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Date: 12/01/2017
Electricity Systems Team
Department for Business, Energy and Industrial Strategy,
4th Floor, 3 Whitehall Place

Moixa Technology Ltd – Response to Consultation
A Smart, Flexible Energy System – A Call for evidence

Dear BEIS/Ofgem,

Moixa Technology welcomes the invitation to provide evidence and comment into this important Call and recommendations – which we are supportive of.

Storage and DSR flexibility lie at the core of achieving a low carbon future, and in particular energy storage – can be treated as energy infrastructure - stable and reliable over time, responsive to a range of services.

Moixa - Executive Summary

- Management of Energy Storage in homes (BTM – Behind the meter), represent the greatest system and end customer value – as UK and Europe are predominantly a residential driven peak. This is also in contrast to say many US States which are more C&I/intraday peaks or ramp gaps.
- Energy Storage can be predictably relied on over DSR to reduce peak energy profiles in properties – independent of behaviour or future electricity / device demand.
- We view that whilst Heat Storage presents important demand management potential, electricity storage is seasonally, occupancy invariant – and represents the strategic energy system challenge as peak demand rises through electrification of transport, heat and growth in IoT - always on, always used at peak devices. In contrast heat demand is not strategically increasing.
- Storage is essential to manage renewable targets, accommodate wrong time of day solar/wind generation, and maintain an effective grid distribution system.
- Distributed resources can deliver the best economic returns, and revenue agility over time by managing behind the meter (customer), utility, network and system benefits, given a supportive regulatory environment
- UK could install million+ batteries in homes by early 2020's forming a virtual 'Dinorwig' of customer, network and system benefits, given supportive regulatory environments.

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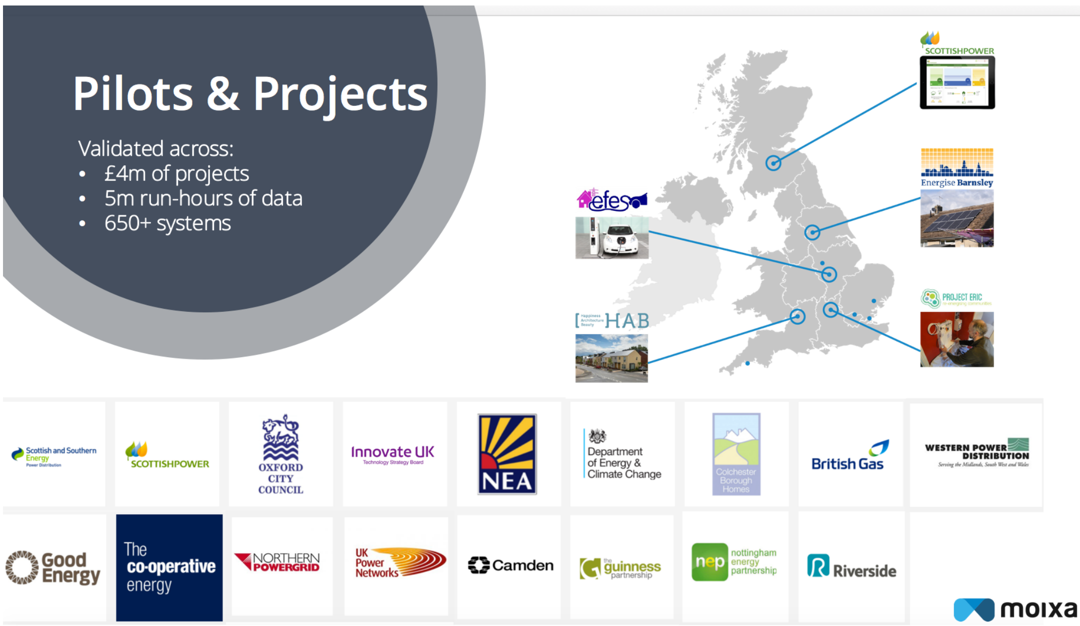
<u>Moixa Background and UK projects:</u>

Moixa is the UK leader in behind the meter (BTM) residential energy storage and aggregation of distributed assets for a range of utility, network, system benefits.

Moixa is in a unique position to comment on the role of distributed energy storage and aggregation in delivering flexibility, through data and learnings gained through delivering multiple projects for BEIS, such as:

- **DECC** – Energy Storage Demonstrator – delivering 0.5MWh of distributed storage across hundreds of homes, data, and aggregating for grid services.
- **InnovateUK** – Lead and participant across 4 – Localized Energy Projects, e.g. Project Eric (localisedenergyeric.wordpress.com)
- **LCNF/NIC** – participant in LCNF Sola-Bristol and NIC (e.g. Northern PowerGrid) demonstrations of storage for peak solar curtailment
- **Utilities** – we have worked with several Big 6 and smaller utilities on storage pilots and customer propositions
- **Social Housing** – we have delivered storage across a range of social housing types and locations, including audited evaluated projects with NEA (for e.g. fuel poverty and energy savings impact)



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Some of which are mentioned in consultation materials. We are also happy to participate in BEIS/OFGEM evidence committees, and have previously provided input across range of meetings, participated in recent Minister round-table, Lord Economic Affairs Witness (*), input into Energy Storage Network and BEAMA Call response, NIC (Infrastructure commission), National Grid (Future Energy Scenarios), Imperial/EU – Energy Storage for Low Carbon Grids, Ofgem HHS consultation, and can provide data or reports on specific projects on request.

