



Let's talk about Flex

Unlocking domestic
energy flexibility



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The Association for
Decentralised Energy

Let's talk about Flex:

Unlocking domestic energy flexibility

Acknowledgements

The content of this report has largely been drawn from interviews with a range of industry stakeholders, both ADE members and non-members. Many thanks to all stakeholders for their time, patience and generosity.

Much of the content of the 'Future Business Models' section has been drawn from Delta EE's **report for Citizens Advice on accessibility of future energy supply business models** and from Everoze's **Swarm Governance report, as part of geo's Core4Grid project**. Many thanks to both parties for their kind permission to use these reports and for their collaborative and open approach.

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Introduction

The UK energy system is on the brink of huge change. In 2019, the Government committed to achieving net zero by 2050 and National Grid set a goal of being able to operate the electricity system carbon-free by 2025.

Achieving these goals will require the adoption of new technologies and ways of working, as well as political will and consumer buy in. Demand side response (DSR) incentivises energy users to adjust their consumption based on signals, in order to provide benefits to the system and save consumers money. The flexibility provided by DSR will be crucial in facilitating the system's transition to low carbon energy generation, allowing huge quantities of renewable energy capacity to be integrated into the grid.

While industrial and commercial DSR technologies and providers offer system flexibility at the high end of energy consumption, domestic DSR is yet to become fully integrated into households across the country. There is huge untapped potential to engage domestic customers with the energy system and combine DSR solutions with energy efficiency measures to help achieve smarter, more efficient, lower carbon homes.

A number of domestic DSR business models are being explored, with some close to full scale roll out, provided that relevant policy and regulatory frameworks are supportive.



Business models

Current business models

Domestic DSR is on the verge of moving to commercialisation; if policy, regulatory and industry changes are supportive, it is likely to ramp up to full commercial scale in the next 2-5 years, with projects involving thousands of homes.

In contrast with the trials of the past few years, which focused on testing new technologies, most current projects focus on gathering data to build commercial models through understanding of customer acceptance and data use. Many of these projects are being undertaken by social landlords, developers, energy suppliers and aggregators.

Business models have examined applications such as demand-shifting to reduce energy import costs or maximise consumption of onsite solar PV, provision of frequency response, and provision of DNO services. A range of customer propositions currently exist, tailored to different customer segments. Some models involve customers being paid a certain amount to allow the aggregator to use their asset. The amount is usually fixed and does not directly relate to revenues from service provision. In the future, this is likely to change, with business models increasingly involving customers rewarded based on actual usage or opting for a ‘technology and tariff’ bundle, allowing their electricity provider to manage everything. A variety of business models are still likely, given the heterogeneity of different types of consumer.

Future business models¹

The core of most business models will be trading in the wholesale market and helping suppliers to manage their imbalance position, as well as retail market arbitrage; this will require policy changes to occur.

A second element will come from provision of services to the DNOs and the ESO; it is essential that revenues be stackable across national and local levels. The ESO’s review of exclusivity clauses, alongside commitments from the DNOs that they are open to revenue stacking, are welcome and we look forward to further progress being made in this area.

Time of Use optimisation

This involves customers’ energy demand adjusting in response to changing energy prices. Time of Use Tariffs can have a fixed structure (e.g. energy prices are cheaper during the night), which can encourage customers to manage their energy usage themselves, or a dynamic structure (e.g. electricity prices varying in response to variations in the wholesale price). Suppliers are likely to promote the latter more strongly when market-wide Half Hourly Settlement is fully implemented.

Time of Use tariffs can be designed for active customers, where customers manage their own energy usage and are provided with the tools to do so. The customer benefits from greater control under this approach, but they take on greater risk as they are solely responsible for avoiding expensive time periods. Tariffs can also be designed for more passive customers, with a third-party intermediary managing energy usage on the customers’ behalf to reduce their energy bills. This offers less direct control but reduces customer exposure to risk, capital outlay and need to engage.

Time of Use optimisation business models are important for enabling domestic DSR to reduce peak demand in the context of increasing electrification of heat and transport, thereby reducing the need to build or upgrade grid infrastructure. This helps to significantly reduce overall costs for GB consumers. This business model is also important in allowing increased use of renewable generation, as well as increased electrification of heat and transport, thereby helping to reduce the UK’s carbon emissions.

Energy as a Service

This involves providing an outcome, such as heating or lighting, for the consumer.

Under an Energy as a Service (EaaS) proposition, the consumer signs an EaaS agreement with an energy service provider who holds a supply license. The provider typically installs hardware such as solar PV, heating controls, a battery, metering or an electric vehicle chargepoint as part of the service. The provider can manage these assets flexibly to help optimise energy demand based on agreed consumer requirements. Consumers benefit from a convenient way to lower energy bills and reduce carbon emissions. There are two main business models under EaaS, one focusing on installation and the other focusing on selling performance.

