment cannot be fully exploited because the system, although clearly in need of greater flexibility, is not currently set up to exploit that flexibility.
- We need to develop new processes that can sit alongside and augment the main settlement process, but which operate in nearer to real time for aggregators to be able to deliver energy flexibility.
- Aggregator actions could be steered to help suppliers improve their imbalance positions at the same time as they effect system actions. The possibility of

positive impacts by aggregators, seems to be overlooked in the Call for Evidence.

Q7. 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.

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

Too much of the current system is overly complex and designed from the perspective of the capabilities of incumbent equipment, rather than from the perspective of what is needed and possible. It lacks clear appreciation of the range of flexibility that might be valuable to the system, or what it might be possible for modern equipment to provide. It creates no market for small consumers to engage with and hence provide value to / earn value from.

Half hourly settlements is a solution driven by what was technically feasible in the 1980s and presents a significant barrier to the deployment of new equipment and solutions. The system was designed for the capabilities of large, monolithic facilities that were prevalent at the time, not for new, agile equipment which could be installed at grid edge (e.g. in domestic properties) and managed via IoT protocols. The capabilities of modern equipment cannot be fully exploited because the system, although clearly in need of greater flexibility, is not currently set up to exploit that flexibility.

More value could be obtained, and many issues such as the impact of aggregators on imbalance management could be significantly mitigated, if we had a more dynamic settlement regime, or if the current settlements scheme could be adapted to support some operations in nearer to real time for aggregators to be able to deliver energy flexibility. However, there is a risk that attempting to make aggregators pay for supplier imbalances caused by the suppliers' failure to predict correctly, will create a disincentive for suppliers support the necessary changes or to invest and update their own systems.

Aggregator actions could be steered to help suppliers improve their imbalance positions at the same time as they effect system actions, e.g. by preferentially reducing demand from assets supplied by suppliers who are short energy, in order to deliver Short Term Operating Reserve (STOR) type services. The possibility of positive impacts by aggregators, seems to be overlooked in the Call for Evidence. Solutions should be sought which make the supplier imbalances visible at an earlier point, so that aggregators can adjust their loads in the most overall positive way. Policy and regulation should be steered to allow a market for such services to develop.

DSR often represents a time shift of energy consumption rather than a change in the absolute level of consumption. So the "added energy costs" for suppliers should not be overplayed, although there may well be a time arbitrage cost, but this will often be in the supplier's favour, as typically demand is shifted from expensive to inexpensive times.

Overall BEAMA have received positive comments reflecting the way in which National Grid are currently opening up the market for balancing services. For the range of balancing services on the market the one area our members (and specifically the aggregators we have spoken to), would like to see addressed is standardisation and simplification between the different services. For example, consistent periods for all services would ensure aggregators can move from one service to another and therefore extract more value from the market. National Grid are paying more currently for some of these services because of the inconsistency between periods for different services and therefore pay a premium when aggregators are unable to access multiple services.

Furthermore transparency of price and volume in the market helps aggregators to reduce risk and this will further drive down costs for National Grid. We believe there is a lot of work to be done on the issue of transparency specifically and to ensure consistency of this data across the different services.

On the matter of consumer protection, we agree that this may be a necessary area of work, however constraints in the market need to be well considered. The market is still small and potentially fragile to constraints set in this area if implemented too quickly. So our comment here is to ensure licensees and any future codes of conduct are implemented with thorough consultation and not too quickly.

Overall we feel the barriers to market for aggregators are well identified in the paper provided with this call for evidence, they key will be ensuring, consistency, transparency of value and ease for aggregators to access multiple value streams. Creating the flexibility in the market for aggregators to access difference services is important as it is currently very difficult for aggregators to move from Wholesale to Balancing Services for example.

Q8. What are your views on these different approaches to dealing with the barriers set out above?

Opening access to the Balancing Mechanism for DSR would be welcomed. However, supply licences are expensive and hence a significant barrier to entry for small, new aggregators. Aggregation is inherently different to supply and should not be forced to fit itself into the supply bucket in order to access flexibility markets.

Thus any plans to open the Balancing mechanism must be accompanied by associated changes which lower the costs to market entry and have less complex rules and requirements for aggregators. This will enable aggregator services to be explained to domestic consumers and small businesses, and will facilitate access by new entrants, with new innovative thinking.

One solution to the risk of intended consequences of regulation is to keep the regulation simple, and to review and refine it regularly. In a world where new generations of equipment come along every 2-3 years, there should be a mechanism to review and adjust regulation regularly so long as it is kept clear and simple. In a world of slower change, more complex and slowly changing regulation could be tolerated, and indeed was probably preferable, but that is no longer the world we live in.

Q9. What are your views on the pros and cons of the options outlined in the table? Please provide evidence for your answers.

BEAMA would like to make Ofgem aware of our members experience in the French balancing market, with specific reference to the proposed bilateral agreement framework for aggregators and suppliers. There is a risk that such bilateral agreements will create competition issues in the market. It is felt this agreement is not required and would only create further barriers to market. In 2013 the French regulator published a statement to remove such an obligation in the French market for this very reason[6]

Q10. Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk?

This goes back to the need to redesign services around system requirements rather than equipment capabilities. Such design could embed requirements for robustness and security, which could then be assessed at service acceptance. It also speaks to the need for greater visibility and dynamism, the way to ensure security is by creating positive feedback loops that monitor the impact of services and have the ability to rapidly adjust the response depending in the impact it has.

The current system is driven largely by attempts to predict and design solutions upfront; modern communications allow solutions that embed much more active feedback loops which are likely to be both more resilient and more cost effective if supported appropriately.

Overall the tools for mitigating risk should always be transparent and outline clearly the assessment of system stability has been conducted. Experience in the French and Belgium markets provide some lessons here which resulted in limitations on aggregators' activity due to potential impacts on systems stability. However, the assessment of system stability was not consistent or well understood and therefore restrictions in many instances where set unnecessarily.

System Value Pricing

Summary

- We expect half-hourly settlement to endure, along with the market structure to support it. We do not anticipate a nationwide change to this structure, whether driven by regulation or markets or both.

[6] Commission De Regulation De L'energie, 2013
Délibération de la Commission de régulation de l'énergie du 22 novembre 2013 portant orientations s'agissant des règles relatives au mécanisme d'ajustement et de l'accord de rattachement du responsable d'équilibre des sites de consommation participant à l'effacement

- In order to achieve greater energy flexibility, all stakeholders need to determine together what additional processes can sit alongside 30 minutes settlements in the wholesale market to support energy flexibility.
- A clear definition and standardising of flexibility services would permit those providing and using such services to better quantify and compare the merits of competing services and technologies
- To make flexibility of the electricity system easy to access and use, data needs to be available in near-real time. Tariffs and the system that takes advantage of them can be thought of as a multi-level control hierarchy consisting of (in diminishing size) the central monitoring and service despatch; a community energy system and microgrid; a home energy management system; and a smart appliance.
- The Smart Meter communications architecture was not designed for mass real time communications, and is therefore limited to what it can deliver in the context of supporting energy flexibility. Services that respond in near-real time to changing network demand need a supporting real time communications channel.

Q11. What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?

The three types of enablers that will best facilitate consumer use of the energy system's flexibility and maximise consumer and network benefits are well summarised by the rest of this consultation. We agree that the enablers (Half-hourly Settlement, Smart tariffs & Smart Distribution / Transmission pricing) would each help achieve benefits from offering flexibility. We expect increased resolution of settlement and tariff flexibility (i.e. the ability to change dynamic tariffs more frequently than twice an hour) to be part of the system when technology and market conditions allow. Likewise, distribution and transmission pricing alone will not fully deliver flexibility. This suggests that mechanisms beyond these will eventually need to be developed.

The flip side of this is complexity. Many consumers struggle to understand their current energy bills, so opening up all these tariffs and costs will be challenging to most consumers. This is another key role for aggregators, and firmly suggests that the aggregator role should be kept separate from either the energy supplier (responsible for tariffs) or the DNO/DSO/TSO (responsible for distribution and other use of system costs). The aggregator can be the trusted intermediary helping the consumer manage all these costs, with no incentive to favour one over the other.

A clear definition and standardising of all flexibility services would permit those providing and using flexibility services to better quantify and compare the merits of competing flexibility services and technologies.

BEAMA agrees that a mandatory standard settlement time will make it easier for utilities to help consumers use electricity when it is cheapest, and will also facilitate energy trading. Retaining this standard settlement time at 30 minutes is a sensible and realistic choice today. Secondly, smart retail tariffs and smart distribution tariffs will enable consumers and utilities to respond to price signals, and receive the financial benefits of doing so. The importance of this will only increase with the proportion of renewable

energy in the mix, especially those forms of renewable generation that rely on solar and wind.

To make flexibility of the electricity system easy to access and use, the data needs to be available in near-real time. Tariffs and the system that takes advantage of them can be thought of as a multi-level control hierarchy consisting of (in diminishing size) the central monitoring and service despatch; a community energy system and microgrid; a home energy management system; and a smart appliance.

The emphasis should be on opening up data, not on creating complex rules. Especially in a time of rapid change, it is data and visibility that is required, at least until the best solutions become clearer.

We would also encourage the Government not to neglect the importance of smart tariffs in managing the gas network.

Q12. If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so?

On the issue of contracted flexibility, the ability to stack revenues is fundamental. Two things make this difficult to achieve: firstly, a lack of clarity in service definitions, and secondly, an assumption by some market layers that they must have exclusive access to an asset rather than a willingness to buy capabilities on an open market.

The ability to combine revenue streams is vital, and work needs to be done to identify and remove barriers and to ensure that contracts for differing services are aligned and do not exclude other services where it may be technically feasible to deliver multiple services from a single asset.

Other barriers include not being able to access revenue streams. Attractive revenue streams include: Energy Arbitrage, Capacity Payments, System Ancillary Services and Network Investment Deferral and Congestion Management. The main barriers in preventing the realisation of these revenue streams (individually or combined) may be regulatory or may be the lack of a market specific to the use of small-scale domestic storage technologies.

Q13. If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits?

There are currently very few Time of Use (ToU) tariffs available to electricity consumers, and even fewer opportunities for consumers to take advantage of dynamic ToU tariff changes. Thus, any plans to deliver flexibility are hampered by the fact that the system is not set up to value it. This applies to services to manage energy consumption by

responding to tariff changes, as well as products that facilitate flexible and responsive energy use.

It should be noted here that potential for dynamic ToU tariff changes that can exploit DSR technologies such as energy storage, will remain limited until systems are developed that allow for the exploitation (monetarisation) of such services, within timeframes that are much shorter than the normal 30 minute settlement period.

The ability to provide flexibility on the low voltage distribution network is currently not remunerated. Flexibility at this level can prevent disturbance from variations in distributed generation from filtering up on to higher voltage networks.

Speed of response is a key benefit of storage and this is not effectively valued in current arrangements. A smaller asset responding very quickly can provide the same benefit as a much larger traditional asset. This is effectively not priced today, except in the EFR contracts (which were significantly undervalued).

Q14. 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?

The most important changes to the system that will allow the efficient use of flexibility are:

- Dynamic time of use tariffs that incentivise consumers to concentrate their energy use to times when it is plentiful and reduce consumption when it is scarce or expensive to provide; and that facilitate more efficient grid management;
- The provision of relevant real-time data so that consumers, through a combination of automated and direct controls, can take advantage of the above-mentioned dynamic tariffs
- Technology, market development and regulation that will augment the 30 minute electricity wholesale market pricing mechanisms, which can in turn value the benefit of aggregated DSR deployed in the network (e.g. residential energy storage) to deliver true energy flexibility. Consumers will want access to technologies or methodologies for getting power when they want it. Central pricing to manage usage may either be too blunt or seem to be a means of raising the price of energy for no value to the consumer.

Smart Tariffs

Summary

- Smart tariffs incentivise consumers to use, store and export electricity at times that are most beneficial or least costly to the system. ToU tariffs are the most important and most visible expression of smart energy network management. However, the questions expressed here need to be considered in the light of

Half-Hourly Settlement, and the Government's view that this is an essential foundational and enabling step for smart energy management.

Q15. To what extent do you believe Government and Ofgem should play a role in promoting smart tariffs or enabling new business models in this area? Please provide a rationale for your answer, and, if you feel Government and Ofgem should play a role, examples of the sort of interventions which might be helpful.

BEAMA agree that smart tariffs, especially Time of Use (ToU) will be critical to gain momentum in smaller commercial and residential consumer properties.

As commercial organisations suppliers will always look to maximise the margin between wholesale cost and retail selling price, taking into account day-ahead trading and, particularly, settlement imbalance risk. The potential cost of imbalance, and the risk element of this within total bill breakdown, should not be underestimated. Suppliers manage this risk through diversity, and therefore predictable behaviour of consumers is important to reducing costs. Unless the new large volumes of real time data are managed effectively, one impact of smart tariffs will be a more dynamic but therefore less predictable consumption pattern. Therefore, if left unchecked smart tariffs may be priced relatively high and suffer from low uptake. The sensible and innovative management of energy data could facilitate both predictability and, more importantly, finely-tuned control of consumption. That would almost certainly outweigh the negative impact of more dynamic consumption patterns: there should be a significant net benefit to the system and to most stakeholders. We expect the best and most cost-effective solutions to become clearer as stakeholders progress from their current minimalist approach and more fully exploit the possibilities.