These projects and experience have provided significant data and market experience, on the value of flexibility and the role of storage and managed storage aggregation/VPP (Virtual Power Plants), in enabling new services and business models, and on

- Smart tariffs, HHS opportunity (see Moixa HHS consultation response)
- Asset funding & challenges
- VPP – Aggregate opportunities of storage
- Market and standards challenges.
- Storage vs DSR reliability over time
- Challenges in delivering sustained distributed services over time
- Complexity and challenges in the UK market and proposed regulatory changes.
- IPR and standards to ensure stable system

Summary and response to Consultation Questions

Moixa is supportive of the proposals – as is essential for the UK energy system to become more flexible and accommodate storage and DSR resources. It is critical that a joined up BEIS/OFGEM/Industrial strategy approach is taken as storage represents critical infrastructure and the only way to reliably deliver a low carbon future and accommodate Low Carbon/intermittent generation without destroying the efficiency of the grid system.

Germany is an example of what not to do, and a form of ***'Ghost of Christmas future'*** for what could happen in 7 years if the UK delivers similar excess solar and wind, without significant multiple GWhs of storage deployed. The result there is significant reduction in use of (network) system costs, translated into rising costs for households – at peak times, as networks and generators seek to recover system costs when renewables (solar) are less predictable. A consequence is also a rising T&D cost surcharge in Germany in 2017, removal of Net Metering in various US states, peak/solar charges in Hawaii, Belgium, Spain.

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UK is in a unique opportunity to deliver energy strategy, leveraging lessons learnt from Europe and US – and to pioneer solutions as a large 'island' independent, and with solutions that could be rolled out world-wide once de-risked ad tested in the domestic market. UK has a number of favourable characteristics in terms of

- Peak capacity challenge – where storage and DSR are likely the only rapid and likely cost effective response
- Liberalized market for Utility services – enabling new business and customer models to be tested and competition
- A reasonable open market for aggregation and grid services, enabling VPP models to be delivered in UK
- Rising volatility – from currency and commodity price rises, and changes in the energy system (e.g. interconnects flowing backwards with French Nuclear issues)
- No or low subsidies – and lower FiT rates, ROC, ECO, Green Deal – and reduction in energy policy – is ironically helpful in enabling companies and technologies to deliver 'subsidy free' solution.
- Innovative companies

Despite these being 'challenges' and problems for the UK grid – it does present a clear market opportunity and innovation for companies and industrial strategy

A counterpoint though is that any lack of clarity or complex policy or red tape regulation impacts the accessibility of solutions in the UK market – and means innovative solutions cannot scale up domestically so lose out to US or other markets with temporal subsidy. Equally UK energy system is already very complex and multi-layered – vs countries with less layers/regulated licenses may find it easier to 'house' solutions and services within a single company P&L (operational benefit) and balance sheet (asset finance ability justified in –house vs dependant on higher priced external asset finance).

Asset finance remains a critical factor in the UK for storage and DSR assets which is a barrier to entry and market scale – dependent in part on ease and clarity of regulation, market accessibility, contract renewal and market stability.

We have reviewed and responded to a number of questions in the attached schedule – focusing on energy storage, behind the meter and aggregation opportunities to improve flexibility

Once again we thank BEIS for the opportunity to provide comment and input, and also for the support and projects we have helped deliver through

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InnovateUK and DECC, NIC funding initiatives – to help make the UK a leader in distributed energy storage and aggregation services.

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Call for Evidence Questions

Moixa will focus our input and comment to distributed energy resources, and the value and role of BTM DSR and Storage, and aggregation for FTM (front of meter) services.

2.1 Enabling Storage - Removing policy and regulatory barriers

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

Broadly the consultation covers principle energy system barriers for enabling storage, but does not cover some of the challenges and opportunities of *'grid edge' behind the meter(BTM) storage*, and the *overall asset finance* challenges for storage as an asset class.

In general BTM solutions are lightly regulated (which is helpful) and indeed large volumes could be delivered and installed by customer, house-builder/developer, solar installer, utility within existing approaches, and without additional regulation or constraint.

However, the benefits and some economic incentives for doing so, are not fully accessible without various regulatory improvements

- Settlement – Half hourly settlement (HHS) or improved profiles, together with cost effective settlement processes, smart metering, and ToU availability
- Network connection – G83/G59, G100, regulatory clarity (2.2), standards/forms and process as well as benefits from deferring capital or saving network costs
- Availability to participate and benefit from providing ancillary services and system benefits (aggregator points below)

Are there any additional barriers faced by the industry?

The above has an impact on reducing the ease of funding such delivery, until such benefits have clear regulatory guidelines – enabling more security on income. The current situation risks creating an AEC (Adverse effect on competition), as customers are not properly rewarded by the network/system benefits of owning and installing storage, unlike in other countries where directives, mandates, reliefs/subsidy e.g. SGIP (California) do help compensate customers for such benefits.

There are some further barriers (and opportunities):