There are different approaches to EaaS. Differentiating factors can include:

- If billing spans electricity, heat and transport or focuses on one or more of these vectors
- If billing only focuses on supply and demand balancing or takes a more holistic approach, such as active steps to improve the energy efficiency of a building
- If the subscription entails payment of a fixed fee for a set of energy services (such as, comfort, light, refrigeration, entertainment or mobility) or also includes non-energy services such as water and internet
- In the future, whether energy bills are issued and paid at an individual level (so follow people, rather than buildings), rather than at the household level, as occurs currently

The EaaS approach could play an important role in decarbonising heat by allowing Heat as a Service propositions, which could involve replacing gas boilers with low carbon alternatives without consumers having to take risks on new technologies or accept reduced levels of comfort. EaaS can help to reduce peak usage, particularly where the model includes electric heating or EV charging, helping reduce the need for grid reinforcement. For consumers focused on simplicity and comfort, who do not wish to engage directly with the energy market, EaaS could represent a desirable approach to managing their energy usage.

¹ Much of the content of the ‘Future business models’ section of this paper has been drawn from Delta EE’s report for Citizens Advice on accessibility of future energy supply business models and from Everoze’s Swarm Governance report, as part of geo’s Core4Grid project. Many thanks to both parties for their kind permission to use these reports and for their collaborative and open approach.

Lifestyle products

Lifestyle products take advantage of the increased connectivity of customers' homes and devices to create value or exciting, engaging propositions for customers. Business models today tend to be based on offering smart technologies to customers via energy suppliers, often packaged with tariffs and services and delivered via in-home devices and apps.

The category includes stand-alone devices (such as heating controls), Smart Homes (multiple connected devices, including both energy and non-energy) and Smart Life (an extension of Smart Homes into other areas, such as providing personal energy wallets for on-the-go EV charging or monitoring the health of an elderly family member via alerts).

While lifestyle products may help enable some of the other business models, they will not directly contribute to decarbonisation goals and do not produce direct benefits to the energy system. They therefore tend to be of less interest to policymakers than some of the other business models.

Efficient consumption

These models often involve companies offering data-driven approaches to improving energy efficiency. These represent a progression beyond traditional business models in this space, which involved installation of standalone physical measures (such as loft insulation or double glazing) in isolation from other solutions, usually not tailored to specific customer needs. Efficient consumption models go further towards coupling technical and physical solutions in order to identify efficiency and retrofit measures best suited to individual homes.

Business models tend to focus either on remote audits of energy usage and customer engagement tools, or building efficiency, which involves building upgrades and retrofits, either through installation of individual measures or 'whole home' upgrades. The 'energy audit' approach is increasingly provided by data analysis specialists, working with utilities to apply their solutions to customers as 'business as usual'. The 'building efficiency' approach is provided by both traditional efficiency installers and, increasingly, expert retrofit service providers who take a 'whole home' approach.

Efficient consumption approaches appeal to customers who wish to reduce bills, although the costs of 'whole home' retrofits represent a barrier to engagement. The resulting increased energy efficiency is of high importance in reducing energy consumption, meeting climate change targets and reducing impact on the grid, therefore tends to be of interest to policymakers.

There is increasing interest in the role of efficient retrofits in enabling flexibility to be offered to the energy system by users, via approaches such as flexible use of heat pumps resulting from an ability to preheat energy-efficient houses more effectively.

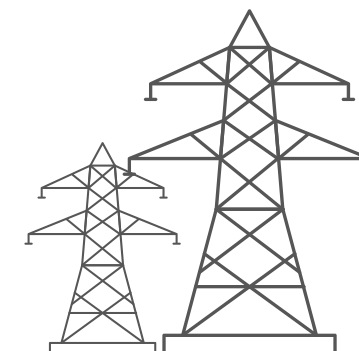


Marketplace operation

This category involves development or transformation of the marketplaces within which innovative energy services are offered. It includes price comparison sites, auto-switching companies, trading platforms (where customers can match directly with generators), and smart markets (where energy and other services can be purchased).

Trading platforms and smart markets represent the biggest change, allowing customers to choose the source and type of generation they use. Customers, particularly highly engaged ones, value the convenience of marketplaces in allowing them to tailor their energy service and enabling greater understanding of where energy is generated, such as via local community energy schemes. The emphasis on consumer choice, local community and renewable energy mean these approaches often thrive in areas with high levels of informed customer engagement.

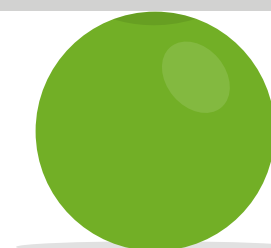
If trading platforms are not widespread, they are unlikely to have a great impact upon carbon emissions or grid reinforcement needs. If they are deployed at scale, however, they have the potential to radically change the operation of the energy system and support other innovative business models.



The future opportunity

A variety of business models are being developed to enable domestic flexibility. These have the potential to vastly increase the flexibility and efficiency of the UK's housing stock and to enable domestic consumers to be rewarded for helping the energy system.

For this vision to become a reality, however, a number of barriers need to be overcome, both commercial and technical. Many of these barriers have clear solutions; it is essential that policymakers take the necessary steps to ensure that they are removed. The rest of this report provides an outline of some of these barriers, together with suggested solutions. Other barriers to scaling up domestic DSR will exist, some of which will become known only as business models develop, but we hope that this report provides a useful starting point for policymakers and interested wider stakeholders.