There is a risk that any regulation aimed at mitigating the risk of less predictable consumption patterns will lock in these minimalist approaches, restricting the emergence of new approaches and business models that fully exploit the capabilities that smarter grids might offer.

Therefore, a role that Government and Ofgem can play is to make adjustments to wholesale markets to create opportunities for suppliers to reduce their wholesale costs through the use of smart tariffs. An example is to look at the role of bilateral arrangements, intra-day markets and gate close, and the impacts of these on suppliers' possible wholesale costs, and how adjustments may favour a more flexible system.

The approach proposed in the Call for Evidence is generally positive and will enable more flexibility and innovation. Half-hourly settlement will be a necessity if we are to trade energy with Europe, so with or without an exit from the European Union, the UK should make it mandatory. However, moves to standardise 15-minute settlement should be resisted. Currently, smart gas meters' communications functions normally sit idle (to save on battery life) and only wake up every 30 minutes to transmit a reading; also, most consumer access devices only hold half-hourly data for the required 13-month period. To require either to support quarter-hourly data would have significant and unworkable consequences for the battery and memory specifications of these devices. Currently all device specifications are designed to allow for half-hourly settlement. Changing this would be a serious mistake. However, this warning applies only to residential metering; although roughly only 10% of volume consumed, commercial and industrial energy

accounts for a significantly larger proportion of total traded energy, and it would be easier to change commercial and industrial advanced meters to allow for quarter-hourly settlement.

BEAMA members would like to be involved in discussions to decide what constitutes a "reasonable tariff structure". For example, settling every half hour may be easier than accommodating a tariff change 48 times a day. Supporting a tariff change every half hour may put unsustainable pressure on devices or on the system. If the Government wishes to allow that amount of flexibility, it should be prepared to support the testing of this function in the end-to-end smart metering system.

Finally, on a general point about the benefits of the proposed changes. There are many millions of pounds levied in fines and charges due to imbalances between generation and consumption. A fine on a utility generally finds its way through the system to being a charge on the consumer. So, any likely or actual reduction in balancing and settlement fines that accrue from the improved network management enabled by smart metering should ultimately be seen as a consumer benefit.

BEAMA's position is that it is better to allow the market to drive itself, if possible, rather than having unnecessary government intervention. If the market is able to drive itself, it is likely that it will be less distorted, will yield more innovative business models and will therefore work better and be more sustainable. However, in the situation where the market is not able to drive itself due to legal or regulatory barriers, Government and Ofgem should take action to remove these barriers and support the development of new markets. Furthermore, Government intervention may be needed to support the development and deployment of new technologies and to enable a diversity of business models which will ultimately benefit the consumer.

Q16. 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 relevant trigger point is the availability of technology that enables energy consumers to take advantage of system flexibility. The Government and Ofgem should liaise with industry so that the relevant regulatory or policy actions are in place in time to take effect when they are needed. Anticipating the availability of the technology is better than waiting until the technology is well-established, as by then it may well be too late.

If there is a proven economic and social benefit from implementing smart tariffs in a certain area and all the stakeholders involved are committed and invested, but for some reason the market cannot start or drive itself, then Government /Ofgem should take action. A good example of this was the National Grid EFR tender in Spring / Summer 2016 which was a result of the market (grid scale batteries / energy storage providers) asking for the opportunity to be remunerated and enter into the market. More initiatives like this are necessary in order to avoid the situation where industry / electricity suppliers who have invested a lot in the area of storage / flexibility / connected home stop investing due to no return on investment.

Q17. What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs?

No response.

Q18. Do you recognise the reasons we have identified for why suppliers may not offer or why larger non-domestic consumers may not take up, smart tariffs? If so, please provide details, especially if you have experienced them. Have we missed any?

We recognise the reasons identified and agree that a slow offering and take-up of smart tariffs could result from a level of uncertainty and risk for the suppliers and larger non-domestic users. Also, the complexity of benefiting from smart tariffs whilst still maintaining the operating efficiency for the organisation may dissuade some organisation from taking up smart tariffs.

Providing price signals for flexibility

Summary

- The exiting charging structure does not provide the signals needed to support full DSR, especially in the residential sector.
- The introduction of an individual supply point capacity charge would be a short term step to encourage DSR.
- In the medium to longer term, a full revision of the charging mechanism is needed to support a fully functional DSR and DG market.
- Work is needed to understand true network costs so that assets can be charged according to their costs and benefits without one-off settlements for each.
- Government policy should as far as possible be technology neutral. A well designed flexibility market should allow all technologies to compete in a transparent fashion.
- The design of such a charging mechanism for the distribution system is not yet understood and urgently needs analysis and trialling. Technical feasibility, commercial viability; consumer acceptance and protection must all be balanced.

Q19 - 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.

The current residential distribution charging arrangement provides little incentive for domestic customers to manage their consumption/generation. Economy 7 and similar tariffs exist but, with the general reduction in off-peak electric space and water heating, there is little customer benefit from this tariff and Economy 7 (with other off-peak tariffs), now only accounts for 22% of residential electricity usage (Dukes- SUB-NATIONAL ELECTRICITY AND GAS CONSUMPTION STATISTICS Regional, Local Authority, middle and lower layer super output area)

Economy 7 is of little assistance to the DNOs in addressing intermittent supplies as periods of excess and shortage become less predictable over a 24-hour period. The distribution networks, however, remain exposed to the real costs of distribution which are strongly affected by capacity. As the DUoS charge is presently primarily based on the energy volume of the customer, the only way they can affect it is by reducing their demand; not by managing it. It follows that when DNOs invest in their networks to reduce costs they cannot directly share the cost/benefit of this with customers so, in principle it seems clear that the current arrangements act as a barrier.

The creation of a sustainable flexibility market requires that the true network costs are exposed to market forces. Network companies incur capital costs and operational costs in operating their networks and the relative proportion will vary from area to area depending on the situation of the network. Thus identifying the true costs is a complex topic and not open to a simple solution. However, it is this variability that creates a market for flexibility, for example, in some parts of the network, there will be a shortage of capacity and a need for reinforcement, the avoidance of which should create value for the network operator which can, in principle be shared with customers. Getting this correct is key to creating a market for flexibility and should be the subject of in-depth analysis and testing. The view of Imperial College is that the DNO will identify the avoided cost of reinforcement in specific cases and then this value can be offered to the consumer via DSR products. This reinforces the need for a DSO planning department to assess the options and raises a number of Regulatory questions such as how long a given avoided cost should be rewarded.

The recent changes to the way DUoS charges are to be calculated reduces the delta between the red zone and amber/green zones and will weaken the financial model for HH metered customers looking to shift TOU to reduce grid access charges. See https://www.ofgem.gov.uk/publications-and-updates/distribution-connection-and-use-system-agreement-dcp228-revenue-matching-cdcm-0 . This will weaken the drivers for DSR.

TNUoS charges (triads) are also under review which could further erode the case. Network charging methodology needs review and the industry needs certainty about grid access charges (distribution & transmission) in order to build a robust business case. The current uncertainty is very damaging. The view of BEAMA is that the current charging structure is very far from what will be required for a functional DSO and both TNUoS and DNUoS should be subjected to a fundamental review to provide a properly transparent basis for network charging and the confidence necessary to invest in this area.

Q20 - What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility?

The cost of a power network is to a significant extent determined by the maximum capacity that it has to carry. The most immediate change to DUoS charges would be to introduce a capacity element into the DUoS charge. This will depend on smart metering as existing meters cannot measure demand. This will make customers recognise the cost

related to their use of the network and facilitate a progression to fully flexible tariffs. Note that UK smart metering as set out in SMETS V1.59[7] measures maximum demand but that this is the calculated as the average consumption for any half hour period. Thus, for half hourly, time of use billing, capacity and volume charging become the same.

For the period until ToU charging is available, domestic customers who have been supplied with smart meters could be offered a capacity element in their bill to encourage them to minimise their maximum demand. However, it is not clear that this would be effective in the absence of proper price signals. A measure that risks smart meter customers identifying their meters with higher bills would be very undesirable so it could be argued that capacity charging should be delayed until all the necessary elements are present:

- SMETS metering
- Advance information on higher cost capacity periods
- The option of a tariff that rewards reduction of maximum demand

Q21 - 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.

It is tempting to see a self-generator customer as somehow different to a 'normal' customer. They are consuming the same energy as previously but making less contribution to network costs as they are purchasing less energy. It might follow that they should make an extra contribution for the availability of the network they are not using. However, this would be an undesirable move. The development of a flexible network demands that customers are treated equally depending on their use of the system as price signals will not be effective if they are distorted; if a customer uses the network less, then they should pay less DUoS. It does follow that their DUoS charges should be based on their demand capacity rather than volume but this would apply to all customers, not just those who are self-generating. It does follow from this that the cost of providing the power network will be spread across a smaller energy volume so that remaining customers will face higher DUoS, but this will put financial pressure on the networks to innovate and on all customers to engage in the DSR market.

Further to our answer to Question 19, being able to properly charge any connected asset for its access to capacity and volume requires a fundamental study. Charging should not be technology specific and used to promote or penalise a given type of load/generator. So long as the charging structure is well designed then any type of asset will make payments and/or receive rewards as appropriate and provide a clear market opportunity for innovative solutions. This topic is beyond current practice and there is little evidence to direct us other than a clear need for further analysis and development.

[7] Smart Metering Equipment Technical Specifications (SMETS), Version 1.59, 18 November 2015

Smart distribution tariffs: Fundamental change

Q22 - 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?

Firstly, we must set out how we expect the networks to evolve. A major purpose of making networks smart and rewarding flexibility is to increase the utilisation of the network; that is to say, delivering greater volume for a given capacity; which in practice results in avoided network reinforcement. Capacity will become increasing import in charging and also the need to reward customers via DSR for the avoided costs of deferred reinforcement. This implies that, as networks evolve, the charges should shift towards a volume basis and away from capacity but that at all times DUoS charges should involve elements of both volume and capacity. In line with the analysis of Imperial College for P2/6[8] looking at the actual value of lost customer kWh, it is also possible that customers might be given a choice over the level of reliability they accept, although this would introduce significant issues around fuel poverty; would the fuel poor be put under price pressure to accept a less reliable service?

A key question for OFGEM will be developing appropriate new KPIs that will reflect this developing world and that will drive the DNO's capital investment. For instance, there could be a deemed cost for meeting reinforcement that DNOs could seek to underspend by innovative approaches.

BEAMA members are strongly of the view that any change in charging approaches are clear and transparent so that they are able to understand the direction of travel as this dictates their product development and manufacturing plans.

Q23 - Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how?

Longer term investment depends on a degree of confidence in the future. This does not necessarily require guaranteed returns but confidence that market conditions in the future will largely be as expected. An advantage of more cost reflective DUoS charging is that it should direct investment to areas of most need. It follows that any charging arrangements are kept stable and reflect fundamental network and market realities. Even for short term price signals, these should be available before the event. Customers must be able to take action beforehand to minimise their costs. How short term these signals are, will probably depend on the level of automation of the response.

Q24 - In the context of the DSO transition and the models set out in Chapter 5 we would be interested to understand your views of the interaction between potential distribution charges and this thinking

[8] Review of Distribution Network Security Standards, Extended Report, March 2015, Imperial College, London.

The DS2030 project[9] identified that, assuming high levels of load growth, then DSR would only delay reinforcement for 4-5 years, not stop it altogether. It is not obvious how a DSR business could be based on such a short-term market, would it be worth their while in establishing a business that is facing imminent redundancy? It follows that DSR should be designed so that it can be rewarded in multiple markets either simultaneously or sequentially. There will also be questions about how local a DSR scheme or balancing market should be - for the entire DSO region or for a specific area? If it is too broad an area it may fail to address a specific constraint, if too narrow it may be impossible to operate an effective market.

Other Government Policies

Q25 - Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future?

The creation of a smart energy future will be a major challenge and involve a degree of collaboration across government, network companies and other stakeholders that is unprecedented. BEAMA is working with other Trade Associations to create an alliance that provides this collaboration and recommends that BEIS and OFGEM engage with this and looks to create other similar forums covering the whole sector..

Q26 - What changes to CM application/verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions within/alongside the CM might be needed to enable newer forms of flexibility (such as storage and DSR) to contribute in light of future smart system developments?

A key requirement will be to enable revenue stacking: when assets aren't required to deliver capacity, then they must be allowed to deliver other services. This will maximise revenue for any given asset, and hence reduces capacity costs in CM. It will also provide more financial security for assets that can earn from multiple markets.

Q27 - Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on a smart system?

No response from BEAMA. It should be noted, however, that this is an area at the boundary of current practice and it is unlikely that there is much evidence for the most forward looking options and BEIS should avoid entrenching current practice as the basis of a future energy system.

[9] DS2030 - STUDY INTO THE 2030, DISTRIBUTION SYSTEM FOR, WORK STREAM 7, Stage 6, Parsons Brinkerhoff, 287583A, Final

Smart Appliances

Summary

- The industry needs an agreed definition of all elements of 'smart' that contribute to flexibility. Recognising not all appliances can provide all functions of flexibility, we need to define the smart elements of flexibility in order to classify appliances. This would be the basis of any market led label for smart appliances - as defined by their ability to deliver flexibility.
- We need to get the market design right first before we can regulate an offering for consumers through the appliance market. The development of smart appliances should be driven through developing the appropriate value proposition through market design, not by enforcing functionality on consumers before they can extract that value.
- To fully answer the questions being asked in this section considerable work is required to define the market and technical requirements for smart appliances. We have only touched the surface of this topic in our answer and invite Government to work with BEAMA to develop this further.
- Interoperability should not be forced through regulation but driven by the market and standardisation work.
- When this work is complete and the value for consumers understood BEAMA would support the development of labelling for smart appliances ensuring consumers can appropriately engage with the flexibility market.