- **VAT** has inconsistent treatment, e.g. 5% on sale of a solar+battery vs 20% on battery only retrofit. This needs to be harmonized and also could act as an opportunity – e.g. a 5% rate on installing solar only with a battery could negate the EU legal case on discounted VAT rates, equally other countries directly offer subsidy for batteries including Germany (KFW fund) so would be consistent with other countries to offer a relief on solar co-installed with batteries, or batteries in isolation, albeit using VAT instead of a subsidy.
- **Install standards and benefits** – a benefit of a storage subsidy in Germany (in practice only £25-30m) has harmonized standards of batteries, both for safety, installation, how sold, warranty and a 'passport' process to both register storage and deploy it consistently (to qualify for the KFW relief/subsidy). A similar light 'subsidy' would be the cheapest way for UK to ensure convergence and consistent delivery in the UK System
- **SAP/ECO/GD** – Storage is not properly classed as eligible/beneficial within existing mechanism that reward efficiency or low carbon building standards – yet have significant benefits to end customers, local network and system cost
- **Topology** – BTM batteries can be installed as AC Coupled (i.e. on the mains side, so they can both be charged when solar exporting, or by smart tariffs at night) is likely the best approach in UK and EU over DC coupled systems (that can typically only act for solar storage, and not access smart or night tariff charging at winter, as to do so would impact FiT meter readings. There could be improved clarity in market on Smart Metering/Tariffs, and guidelines as there is a risk that DC batteries are 'dumb' assets that could be obsolete when smart meter and ToU tariffs become properly available with the DCC and smart meter roll-out. Equally clarity is needed in LV, IET, Building code, qualifications (MCS, RECC), and standards – again accelerated in Germany by a 'passport' process for obtaining subsidy access.
- **FiT Deemed Export** – it remains unclear in UK legislation the extent to which future 'metering' might reduce existing 'deemed export' payments set at installation date. This has a significant risk to funded assets – as presents an uncertainty on cash flow – and disincentive to storage installation or self-consumption (both of which significantly benefit and save money for the grid, e.g. NIC report). This should be clarified that Deemed Export remains static or even used as an indirect opportunity, to remain only if storage is installed alongside metering, since the SoS may have discretion under the Act to determine if deemed export is replaced by metered export.
- **Asset Definition** – in line with 2.6 – clarity on storage as an asset class, who can own, how funded, and how portable contracts are (e.g. between Utility suppliers – like meter asset provider finance) or House purchases/sellers (treated as part of building / fixture)

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

There are some specific areas for BTM storage that should be assessed as it is critical that there is light or simple process and regulation for easy deployment of distributed resources, and to use this as an opportunity to capture / or register distributed assets – as growing potential resource to the energy system.

Existing G83/59 Distribution Generation Code is appropriate however, for

- Dumb/DC coupled battery installation – this does not directly hit a requirement of network notice, since includes no additional inverter (though has a potential impact on existing inverter warranty/performance, as well as MCS compliance for original install)
- For new installs of AC coupled batteries, this requires a G83 (and potentially a G59 pre-application for multiple installs in an area (e.g. social housing) or when going above a net 16A per phase export limit – even if marginal, or when adding EV or other resources. This could create additional paperwork and process, and may be inconsistent in response time across different network operators.
- A broad class exemption might be better for storage assets (up to a limit on power or capacity) configured to certain functions, such that by centrally registering – they are notified to the grid/and available for future services, rather than require local G83/G59 process – on the basis that BTM are beneficial to grid in helping to reduce peak solar and evening peaks, and increase demand during off-peak times.

There is an opportunity here on a form of registration, or incentive to do so (perhaps for a VAT relief or marginal subsidy) that creates clear tracking of such distributed resources, and location. Smart batteries are also relevant as enable networks to see real-time positions or solar activity, and capture such activity for utilities and metering. This area remains poorly monitored in the UK – resulting in poor data on the role/scale and impact of BTM resources on the grid.

Q3. Have we identified and correctly assessed the main issues regarding storage and network charging? Do you agree that flexible connection agreements could help address issues regarding storage and network charging? Please provide

evidence to support your views, in particular the impact of network charging on the competitiveness of storage compared to other providers of flexibility.

There are issues on network charging for FTM/Grid connected assets that are clearly an AEC, and have been correctly addressed to level the playing field.

BTM side is not significantly impacted by current network charging methodologies – though C&I/large scale sites may use storage as a form of Duos/TNUos arbitrage that may be unsustainable (Germany may show shortly a significant increase in standing charge for T&D costs – independent of KWh consumption).

The report correctly identifies (2.1.2 Point 10) that storage can reduce stress on network in curtailing peak solar and peak load. This is not correctly monetized or recommended as a guideline or target under RIIO. This could be addressed by

- Mandates/targets similar to California under RIIO or as separate reward/incentive to DNOs
- Use of flexible connection agreements to pay BTM battery installers a capex contribution or contractual income for benefits in reducing peaks
- Allowing storage to be an allowable measure to reduce network charges (that might be levied on Solar PV scale deployments, or new build)
- Allowing a reduced network charge/power obligation for new towns built with reduced overall energy profiles at peak (e.g. solar/storage/efficiency) as enables more homes within a network charge levy
- Encouraging asset finance provision by DNOs in areas / heat map where storage additions could help reduce or defer network upgrade costs

There is a clear opportunity (and learning from Germany) that excess renewables can drive up costs of operating the network system if only levelled on metered consumption. Storage clearly helps spread consumption and balance system so should be incentivized to be aligned to network needs, but also needs to be managed to not distort market in scale. E.g. higher standing charges as default (to ensure system costs are recovered – regardless of consumption) but then reliefs if BTM assets are seen as beneficial in reducing network costs.

There is likely to be a partial impact on BTM assets from final consumption levies, that could be offset as aggregates of BTM assets form valuable resources to export – so double counting of charges reduces economic and system benefit.

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

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

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

Network operators should help own or provide low cost finance for storage. A BTM storage resource provides benefit across the full stack and could be viewed simplistically as a third for BTM (customer and utility related), third for network operator (DNO) and third for system operator (ancillary and balancing). An issue with LCNF is perhaps desire to make a business case by projects that only look at DNO impact or regulated RIIO income streams, without proper ability to monetize merchant or Arbitrage opportunities (as outside their regulated layer). This means that

- LNCF & NIC project outputs that may underplay the whole system approach to storage benefits (as shown by the Imperial. G.Strbac team analysis)
- Countries with more integrated Wholesale agent/DNO, or nationalized systems may create more favourable (vertically) integrated models
- Introducing yet more layers to UK regulated may erode benefits, margin and deliver non-competitive fixed price activities rather than novel or innovative system solutions

Network operators, and future DSO must clearly play an important role in storage as long as this does not exploit a monopoly.

