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PROJECT REDMAST: SUMMARY

Research and Development of Market Structures report WP4

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EXECUTIVE SUMMARY

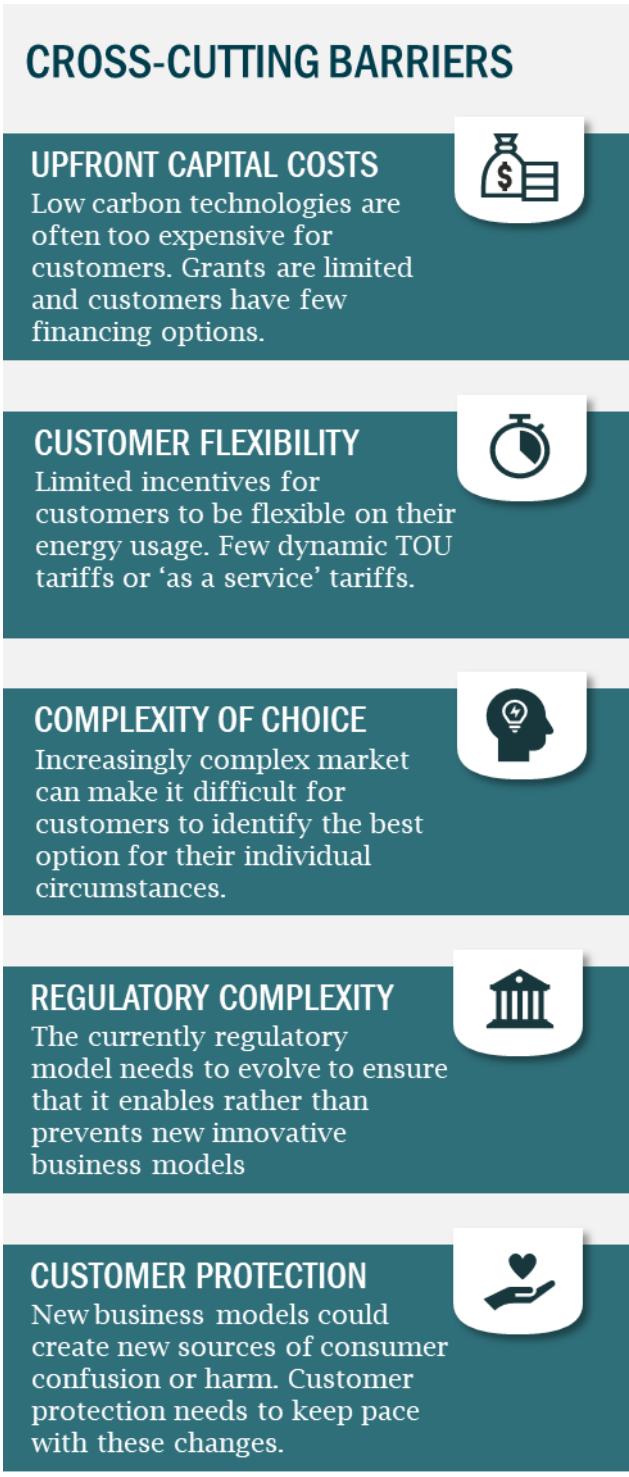
The UK has a legally binding target to deliver net zero by 2050, which includes decarbonising the electricity system by 2035.[1] This will require a fundamental change in customer behaviour, from the technologies they use to the way in which they use them. The market structure should support customers to make these changes.

The net zero transition is fundamentally customer led. Customers will need to swap out their gas boilers for low carbon technology (LCT) alternatives, switch to electric vehicles (EVs), and install thermal efficiency and solar panels in their homes. They will need to use energy flexibly to avoid costly network reinforcement that would otherwise be required to meet increased electricity demand.

The market structure needs to enable customers to make these changes. Currently the energy retail market is structured around a supplier hub model. The supplier acts as the gateway between customers and the energy system. Whilst this structure has delivered benefits to customers, it also contains several barriers to the net zero transition. Some of these barriers can be resolved via changes to the underlying market structure.

We have explored three illustrative market structure archetypes which could help address these cross-cutting barriers. Whilst we have tried to make these internally consistent, it is not possible to assess all combinations of market types and there will be options that combine elements of each of these archetypes.