Q28. Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)?

It is important to note at the start of this section that BEAMA have framed all our answers around the definition of smart appliances based on flexibility only, i.e. the functionality to enable an appliance to respond to the grid and external signals for load management (turn up/turn down). We therefore do not consider herein, the additional range of 'smart' functionality some appliances can offer including the links to convenience or Assisted Living Services which are a highly important market today driving a lot of standardisation work in this area.

BEAMA believe that three of these are principles for the operation of smart appliances and in that context are agreeable. However, we are of the opinion that energy consumption is less of a significant concern and does not warrant classification in the 4 key principles, and we have expanded on this below.

Energy Consumption

We agree that interoperability, data privacy and grid security are key principles for smart appliances to meet. However, we believe energy consumption to be a negligible

principle in the context of what we are aiming to achieve. The range of technologies considered in this review are all very different and therefore will require different mechanisms to enable flexibility. The functionality they are required to deliver will also determine this and therefore any additional energy consumption. However, our members believe that in all known use-cases today this is negligible, and considering a market for smart appliances in the future driven by a standard value proposition, this would never be significant enough to override the customer and system benefits of smart appliances.

Some work has been conducted to review this as part of the Eco Design Preparatory Study for smart appliances. BEAMA have some concerns regarding this review overall and how thorough this has been, especially in reviewing the different requirements for the range of smart appliances we are considering. However, this is the only review known of in the market that looks at additional energy consumption of smart technologies. This work concludes '*the surplus consumption is considered to be negligible*[10]'. We agree with the point that '*the end-user should be compensated for this surplus energy consumption with an acceptable margin that still lies within the surplus added value of providing the extra flexibility'*. Therefore this, all be it likely small consumption difference would be considered in the value proposition to the customer.

Interoperability

With regards to interoperability, yes this is a key principle, and BEAMA agree we need open standards to ensure customers are not locked into products by one manufacturer. We would like to ensure BEIS and Industry are defining what they term as open standards correctly. In this context within the principles outlined in the call for evidence when we refer to 'open standards' we are agreeing these are standards that ensure interoperability and data exchange across different products potentially using different communication protocols and methods of communication. This interoperability will be achieved through standard data formats.

BEAMA's connected homes group have conducted some work to agree the industry view on how the market for interoperable standards should develop[11]. There is a lot of work already ongoing in Europe to develop standards for connected devices in homes (E.g. CEN CENELEC TC 205). A lot of this standardisation work will achieve common data objects and use-cases to be applied by the range of technologies on the market, thereby ensuring interoperability of devices.

BEAMA supports the need to ensure open standards in the Consumer Home area Network as a means to achieving interoperability and ensuring we do not lock consumers into one technology. BEAMA members acknowledge that very few consumers purchase devices and appliances form the same manufacturer and therefore, in maintaining open standards we will ensure the interoperability and inter-changeability of devices and appliances in the home. We therefore do not need to mandate the communication infrastructure in the C-HAN.

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[10] http://www.eco-smartappliances.eu/Pages/documents.aspx Eco Design Preparatory Study Task 6 report

[11] http://www.beama.org.uk/resourceLibrary/the-beama-connected-homes-demonstration---beyond-smart-metering.html BEAMA, Beyond Smart metering, 2015

Interoperability doesn't require legislation to force developers to use one or another open standards.

Q29. What evidence do you have in favour of or against any of the options set out to incentivise/ensure that these principles are followed? Please select below which options you would like to submit evidence for, specify if these relate to a particular sector(s), and use the text box/attachments to provide your evidence.

- Option A: Smart appliance labelling -
- Option B: Regulate smart appliances - *This may be required for the EV charging market*
- Option C: Require appliances to be smart
- Other/none of the above (please explain why)

BEAMA have been closely involved in the UK contribution of work for the Eco Design Preparatory Study for Smart Appliances. The work undertaken here directly links to the answer for this question and it is important UK government considers the breadth of European work to develop standards and products regulation in this sector. Regardless of whether the UK is in or out of the EU, manufacturers in the UK will always be part of an international market and we need to conform to product regulations set at a European level.

The Eco Design work specifically looked at the functionality required for Demand Side Flexibility (DSF), and in the context of this question and the definition of 'smart appliance' BEAMA's answer here considers 'smart' as the ability of a device to shift load in response to a price signal or direct control.

BEAMA members agree that Option A, B or C may be suitable for different smart appliances in the future. But in today's market it is not feasible to support one or the other for the following reasons which we will expand on:

- Insufficient information exists on the value for consumers to support a labelling scheme. A clear definition is required to understand the call to action on different appliances.
- Without a clear value proposition it is not feasible to introduce any form of product regulation and especially to ban, non-smart appliances from the market which is what we interpret option C indicates.
- Different appliances may in the future benefit from any of the above options. Below we outline the need to further breakdown the list of appliances in Q30 and evaluate their ability to provide flexibility and therefore pass on value to the consumer.
- Different appliances are supplied into the market via different routes, including suppliers, installers, direct consumer purchasing, developers and specifiers. In the future these options may also grow considering the type of companies potentially offering DSR services. This will influence the type of regulatory and policy action.

We therefore feel we aren't being asked the right question for the needs of the market today and the questions being asked in this section are skipping some steps as well as not considering the other mechanisms for driving the market for smart appliances.

What do we need to develop the market for smart appliances?

1. Development of an industry definition for smart flexible appliances

To help tackle the issues listed above, and appropriately evaluate the regulatory requirement for smart appliances and/or labelling, BEAMA members are calling for a clear definition of all elements of 'smart' that contribute to flexibility. Recognising not all appliances can provide all functions of flexibility, we need to define the smart elements of flexibility in order to classify appliances. This would be the basis of any market led label for some appliances - as defined by their ability to deliver flexibility. As part of this definition we need to fully understand the needs of the network/system to evaluate the type of flexibility services appliances will need to provide.

The call to action on appliances from a system perspective also varies, including - ON/ OFF, turn up, turn down and appliance negotiation. Not all appliances are able to deliver all of these applications, across different timescales. This therefore influences the type of flexibility services different appliances can contribute to.

Furthermore this definition needs to determine the value assigned to different services and how this value is passed through the system and to the consumer. Without a clearly articulated and understood value chain it is not possible to determine what we would put on a smart appliance label. We need to get the market design right first before we create the consumer offering.

This is not to say companies are not already developing service offerings based on smart appliances for consumers today, however these are often based on added value not from the flexibility market, but for home comfort or convenience. It is from these products DSR functionality will evolve and many manufactures are already considering this as part of the product designs.

Key to the development of any policy approach is understanding how different appliances operate. BEAMA have worked to expand the list of smart appliances provided in Q30. This list doesn't adequately reflect the range of technologies available to consumers, and importantly the varying levels of flexibility these appliances may be able to provide. Some appliances will arguably add significantly more value to the consumer from a flexibility perspective and therefore we can't assume these should be targeted in the same way (options A, B or C).

Different technologies or combinations of systems in buildings will also be able to provide different levels of flexibility with regards to the timing of the balancing services they may respond to, for example they may be able to provide a real time response, or require half day, or day head notice. Like-wise different consumer types will require different services and appliances if we are to ensure they are able to extract value from the DSR market.

Considerable work is therefore needed to understand the hierarchy of appliances for different applications. Until this work is conducted and a value proposition is developed

in the market for domestic consumers, we should not be considering labelling or regulatory mechanisms. The proposed work to define smart appliances for flexibility would contribute to understanding how you would class appliances by their ability to contribute to flexibility services e.g. you might class appliances 1 – 4 based on the capacity for load shifting and the range of services they can/ or cannot contribute to.

Overall we feel this work would help to refine the customer proposition for smart appliances and build a framework for information to be passed to the consumer.

BEAMA have responded to the Eco Design Preparatory Study on Smart Appliances[12]. We have made this position available to BEIS and hope this is also reviewed alongside our response to this call for evidence.

2. Targeted regulation

At this stage in the market and until we understand the value proposition for customers and other market actors we need to be considering more targeted regulation. Furthermore, we should be selecting the areas that are easy to regulate for, without picking technological winners.

A good example would be the Building Regulations and Part L. This is not targeted or integrated with government policy effectively. Today Part L is driven by energy efficiency and therefore buildings are evaluated by blunt mechanisms to determine energy conservation. The amount of energy that could be conserved and the carbon intensity of energy potentially avoided by DSR is not evaluated or rewarded. Regulation driven by energy efficiency alone could stifle the DSR market and other benefits. We could therefore look at this regulatory framework to drive smart appliances, targeting those solutions most suitable to the building type and customer. This would focus more on creating the volume for flexibility rather than determining exact technologies.

BEAMA have communicated this point to government in the past, specifically relating to the EU heating and cooling strategy. It is vital building regulations and incentives do not result in the phase out of energy storage in buildings. Heating and hot water currently represents 80% of thermal energy use across EU residential buildings. BEAMA called for a clear strategy from the European Commission for heating and cooling to drive national regulation and policy in this area, as we do not see this being effectively supported in the UK[13]. This included a call for a commitment to promote demand response tariff options across the EU by 2025, and a minimum water storage requirement providing up to 50ltrs in all new heat installations in single unit EU residential homes by 2025. Today 52% of homes have a hot water tank in the UK, due to the replacement of system boilers with combi boilers, this number is rapidly declining. Based on the decline in the last 4 years BEAMA have estimated a 1% annual decline in the number of hot water storage tanks in homes across the UK[14], thus significantly reducing our capacity for DSR in the future. In defining minimum storage capacities within regulation we need to be careful this doesn't exclude other technologies, therefore we may need to reference other vectors of storage and associated capacities. For example, thermal stores based on phase change materials

[12] BEAMA response – task 5,6 and & reports - Eco Design preparatory study for Smart Appliances
[13] Heating and Cooling – A pan European Strategy Linking Current Policies to Clear Objectives , BEAMA 2015 www.beama.org.uk
[14] https://www.gov.uk/government/statistics/united-kingdom-housing-energy-fact-file-2013

that could then be used to heat water as required. This would take a similar approach to our answer to Q5 and 6 where we call for a definition that reflects multiple vectors and vector substitution.

In welcoming the new EU Heating and Cooling Strategy last year[15] BEAMA continues to work with our EU trade bodies to ensure this is driven through the principles in the Energy Performance in Buildings Directive. This forms part of the recently published Winter Package by the Commission and BEAMA will respond to this to promote our views on how future regulation should drive both energy efficiency and demand side flexibility. Notably there are two components of the package which we feel go some way to help shape future building regulations, the 'smart building indicator' called for within the Energy performance of Buildings Directive[16] , and 'smart labelling' for appliances called for within the Energy Efficiency Directive.

We therefore call on UK Government to set minimum targets within the building regulations for storage at a national level. This wouldn't pick specific storage technologies but set a capacity target for flexible load in buildings. This would also help shape policy around buildings rather than the products themselves. As an industry we should develop better capabilities to evaluate whole building functionality from a flexibility perspective.

In summary and acknowledging a forthcoming review of UK Building Regulations we make the following recommendations:

- Adoption and development of the concepts set out in the EED and EPBD as part of the EU Winter Package, as a means to encourage and regulate the adoption of demand flexible buildings
- Review policy and regulation for the construction industry and there are two obvious options for consideration:
    - Within the next decade, utilise Part L provisions to encourage A+ rated heating products which ensures regulations remain technology agnostic but encourage greater emphasis on hybrid solutions
    - In the shorter term promote smart infrastructure and flexible heat and ventilation system deployment as a requirement for Garden City development utilising the Accelerated Construction Fund in pre-fabricated construction. BEAMA is working with BEIS to develop a list of potential pre- fabrication service options.
- Align building regulations to government policy for flexibility so they are evaluated on energy conservation and flexibility
- Adopt a buildings and systems approach to reviewing flexibility and smart appliances. We have existing mechanisms we use to evaluate the energy consumption and efficiency of buildings, namely SAP (also under review and consultation at the moment). BEAMA believe it would be possible to create a

[15] http://www.beama.org.uk/news/beama-welcomes-clarity-of-direction-within-new-eu-heating-and-cooling-strategy.html

[16] Proposal for a Directive of the European parliament and of the council amending Directive 2010/31/EU on the energy performance of buildings page 17

'Future Connected Homes Model' to evaluate the flexibility potential of a property. You could also tie in measures for social care and assisted living.

3. Develop regional market mechanisms

BEAMA have been working with our members and other organisations, including the Energy Systems Catapult, to consider the value of regional mechanisms for the rollout of energy services, specifically relating to heat. We have provided with this consultation response an annexed paper titled 'Galvanising the Supply Chain', explaining exactly how we see this approach working. We will be providing follow up evidence on this in February for BEIS, following a workshop with the Energy Systems Catapult on their Smart Systems and Heat programme.