- They could play a role in providing low cost / asset finance for storage assets deployed in their region in favourable locations (that reduce or defer capital or manage issues). This is a logical role that could be regulated as a target – since DNOs know their network capabilities and future demand costs
- Higher incentives (profits to DNOS) for HV changes over LV though may bias delivery to HV network specific changes that have high regulated profits over LV. So RIIO is essential
- DNOs could own and operate perhaps within a % cap within a region so as not to distort market activity.

Moixa has developed a model for expanding the principles of MAP (meter asset provider) and MOP (meter operator) to Batteries – as BAP (battery asset provider) and BOP (Battery Operator)

It would be logical for existing regulation on MAP/MOP to be expanded to allow BTM Storage as a meter related accessory – and therefore financed and portable between utility suppliers in a regulated bill. Also without batteries co-installed with meters – it is questionable whether meters alone can successfully deliver demand change and shift. It is arguable that 30-50% of Storage could be part funded in this way.

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DNOs (or DSO) could act as a BAP – Battery Asset provider – in providing low cost funding for a portion of battery system costs, in areas that are identified for storage value for network costs. E.g. in a zone 1-4 type map – e.g. perhaps as 1% to 4% i.e. incentivizing storage low asset finance rates in certain locations, and treated as a regulated asset.

Similarly, System operator could provide part asset funding for a proportion of battery costs – due to the value of storage (NIC) for system ancillary, services balancing.

BOP – battery operators need to be free to maximize flexibility and income, trading, merchant independent of being a pure utility, network operator, or system/DSO.

It would be wrong, in our view, for full cost of battery to fall on utility / end customer bill – since flexibility delivered by such assets benefits the full system, and delivers infrastructure. Each £1bn on distributed assets saves multiple £bn across the energy system (in effect reducing DNO, TSO costs) at the expense of utility side margin and customers. Arguably Final consumption levies also distort this – or create inequality across customer groups.

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.

Planning guidelines provide an opportunity to accelerate the deployment of BTM storage of benefit to the grid. Currently building code (low carbon homes, SAP, ECO, Green deal, VAT, reliefs) do not provide proper recognition of the value of storage in planning, so are an adverse effect on competition and deployment of storage in scale. Equally network charges (Q3-4) do not correctly compensate or defray charges for storage as an abatement measure.

There are few restrictions though on deploying storage in scale across multiple sites, and is a rapid deployment. For example, Moixa completed an Energy Storage Demonstration for DECC (across a few hundred homes) arguably before other DECC storage projects got permission (environment/network connection/community) to deploy assets.

In California – following the major Aliso Canyon gas leak – over 70 MW of battery storage was rapidly (8 months from procurement) deployed to address the reduction in capacity caused by loss of that line.

Several GW's of storage could be installed BTM by 2020, given the right economic and regulatory clarity, and deploying solar+storage is likely one of the fastest ways to build scale plants in a short timescale (as may become required in France should a significant reduction in nuclear capability be dictated by policy or safety considerations).

Storage presents an opportunity for new towns – e.g. the new 14 garden cities, to reduce network costs significantly, in say combination with solar, LED lighting and other efficiency measures. Moixa projects for innovate UK and DECC have previously demonstrated reduced overall energy profile – and peak profiles, so where dictated as planning policy – new towns could have

- A lower domestic profile, resulting in reduced network charges and infrastructure cost, e.g. of the nature of 2 homes per traditional 1 home network limit, or 3 homes where combined with air-source or CHP
- A lower carbon profile and lower lifelong energy cost for the household
- Improved capacity to accommodate expected peak rises with electric vehicle adoption or new IoT demand technologies

Moixa is supportive of the NIC (National Infrastructure Commission) report, which also cites Moixa & Tesla, in its recommendation that OFGEM and RIIO need to incentivize network owners to make better use of storage

California achieved this by:

- Top-down mandate and obligation shared across network operators and suppliers to deploy (no technology dictated) storage targets
- SGIP benefit (capex) to end users installing storage, but levied onto network operators/suppliers

Moixa welcomes the 2016 Budget and Network Innovation Competition focus on storage and DSR, and indeed has delivered projects for DNOs including current National PowerGrid
(http://www.smarternetworks.org/NIA_PEA_PDF/NIA_NPG_011_5119.pdf)

Given storage has value behind just network benefits – it is important that such and additional funding not be managed more holistically across areas not yet in RIIO, or where storage benefits the energy system.

Q6. Do you agree with any of the proposed definitions of storage?

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If applicable, how would you amend any of these definitions?
Please provide evidence to support your views.

Moixa welcomes the proposals to define storage, to enable better treatment under existing Acts, though storage is a different asset class as enables both push/pull, wider system and customer benefits, and unlike DSR is perhaps for BTM / households more persistent as infrastructure as can be independent of occupancy or season.

A critical opportunity is to use any definition or policy change to enable

- Distributed energy storage resources to better and easily participate in accessing and delivering ancillary services
- Be treated as an asset with secure income streams to enable cost effective asset finance

Along with existing programmes on HHS/Settlement improvement, smart metering, and areas above (on network, MAP/MOP etc.).