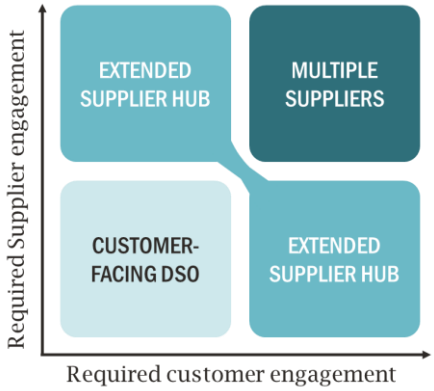
- **Extended supplier hub**. The supplier remains the key gateway for customers. Their role is enhanced with a wider set of obligations that include LCT take-up and provision of customer flexibility.
- **Multiple suppliers**. The role of the supplier is streamlined and customers are able to have multiple suppliers. This is intended to help foster competition and innovation, including technology specific business models that incentivise flexibility such as 'as a service' models.
- **Customer-facing DSO.** This alternative moves some of the 'gateway' role of the supplier to the distribution system operator (DSO). Customers have a separate contract with their DSO, which interacts directly with its customers to send flexibility signals.



[1] HM Government (2021). Net zero strategy: Build back Greener

Each of these models have the potential to overcome the existing cross-cutting barriers. However, which of these will be most successful in practice will depend on the degree of customer engagement.

If customers are able and willing to choose between highly differentiated products, then the 'multiple suppliers' model could enable firms to compete on new innovative business models for LCTs and flexibility. However if this is not the case, this additional complexity could instead result in consumer harm and another market model may be more suitable.



Another consideration is the distribution of flexibly risks Availability of local flexibility may be particularly crucial for DSOs, but if it cannot be accessed when and where it is needed (either due to a lack of customer acceptance, or an inability to procure via flexibility markets) this will generate costs for the system. Again, there is a trade-off: A market structure such as the multiple suppliers option could stimulate new business models that make flexibility more attractive to customers, increasing its availability and reliability. Where DSO access issues remain, these could be addressed via appropriate regulation. However, this relies on these new business models emerging via market mechanisms. If this is not forthcoming, or DSO access issues cannot be sufficiently addressed via regulation, options such as the 'customer-facing DSO' may be required. However, these models could limit innovation and if possible, the market should avoid imposing these types of limitations.

POLICYMAKERS NEED TO DEFINE A CLEAR ADAPTIVE PLAN

The optimal market structure is not yet obvious and there are significant steps involved in transitioning to each model. Rather than committing to an alternative model today, policymakers can take an adaptive planning approach to provide greater confidence that the market is sufficiently 'ready' to unlock the benefits of any archetype before making costly changes, while still meeting the 2035 target.

1 CONFIRM OUTCOMES

Set a clear criteria for a 'successful' market

2 'LOW REGRET' OPTIONS

Identify and implement 'low regret' options which are beneficial in all market structures or support decision making. This could include:

- Data initiatives to support better customer engagement and decision-making
- Encouraging domestic aggregation
- Extending interoperability requirements
- Test beds and trials where possible

3 MONITOR KEY METRICS AND TRIGGERS

Define a set of key metrics and triggers that are used to determine the final direction of travel. This could include monitoring LCT take-up, customer engagement, and availability and uptake of dynamic TOU tariffs.

CONTENTS

1 INTRODUCTION

The UK has an ambition to fully decarbonise its power system by 2035 as part of its 2050 net zero commitment.[2]

At its heart, this transition is consumer led. It will require households to change the way they use energy, from new technologies to new consumption patterns. In this context, it is time to review whether the current market structure enables or prevents consumers from making these changes.

SIXTH CARBON BUDGET

A LARGE PART OF MEETING NET ZERO IS A TECHNOLOGICAL AND INVESTMENT CHALLENGE. BUT IT ALSO REQUIRES A FUNDAMENTAL RESPONSE FROM *PEOPLE.*

CLIMATE CHANGE COMMITTEE

1.1 PROJECT OBJECTIVE

Western Power Distribution (WPD) has asked Frontier Economics to review the current structure of the energy retail market and evaluate this against future market requirements in the context of the net zero transition. This will inform an evaluation of potential future market structures and whether the current market structure needs to be adapted going forward.

The purpose of Project REDMAST (**Re**search and **D**evelopment of **Ma**rket **St**ructure) is not to identify and evaluate all possible alternative market structures. Instead we evaluate three illustrative alternative market archetypes which recast the roles of market entities to varying degrees, and use these to draw out considerations for alternative market structures of the retail energy market.