Q 30. Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence:

- Wet appliances (dishwashers, washing machines, washer-dryers, tumble dryers)
- Cold appliances (refrigeration units, freezers)
- Heating, ventilation and air conditioning
- Battery storage systems
- Others (pl ease specify)

BEAMA would like to further break down the list of appliances in this section of the call for evidence. It is not feasible to analyse the evidence to support actions for demand side flexibility based on the list provided. This is because appliances vary considerably in their:

- ability to provide flexibility
- existing regulatory framework and how this is driving energy efficiency measures and additional control mechanisms.
- ability to be automated and therefore their dependence on consumer actions.

We have therefore broken the list down further to include the following:

- Wet Appliances
  - Washing Machines
  - Dishwashers
- Cold Appliances
  - Fridge
  - Freezer
- Electric space heating
  - Storage heaters

- Heat pumps
- Electric Water heating
  - Hot water storage
- Hybrid heating
  - Heat pumps
- Ventilation
- Battery storage
- EV charging

Below we have provided some further detail and evidence on the type of flexibility these appliances could provide and the associated benefits but we do not support any particular policy or regulatory action regarding Q29 to specific appliances, except where it is applicable to existing regulations. We therefore refer to our main recommendation for the development of an industry definition for smart appliances and a clear market proposition for consumers.

It is also important to note this list is not exhaustive and a full review of appliances' capabilities (as per the proposal in Q29) is required to understand the policy and regulatory requirements for this market. With more time available BEAMA could reflect at length on all the categories of appliance referenced above and invite BEIS to engage with BEAMA and our members to do so as the discussion continues following this call for evidence.

In many cases appliances can offer significantly more value when installed as a system. For example, there could be real opportunity from the installation of batteries alongside water storage facilities. These technologies could complement each other in delivering value to the consumer and the energy system. If we regulate at appliance level we may miss the opportunity to evaluate such device interaction. This again comes back to the desire to regulate/drive policy at a building level and develop tailored approaches for customer and building types.

Wet Appliances

Generally such appliances are not constrained to be on at specific times, as long as the function or service they provide is delivered within a specific time frame to meet the consumer's requirements. Thus such appliances can be considered in the context of electrical load which the consumer can be incentivised to move in time, i.e. to low demand periods, by tariff pricing signals provided through customer engagement with smart meters, IHDs and associated time of use tariff regimes. The main consumer engagement barriers are seen as "inconvenient" timing of actuation e.g. during normal sleep period (if device activation is automated) and concern over safety and potential property damage as a result of device malfunction, if a device is actuated when the home or building is not occupied.

Electric Space Heating - Storage Heaters

As mentioned in previous sections, behind the meter energy storage solutions should not be over looked in policy / legislation. In particular, we would like to highlight the area of power to heat and small scale thermal storage solutions which we believe is a solution which is currently not given as much attention as it deserves. There are 2.4M electrically heated homes in GB of which 1.8M have electric night storage heaters installed. These have been installed over several decades and many are now approaching the end of their useful life. Assuming a 20-year replacement cycle yields between 90 – 120k homes per year which are replacing existing electric storage heating systems, often with direct electric heating systems. If these systems were to be replaced with the new generation of electric storage heating i.e. Smart Electric Thermal Storage ('SETS'), they can be linked to the grid and used for demand side management. SETS can be used to provide decentralised space heating and hot water, and can act as an energy storage system to provide distributed flexibility to the electricity grid. It can drive down energy bills as a result of up to 20% efficiency gains compared to current night storage heaters. Its demand side management functionality also brings flexibility to the energy system by storing heat from renewable electricity generated at times of high supply and low demand. SETS is fully controllable and designed for integration into smart grid control systems. It can contribute to accommodating the increasing penetration of renewable resources in GB.

Electric water heating - hot water storage

There is a legacy of properties that have water cylinders (in airing cupboards) and boilers (in kitchens), and the move towards installing combi boilers means that the simple water cylinder which could have been independently heated, for example by adding a direct element and linked to a smart tariff, is disappearing from the market. This means that a huge potential 'battery' of water that needs heating 365 days of the year is being made less accessible. The storage water heater market has seen a steady, gradual decline (1% per annum) losing the potential for domestic level energy storage in the form of hot water. This decline is predominantly driven by a lack of Government policy. Targeted legislation and policy needs to be put in place to halt this decline and ensure better use of existing storage capacities within buildings.

This is a readily available, affordable and relatively widely used technology that could be easily adapted for smart grid control. Control systems already exist to provide this function and have been demonstrated in small scale field trials. However, hot water storage products are not routinely supplied "smart grid enabled" at present, mainly due to lack of market requirement. The infrastructure and incentives for consumers do not exist for the technology, so consumers would be unwilling to pay the additional cost of such controls. The technology will only become mainstream and affordable in the mass market if there is a mechanism that gives consumers lower running costs to incentivise uptake.

Consideration would also need to be given to consumer choice and comfort. A smart gird connected DHW vessel must always give the consumer hot water at times they

want/need it. Acceptance will be low if energy input is always determined by the grid as this may lead to consumers not having enough hot water, or a sufficiently quick recovery time at some periods.

Ventilation

Residential applications offer minimal opportunities for demand side flexibility, both in terms of the current scale of GB deployment and the typical electrical load presented by the devices. However, this is not the case for industrial or large commercial ventilation applications, where the overall installed plant capacity often exceeds the normal operational requirements of the building. Localised (in building) load management interventions to limit the building's maximum demand and/or overall electrical consumption have traditionally been deployed in the commercial / industrial sector and could be included in DSR initiatives either through commercial load management tariffs (if of suitable scale) or through the services of 3rd party aggregators.

Battery Storage

This technology offers perhaps the most opportunity for achieving a flexible energy system. Coupled with a suitable local generator (e.g. photovoltaic roof panels), the excess electricity generated could be stored locally during periods of low energy consumption and delivered back into the buildings electrical systems during periods of high network loading, reducing the peak demand on the local network.

A battery store could also be deployed without supporting local generation and charged using energy available during periods of low network demand e.g. during the night period or when a surplus of renewable energy e.g. from wind farms is available within the local network. In principle this is a similar application to charging thermal stores (hot water or storage heaters) when there is a surplus of generation (at night time or from renewables). The electrical energy could be released during periods of high electricity demand, reducing the strain on the local network. Thus a battery store could be used to provide both turn up and turn down DSR services within a flexible energy system.

Considering the treatment of an existing generation connection (e.g. residential PV panel and inverter), when a home owner is adding a battery store or considering installing an EV charge point. Taken together such "generation" equipment configuration could easily exceed the 16A per phase export current limitation in the G83 Distributed Generation Connection Code. This would have knock on implications for both the consumer and network operator in relation to planning and approvals, increased connection costs and extended timescales for installations. Lack of clarity on these matters has already been identified as a barrier to market for the installation of building energy storage. But any change to the rules here would probably require a change to primary legalisation. Either we pursue this route, or we look to agree a process that simplifies the approval and installation procedure with the ENA and their members. If changes are to be made to the Electricity Act (options 1-d in point 38), this could open further opportunities for changes in this primary legislation in the context of building energy storage. This would be significant action and may take some time, therefore in this short term we should pursue

clarity on the process with ENA to enable the market for building energy storage to develop.

Further to this, it may be feasible to agree a process of notification and installation with the network companies that ensures the 16A per phase limit is not exceeded. This could involve some form of load limitation, or functional requirements. But we believe there may be options worth considering for storage providers to ensure they are not phased with unnecessary barriers. This is especially true if a storage device is seen to benefit the local network. This therefore refers to a key principle in our overall response - that regulation and policy should not focus on the assessment of asset type, but the effect and potential benefit this asset may have to the overall system, and therefore the services they provide.

Hybrid Heating & Heat Pumps

The Government has recognised the important role that heat pumps will play in ensuring a decarbonised and flexible energy system in the future. Incentives are in place, focused primarily off the gas network. Future growth in heat pump technology will spread to gas serviced regions through hybrid technology which also offers a suitable solution for very cold areas of the UK where a combination system is best deployed to cope with extremes of temperature. Hybrid technology not only offers CO_2 emission reduction potential versus combustion boiler technology (up to 35%. Source: Daikin Group), but it also offers switchable demand opportunities in which the heat pump can be switched off or throttled back to reduce power consumption. This technology is available on the market today but requires support for growth through appropriate recognition in the Government's national calculation models (SAP and SBEM) and a high efficiency heating system rating approach to building regulations (i.e. pushing for very high efficiency appliances via the energy labelling mechanism). BEAMA advises BEIS and Ofgem to closely monitor the Smart Communities Project in Greater Manchester which is assessing the dynamic operation potential for hybrid technology through installing units in 600 dwellings; an emphasis of the project will be made towards electricity aggregation, trading opportunities and load balancing. Such an approach will require clustering of deployment which again lends itself to the regional heat model mentioned earlier and covered in the annex of our published response.

Daikin, members of the BEAMA connected homes group, are already designing interfaces for hybrid heat pump systems that can allow customers to 'opt-in' or 'opt-out' of each Demand response event. Customers' choice as top priority over demand response actions

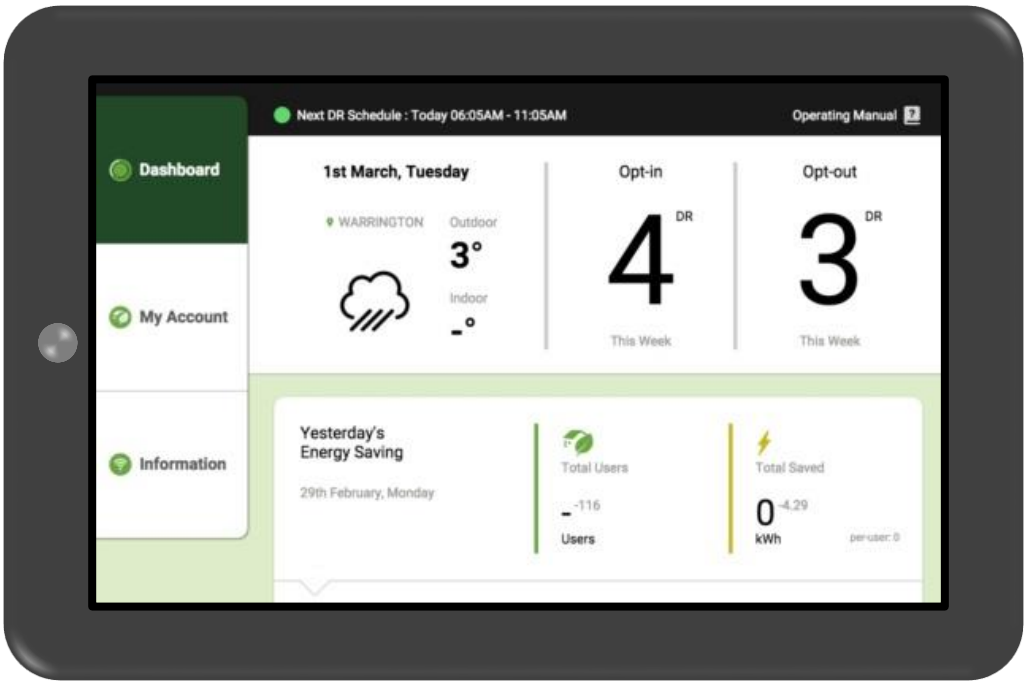

Fig 1 - Visual display for Daikin Hybrid heat pump interface - showing number of 'opt in', 'opt out' DSR events chosen by the customer.

EV Charging

Although EV charging is included in the following section of the call for evidence we feel this needs to be reviewed along with all other smart appliances. While at a functional level demand side flexibility may be delivered in very different ways by the appliances listed above, in our view the market mechanisms by which we potentially manage the loads from the above must be reviewed for all. We are currently being consulted separately on Smart EV charging options. This consultation on managed EV charging has been managed by EA technology as a continuation of the My Electric Avenue Project, and delivered on behalf of a consortium on government, industry, utility and consumer stakeholders. BEAMA are part of this consortium to try and ensure the wider market factors for smart appliances such as this consultation, Eco Design and the standardisation work we are engaged with in Europe are appropriately considered. With therefore believe it would not be suitable to develop a specifically separate control mechanism for EV charging. In developing control mechanisms for smart appliances we must look at how this may be delivered for all. In evolving separate approaches we will stunt the DSR market.

Further evidence

BEAMA members do a lot of their own monitoring and testing of different approaches to reduce peak demand and manage system stability.

Here we provide one example from Green Energy Options, a member of the BEAMA Connected Homes group, which helps to explain the need for rational building design from a systems perspective and the value of storage.

Evidence provided from a study of several thousand homes, reviewed on the basis of a 200 home estate with full integration of EV charging (worst case scenario):

- Using today's average consumption of 11KWh/home/day the estate's peak demand would be 144KW.
- Adding solar generation makes no difference to this peak between September and March
- Adding a worst-case scenario with all homes using an electric vehicle and no demand management the peak demand increases to 217KW and the average consumption rises to 20KWh/home/day
- Adding in-home demand management using 16KWh of behind-the-meter energy storage flattens the peak demand to 74KW – half the original peak leaving plenty of scope to add electric heating
- Applying implicit demand management[1] using off-peak tariffs we can demonstrate how such a home's annual energy bill could be halved.

Furthermore, the only changes to the electricity system needed to achieve this is the introduction of smart meters (underway), the introduction of smart tariffs (being trialled by some Retailers) and half hourly settlement for such estates. Such a solution delivers significant benefits to the local network *and* the consumer.