It may be useful for BEIS to note recent developments in the US under FERC, as their definitions are quite helpful and structured to make storage and distributed energy storage and aggregation available to participate in markets (e.g. CASIO)

The US recently published FERC proposals (FERC - 157 FERC ¶ 61,121 – Nov 17 2016) - Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators; https://www.ferc.gov/whats-new/comm-meet/2016/111716/E-1.pdf , e.g.:

- First, we propose to require each RTO/ISO to revise its tariff to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, accommodates their participation in the organized wholesale electric markets

- **FERC's Storage definition** - We define an electric storage resource as a resource capable of receiving electric energy from the grid and storing it for later injection of electricity back to the grid regardless of where the resource is located on the electrical system. These resources include all types of electric storage technologies, regardless of their size, storage medium (e.g., batteries, flywheels, compressed air, pumped-hydro, etc.), or whether located on the interstate grid or on a distribution system.

- **Distributed definition** - We define distributed energy resources as a source or sink of power that is located on the distribution system, any subsystem thereof, or behind a customer meter. These resources may include, but are not limited to, electric storage resources, distributed generation, thermal storage, and electric vehicles and their supply equipment.

- **Aggregator definition –** 'We define distributed energy resource aggregator as an entity that aggregates one or more distributed energy resources for purposes of participation in the organized wholesale capacity, energy, and ancillary service markets of the RTOs and ISOs."
-

Within the FERC proposals – the participation model is outlined as:

"The proposed participation model must (1) ensure that electric storage resources are eligible to provide all capacity, energy and ancillary services that they are technically capable of providing in the organized wholesale electric markets; (2) incorporate bidding parameters12 that reflect and account for the physical and operational characteristics of electric storage resources; (3) ensure that electric storage resources can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price; (4) establish a minimum size requirement for participation in the organized wholesale electric markets that does not exceed 100 kW; and (5) specify that the sale of energy from the organized wholesale electric markets to an electric storage resource that the resource then resells back to those markets must be at the wholesale locational marginal price (LMP)."

So in effect creating a simple level playing field, enabling storage resources to be eligible and participate (within their technical capability) with low minimum thresholds (Moixa supports the recent lowering of the National Grid FFR threshold from 10MW to 1MW) but principles like this are a good one, since there is 'longtail' of energy assets across the UK system that in aggregate constitute a significant resource (e.g. 2GW of estimated laptop batteries, or similarly in UPS systems).

2.2 Clarifying Role of Aggregators - Removing policy and regulatory barriers

Successful UK policy and market environments for Aggregators are likely to create the fastest delivery of system savings as well as demonstration for export to world markets. Storage is an essential part of this as has merits over DSR particularly in domestic properties (where DSR is hard or not sustainable in peak periods), and as predictable (bankable) infrastructure asset.

It is important as per Q6 (and FERC examples) that distributed assets can participate fully in the market. It is important also to recognize the speed at which managed aggregates of distributed resources could be significant in the UK and world-wide infrastructure, and the role of large swarms of millions of devices – electric vehicles, eMobility, customer assets, robotics, IoT and consumer electronics, UPS will have in managing energy systems.

This has been at the heart of Moixa systems and IPR for some-time, and a recognition that this longtail represents in aggregate a considerable potential rise in electricity demand – particularly during peak hours – and rapidly.

Our view from DECC and other data sources, is that domestic electricity consumption on an average basis has stayed static (at 5KWh for non heating per day) for intermittent use of high power AC goods such as washing, wet-goods, cooking, since 1980, whereas there has been a gradual rise in low power (often DC) goods of 0.5KWh per decade, for media, computing, ICT, IoT, and lighting (falling with LED but rising with controls) rising since 1980 to nearer 5KWh per day in 2017. Much of this rise is concentrated during peak hours or forms a rising base load (e.g. communication and 'smart appliances').

DSR is highly challenging over such low power goods as are always on, often at peak and consumer centric – inaccessible to price responses over behavior (or need). Rising IoT will increase this.

DSR has some merit on high power goods – though in practice these average out, and do not concentrate at peak hours, and only some of potential inventory is ever accessible to a change in use time, despite price optimism

Energy storage in contrast can be managed invariant of household occupancy, season, behavior so is arguably more predictable (chemically) and physically over time. Storage also forms a considerable and growing resource across devices and IoT since most battery production goes into 'stuff' rather than physical BTM or grid scale battery resources, or indeed Electric Vehicles. In 2014 there were more batteries in UK's mobility scooters/fleet than in electric vehicles, and today several GWhs of laptop/computer batteries charge daily – forming a potential shift-able demand. Whilst similar battery capacity resides in UPS systems these typically are not cycled daily (for chemistry lifecycle or UPS back-up reasons) and so are less relevant as shiftable demand or trading resources, form a capacity back-up (as is their purpose).

As an example of scale – there are 150 million electric bicycles now in daily use in china, forming potentially over 40GWh of daily charging – or equivalent to a typical hourly demand in the UK, or the typical energy lost through wind

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curtailment daily in China. This illustrates the potential of aggregation should millions of such devices be managed in line with grid objectives.

The future is somewhat predictable, in that rising fleets of electric vehicles, robotics, IoT will form a growing daily increase in storage charging (as shiftable demand) and capability for bi-directional or managed appropriate services.

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?

Aggregators are largely un-regulated – which has positive (freedom to innovate and deliver) and negative (reduced control or monetary value), and also represents a rapid loss of control to system operators – where such swarms of devices in aggregate form meaningful and shiftable demand (e.g. turning off every internet connected device in a class – e.g. electric vehicle or ebike) at will for a motive (grid opportunity) or problem (cyber security). It's likely the impact of this will make itself visible to system operators – before the regulation evolves to be capable of efficiently using and rewarding such resources.

This will have a considerable impact and opportunity by 2020 as significant proportion of UK grid, so needs to be a much higher priority on policy (not clarifying), and also represents an innovation / export opportunity for UK.