1.2 STRUCTURE OF THIS REPORT

This report provides a high-level summary of the more detailed documents produced for the project:

- Section 2 provides an overview of the current retail energy market structure. *More detail, including the recent history of the market, can be found in the work package 1 (WP1) report.*
- Section 3 lays out the future market requirements in the context of the net zero transition and where barriers exist in the current market structure. *The WP2 report covers this content in more detail.*
- Sections 4 through 6 discusses alternative market structures designed to address some of these barriers, evaluate them, and consider the issues involved in any transition. *Please refer to the WP3 report for a more detailed discussion of the alternative market structures and conclusions.*
- Section 7 sets out our final conclusions for this work.

Throughout this report we describe the role and risks associated with flexibility – particularly for DSOs - in blue boxes. While flexibility will be crucial to decarbonising at lowest cost, DSOs will have a highly local demand for flexibility and may therefore be sensitive to any issues procuring it.

[2] HM Government (2021). Net Zero Strategy: Build Back Greener

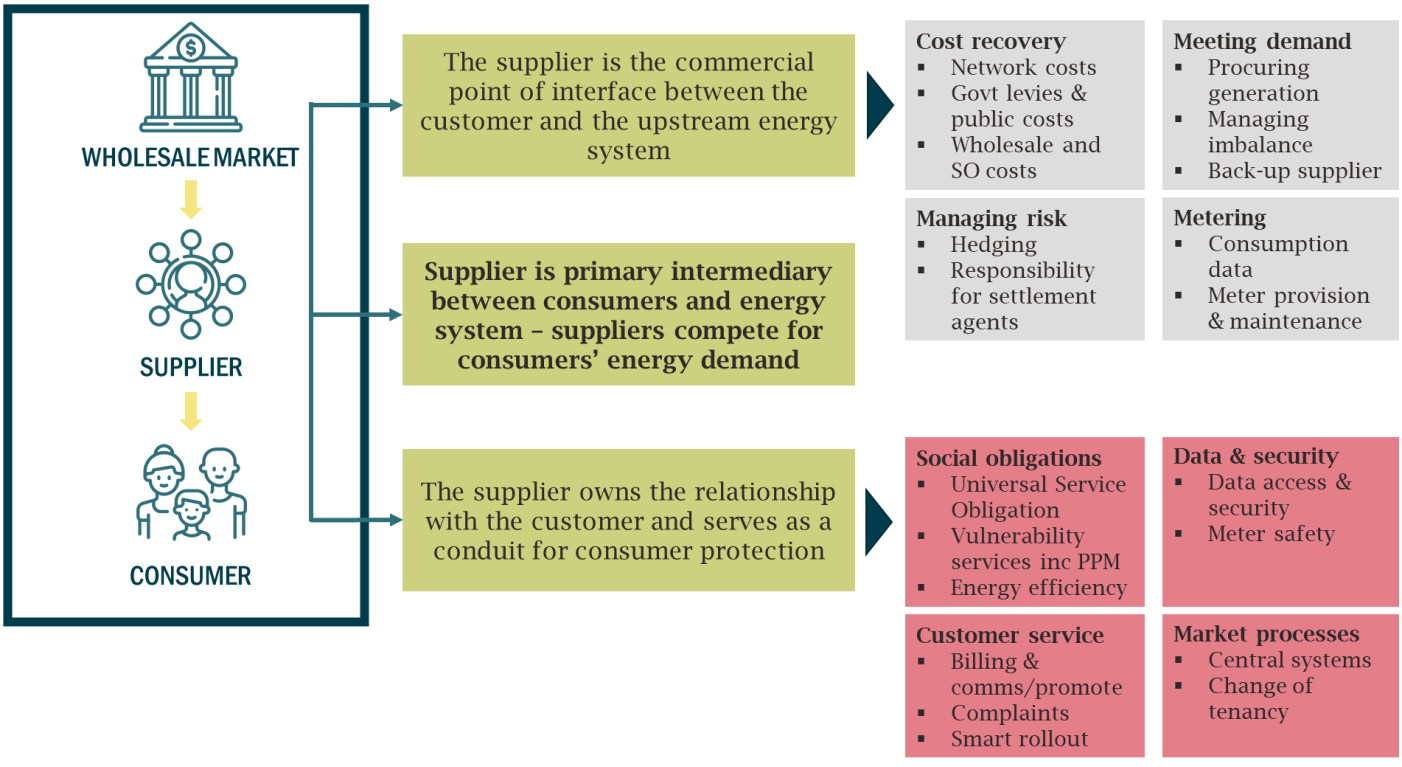
2 CURRENT RETAIL ENERGY MARKET STRUCTURE

The current retail energy market is structured around a 'supplier hub' model where suppliers act as the main interface between customers and the energy market. Suppliers are responsible for:

- Collecting all payments owed to the network companies, generators (electricity), and gas shippers (gas);
- co-ordinating the provision of metering services, including the smart meter rollout; and
- collecting funding for, and delivering, certain environmental and social programmes.

The figure below, based on Ofgem's 2017 review of supply market arrangements, illustrates the supplier hub model.

FIGURE 1 OFGEM'S 2017 SUMMARY OF THE SUPPLIER HUB MODEL



Source: Ofgem (2017). Future supply market arrangements – call for evidence

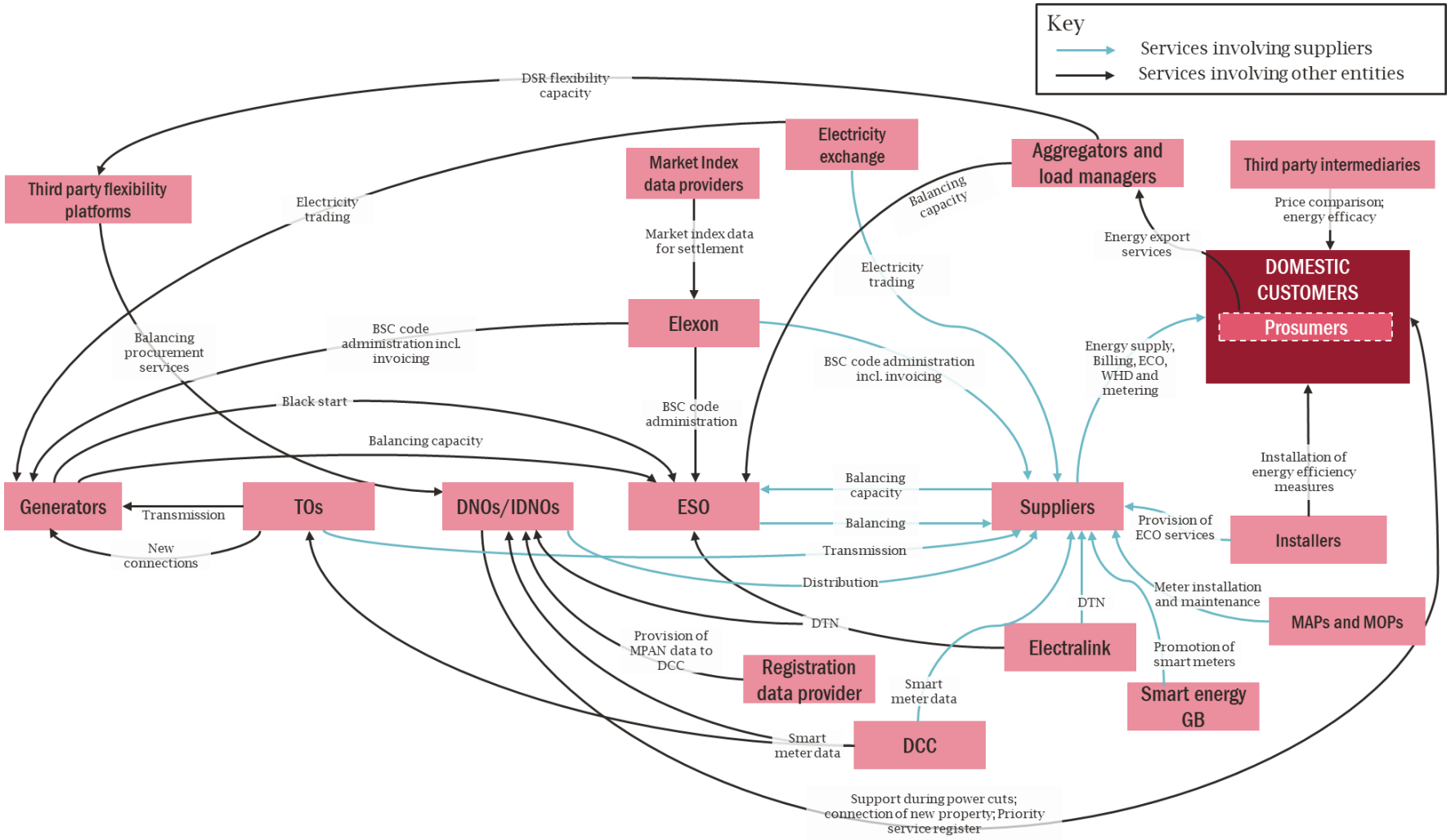
Whilst customers primarily interact with their supplier, the supply of both gas and electricity relies on multiple entities including energy producers and network companies. The flow of energy, data, and services between these organisations are facilitated by a wider network of central system delivery bodies. These central bodies co-ordinate essential services including balancing of the electricity market, administration of network codes, and delivery of essential data flows. There are also several roles undertaken by third party entities that provide services such as price comparison, energy efficiency advice, and installation of thermal efficiency measures.