Such an approach would be in-step with the developing European approach to demand management as laid out in the recent Winter Package. Two components of this package are the 'Smart Building Indicator' called for by the Energy Performance of Buildings Directive[17] and 'Smart Labelling' for appliances called for by the Energy Efficiency Directive. The Smart Energy Demand Coalition is recommending that this becomes an "active" building/appliance certificate that defines the active demand capacity of a building or appliance in terms of kWp and kWh. This would complement the passive energy efficiency certificates.

Thus, a starting point would be to address the new build market now, encourage "active" demand management technology to be built into new homes and follow best practice

[1] Demand Management is increasingly categorised as implicit and explicit: i.e. non-contracted and contracted. Implicit DM requires load signals to be passed to the consumer, often in terms of tariffs, the role of an energy retailer whilst explicit DM requires a contractual relationship with the consumer, the role of the Aggregator (which could be a Retailer).

[17] Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2010/31/EU on the energy performance of buildings page 17:
6. The Commission is empowered to adopt delegated acts in accordance with Article 23 supplementing this Directive with a definition of 'smartness indicator' and with the conditions under which the 'smartness indicator' would be provided as additional information to prospective new tenants or buyers.
The smartness indicator shall cover flexibility features, enhanced functionalities and capabilities resulting from more interconnected and built-in intelligent devices being integrated into the conventional technical building systems. The features shall enhance the ability of occupants and the building itself to react to comfort or operational requirements, take part in demand response and contribute to the optimum, smooth and safe operation of the various energy systems and district infrastructures to which the building is connected.';

from the automotive industry with a combination of regulation, tax incentives and purchase schemes.

Q31. Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified?

The lack of clarity or certainty of how products may interact with the smart grid and the services they will need to deliver could be holding back development of such products. As previously stated we need a clear market design and understood value proposition for the market for smart appliances to develop.

There currently exists a conflict in the understanding of a "smart" water heating product. Under ErP legislation electrically heated water heaters can employ a "smart" function to optimise the energy input to a water heater as a means to providing a higher efficiency when measured against the ErP defined tapping profiles. Such controls and the probable on/off heating periods are likely to conflict with when excess generation and hence demand side control is required; so a "smart" product in ErP terms may not necessarily be "smart grid" ready or controllable. Currently under ErP there is no recognition of smart grid controlled or enabled products or any benefit assigned to such products. Without "smart" product control many of today's storage water heaters are unlikely to meet the minimum energy labelling threshold that comes into force in September 2017, i.e. Band C. So products best suited for grid control (i.e. without smart product control) will disappear from the market. In the short term the driver for manufacturers of such products is ErP compliance so that their products can remain on the market beyond Sept '17. When talking about 'smart' devices and appliances we therefore need to be clear how we define smarts. In the context of this call for evidence we are considering 'smart' relating to flexibility services. The example above shows how the term smart is already being used in product legislation and how this may conflict with requirements for flexibility.

In a number of cases the installation of low carbon energy technologies and smart devices in buildings is limited today by the installation process. As referred to in our answer to Q30 for batteries, an existing barrier today is the connection and approvals process with the DNO according to G59 and G83 rules.

Furthermore BEAMA is leading an area of work to engage with our members and the installation community to develop the skills and training modules for connected devices in the home. This acknowledges the lack of standardised skill sets for networked devices in the market. BEAMA invite BEIS to engage with this work and are happy to share further details.

Additional question - asked by BEIS directly to BEAMA members - Is it feasible to evaluate the additional cost of 'smart' functionality for appliances?

BEIS have asked BEAMA for more information on additional costs for smart appliances. This includes the additional functionality to enable demand side flexibility. Some work has been done as part of the Eco Design preparatory study for smart appliances to evaluate the potential costs for DSF functionality of different appliances. However,

BEAMA believe that this work is not very comprehensive and should not be taken as a true reflection of the UK and EU market for smart appliances.

This is a difficult question and the cost of additional functionality will vary depending on how the market is being driven. For example a regulated requirement versus a market led initiative. In a regulated market it is more likely these costs may be higher depending on the way in which a specific product regulation is administered and policed. Costs will also depend on the volumes produced of some of the higher value products. Of course this will also be technology dependant. For some appliances the functionality required may be easier to achieve than others, and also may already be in the market place today.

Furthermore, here we also need to consider what we term as 'smart'. For the purposes of this consultation BEAMA maintain that this is the additionally functionality to enable Demand Side Flexibility. However, Smart can also be to enable other services, assisted living, comfort and energy. If BEIS are looking to develop policy for smart appliances and understand the Cost Benefit Analysis for smart appliances a full market study will be required. The way to do this would be to base it on industry costs and select the technologies available on the market today. The costs will need to be explored against a range of potential service propositions, also considering wider applications for assisted living services etc.

TSO/DNO requirements for metering, frequency measurement, etc, currently drive a lot of extra costs for DSR, both in terms of the hardware that must be installed and in terms of the testing which must be done. For example, the requirement for frequency to be measured locally at each device, and that each site must be tested (rather than class approval for specific classes of equipment) is inherited from the time that services were provided by large generation plant. The desired effect (accurate measurement of frequency, even in the face of islanding of portions of the grid) could be achieved by alternative and much cheaper solutions. This would help contain the cost of DSR-enabled appliances and hence support their wider roll out.

Q32. Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers?

Ultra-Low Emission Vehicles in a Smart Energy System

Summary

- Home EV charging is highly suitable for DSM interventions when coupled with consumer controlled parameters, equipment is commercially available today to perform these functions.

- The difficult part is creating the right market conditions to encourage consumers to install and use smart functionality. Two elements are vital in achieving this in the long term:

- Ensuring that the systems themselves are part of a unified smart technology sphere developed in conjunction with other products by industry standards bodies for interoperability (i.e. government might set goals but not the specific standards of how to achieve them).
- EV smart charging must be an integrated part of the domestic DSR market mechanism and not dealt with separately –this would be bad for EVs and harm progress in the rest of the market.

- V2H and V2G are again technically feasible and available today and may in the future serve a useful purpose but may be overtaken but other solutions such as static battery storage. Timely development of such systems would be enhanced by clearer understanding across different industries of the detailed nature of the need and the rewards for meeting it.

Q33. How might Government and industry best engage electric vehicle users to promote smart charging for system benefits?

It's not clear how the home chargepoint market will develop once government grants are withdrawn, but until smart appliances become the norm in British homes there may need to be considerable effort to persuade mass-market consumers to opt for, and use, smart functionality in chargepoints.

- When purchasing a vehicle the options are visible, aspirational, emotional; conversely, added features on the chargepoint may be invisible and "uninteresting". Couple this with the cost of a vehicle being up to two orders of magnitude greater and it's not hard to imagine most consumers focusing on the car and overlooking the technicalities of the chargepoint.

- EVs will be a significant part of a household's monthly electricity cost. However, EV purchasers may make the comparison to the running cost of their conventionally fuelled vehicles instead of home appliances. In this respect, EVs seem very cheap even at peak electricity prices so there is a challenge to find a sufficiently appealing package to get the consumer to "compromise on their 24/7 access" as they might see it.

Nevertheless, with the right pricing formula there are positive arguments to be made and it's feasible to show that savings can be made and that the risk of inconvenience to the consumer is extremely low.
There is a role for vehicle manufacturers, dealers, chargepoint suppliers and electricity retailers to provide a consistency of message on the benefits of smart charging, and a supporting role from Government is needed here. Whether a vehicle manufacturer/dealer is involved in the provision of a chargepoint or not they have the initial contact with the consumer and the first conversation with them about charging, so it's important they establish with the consumer that smart charging is a good option. It then needs to be followed up at each stage of the chargepoint sale and installation, and

then by the electricity supplier. Recognised endorsement by government would support the recognition and validity of the message across all these steps.

Other parts of the market are less visible and more difficult to influence e.g. chargepoint sales through wholesalers to individual electricians or from DIY outlets direct to consumers. Education through the ECA, chargepoint manufacturers and broader publicity would help.

Chargepoints and vehicles can readily be supplied capable of smart charging functionality; the bigger challenge is ensuring consumers are convinced they want to use it.

34. What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, network and system operators) to develop consumer propositions for the:

- 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?

BEAMA members already manufacture chargepoints that facilitate smart charging, and the wider standardisation process is well underway through BEAMA, BSI and European agencies. The primary issue for them is not technical but one of demand vs cost. The UK chargepoint market is extremely price-driven at present and does not readily sustain sales of higher quality products with good support and features that ensure longevity.

To create market demand for these more sophisticated products, the electricity pricing regime must be right, but we also need to change the purchaser's valuation criteria.

Whilst remaining very cautious about legislation, BEAMA does recognise there are calls to mandate certain functionality within charging equipment (the capacity to perform smart charging) and some members accept this may be an appropriate approach. This does add considerable cost to equipment so if a mandated approach was to be taken it must be done very thoughtfully, with stated objectives and a very clear roadmap. Interoperability and longevity are vital components and are interlinked. The added investment must be reflected in the quality of the product which needs to be safe, robust, and designed to be future compatible downstream to the vehicle, and upstream to linked DSR equipment. This can only be satisfactorily achieved through the established standards development groups. For that reason, in order to support any Government initiative in this area BEAMA members would insist that EV smart charging does not get isolated from other DSR initiatives, that industry shapes any minimum requirement (should there be one) and that the specification for this develops in harmony with wider standards work. We see EV charging as an integrated part of the smart home and the success of the market for smart EV charging as symbiotic with that for all other smart equipment in the home. Please refer to the section on smart appliances.

The same can be said for V2H and V2G as a technical challenge – i.e. BEAMA members have systems commercially available right now. How the commercial case stands up against the downside of offering access to a vehicles' reserves is far from clear at this stage and both these elements need further consideration for informed comparisons to be made (between V2G and dedicated battery storage for instance).

To identify the best solution, requirements must be defined in more detail:

- How often would an individual vehicle battery be accessed?
- What times of day?
- For how long?
- How much energy would be drained?
- When and how quickly would the network replenish it?

Static storage batteries offer flexibility unconstrained by any of the down-sides of vehicle batteries and may be a more appropriate approach for many of the use scenarios that may arise. However for some scenarios, accessing the batteries of hundreds of thousands of EVs in people's homes could be a very workable solution if the economics work, so no policy action should discourage development in this area. Greater clarity of the specific needs and rewards is needed, shared across all parts of the industry (not least chargepoint and vehicle manufacturers) following which the products and standards that best meet these will evolve.

A System for the Consumer

Summary

- The move to DSO presents several valuable opportunities for DNOs and the effective coordination of key resources, ownership and enabling policy frameworks are an essential aspect of this.
- Generally trigger points for further engagement should be in advance of the points at which the flexibility services and customer participation at domestic level (where appropriate) become necessary from a system perspective. We therefore need to start working on developing the market design and mechanisms to support a market for domestic energy flexibility today.
- There is a continued role for suppliers, aggregators, providers and installers in encouraging customer uptake of innovative solutions and new technologies and in clearly demonstrating the inherent value propositions.

Q36 - Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services?

There is one flagship scheme that BEAMA are aware of that is designed to increase awareness of response services. National Grids Power Responsive programme aims to increase flexibility provision and stimulate participation in DSR and Storage. This is a Stakeholder led programme with broad stakeholder representation from supermarkets to aggregators. The role of Power Responsive is to:

- Raise awareness of DSR and engage effectively with businesses.
- Shape the growth of the market in a joined-up way and ensure demand has equal opportunity with the supply side when it comes to balancing the system.

Information available from National Grid and Service Aggregator websites provides further information for new entrants seeking to provide flexibility services. In recent times and since the delivery of successful innovation programmes in this area, some if not all DNOs are now actively seeking to procure various flexibility or response services for example WPD's FALCON and SSEN's Constraint Managed Zones, this is broadening the market for aggregators and suppliers. DNOs, under current operating arrangements, will however require less frequent, more targeted services (i.e. outage planning) than the System Operator (SO). Access and visibility for DNOs and the ability for providers to provide services for the DNO demonstrates good progress. A more holistic approach in areas (such as flexibility, response services etc.) where there are key benefits and value to the consumer would demonstrate good ambition in these areas.

Q37 - Do you recognise the barriers we have identified to large non-domestic customers providing DSR? Can you provide evidence of additional barriers that we have not identified?

ENA's DSR Shared Services group's aims to remove barriers and contract exclusivity for DNOs seeking to gain visibility of service providers currently contracted to provide services for National Grid. These providers have the capacity and flexibility to provide services for more than one party and for multiple events on an annual basis. The progress of this work has been reported under the auspices of ENA's Transmission Distribution Interface Group (TDIG) which is coordinated by ENA with involvement from Government and the Regulator. It is suggested that the actions agreed under the auspices of the Smart Grid Forum WS6 and the deliverables of the groups reporting to TDIG continue to be progressed and delivered in a timely manner with involvement from industry stakeholders and market participants to ensure outputs are reflective of market requirements and participant needs. This should be backed by clear policy and timescales with responsibility placed on the key participants. This will ensure delivery is timely and the outputs are coordinated and aligned so that they function in line with initial ambition and scope, the work completed to date, and ensure any work in progress is effectively coordinated and amalgamated. Whilst these do not present specific barriers to non-domestic consumers providing DSR services, if these are addressed it will help to provide clarity and send a strong signal to participants and industry that the market is a solid commercial proposition.