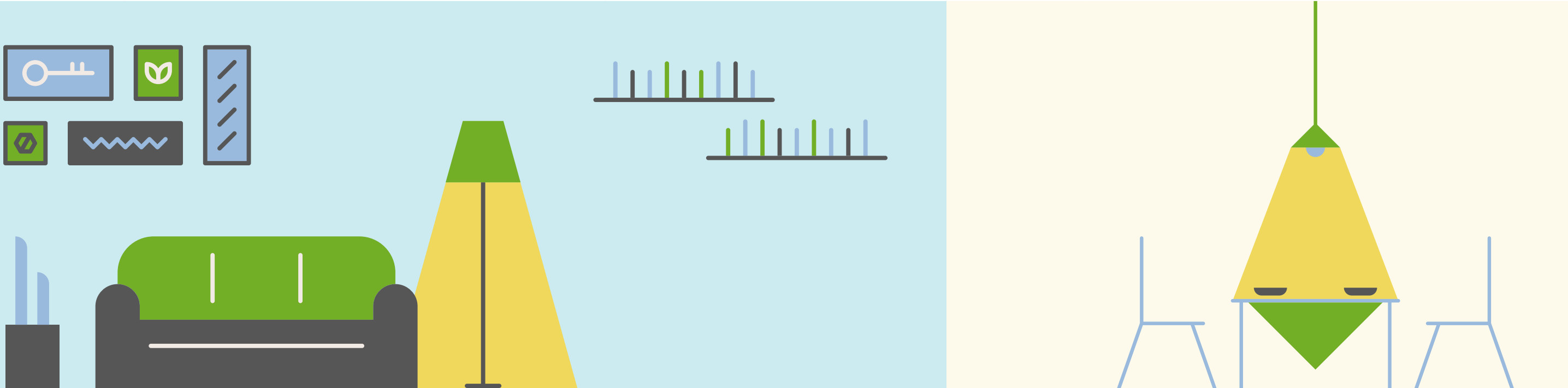
Key barriers and potential solutions

It is worth noting that while the following pages focus on barriers to domestic DSR uptake, many of these barriers are also relevant to industrial and commercial DSR.

Commercial barriers and solutions			
Barrier	Explanation	Potential Solution	What can policy stakeholders do?
CB1 Revenue stacking is difficult	The ability to stack revenues across local and national levels will be key to any domestic DSR business model.	In the short-term, DNOs and the ESO should remove exclusivity clauses that lack explicit justification and establish clear service prioritisation rules (please see CB2). In the medium-term, conflicting dispatch instructions should be automatically reconciled and, if an action creates benefits for multiple parties, providers should be rewarded for all the value their action provides. Suggestions from projects looking at the interoperability of different markets (such as the recently launched Flexibility Exchange and the Cornwall Local Energy Market) should be reviewed and incorporated into the markets in the medium-term.	Removal of unjustified exclusivity clauses and establishment of clear service prioritisation rules should be undertaken by the ESO and DNOs, in consultation with industry. Some steps have already been taken via the Open Networks project; these should be rolled out more widely and uniformly. Ofgem should ensure that this is a priority in the upcoming RIIO-2 price controls for the ESO and DNOs. BEIS should move to a more flexible way of managing exclusivity within the Capacity Market than the use of the Capacity Market's 'Relevant Balancing Services'. This could, for example, involve the Independent Panel of Experts or the newly proposed Capacity Market Panel setting out which services cannot be stacked with the Capacity Market.
CB2 Unclear service prioritisation rules	When assets are contracted for multiple services, it is not always clear which takes priority in the event of a conflict.	BEIS, the ESO, the DNOs and industry should work together to establish hierarchies of priority for provision of services. It seems reasonable that a network stability issue (which addresses a technical issue) should take priority over a balancing service (which addresses an economic issue).	BEIS should work with the ESO, DNOs and industry to establish clear hierarchies of service provision, beginning with system stability. This should build on the work already undertaken in the projects mentioned in CB1.
CB3 Neutral market facilitation	The current lack of clarity around what constitutes a 'neutral market facilitator' makes it difficult to assess if DNOs are able to fulfil the role, what they need to do to fulfil it, and what alternatives are possible if they are unable to do so.	Publication of clear guidance on the required characteristics of a 'neutral market facilitator', assessment of whether DNOs currently meet these requirements, a roadmap of what DNOs need to do to fulfil them and an assessment of alternative options.	BEIS and Ofgem should issue guidance on characteristics of a 'neutral market facilitator' and further develop a functions-based approach to the DSO. This should allow separation by RIIO-3, if this is the optimal solution.
CB4 Lack of clarity on where flexibility will be needed	DNO flexibility tenders are often issued with insufficient notice to providers meaning that, unless they have existing assets in the area, they cannot participate. Tenders are also published on a range of different platforms.	Publication of clear guidance to DNOs on required levels of transparency and notice period for flexibility tenders, together with uniform assessment criteria. Consideration should also be given to mandating that DNOs must publish their tenders across all platforms.	Ofgem to mandate standard notice periods, levels of transparency and assessment criteria in the run-up to RIIO-ED2. Ofgem to consider mandating publication of tenders across all platforms. Ofgem's consultation on network charging represents a key opportunity to signpost the value of flexibility at a more granular level.
CB5 Contract reform	ESO and DNO contracts often require providers to test and deliver at the asset level, not the portfolio level. This is unsuitable for many smaller assets, where delivery at portfolio level allows providers to manage non-delivery risks through dynamic allocation of assets. Contracts for services often require symmetrical delivery (i.e. for an asset to make up and down bids for a service at the same time). This requirement is unsuitable for many flexibility assets and negatively impacts market liquidity by creating an unjustified barrier to entry.	Testing and delivery should be possible at portfolio level to allow for dynamic allocation of assets from a portfolio. These types of contracts (with service stacking where possible) would make it easier to bring domestic DSR capacity into the market. Some work is being done to align contracts and standardise services across all DNOs. More work is needed to do the same across DNO and ESO services to reduce barriers to entry for domestic DSR. Contracts for services should not require symmetrical delivery. This requirement should be removed from all contracts unless there is a clear operational reason why bids must be linked.	ESO and DNOs to reform contracts to allow testing and delivery at portfolio level. ESO and DNO to remove any requirement to provide services on a symmetrical basis, unless justified by a clear operational need. Ofgem may have a role in progressing this if insufficient improvement is delivered by the ESO and DNOs alone.
CB6 Variation in processes between different DNOs	Different DNOs have markedly different processes and policies in many different areas, creating significant administrative burden for providers and longer customer journeys, leading to higher dropout rates. An example of this variation is the installation of 100 amp fuses; while some DNOs install these fuses for free, others charge a fee per fuse. This creates uncertainty about whether the customer or the provider should pay this fee and delays customer journeys. Other examples include different lead times for feedback from DNOs regarding if a customer property is suitable to adopt a technology, varying costs for DNO intervention, and AC and DC chargers of the same power rating being treated differently. Standardisation of DNO procedures across many different areas is essential in facilitating increased domestic DSR.	Standards and approach should converge across DNOs.	Ofgem to mandate standardisation of DNO processes via RIIO-ED2 price control.