There are a number of barriers which impact effective commercial opportunity and stable management (visibility / reporting) of aggregated resources.

- Full access (as per FERC) to be able to provide inventory, resources into market mechanisms
- Stacking of multiple revenue streams (vs constraint by TSO contracts requiring exclusive periods) and ease of stacking and managing
- Standards and acceptance of central platforms (cloud) reporting over individual metering for access to ancillary services
- License requirements or high costs for access e.g. to supply licenses – though mechanisms to work in layers to other aggregators
- Monetization either through reporting, capex/relief on device capability, settlement

Moixa is supportive of the moves and BSC changes towards HHS (half-hourly settlement) as it is important to be able both to record and monetize distributed generation and demand fairly and to enable smart meters and storage to deliver significant network and system savings.

Moixa have developed, and patented, a platform to aggregate storage across multiple sites, to perform for various grid services – and validated across a range of utility, network and system pilots. We view distributed storage resources need a persistent 'middleware' and 'API' to enable persistent management over time, and to work with or through pure play 'Aggregators' of the day (or ones winning temporal auctions/contracts). This is the challenge of distributed energy – to ensure effective service over time, through various regulatory, market, changing third-parties, and other uncertainties. Our view is that clear or simple policy, standard/APIs as well as IPR helping to ensure consistency – is essential for distributed storage and other resources to play a meaningful and reliable part in the energy system.

Moixa is also supportive of DSO plans – as the complexity of the system could be mitigated in part by effective regional management. Part of this would be accelerated by DNO roles in regional management through DSR, Storage and aggregation.

HHS may not be sufficient for effective system management which various bodies view could be in minutes.

Utilities in particular, smaller utilities without generation assets, are paying a growing share of balancing costs and volatility, as partly expected since the single cash-out mechanism change in Nov 2015, and uncapped limit. This is likely to continue to wipe out small suppliers unable to manage this flexibility but also rises the challenge and competitive opportunity for such suppliers to more rapidly adopt storage/DSR to deliver flexibility to minimize their direct exposure.

From a market categorization there may be merit in combining MOP and BOP (battery operator) activities with Aggregator roles, since storage will form a significant portion of DSR services and likely more stable and measurable.

Moixa is supportive of PowerResponsive initiatives, and particularly the unique role BTM storage can have in DTU (Demand turn-up) and Utility Imbalance management as well as supporting effective delivery of smart tariffs.

A concern and potential barrier is the rising complexity of the market as well as the growing number of participants – resulting in low margin business models (utilities) and likely pure-play aggregators, and ultimately a lack of competition in the market that may favour large scale (utilities and system operator) only.

Q8. What are your views on these approaches to dealing with the barriers set out above?
Q9. What are your views on the Pros and cons of the options outlined in Table 5.

The market is complex so early tests/demonstration will de-risk and inform policy requirements. Monitor is fine but enabling and evaluating (e.g. under NIC or other BEIS Innovation mechanisms) should be encouraged – e.g. market tests that simulate a market income – rather than auction – under BEIS of PowerResponsive type approaches.

BSC HHS and greater allowance of aggregators, independent aggregators to participate, as well as lower thresholds should be encouraged, as should be greater allowance for stacking or combining conflicting contract opportunities.

Aggregators should not be managed under supply licenses, however, code of practice as well as standards are essential for aggregation approaches to be persistent over time. This is both a technology challenge, standards and regulatory alignment challenge.

Q10. Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure?

Aggregation is likely to happen regardless of regulatory control, and may like the WEB and IoT/International services be driven by end devices and service providers or asset owners. It is therefore important in the short term that regulation is light to allow early evidence of how such future services evolve, to surface out any theoretical risks to future system whilst inventories are small, and to allow suitable future regulation to be developed.

Cyber and other risks cannot be overlooked – particularly into early large volume deployments like electric vehicles – as both the car manufacturer (e.g. doing a fleet wide update) or a cyber breach – could aggregate to constitute a meaningful sudden change in system demand and balancing requirement.

Feedback on pricing, and market through agent based, and trading algorithms will also create price spikes and impacts.

Early mechanisms to reward aggregation are likely the best way to ensure consistent deployment, data gathering and control.

3. Providing price signals for flexibility

Moixa is supportive of Half-Hourly Settlement, Smart Tariffs and Metering as enablers of a more flexible energy system – but views energy storage as the central mechanism to deliver system value for end customers. We believe price signals need to drive technology and plans rather than people – in part due to the 'low attention' energy has for consumers and households (other than concern on high cost) and lack of fair or general ability for end consumers to genuinely respond to price signals.

System Value Pricing – Q11-Q14.

Price signals (wholesale, imbalance) are essential for energy operators – who care about energy and understand its supply complexity and are in a position to manage energy fulfillment for price or stability motives. End customers, P2P cannot be fairly relied upon to be 'responsive' in an energy system – particularly one with an unknown and likely growing future energy demand profile. It must be managed in an expectation of increased self-automation

It is also essential with a growing intermittent generation portfolio that Storage and DSR are used to mitigate volatility and the German model of concentrated system price recovery at peak times from domestic households (punishing those that do not have generation or ability to respond or vary demand profile).

Simplicity may also be important in market design for pricing, rather than as market traded or demand price driven. For example arguably part of the US SGIP approach (& KFW Germany for storage) vs UK FiT was to provide an upfront capex payment for installation of solar/storage, i.e. recognizing in a relief or capex contribution the value contribution to the system. Such a mechanism is used say for energy efficiency technology (e.g. should be for LED lighting), and could perhaps be an alternate mechanism for DTU (demand turn-up) rewarding upfront assets that by default could be set to store energy in peak solar, or at night, rather than require complexity/trading and reporting for on-demand response to such needs.