It is suggested that a reduction in the complexity of DSR provision would have positive impacts on new suppliers entering the market. Any reduction in complexity would work two fold as this would identify and remove barriers inherently whilst simplifying. There is progress noted from National Grid who have worked recently to simplify Short Term Operating Reserve (STOR) services in addition to progress in other schemes noted in this response, this is welcomed and supported by participants and stakeholders. The ability to stack value is essential in providing an attractive proposition to providers and this should be enabled as much as possible, if providers are unable to stack this value, this in itself could act as a barrier. i.e. providers can provide services for multiple parties if they have

the capacity to do so. Providers should not be locked in to exclusive contracts where they can only provide for one service.

After discussion with industry colleagues at The Association for Decentralised Energy, (ADE) we would like to add the following points to our response as set out in ADE's 2016 publication 'Flexibility on demand: Giving customers control to secure our electricity system'.

1. Currently DSR providers are not able to sell their electricity or demand reduction on the Wholesale Market or Balancing Mechanism without going through the customer's licenced supplier, limiting the participation and growth of the DSR sector.
2. The Capacity Market was principally designed for large, centralised generators, and this has limited the ability of DSR providers and distributed generation to participate. Participation by flexible business energy users can be increased, leading to lower costs for consumers, by: allowing all participants to access the same lengths of contract; setting a minimum procurement level for every year ahead T-1 auction; and simplifying the participation of DSR providers.
3. National Grid procures Balancing Services that provide vital operational flexibility that the system needs. DSR could be a key participant in these markets. A simplified, more user-friendly system designed for energy users would help increase cost-effective DSR participation.

Q38 - 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?

Significant progress has been and is being made in this area via multiple parties. There is a need to ensure that that constituent elements of DSR delivery are highlighted and responsibility and ownership is allocated to the key participants with delivery dates agreed. Aspects of this work are being covered by ENA's DSR Shared Services Group with steer provided from the TDIG, this covers the network operator perspective. It is suggested that government, regulator, aggregators, suppliers and other key stakeholders join this collective discussion to ensure that key market areas are represented and outputs coordinated, if this is not in place or planned already.

Increased visibility of the initiatives and associated participants i.e. DNOs in addition to the SO will continue to engage new entrants to this area. Longer term centralised approaches teamed with competitive transparent markets for DSR either aggregator led or via trading platforms could facilitate increased visibility and consumer awareness in this area, these would work for all market participants from electricity suppliers to aggregators. The learning from these approaches could be used as a basis to build localised domestic platforms and markets in the near-term future. Currently National Grid (as the SO) manages and procures this market and sets the conditions, if there is appropriate scale and benefit proposition in other organisations procuring services a centralised approach from all participants could be beneficial. As a minimum, straightforward and competitive access should be ensured for DNOs, suppliers (and other relevant parties) seeking to procure response services.

Finally, there are perceived barriers in SO & DNO willingness to engage with consumers, and in their willingness to open their systems, e.g. for real time dispatch of services. It's right to protect the vulnerable consumer, but there is also a class of active "prosumer" who should be enabled to participate more actively. Currently the emphasis on protecting the former, risks precluding the latter from gaining and delivering value to the system. (And the vulnerable consumer often has intermediaries capable of acting on their behalf, e.g. social landlords and consumer advocacy groups — such intermediaries need to be recognised and supported.)

Q39 - When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)?

It is regrettable that in a call for evidence that is about giving the consumer an active role, this is the only question that is about the domestic consumers' engagement with DSR and it is framed very narrowly. There is without a doubt a need for consumers to have an active role in the energy system (justified by the figures we present in our introduction). Demand management is central to a Smart Flexible Energy System and it is consumers' demand that needs to be managed. Given the narrow scope of this question we have expanded on this in our introduction and the supporting pre-face to this response.

The Smart Meter rollout and thereafter provides an unprecedented opportunity to engage with consumers at scale. There is a need to back up the value of customer propositions with evidenced statistics to clearly demonstrate the value of customer participation in flexibility schemes via the smart meters and via engagement from energy suppliers, network operators, market participants and stakeholders. These propositions need to be simple and involve minimum engagement from the connected customers to ensure that the scale of customer involvement is large enough to have positive benefits on customer's energy usage and associated infrastructure. Customers are diverse and some more proactive and engaged with energy savings than others. For example, customers could be targeted based on whether they change their tariffs regularly as this may indicate whether they are a more 'proactive' customers. Application style energy engagement could provide both the up to date energy offering and savings in addition to ensuring the responses are quick and effective. Alternately and perhaps more foreseeable at the scale required, is for customers to opt in to agreed service levels for response services and flexibility schemes to allow third parties to action flexibility requests in line with agreed and contracted parameters.

There is a continued role for suppliers, aggregators, providers and installers in encouraging customer uptake of innovative solutions and new technologies and in clearly demonstrating the inherent value propositions.

With regards to information exchange for domestic customers it is worth considering here the work ongoing as part of the 'Each Home Counts' review. This is an independent review of Consumer Advice, Protection, Standards and enforcement for energy efficiency and renewable energy and could therefore offer a good basis for future advice services to consumers on smart energy. BEAMA are directly involved in this work and continue to support its development.

Customers with existing onsite generation and storage could be targeted today for flexibility services. There are now over 1,000,000 homes with PV, many of which want to engage more actively in energy generation, supply and DSR, or would be very willing to do so if the market was opened to them. Success of firms like Moixa, Tesla and Sonnen demonstrates this. The full market will take time to develop, so if we want to have access to the flexibility that consumers could provide in 5-10 years' time, we need to start actively addressing them now. Referring to our answers on smart appliances we could target homes and customers with existing stores and onsite generation, as well as develop market mechanisms that don't prohibit the development of stored energy in homes (e.g. hot water storage).

More generally, trigger points for further engagement should be in advance of the points at which the flexibility services and customer participation at domestic level (where appropriate) become necessary from a system perspective. We therefore need to start working on developing the market design and mechanisms to support a market for domestic flexibility today. This should be backed by engagement schemes that provide a clear customer offering and should demonstrate the level of 'active' customer required, the associated time commitment and a clear indication of the savings on offer. Learning should be taken from the smart meter rollout in terms of how to ensure successful customer engagement and projected penetration levels should be established.

The work by UKPN on the Low Carbon London project is one example of DNOs trialling domestic time of use tariffs designed to test the application of DSR and consumer engagement with associated applications (smart washing machines, heat pumps etc). BEAMA have used some of the learning from this trial to inform the design of our recent Connected Homes demonstrations[18]. The Low Carbon London DSR trials included both generation-led and demand-led DSR services to the DNO and were designed to relieve network constraints when network load was at its peak. It is suggested that trials such as Low Carbon London or Northern Powergrid's Customer Led Network Revolution can be used as a foundation to further develop domestic response services in parallel with the smart meter rollout.

[18] BEAMA, 2016, BEAMA Connected Homes Demonstration, Beyond Smart Metering http://www.beama.org.uk/resourceLibrary/the-beama-connected-homes-demonstration---beyond-smart-metering.html

Consumer Protection and Cyber Security

Summary

- The market demand for products at a system and consumer level is already driving increased security standards for the market. Standards for communication protocols are already being upgraded for improved security and protection.
- Any DSR system needs to be designed with the threats outlined in our response in mind. We already have a lot of this protection enshrined in current policy and regulation, including the Data protection Act. Furthermore, we should be following the precedent set by smart metering for the ownership dissemination and storage of customer data.
- BEAMA members are engaging with the standardisation work around this topic at a European and International level and will continue to supply products onto the market that meet the existing and evolving standards for Cyber protection and security.

Q40. Please provide view on what interventions might be necessary to ensure consumer protection in the following areas:

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

Cyber security and data protection is fundamental to the market design for energy systems, especially for consumer data. BEAMA provide some reflections here in relation to the questions. Due to time constraints around this call for evidence we haven't been able to cover this in detail and would like to engage with BEIS and Ofgem further on this subject.

Types of threats identified by BEAMA members include:

1) External attack on a flexibility provider / aggregator.

2) External attack on an individual consumers systems.

3) External attack on a class of consumer systems, e.g. by attacking a flaw in manufacturer equipment / software. This could pose both system risk (e.g. denial of service attacks; grid destabilisation as per (1) above) and risk to individual consumers and market confidence (as per (2) above).

4) Loss of privacy due to large volume of data about consumer energy consumption patterns etc that is being captured into the cloud, etc. .

The market demand for products at a system and consumer level is already driving increased security standards for the market. Standards for communication protocols are already being upgraded for improved security and protection.

Any DSR system needs to be designed with the above threats in mind. We already have a lot of this protection enshrined in current policy and regulation, including the Data protection Act. Furthermore, we should be following the precedent set by smart metering for the ownership and storage of customer data.

BEAMA members are engaging with the standardisation work around this topic at a European and International level and will continue to supply products onto the market that meet the existing standards for Cyber protection and security.

Q41. Can you provide evidence demonstrating how smart technologies (domestic or industrial/ commercial) could compromise the energy system and how likely this is?

Q42. What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact

Types of threats identified by BEAMA members include:

1) External attack on a flexibility provider / aggregator.

2) External attack on an individual consumers systems.

3) External attack on a class of consumer systems, e.g. by attacking a flaw in manufacturer equipment / software. This could pose both system risk (e.g. denial of service attacks; grid destabilisation as per (1) above) and risk to individual consumers and market confidence (as per (2) above).

4) Loss of privacy due to large volume of data about consumer energy consumption patterns etc that is being captured into the cloud, etc. .

The role of different parties in system and Network Operators

Summary

- This section identifies some of the perceived barriers of DSO as well as examples of known work in the area. These new ways of operation present considerable benefits but there is also a need to consider the risks and cost implications, particularly the variations arising from the different market models and optionality therein, as well as the participation of the key stakeholders involved in scoping, delivering and harnessing benefits from the proposed changes. The move to DSO presents a number of key benefits to network operators and customers and this section aims to capture some of the most valuable benefits as well as suggesting industry ownership and examples of work undertaken to date or in progress as appropriate. Lastly this section identifies the key initial risk,

benefit and cost implications of the presented high level market models and highlights the key requirement for broad stakeholder involvement in shaping and delivering these new approaches.

Q43 - Do you agree with the emerging system requirements we have identified (set out in Figure 1)? Are any missing?

The figure generally provides a comprehensive overview and demonstrates the current electricity networks focussed position and the transitional requirements. It is however valuable to consider the potential network value that can be gained via network interaction with the other side of the meter such as in home automation, smart home control and wider technologies. In addition to this it is suggested that consumer engagement is a key aspect in facilitating system change at the scale required via interaction with smart meters, providing response actions and participation in other schemes.

Q44 - 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?**

BEAMA do not possess this information. Network Operators may be able to provide more comprehensive data from WS7 and other industry projects etc.

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

As above.

Q45 - 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?

The move to DSO should be facilitative of the following key value areas:

- To more effectively manage and harness a more diverse generation mix and distributed energy
- Increased flexibility to more effectively manage the networks and ensure security of supply and efficient use of infrastructure
- More active management of demand, generation and ability to more actively engage with customers to access domestic flexibility in the longer term
- To promote increased coordination across the networks and with key stakeholders

- To draw benefits from the smart meter rollout and increased network visibility, this will allow network operators to better understand network load and demand patterns as well as improving network reliability
- Minimising outages and ensuring even higher levels of customer service with more localised control
- More effective management across the Transmission Distribution interface
- To facilitate the increased rollout and optimisation of innovative solutions and technologies
- Facilitate the development and implementation of local tariffs and optimised offerings to the customer to ensure efficient network usage and efficient use of generation and demand
- An overall better customer offering

Much of the thinking about the DSO assumes that the primary buyer of flexibility will be the system (SO, TSO, DSO). Other buyers will also influence the market – energy suppliers can benefit from buying flexibility, as may community energy groups and other prosumers, and there may well be scope for flexibility providers to manage portfolio risk by undertaking peer-to-peer trading amongst themselves. Market design must not preclude or overburden these options.

Again, this speaks to the value of aggregators as independent parties - separate to DSO, TSO, energy supplier, etc. hence being able to shift between markets to maximise value for the consumer. Some parties may have other interests that will make it difficult for them to do this.

It is suggested that any market design should consider the role of all likely stakeholders – aggregators, suppliers, community energy groups, prosumers, etc – not just TSO & DSO. There is a risk of embedding or only making relatively minor changes or updates to the current state if this wider picture isn't considered.

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?

The industry can best take these issues forward by defining clear actions and deliverables within appropriate timescales. This should be a coordinated approach with a clear steer from the regulator and government and market participants and stakeholders.

Yes, there are already examples of DNOs working towards this goal as described in the consultation and more widely under innovation and business as usual funded work. Some of this work is being undertaken by specific DNOs and has not been rolled out industry wide. Work is required by government and the regulator to further promote the replication of successful innovation GB wide, to replicate successful innovation network operators require staff resource and business funding. If a technology or solution is proven and will bring about cost savings this resource and funding 'bottleneck' can often be preventative of delivering increased proven innovative solutions as business as usual and miss the delivery

of further customer value. Increased standardisation and the definition of common terminology for innovation solutions across GB will send a clear signal to the market so that technology providers, manufacturers and other stakeholders can respond in kind. Standardisation and commonality should be encouraged as a key aspect of the innovation funding, price controls and policy. Standardisation helps to enable more coordinated and efficient responses from the supply chain in terms of technology development, modification and interoperability considerations etc. Work similar to ENA's Active Network Management Good Practice Guide provides a good starting point for stakeholders although further work is still required to better categorise and define innovative solutions, particularly those that are being rolled out at GB scale.