Barrier	Explanation	Potential Solution	What can policy stakeholders do?
CB7 Procurement approaches are inconsistent across different DNOs	Different DNOs have adopted different procurement approaches for flexibility services, making it difficult for providers to enter different markets.	The ENA's work on standardisation of contracts and markets is welcome, as is BEIS' focus on coordination of marketplaces across transmission and distribution via the Flex competition. If these initiatives are not successful in promoting a standardised approach, however, there is likely to be a role for Ofgem in mandating standardisation as a condition of RIIO-ED2.	Ofgem to mandate standardised approach to procurement across DNOs as part of RIIO-ED2.
CB8 Link between innovation projects and business as usual is sometimes lacking	The ESO and the DNOs undertake a variety of innovation projects, many of which result in outputs of real value. The lessons learned, however, are not always fed into business as usual. When they are, the process is often too slow.	ESO and the DNOs to ensure that learnings from NIA/NIC projects are reflected as quickly as possible in their business as usual operations and tenders. Barriers to provision of services by innovative market participants that are discovered in these projects should be removed as quickly as possible.	Ofgem to use price controls to ensure that the ESO and DNOs are incentivised to incorporate learnings from innovation projects into business as usual as quickly as possible.
CB9 Data access	Data access is limited in a number of areas: - Sharing of data between commercial entities e.g. State of Charge data between vehicle manufacturers, charge points and flexibility providers - Sharing of data from the ESO in machine readable format - Sharing of DNO data in a standardised, accessible way across the UK - Consideration of consumer data privacy concerns and how these can be addressed	The Energy Data Taskforce recommendations are very welcome. Furthering these will require - - Guidance on data sharing between commercial entities – what needs to be mandatory to share and what can be left to commercial contracts? - Regulatory scrutiny to ensure the ESO abides by its commitment to share all data that does not breach confidentiality and privacy considerations in machine readable format - Guidelines for the DNOs on data sharing formats, standardised templates and accessibility - Analysis and regulatory scrutiny to ensure that consumer data privacy is respected	BEIS to release guidance on data sharing between commercial entities. BEIS to regulate to implement conclusions of Energy Data Taskforce. BEIS to create guidelines for DNOs on data sharing format and quality. BEIS to conduct analysis of necessary steps to ensure that a smart, flexible system develops while consumer wishes on data privacy are respected
CB10 Wholesale market access	Flexibility providers cannot currently access the wholesale market without becoming or partnering with a supplier. Many providers expect trading in the wholesale market or helping suppliers to manage their position to become a key part of their revenue stack in the future.	Allow independent access to the wholesale market, using Wider Access to the BM as a model. Under P344 and P354, systems are in place so that, when a supplier has bought energy in the wholesale market and a flexibility provider adjusts a customer's load, they compensate the supplier for the impact on their position. This could be extended to enable Wholesale Market access, with the mechanism being triggered by an aggregator's decision, not a National Grid ESO dispatch.	BEIS/Ofgem to provide policy steer via an open letter. Industry to work with Elexon to progress BSC modification.
CB11 Access to Balancing Mechanism	Independent access to the Balancing Mechanism is a key part of domestic flexibility providers' future business case.	Ensure that Wider BM Access is delivered on time and allows effective access for smaller players.	BEIS and Ofgem to support delivery of modifications P375 (sub-site metering) and P376 (baselining), which help small players access the BM more effectively, by mid-2020. These modifications are crucial to allowing domestic and non-domestic behind the meter assets to provide flexibility services.
CB12 Uncertainty in value streams	Regulatory changes, particularly the Targeted Charging Review, have created uncertainty and reduced incentives for flexibility. The Access and Forward-Looking Charges Review will play an important role in providing signals for flexibility, if implemented correctly. This is particularly the case over the next few years as flexibility markets remain in their infancy.	There needs to be a stronger, more quantitative view of the future value of flexibility in the market – taking into account reforms by Ofgem, the ESO and the DNOs. A standardised way of determining the value of deferred network reinforcement at DNO level would give flexibility providers more clarity on the potential added value from providing the service.	Ofgem to set out how the combined impact of the Targeted Charging Review, Access Significant Code Review and their development of DSO functions and RIIO-2 framework on the future value of flexibility. The Access and Forward-Looking Charges Review should maintain the role of forward-looking network charging as a signal for flexibility as part of a coordinated roadmap. Ofgem to use RIIO-ED2 to mandate better data capture, monitoring, modelling and outputs by the DNOs, in collaboration with the ESO and industry. Tangible outputs, such as local network models, should be prioritised. BEIS to provide a clear policy steer, potentially via a more detailed and quantitative Smart Systems and Flexibility Plan, to set out the overall, quantitative impact of reforms on the different markets for flexibility in the GB in the medium term, whether this is consistent with what is required to reach a low carbon, smart system and whether policy gaps remain.
CB13 Tech ownership in case of customer switching	If customers are able to switch supplier on an hourly basis, it is unclear how installation and ownership of the technologies needed for a smart, flexible system will work.	Commercial solutions to this issue are likely to emerge but, to do so, the limitation to a single energy supplier needs to be reformed (see CB14). Multiple supplier models could allow customers to combine 'standard, switchable' suppliers with 'asset-backed, committed for a certain time period' suppliers, allowing the development of Energy as a Service models.	N/A – BEIS can support innovation but responsibility lies with industry and Ofgem's oversight of code modifications.