It may be simpler for such 'flexibility' in some device categories to be paid one off/upfront, or as a form of 'availability payment' as a capex contribution upfront to record/and make known the deployment of the asset, and availability for future demand opportunities. E.g.

Stacking revenues is essential to ensure full utilization of distributed resources, and maximize revenues as well as provide agility over changing regulatory or market requirements. It is likely essential that rare 'on demand' services at system operator can accommodate in contracts use of assets for merchant and other network income opportunities.

Smart Tariffs – Q15-Q18.

Moixa has responded separately to the Ofgem HHS consultation and are supportive of the proposals and for mandatory HHS, together with Smart Tariffs/ToU, Smart Meters as the only way to properly deliver flexibility and fair billing across all participants in the energy system.

It is also key that market participants can get better access to fiscal meter readings, to enable best DSR, aggregator and storage services, at low cost for data access and at low overall settlement cost.

We believe such initiatives are only valid if energy storage is properly available as part of the energy system, and that tariffs are kept simple for end customers and automated by technology in smart batteries and appliances.

Smart Batteries are a logical co-installation with Smart Meters as can deliver an immediate ToU benefit and a customer benefit to households – without requiring complex/time bills. Without this there may be customers may not wish to have a smart meter installed – if they for example work during the day and have no choice but to use energy at peak evening times. Without a DSR or storage asset installed, there is a major disincentive to allow the smart meter fitter through the door (similarly with water meters).

There is a real potential issue to consumers – already faced with complex bills (simplified by Ofgem RMR, and TCR – tariff comparison rates) that bills will become uncertain and confusing by adding a new 'time' dimension. Such billing complexity strategies have been used effectively in the mobile industry to systemically raise prices.

However, enabling new ToU tariffs will require removing restrictions on tariff types. However, delivering flexibility into homes requires encouraging a term relationship between suppliers and households – and in contrast to the switch marketplace – unless mechanisms are in place for assets to be portable between suppliers – e.g. like MAP/MOP obligations otherwise there is a structural disincentive for Suppliers to invest or work with customers over time to save energy.

An alternative approach for fair apportioning and simplicity in ToU tariffs, could be for the system operator to levy a system wide winter evening peak surcharge (e.g. few pence) to all consumption. This in one action would create a nationwide understanding that peak actually costs more – rather than staged self-selecting, adoption and arbitrage/changes on series of complex Time of Day price experiments. Consumers could then likely use this learning to inform later choices for bespoke or smart tariff selection that has time of day elements of shift changes – however, many household energy demands are not available to be persistently moved without automation – which feeds back to the critical dependency on storage or charging customer devices/batteries to such prices as a viable solution.

Smart Distribution Tariffs – Q19-Q21.

Some smart distribution tariffs could be levies, rebates or reduced network charges in respect of assets deployed that deliver network savings by addressing problems – such as excess solar export, or peak consumption. In Germany for example – solar is capped to 50% export to get permission or higher if combined with storage – rather than as a demand / smart price response. There needs to be a consistency across DNOs and likely within the current RIIO control period rather than into next phase.

We suspect Smart Distribution tariffs, will need to be split into an 'access to system' charge, as well as new charge mechanisms that reflect usage charges rather than capacity, and will likely require a shift to a Distribution System Operator (DSO) model to properly deliver, along with aggregator and Battery Operator (BOP) market roles.

Smart Distribution Tariffs – Q22-Q23.

Again Germany is a significant warning here. Use of UK system is down over 10% in terms of KWh through system each year, compared to few years ago (driven by grid-edge PV/wind, and potentially some efficiency/recession impacts), and this is likely to increase with current UK renewable strategy. Germany has significant volatility in use of system – particularly on solar weekend/bank-holidays where solar generation alone can be the majority of the grid. This is not an efficient use of system, or design, and likely pre-empts the expected 80%+ rise in T&D costs in Germany in 2017.

For UK each 10% fall in system use will simply translate to a 10% increase in T&D costs for end customers. A combination of access, standing charge and use of

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system costs to DSO management is likely required.

Other Policies – Q25-Q27.

Uncertainty or delay in policy can be unhelpful, particularly to investment markets and asset finance. In contrast no policy or removal of policies (e.g. FIT, ECO, Green Deal) at least provides certainty and enables a level playing field for market evolution.

The refocus of DECC and Innovate, into BEIS and Industrial strategy is welcomed to take a holistic approach, and to effectively drive policy from macro commercial (domestic saving, security) and export considerations. A key policy opportunity is ensuring there is a strong enough domestic market to exploit innovation and scale-up to enable effective export (and defense against better funded or scaled technologies from markets providing early market subsidies to achieve scale).

4. A System for the Consumer

The UK has difference profile characteristics to say California where DSR can drive significant flexibility. E.g. Solar is an asset in California due to high intraday energy demands e.g. from Air-conditioning (and in southern Europe, North Africa, and south east Asia). In general Solar is a liability to the grid-system in northern Europe as produces energy at the wrong time – when energy generation is in surplus from other sources.

Equally UK does not have the same proportion of easy DSR such as air-conditioning that drives volumes of smart and DSR activity in other countries.

Smart Appliances are relevant but have a long churn/replacement cycle and forms a self-balancing resource as are all intermittent – e.g. a washing machine is on average used for 5% of the day time – so 1 house in 20 is using a washing machine over each average hour. Changing such households to use appliances at different times is hard – if they are used for a reason (time occupancy/need) and on average can potentially only be moved for short intervals.