It is important to note that it can take several years to take solutions through the various TRLs and to deliver a commercialised network ready product. Innovative solutions are not often delivered in short timescales, the need to prioritise the proven solutions and technologies at GB scale to deliver customer value, ensures that innovation can continue through the TRLs in parallel. Funding can facilitate this and provide certainty to network operators and partners to allocate or recruit staff, invest the time and bridge the perceived gap between proven innovation and business as usual.

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.**

Removing contractual complexity and exclusivity that can often act as a barrier for third party participation and new market entrants. Flexibility and regulation of innovation outputs should be reactive and accepting of change to ensure that new solutions and ways of working, including those mentioned in the passages above, can be delivered quickly and so that the benefits and value on offer can be accessed. Engaging with key market participants regularly can help to ensure that barriers are highlighted and that solutions can be implemented in a coordinated way.

Q46 - 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?**

As this will be a move towards a new way of operating with new techniques, roles and responsibilities, there will be a need to manage the transition and ensure that the outputs are reflective of the defined scope and objectives. There will be an element of learning by doing and there should be flexibility

built in to leverage greater benefits and implement beneficial deviations from scope and objectives proactively, if these are encountered.

There is a need to monitor the transition and the rollout to be reviewed at appropriate points, progress monitored, benefits gained and deviations granted highlighted. In addition, market participants and key stakeholders should be involved at appropriate points in discussing and finalising approaches.

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 provide a good level of optionality with references to existing examples to provide evidence. These models provide the basis to inform discussion with key stakeholders and participants. The extension of the local and system wide use of resources could provide a basis to build upon for domestic arrangements in the longer term, as this is not alluded to in the text.

Local energy is fundamental, it could lead to new models of network topology for example. There is a need to engage with community energy, property developers etc to understand the possibilities and requirements here. Market participants and key stakeholders should be involved at appropriate points in discussing local energy. For the DSO/SO Procurement Mechanism and as alluded to in responses to other questions, centralised models for flexibility and response services ensure efficient use of system wide and local resources, ensuring transparency and fairness in terms of procurement and visibility of services on offer in a location. How these interactions are communicated when called by a DNO to other parties such as the SO or TO requires consideration to ensure that visibility and availability is only provided if the resource has the capability and capacity to provide a service and to ensure that the resource hasn't been called and depleted already.

The Market Systems and Arrangements Model suggests dynamic pricing which, once implemented, will ensure efficient use of resources and demonstrate a strong value proposition for the consumer and ensure that energy is used at times of surplus or low demand at a cost reflective price. For such approaches to be successful customer awareness is key to ensure interactions at an appropriate scale, alternately market platforms with delegated authority to aggregators, local authorities, social landlords etc. could manage this service on behalf of multiple consumers and deliver the scale required.

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

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

Risks

Not delivered in a timely fashion and lag between inception and benefit realisation.

Smart metering should facilitate new market and customer opportunities and not act as a barrier for some opportunities. As well as improving customer service it's should, as much as possible, improve the customer and market participants value proposition as well as being a tool for keeping the networks within operational limits and managing high and low load conditions effectively i.e. ability for low load signal customer demand increase and high load signal decrease in customer demand.

Failure to involve the correct stakeholders and participants to inform the discussion and contribute to concept and rollout.

Costs

Who funds the procurement mechanism and who are costs paid to?

Highly dependent on extent of functionality sought and parties involved in shaping the markets and frameworks and policy elements.

What is the cost benefit analysis for central vs distributed model i.e. DNO - DSO?

Benefits

Efficient use of distributed resources for balancing, demand and generation, fair and competitive pricing models if handled centrally.

Potential for a better more efficient customer offering with greater embedded flexibility.

Innovation

Summary

- Sufficient funding should be available for significant demonstration projects in these areas which have high TRL levels (above 5). Furthermore there should be funding available for the capital cost of these demonstrations and not only for research. For priority number 1 (Commercial and Residential automated DSR) there should also be a strong emphasis on research, and funding available for consumer side / consumer behaviour evaluation. Innovation spend should now be targeting trials at scale, aimed at moving into the commercialisation of new business models and technologies.

- Focus now needs to be on driving innovation through to Business As Usual and innovation should be established as a core part a Network operator's business.
- BEAMA members have reported on the limitations the NIC and NIA governance processes may place on innovation and the ability for truly innovative projects to come to the fore.
- Overall collaboration for LCNF, NIA and NIC projects with partners has been positive. BEAMA have reported to Ofgem in the past concerns over the level of risk companies are often forced to take on in delivering a project. This risk in most cases is also not proportionate to the size of the company that could be involved, and therefore favours the involvement of larger companies to partner on projects, likely to also already be active suppliers into the DNOs BAU procurement. This risk is reputational as well as financial. Alleviating the risk SMEs would have to take on as part of a project would encourage more of the SME community to take leading roles in project delivery under NIA and NIC, benefiting the UK market overall.
- Issues around the treatment of background and foreground IP must be addressed. This is something BEAMA have been reporting on for 3 years and it is a significant barrier for many companies engaging with innovation projects.

Q47. Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?

Sufficient funding should be available for significant demonstration projects in these areas which high TRL levels (above 5). Furthermore there should be funding available for the capital cost of these demonstrations and not only for research. For priority number 1 (Commercial and Residential automated DSR) there should also be a strong emphasis on research, and funding available, for the consumer side / consumer behaviour evaluation.

BEAMA responded to the recent Poyry consultation to evaluate the Low Carbon Network Fund. With this we also reflected on our member's current experience of the Networking Innovation Competition and Allowance. We repeat some of the key points made in our response here as we feel they are still very relevant and need careful consideration.

We are conscious of the recent announcement from Ofgem in response to this consultation process and the decision to reduce spend under the NIC[19]. The recent announcement from Ofgem confirmed a reduction in NIC spend from £90million to £70million to 'deliver more innovation for less'. This is a surprising decision when the Poyry work revealed LCNF produced net benefits of £1 billion (three times initial investment). BEAMA members do not support this decision and feel this particular mechanism is important in delivering innovation at scale. We comment further on the importance of scale latter in our response to this question.

While it is a shame this spend has been reduced, we do also feel that innovation through the Network Companies is now best delivered as Business as Usual and mechanisms in

[19] https://www.ofgem.gov.uk/system/files/docs/2016/12/innovation_review_consultation_final.pdf

RIIO such as the Innovation Rollout Mechanism are the way in which this could be delivered. We comment later in this section of the response on how effective this mechanism is currently. We also hope that the decision to reduce spend was not made based on the low spend currently seen through the NIA and NIC, as BEAMA strongly believe this underspend to be a result of the governance and selection criteria, not the availability of innovations and projects. Driving further innovation through BAU mechanisms may help reduce the risks associated with previous innovation funds, relating to governance and selection criteria, as well as IP.

Innovation as Business As Usual (BAU)

BEAMA members have reported recently good signs that innovation and learning from LCNF, NIC and NIA projects is driving BAU investment in the Network Operators Business.

BEAMA members have also reported on the limitations the NIC and NIA governance processes may place on innovation and the ability for truly innovative projects to come to the fore. To some degree the projects today are being moulded more by the planning process and less by the needs of the market or viable innovations. So in light of this feedback we are not convinced that 'innovation' is part of core business for the DNOs, or not as much as it could be.

BEAMA members are often asked for innovation proposals but are seldom provided with the details of the specific issues being faced by the network companies. So it is difficult to target their innovation where there is likely to be a stronger cost benefit.

BEAMA is aware that a number of technology applications trialled through LCNF are now making their way into BAU and therefore contributing to a low carbon business and security of supply. This includes flexible connections, dynamic reconfiguration of networks to meet demand and restore outages, and demand response techniques. However a large body of solutions proven during trials under LCNF are still transitioning to BAU. Until this happens perhaps this objective won't be fully met.

Innovation Rollout Mechanism

The Innovation Rollout Mechanism (IRM) is designed to fund the roll-out of proven innovations which will contribute to the development of a low carbon energy sector or broader environmental benefits in Great Britain. To qualify for the IRM, the innovations must deliver carbon and/or environmental benefits or provide long-term value for money to customers. Whilst this is a key enabler, there is little evidence to suggest that this is easily accessible or the effort required is proportionate to the value potential on offer to the GB customer. There is evidence that highlights a successful application to access the IRM from SP Energy Networks. The IRM as it is defined and intended could help to bridge the gap between proven innovation and BAU rollout, however the lack of uptake by network operators suggests that this is a complex or disproportionate process.

Enabling proven innovation has obvious benefits to the consumer, this is reinforced by the Poyry Report – An Independent Evaluation of the LCNF which estimates the potential GB scaled benefit to be between approximately £7bn and £11bn over the current estimated gross benefit of the LCNF – including current as well as future benefits ranging from £1.8bn to £2.4bn. Scaled and replicated successful innovation is key to delivering a smart energy system that can help to meet the challenges of increased renewable

uptakes and more diverse network usage by the consumer, as suggested in 'The role of different parties in system and Network Operators' section of this response. If a technology or solution is proven and demonstrates clear cost savings any resource or funding 'bottleneck' or business reluctance or buy in can be preventative of delivering increased proven innovative solutions at business as usual and the delivery of further customer value and an enhanced customer offering.

If the IRM is not successful or attractive in practice, changes or other schemes designed to ramp up rollout of innovative solutions are welcomed, as this is perceived as a valuable tool in bridging the gap between innovation and business as usual approaches for GB network operators. It is suggested that Ofgem work closely with network operators and key stakeholders to assess why the take up of the IRM has been small, or alternately provide guidance to stakeholders on the reasons for low take up and access of the IRM.

Risk

Overall collaboration for LCNF, NIA and NIC projects with partners has been positive. BEAMA have reported to Ofgem in the past concerns over the level of risk companies are often forced to take on in delivering a project. This risk is most cases is also not proportionate to the size of the company that could be involved, and therefore favours the involvement of larger companies to partner on projects, likely to also already be active suppliers into the DNOs BAU procurement. This risk is reputational, and financial. Reducing the risk SMEs would have to take on as part of a project would encourage more of the SME community to take leading roles in project delivery under NIA and NIC, and this would benefit the UK market overall.

The DECC Ofgem Smart grid forum WS9 has reported some specific examples of where significant risk has been taken on by delivery partners for LCNF projects.

In a number of cases BEAMA members have had issues with the treatment of 'relevant' foreground IP that might be developed during the project. The Guidelines suggest that if such IP is within a commercial product then it is not 'relevant' provided that the commercial product can be purchased after the project. This is crucial, because if this is not applied, the IP is 'relevant' and the DNOs get a free licence to this IP. But the DNOs think they own the Foreground IP, or have some joint ownership of it because they funded the project. This means companies are not free to incorporate the foreground IP into their products and hence state that it is not 'relevant'.

Therefore IP is never 'clean' and separable. An example would be a supplier providing a monitor to capture fault waveforms, and then run a project with a DNO to test it on their network, the supplier will inevitably be able to improve the monitor as a result of the project. The DNO will claim some ownership of the improvement to the IP as they funded the trial, and then the supplier will be in a position where they have to negotiate a licence with the DNO to sell the improved product. Suppliers cannot make these improvements (innovations) to their products without a real network to develop and test on. Therefore the innovation funding mechanisms, including LCNF, NIA and NIC are essential in developing the right products for DNOs and innovation in the supply chain.

It is a huge overhead to negotiate a licence with the DNO, often out of proportion to the scale of investment required for the project. There is little appreciation in the new

criteria for NIC and NIA governance of what this entails for a supplier in the market. Most SMEs will not have the experience or resource to do this. This is therefore a significant barrier that we see prevailing in the market for innovation projects, and a particular barrier for SMEs. It is our understanding that this is limiting the number of projects coming to fruition under NIC and NIA today.

One way to avoid this is to scope projects such that suppliers of products can have it clearly stated that they don't develop any foreground IP, and claim it all as background IP. They are just testing and qualifying it through the project. This is happening in a number of cases already, but is still an obstacle for scoping new innovation projects.

Scale

BEAMA believe the focus with regards to innovation trials should now be on scaling up new technologies and market services. Programmes like the Smart Systems and Heat project being delivered by the Energy Systems catapult is a good example of this and where delivery is regionally focused. BEAMA have provided an annexed paper with this response 'Galvanising the Supply Chain', which is aimed at articulating the value of regionally led programmes. In doing so you can engage an active supply chain and build up volumes, thus reducing costs and engaging a higher number of consumers.

In the delivery of future innovation we now need to be delivering programmes at a larger scale and aiming them at rolling into full mass deployment whether that is for a new products and/ or services. This alleviates some of the risks mentioned previously and helps ramp up the supply chain required to deliver a lot of the new system applications we are now targeting. With previous projects we have found that following completion, the demand for new products and services drops off and the lack of BAU investment post project applies significant risk on the supply chain involved.

Q48. Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer.

Overall these are good areas to be targeting for future innovation spend.

BEAMA support the need for continued innovation but would like to raise the issue that whilst we continue to fund viable innovation projects and studies, we need to be directing funding towards developing a UK supply chain. We are aware that in a number of cases funding has been allocated to foreign companies and, whilst there is a UK supply chain for a lot of the technologies and services we are targeting here, they are potentially not being adequately supported to build critical mass, and therefore not capable of providing competition to the larger international players. Battery storage and cell manufacturing could be an example here.