Barrier	Explanation	Potential Solution	What can policy stakeholders do?
CB14 Limitation to a single energy supplier – ‘Supplier Hub’	This limits the range of possible business models due to need for the main supplier’s consent – constrains ability to switch supplier, prevents multiple parties from supplying the home, locks new entrants out of value chains, constrains Energy as a Service propositions.	Some reform is being undertaken via the P379 modification to the BSC, but more is likely to be required.	BEIS/Ofgem to provide policy steer via an open letter, emphasising the role of P379 in moving beyond a ‘supplier hub’ approach, highlighting issues that need to be addressed by the modification, and suggesting where further reform may be needed that is beyond the scope of P379. In particular, Ofgem should consider reform of the exempt supply arrangements.
CB15 Inability to trade network capacity	At distribution level, generation, demand and storage cannot currently trade their capacity rights to import and export.	Shared Access (currently being considered under the Access and Forward-Looking Charging Significant Code Review) could help increase rates of asset utilisation and reduce the need for costly network reinforcement.	Ofgem should use the Access Significant Code Review to develop detailed proposals for shared sites and other innovative solutions to allow local balancing.
CB16 Unclear baselining process	There is currently no baseline against which to measure domestic demand, except at supplier BMU level.	P376 (baselining under BM Access/TERRE), P375 (sub-site metering under BM Access/TERRE) and P379 (Multiple Supplier models) may help to resolve this issue. Extension of the solutions developed to other balancing services and markets may be necessary. P376 could be extendable to other markets, with providers registering a portfolio of customers into a Secondary BMU, then using this portfolio in other markets. Standardised baseline methodologies to be used across DNO and ESO markets could be useful.	Elaxon to help extend use of P376 solution into other markets. ESO to use findings of FFR baseline trial and work with industry to develop means of providers submitting baselines close to real-time.
CB17 Making the Capacity Market work for smaller assets	The Capacity Market has a minimum bid size of 2MW, which is too high for most small-scale flexibility. Making it easier to aggregate units could be an alternative to reducing bid sizes. Contract length of one year is unsuitable for some assets. Rapidly changing portfolios may require more flexibility around component reallocation. The administration of the Capacity Market is overly clunky and manual.	Reforms should be made to the design and information system processes supporting the Capacity Market towards an automated and efficient system. Reforms should be made to access to longer contract lengths so that it is based on their impact on overall system efficiency. Reforms should be made to allow more effective management of portfolios through re-allocation of components and secondary trading.	We support BEIS’ and Ofgem’s intention to reduce the minimum threshold to 1MW and reform secondary trading. BEIS should amend the CM design so that: The portal under development by the ESO allows a fully automated pre-qualification process for entering components. Pre-qualification is done on an ongoing basis up to a deadline rather than the current window. Eligibility for multi-year contracts for Demand Response is judged on a more suitable basis than ability to meet the capex thresholds. Participants can move registered components into CMUs, without notification or verification periods. In the future, the CM should allow unlimited component re-allocation during a delivery year.
CB18 Building regulations do not reflect smart functionality	Standard Assessment Procedure (SAP) does not cover smart energy functionality and is overly prescriptive on technology type.	Reforms to SAP for 2025 are planned to include more innovative technologies such as batteries. Consideration should also be given to introducing new assessment of the smartness of a dwelling; including, for example, a UK version of the EU’s Smart Readiness Indicator.	BEIS and MHCLG should explore the use of real-time performance monitoring data at domestic level to ensure compliance with Planning and Building Regulations, in addition to ongoing regulations and incentives.