The rising demand of new appliances (EVs, Ebikes, Robotics) are likely to constitute new sources of flexibility but we are suspect of approaches that rely on the 'consumer' as being at the heart of the system, given low attention (and sometimes price compared to say communications or media cost) for households.

A better approach is B2D – or business to device, or IoT / M2M – where swarms of devices are managed. The consumer is the owner or needs to be aware to purchase efficiency or smart – but the device succeeds if the customer does not need to then engage in any activity – and systems self-manage.

The challenge is to ensure this over time, decades, given the reliability of early stage technology. Consider broadband – needing many different iterations or replacements to stabilize. Most early Smart homes, as with early Microsoft/computing systems and operating systems, are a nightmare of 'Roald Dahl' Tales of the Unexpected proportion. It will take considerable time for Smart to be useful and save consumers time/hassle and money.

Technically open standards, inter-operability are key – to achieve longevity and serviceability. Data privacy and security are equally important but too much emphasis is placed on device/data privacy (which can save customers money) when customers often concede considerably more data, privacy and consent rights each time they use an App or online service, or Google or Facebook. Ultimately enabling a provider to manage devices or energy will likely give much greater saving and efficiency to end users than providing an active role for the consumer.

28. We agree with the 4 principles for smart appliances, but that they should be managed on behalf of the customer

29. Labelling is key initially but ultimately all appliances become smart as customer chosen attributes. Directives can help converge and accelerate adoption.

30. Moixa has data sets, and experience, and can provide more profile models from data, as well as Battery Storage Systems.

31-32. Smart appliances present challenges for vulnerable customers on maintenance and reliability and increasing complexity. Moixa has a range of views on how to help address.

4.2. Ultra Low Emission Vehicles in a Smart Energy System

Moixa has some and growing experience of integration with Electric Vehicles and VPP services.

Ultra Low Emission Vehicles Q33-Q35.

EVs ultimately create a significant challenge to the UK grid in raising the average

'Elexon' profile by a factor of 2 or 3 if unmanaged. On an average basis a UK EV uses the same daily consumption as a household – but will fall over a peak and night period. Obviously tariffs, and charge points, and policies can directly mitigate this and present a price opportunity for night tariff charging, as well as useful Demand Turn up resource for National Grid.

EVs in general are problematic as V2G (Vehicle to Grid Services), but are good for managed demand, Frequency response, and emergency back-up (where suitable access is provided). They are therefore good at short power rather than capacity opportunities so are more G2V grid to vehicle services than acting as a reservoir to charge and power a home (which reduces a journey for the vehicle so is very expensive use of EV resource). However as shiftable demand – they can act as a negawatt – effective generation, without directly pushing capacity out of the vehicle.

4.3. Consumer Engagement with Demand Side Response (DSR)

Large energy customers will have a P&L/budget focus on managing down energy costs and service providers keen to offer and make recommendations. Transparency on opportunities and benchmarking are key to enable fair pricing and benefits.

4.4. Consumer Protection and Cyber Security

There is a sense (see earlier) that these risks are overplayed as consumers concede far more privacy and data risks through online services. The significance becomes when assets can be controlled remotely of potential risk or damage that are the critical areas that need protection. Recent examples include group control of 'web-cams' more for Denial of service attacks rather than in home observation – but consumers are already handing over control by purchasing 'listening' devices from Amazon, Google and others that are far more potentially intrusive

Consumer protection is needed on how energy products are sold, financed and on how bills are presented – as time bills will represent a step-change in complexity.

Social impacts also need to properly consider the rising complexity of the energy system and to avoid (as CMA) identified penalizing those on pre-payment or other mechanisms.

6. Innovation

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UK is a leader in energy innovation and on funding for early stage technology – with over £0.5bn in energy related technologies across LCNF, DECC Innovation, InnovateUK and other initiatives. Arguably this 500m+ at 0.3% of forward energy infrastructure spend – is designed to find ways to save multiple billions from the future spend.

Arguably full system/open calls can deliver system wide insight and novel approaches, whereas regulated layer innovation may only consider a subset of system benefits from the lens of the regulated and rewarded layer.

Whilst government is right to recognize that diversity in funding sources might be problematic (or overlapping and wasteful), the result of diversity is innovation – since by focusing on one consolidated (e.g. thematic) approach results will be constrained by the funding brief – and may not deliver the true innovation that often surfaces from the blend of different funding situations in the UK. The change away from EU projects may both help and hinder – if assumed that innovation can drop under an existing consolidated initiative.

UK is less good on creating an open/accessible scale-up market, and arguably has too many SMEs competing for similar margin and service opportunities, that will ultimately lead to market favouring incumbents

The UK significantly needs an active and functioning venture market for energy scale up – to leverage innovation delivered and enable growth companies to be created. This is weak in UK due to many years of changing policy, and speed in removal of existing mechanisms / subsidies.

Other countries are weaker on innovation, but have better scale-up markets (e.g. California for Energy Storage on mandates and SGIP). Sadly this means international players may use UK innovation, scale up and achieve market dominance and reduce UK export potential unless there is a significant alignment between government and quasi government related venture or scale up capital.

The UK DNOs, and TSO could play a significant role here. In EU Big 6 Utilities and corporate venture funds are playing a growth role in DSR, Storage and Smart investments.

NIC (National Infrastructure Commission) also needs to play a role in helping to address systemic asset financing issues for storage and other grid scale assets – perhaps in providing back-stop – merchant income guarantees – if say market

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regulation or dysfunction does not allow assets to fully access the income available in the short term.

BEIS should also recognize that whilst future market changes (like licenses and new Acts) may be an advantage to a future energy system – the prospect of protracted legislation may itself create an uncertainty or delay much needed investment I the UK companies ready to exploit current market place.

END