BEAMA feel the decision to support Vehicle to Grid specifically, is potentially limiting given the current market readiness for this application. It may be more appropriate to target funding in opening up new value chains for the market, for both the customer and flexibility provider, for all types of suitable building energy storage. BEIS and Ofgem have highlighted the need to reduce the cost of gird level storage but there is little mention of

the range of building energy storage technologies and the system value of these technologies. Arguably static storage in buildings will have more market viability, given this provides more scope for pay back to the customer and value add to their energy services and potentially the property itself and re-sale value. Storage has significant value in reducing peak demand and levelling demand profiles, arguably an easier sell to the customer than direct control of appliances in the home, as well as providing more certainty to the network operators. Given there is a growing UK supply chain in this sector we feel this would be an appropriate target for government support. Furthermore, in opening the market to a range of storage types this would naturally encourage the Vehicle to Grid market and its associated value chain.

Annex I - Success of Network Operator Regulation and Spend

Development of a smart energy system depends on:

- DNOs having a proper understanding of their costs and at increasing granularity.
- Regulatory incentives for the DNOs to expose these costs in flexibility markets.
- KPIs and outputs (most likely secondary) that allow OFGEM and other stakeholders to track the progress of smart network implementation.

An analysis of RIIO ED1 spend for 2015/16[20]shows a mixed picture for the DNOs. Notably WPD has spent above its allowance whilst a number of other DNOs (LPN, SPN, EPN) have significantly underspent their allowances. Almost all DNOs have underspent their allowances on asset replacement. However, the data fails to reveal a true picture of how well the DNOs are responding to the changing needs of the networks.

BEAMA members have reported a significant reduction in spend for asset replacement, according to BAU and that expected for RIIO. It is our view this spend is being back ended in RIIO and this has the potential to be very damaging for the supply chain. This is something we highlighted as a key risk when responding to the RIIO strategy consultation several years ago, and we feel this needs to be addressed.

Under RIIO ED1, the DNOs are rewarded for meeting reliability targets and it appears that, according to their annual regulatory reports, reliability is still high. The question is whether this is concealing the situation; are the DNOs relying on previous over investment (some DNOs report a 200 year average asset replacement rate). Also, are system margins being allowed to fall so that reliability will fall in the near future? RIIO attempts to address this by introducing secondary outputs including asset health.

The key question is whether the outputs and secondary outputs are capturing relevant network measures to track the evolution of the networks; are there further additional outputs required or is maintaining reliability the only necessary measure? If reliability is retained as the sole relevant output might it be necessary to devise a new secondary output to monitor the shift towards a functional DSO. For example, it might be possible to introduce a measure of DNO annual spend on reinforcement versus increased renewable generation in their area. DNO could then be compared on the efficiency of their spend. This is not necessarily to say that this specific measure should be introduced but a recognition that the need for the DNOs to introduce innovative approaches and to spend efficiently will likely require new outputs or secondary outputs and should be reviewed in the medium term.

[20] https://www.ofgem.gov.uk/publications-and-updates/riio-ed1-financial-model-following-annual-iteration-process-2016

Annex II – Galvanising the Supply chain –Regional Heat Zones

1. Introduction

The call for evidence has a section relating to the deployment of smart tariffs and smart appliances.

BEAMA believes that the enhanced impact of smart tariffs for the valuable flexibility presented by all forms of heat storage (whether through the medium of storage heaters, hot water storage or heat pumps) will require an innovative targeted approach that promotes the growth of heat pumps and encourages the specification of suitable 'flexible and dynamic' storage technology.

The transition to a low carbon heat market in the UK – most specifically for heat pumps - has been hindered by promoting a national policy approach which anticipates homogenous deployment of technology based on nationally derived targets and schemes; usually grants or incentives. The problem with this approach is the diversity of fuel supply, housing stock and developed supply chain and networks infrastructure across the UK (See Figure 1).

Additionally there has been little targeted support for upgrading electric storage heaters to modern 'dynamic' and efficient technologies (See Figure 2). A final observation from BEAMA members is that with the combination boiler market now in excess of 50% of overall boiler unit sales, householders are actively removing storage hot water capability from their homes with little likelihood of it being re-installed due to lack of available space once the original store area has been converted for other uses. These are all problems for the smart and flexible grid aspirations of UK Government.

Figure 1: Heat Pumps

Due to the economics of fuel pricing and potential financial savings, the most logical market for heat pumps is to replace counter-factual LPG and/or oil boiler technology. However, the counter-factual technology is normally off the gas distribution network in areas that have weak electricity distribution infrastructure. A national approach has a range of consequences:

1. The relevant Distribution Network Operator has little ability to plan infrastructure upgrade spend based on targeted deployment rates
2. BEAMA members have many experiences of customers being presented with additional charges for infrastructure upgrades that should be covered under the current RIIO rules in a planned process
3. The additional charges run into many thousands, typically >£3,000 which can make the case for heat pumps uneconomical
4. Installers will avoid heat pump technology if customers have financial and administrative problems with connections; they will promote the simplest technology

In addition to the above, there are currently no heat pump tariffs available (smart or not) which is due to a combination of factors including the inability to target a suitable critical mass of deployment.

Figure 2: Dynamic Storage Heaters

Dynamic Storage Heating can also be described as Smart Electric Thermal Storage (SETS) with the potential to provide flexible charging as a storage medium utilising low carbon renewable generation. It is a 'drop-in' technology which enables not only dynamic charging for peak heating periods but grid balancing opportunities as it is not pegged to defined and fixed off peak periods.

The regional heat zone approach will enable:

1. Targeted tariff provision to clustered customers which provides financial reward for load balancing potential
2. Network investment to accommodate flexible operation
3. Development of local supply chains to target existing electrically heated homes and switch to flexible SETS technology
4. Targeted ECO type propositions (ECO currently has provision for storage heating replacement)

2. The Solution

BEAMA advocates a 'Regional Heat Zone' approach which is backed by consortia driven 3-5 year strategies involving technology deployment targets, focused supply chain capacity building, targeted infrastructure investment and supply side propositions to make measures financially attractive.

This regional approach enables appropriate channels of investment and sets ambitions that will attract interest from contractors and support services (e.g. an oil boiler installer may not invest in growing his/her business to install heat pumps based on natural market development, but may do if the regional consortium has set a target for 50,000 heat pumps over 5 years with associated training funding and delivery available from manufacturers along with network investment from DNOs).

A RHZ Framework should:

- Produce a 3-5 year plan for heat technology deployment
- Identify the available regulatory/policy stimulus to affect consumer decision making (i.e. building regulations, Energy Company Obligation or equivalent)
- Identify and attract suitable inward investment
- Agree marketing plans to target householders (either driven by the partner framework or by individual partners) with approved access to information from the Data Warehouse/Hub as recommended by the Each Home Counts Review
- Establish manufacturer participation to assess training and likely sales promotion investment opportunities
- Agree marketing plans and activities to attract installers to support the framework

- Draw up a 3-5 year plan for local infrastructure development
- Utilise the Each Home Counts Quality Mark and Information Hub

The over-arching objectives of RHZs should be to:

- Increase uptake of heat pumps (including hybrid technologies where appropriate in gas connection areas)
- Promote retention of hot water storage capability
- Identify and exploit opportunities for electric storage heating upgrades where appropriate
- Achieve the above through working with the local supply chain and partners with influence on housing stock specification or energy retail offers
- Share information and targeting with DNOs to maximise necessary investment opportunity in grid development

3. The Regional Heat Zone Framework Partners

In order to ensure a targeted approach to flexible heat technology deployment, the following potential Zone partners would need to be included:

- Local Authority

A potential lead facilitator of the RHZ, the local authority has access to details related to housing stock and can be a natural catalayst to bring together local data and information related to infrastructure planning and regional development. Possible data sources can include MCS and RHI along with House Condition Survey and EST surveys.

Potential issues: Available human and financial resource to facilitate the RHZ; lack of policy/regulatory driven motivation to take action; quality of information on housing stock

- Energy Retailer(s)

The energy retail partner(s) bring the tariff incentives and potential Energy Company Obligation (or equivalent) funding to the framework.

Potential issues: Motivation within a diluted competitive environment; a probable will to create exclusivity arrangements for customers

- Distribution Network Operators

A crucial part of the framework as the DNO needs to invest in infrastructure to accommodate increased electrical load on the distribution network. The DNO brings investment capability and benefits from better business planning information.

Potential issues: No policy or regulatory driver to ensure participation; business plans may already be in place and would need re-framing.

- Manufacturers

Manufacturers have the capability to structure their own product marketing initiatives to capitalise on a framework plan. This will include sales promotion to householders (including industry led promotional incentives) and installers (training vouchers etc) and training investment through their own or private training facilities. This is essential to upskill the supply chain.

In addition, we have evidence to suggest that the process of hand-holding tenants with new technologies in social housing leads to better outcomes of adoption and ongoing operation. Manufacturers work with social housing providers on this type of work and a regional focus will lend itself to facilitating common processes with project partners.

Potential issues: Ensuring multiple manufacturers can access local plans

- Training Providers

Training provision is channelled through private centres and colleges (sometimes manufacturer centres). However, targeting training delivery to satisfy business models based on pupil attendance and payments is difficult without a strategy for deployment. The regional model can give signals to training providers for investment in developing and delivering courses. Note that training providers already have close relationships with certification and manufacturing stakeholders which will facilitate a co-ordinated effort if backed by a regional plan.

Potential issues: Scale of attendance based on levels of regional ambition and local competition

- Installers (and system designers)

As already stated, capacity building in the installer pool is generally constrained by business confidence for investment. The regional model sends positive signals to installers of existing fossil fuel technology or individuals/organisation looking to diversify their skill base. A parallel consideration is that with a plan based on scale, there could also be scope for the development of new innovative design support services that aid new installers who have installation skill competencies but do not wish to fulfil the more time consuming design aspects of projects.

Potential issues: Levels of trust likely to exist with installers; cost of up-skilling and certification (which also exists within the national framework model)

4. Next Stage of Regional Heat Zone Idea Development

The Energy Systems Catapult (ESC) has been trialling a similar approach to the RHZ through its Smarter Systems & Heat programme. BEAMA has had a number of meetings to discuss the model and the ESC has presented its work to the IEA Heat Pump forum in September 2016.

The ESC and BEAMA understand that to push the RHZ idea to the next level, we need to determine who the consortia partners may be and their roles; how the zones would work on a day to day basis; how investment can be channelled; the realistic outlook for

funding support to champion the regional approach; and how the national 'scattergun' approach can result in poor transition.

BEAMA will be co-hosting a workshop on 8th February 2017 to progress the development of the potential RHZ structure. The workshop will be tackling the following questions:

- Who would be involved in a Regional Heat Zone consortium?
- Is this only a heat issue or should the focus be broader?
- How would investment plans be affected by this across networks, manufacturers, training companies, contractors, supply chain marketing, energy retail?
- Can a regional approach drive the sales of low carbon heat technologies and why?
- What would the consortium have to do to ensure investment and activity?
- Are there innovative funding mechanisms for technology out there that can support Regional Heat Zone strategies?
- How does this approach work alongside funding schemes such as ECO and RHI?
- How could the RHZ approach interact with the Each Home Counts Data Warehouse and Information Hub models?

BEAMA members and Contributing companies

Here is a list of the key companies who have contributed to this response. This is not a complete list of BEAMA members but includes those within the main sectors in BEAMA that have inputted into this work. This includes the BEAMA Connected Homes, Building Energy Storage, Electric Vehicle Infrastructure, Networks and Energy Systems Groups.

ABB
Balfour Beatty
Baxi Group
Bowers Electrical
Brush Transformers
Cable Management Group
Cembre
Chameleon Technology (UK) Ltd
Climote Ltd
Cooper Bussmann (UK) Ltd
Daikin
Drayton Controls
Eaton Electric
EDMI Ltd
Electrium Sales Ltd (Wythenshawe)
Elster Metering Systems Ltd.
Energy Pool - A subsidiary of Schneider
Fundamentals
Gamma Intelligent Building Services
GDC Group
GE
GE Grid Solutions
Green Energy Options (GEO)
Hager Engineering Ltd
Hawker Siddley
Heatrae Sadia Heating
Honeywell ACS Control Products
In Home Displays Ltd
Itron UK Ltd
Legrand Electric Ltd
Lucy Electric
Mitsubishi Electric Europe B.V
MK Electric
Moixa
NetThings Ltd
NIBE Energy Systems Ltd
Ormazabal
PB
Pegler Yorkshire Group Limited
Schneider Electric Ltd (Telford)
Secure Controls (UK) Ltd
Secure Meters (UK) Ltd
Sentec Ltd
Siemens Energy

Smart Buildings Ltd
SSE Labs
Stiebel Eltron
Sunamp
Tyco Electronics
Upside Energy Ltd
Vaillant
Viessmann
Wilson Power Solutions
Winderpower
Worcester Bosch

BEAMA consulted the following organisations during the development of this call for evidence:

- Energy Networks Association
- Energy Systems catapult
- Energy Storage Network
- Association of Decentralised Energy

About BEAMA

BEAMA is the leading trade association which represents manufacturers of electrical infrastructure products and systems from transmission through distribution to the environmental systems and services in the built environment.

We work with our members to ensure their interests are well represented in the relevant political, regulatory and standardisation issues at UK, EU & international levels