Technical barriers and solutions

Barrier	Explanation	Potential Solution	What can policy stakeholders do?
TB1 Open protocols and standards – platforms and appliances	Interoperability is essential in the context of rapid consumer switching and multiple supplier models.	Develop open protocols and standards through workgroups, followed by legislation codifying these in a way that is easy to amend in the future.	BEIS should ensure that protocols and standards are developed through a process that is transparent, makes best use of industry expertise and focuses on setting the necessary technical parameters, rather than seeking to define set business models and roles. It is essential that the standards being developed by the BSI under PAS 1878 and 1879 meet these criteria in order to provide regulatory clarity without harming the development of the domestic DSR market. BEIS should bring forward any legislation necessary to implement the EU's Ecodesign directive.
TB2 Metering requirements	Metering requirements are too often expensive, poorly suited to portfolios of thousands of products, contain overly stringent accuracy standards and unnecessary additional requirements.	Clear standards via metering Codes of Practice – CoP 11, which is being implemented under P375, is a good template for this approach, which should be extended across services. The ESO should automatically approve meters that are CoP compliant under the BSC and meet the necessary threshold for accuracy of response. In addition, the ESO should define clearer pass/fail criteria and metering requirements for provision of frequency response services. These requirements should not be so stringent as to prevent domestic DSR assets from providing services. The CoP 11 requirements could provide a suitable basis.	BSC to set clear standards for metering via Codes of Practice, with size thresholds around use of Meter Operators. The ESO should automatically approve CoP-compliant meters that meet necessary accuracy thresholds and definite clear pass/fail criteria for provision of balancing services. The ESO should balance the need for accurate metering with cost considerations for providers, striking a sensible balance.
TB3 Testing requirements	Testing requirements at ESO and DNO level often focus on prequalification and performance testing at asset level, rather than the portfolio level. Many tests still lack clear, objective pass/fail criteria, which hinders the approach to independent testing. Testing should not require higher sample rates than is necessary to demonstrate performance, as a 20Hz sample rate, for example, greatly increases the cost of meters compared to a 1Hz or 10Hz sample rate, making it harder to scale up domestic DSR.	Allow testing at portfolio level based on actual performance, as opposed to prequalification testing at the asset level, to enable delivery by aggregated portfolios of domestic consumers. Shift emphasis from complicated prequalification testing to performance monitoring in flexibility markets at national and distribution-level. Greater automation of the testing process will make it simpler to qualify multiple small assets. Move towards type testing will enable faster incorporation of standard domestic assets. Ensure all tests have clear and objective pass/fail criteria.	The ESO and DNOs should lay out clear roadmaps for how testing will evolve, allowing type testing and part automation of the testing process in the medium term, followed by full automation with a focus on performance monitoring. The ESO should clearly lay out approved testing configurations for different kinds of suppliers. The ESO should ensure that aggregated portfolios delivering balancing services are tested at portfolio level, with enhanced performance monitoring, rather than mandating that each individual asset must be able to pass testing on its own.
TB4 Asset registration is overly manual and insufficiently standardised	Asset registration processes in various markets were not designed with distributed portfolios of many small assets in mind. There is also a lack of transparency around which assets are registered. Data formats are not standardised across the system, potentially leading to lower quality asset registration data and difficulty in sharing data.	Create processes which are standardised and amenable to automation. This involves ensuring that all pass/fail criteria are objective, that data can be submitted from platforms via APIs, that asset registers auto-update and that procedures are aligned across different DNO markets. In FFR, for example, providers should be able to run all FFR tests and send the results via an API, resulting in automatic asset qualification. These assets should be able to be registered in bulk, then assigned to different markets. The ESO should assign a unique ID to each asset and develop an asset registry that is auto-updated with all proven assets, linked to the unit they are in and the provider. The register of assets should be shared by the ESO, DNOs and other stakeholders.	The ESO should ensure that processes are standardised and amenable to automation, as described under TB3. The RecorDER project is examining standardised asset registration, as is the Open Networks project; the recommendations from both projects should be analysed and, if appropriate, mandated for implementation.
TB5 Market-wide Half-Hourly settlement not fully in place	Market-wide Half-Hourly settlement (MHHS), which is essential for energy-driven services like arbitrage in the BM and Wholesale Market, is not in place. Ofgem have decided that when it is introduced it should be opt-out, rather than mandatory in the first instance. Supplier billing systems need to be updated to be able to account for MHHS and net off energy costs that do not apply to their services.	Ofgem to review decision to make MHHS opt-out, rather than mandatory, by 2023, based on the necessity of achieving a sufficient volume of domestic consumers agreeing to be settled on a half-hourly basis.	Ofgem to review decision to make MHHS opt-out by 2023. Elaxon to ensure supplier billing systems are set up to account for MHHS and net off energy costs that do not apply to their services, progressing any changes under the BSC necessary to ensure this.
TB6 Cyber-security protocols	Cyber-security is an essential part of any domestic DSR offering, but common protocols have not yet been established.		BEIS to establish a set of minimum cyber-security standards, which can be included in any extension of FlexAssure to domestic DSR providers or implemented through legislation based on BSI standards development. It is essential that these standards achieve cyber-security without creating barriers to innovative business models and service propositions.

Speed of rollout

Concerns remain that the rollout of SMETS-2 meters is not happening quickly enough. It is important that BEIS and Ofgem ensure that the 2020 rollout target is achieved or overhaul the approach to the rollout. They should also ensure that suppliers are not installing any further SMETS-1 meters and that all legacy meters can be upgraded to be interoperable with all software platforms and can produce sufficiently granular data.

Lack of functionality for many services

Smart Meters lack a number of functionalities that are key to domestic DSR and a smart system; a summary of the main issues can be found below. In order to tackle these issues, it is important to maintain the principle that smart meters may be used but other metering can also be used, as long as it meets overarching standards (for example, cyber-security and interoperability). BEIS and Ofgem should issue guidance that a ‘level playing field’ approach to metering should be adopted, where smart meters are never the only option for service provision. Other meters should be automatically eligible, as long as they can meet the requirements of the specific service and the overarching standards of cyber-security and interoperability.

Issues faced by smart meters:

Sub-metering: Smart meters operate at the grid point and do not support sub-metering. This is key, because the direction of travel in policy is towards being able to operate and measure assets independently of one another.

PAS 1879, which is being developed under the BSI, seeks to attain granular details of all the controllable assets in a home. In order to maximise the financial benefit to the end consumer, it will be necessary to be able to operate these assets independently of each other. On a cold evening, for example, a consumer may be happy for their EV to be flexed but not their smart heater.

In order to achieve this, sub-metering at a level below the grid point is needed to show that these loads are responding. Under P375, a sub-metering solution is being developed for complex sites wishing to participate in balancing services – this solution is likely to provide a more flexible, innovative and enduring approach than simply using a smart meter.

In addition, this approach aligns with P379, which seeks to allow consumers to have multiple providers providing them different services, rather than going through one supplier. This opens up a huge range of

business models and enables far greater consumer choice, contracting, for example, with a community windfarm for some of their energy, a specific EV supplier for their EV and a ‘main’ supplier for all other services.

Mandating the use of smart meters would preclude these business models, limit innovation and reduce customer choice. It would also limit the services that can be offered to aid grid stability and greatly reduce the number of assets that can take part in these services.

Granularity of data: Several balancing services, such as frequency response, require data at one-second granularity. Smart meters are unable to provide this; if accessed via the Home Area Network (HAN), data is provided at 5-10 second granularity at best, while data via the DCC is at 30-minute granularity. This makes smart meter data granularity unsuitable for the provision of a range of balancing services.

Latency of control: Providers report that accessing data via the DCC leads to significant delays of hours to days for access to both data and control paths.

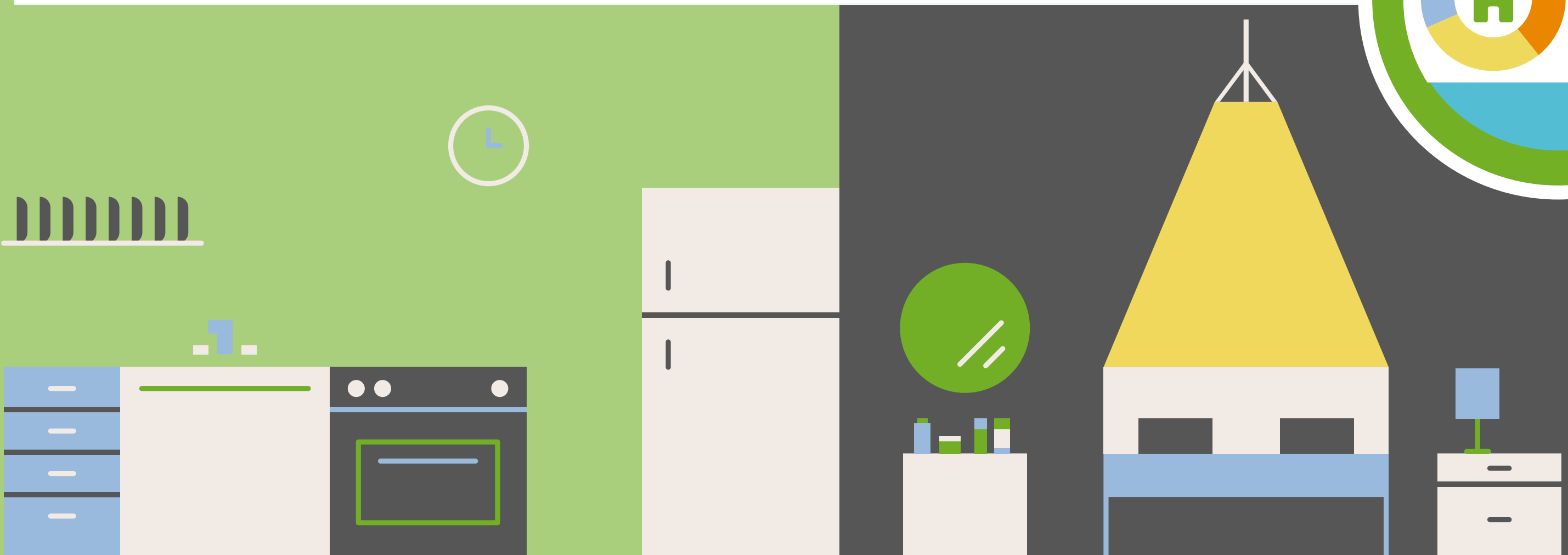
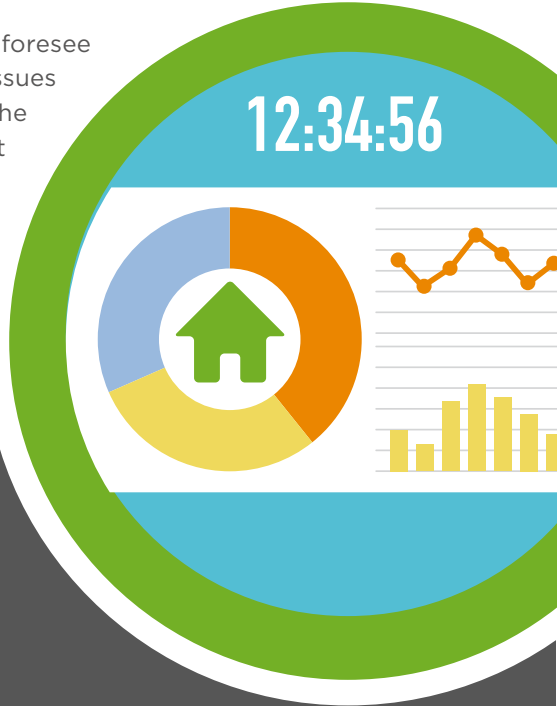
While there is a control route via the DCC that offers closer to real-time response, it is unclear how this performs for large volumes and at scale. Faster

response can be achieved by accessing data directly via the HAN, but this is more complex to set up and introduces complexities around interoperability and permissions.

Smart meters were designed as a post-facto measurement device, not a real-time control device, so struggle to provide the close to real-time control path necessary for many balancing services, such as frequency response, the Balancing Mechanism and DNO peak shaving.

Some of the issues outlined above could be tackled by system changes, but there are questions around the length of time that this will take, particularly if smart meters need to be upgraded to achieve these functionalities. The length of time and cost entailed mean that alternative approaches should be considered.

In addition, it is difficult to foresee how some of the issues raised, such as metering the operation of independent loads, could be tackled through system changes.



Looking to the future

Domestic DSR can play a key role in delivering the UK's net zero targets while reducing costs to consumers and increasing system resilience.

As set out in this report, there is a range of innovative business models and services that, subject to regulatory changes, are ready to be rolled out for wider use. In addition to the changes outlined, uptake of technologies such as EVs, combined solar and storage, and heat pumps is key to widespread rollout of domestic DSR. It is important that, in addition to removing direct barriers to DSR, policy stakeholders take measures to promote this uptake. In particular, there may be merit in:

- HMT, BEIS and HMRC working together to reconsider the decision to raise VAT on some solar and storage installations to 20%
- BEIS and HMRC considering innovative ways of financing installation of smart technologies at scale – the approach to smart meter financing may provide a useful case study
- DfT, BEIS and OLEV working together to accelerate the Road to Zero strategy, ensure that smart chargepoints are rolled out at scale and ensure that the metering approach chosen does not preclude provision of flexibility services

- MHCLG and devolved administrations legislating that all newbuild housing must have zero carbon heating supply by 2025 and meet high standards of thermal efficiency, recognising progress through the Future Homes Standard

Should the recommendations laid out in this report be enacted, the UK will be considerably closer to putting in place the smart, flexible, low-carbon energy system of the future. High levels of consumer engagement and support will be crucial in delivering this vision. Domestic DSR facilitates this by allowing consumers to take control of their energy usage, save money and lead the transition to a low-carbon society.

For further information please contact:

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Acronyms used in this report

AC	Alternating Current
ADE	Association for Decentralised Energy
API	Application Programming Interface
BEIS	Department for Business, Energy and Industrial Strategy
BM	Balancing Mechanism
BMU	Balancing Mechanism Unit
BSC	Balancing and Settlement Code
BSI	British Standards Institution
CB	Commercial Barrier
CM	Capacity Market
CMU	Capacity Market Unit
CoP	Metering Code of Practice
DC	Direct Current
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
EaaS	Energy as a Service
ENA	Energy Networks Association
ESO	National Grid Electricity System Operator
FFR	Firm Frequency Response
HAN	Home Area Network
MHCLG	Ministry of Housing, Communities and Local Government
MHHS	Market-Wide Half-Hourly Settlement
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
PAS	Publicly Available Specification
RIIO-2	Next price control for the network companies running the gas and electricity networks (RIIO - Revenue=Incentives+Innovation+Outputs)
RIIO-3	Price control for the network companies that will follow RIIO-2
RIIO-ED2	Next price control for the Distribution Network Companies
SAP	Standard Assessment Procedure
SMETS-1	First generation Smart Meter (SMETS - Smart Metering Equipment Technical Specifications)
SMETS-2	Second generation Smart Meter
TB	Technical Barrier