The accompanying WP1 report describes the roles of these different entities in detail. Figure 2 below, taken from that report, shows the main services provided by different entities in the electricity sector. Each

arrow relates to a service that one entity provides to another. For example, suppliers pay DNOs charges for network services, and so this is shown as an arrow from DNOs to suppliers. This illustrates clearly how most services are provided to suppliers (rather than consumers directly) with the exception of:

- Price comparison websites (PCWs) and other third party intermediaries which advise customers on selecting a tariff or taking up energy efficiency measures;
- DNOs, which provide support during power cuts as well as providing specialised services such as installing or upgrading connections;
- installation of energy efficiency measures, even if these are paid for by the supplier through the Energy Company Obligation (ECO); and
- for a very small proportion of customers ('prosumers') aggregators deliver flexibility from assets such as electric vehicles to the wider system.

FIGURE 2 ELECTRICITY: SERVICES



Source: Frontier Economics

3 FUTURE MARKET REQUIREMENTS

The UK has a binding target to achieve net zero by 2050 and the government's net zero strategy plans to decarbonise the electricity system by 2035.[3] A wide variety of projections have been made for the transitions required to deliver this ambition. In this report we have used the Future Energy Scenarios (FES) developed by National Grid ESO[4] as the reference point to identify the key customer-facing transitions.

3.1 CUSTOMER-FACING TRANSITIONS

The FES 2021 lays out four paths for decarbonisation, three of which are consistent with the government's 2050 net zero target and are considered in this report. While the specific mix of technologies and customer behaviour varies across these pathways, the consumer-facing transitions are consistent across all three.

DECARBONISATION OF DOMESTIC HEAT

Heating makes up almost one third of the UK's annual carbon footprint. The majority of this is from homes.[5] Domestic heating is dominated by gas boilers which accounted for 83% of homes in 2020.[6] Customers will need to switch to low carbon technologies (LCTs) such as heat pumps, electric resistive heating, or potentially hydrogen boilers.

ELECTRIFICATION OF DOMESTIC TRANSPORT

The main source of emissions from domestic transport is from the use of petrol and diesel vehicles. In the FES scenarios, customers will need to move away from these to EVs.

CUSTOMER FLEXIBILITY

Electrification of heat and transport will place stress on the electricity system, increasing overall demand and leading to greater peaks. Avoiding costly network reinforcement requires an increase in customer flexibility, the use of demand side response (DSR) to reduce or shift electricity consumption to where has the least cost to the overall system.

INSTALLATION OF DOMESTIC PV

The FES pathways anticipate an increase in prosumers who install solar panels on their rooftops. However, even under the most ambitious scenario this is only expected to affect 30% of households by 2050[7] and is less encompassing that the other transitions

MORE GENERATION CAPACITY AND INCREASED SHARE OF RENEWABLES

Without a significant increase in DSR and other flexibility services, the increase in intermittent generation will lead to consumers facing an increase in price volatility and energy bills.

[3] HM Government (2021). Net Zero Strategy: Build Back Greener

[4] National Grid ESO (2021). Future Energy Scenarios 2021. FES 2022 is now available, and contains broadly similar scenarios.

[5] HM Government (2021). Heat and Buildings Strategy.

[6] National Grid ESO (2021). Data workbook FES v08

[7] European Commission (2017), *Study on "Residential Prosumers in the European Energy Union"*

3.2 CROSS-CUTTING BARRIERS

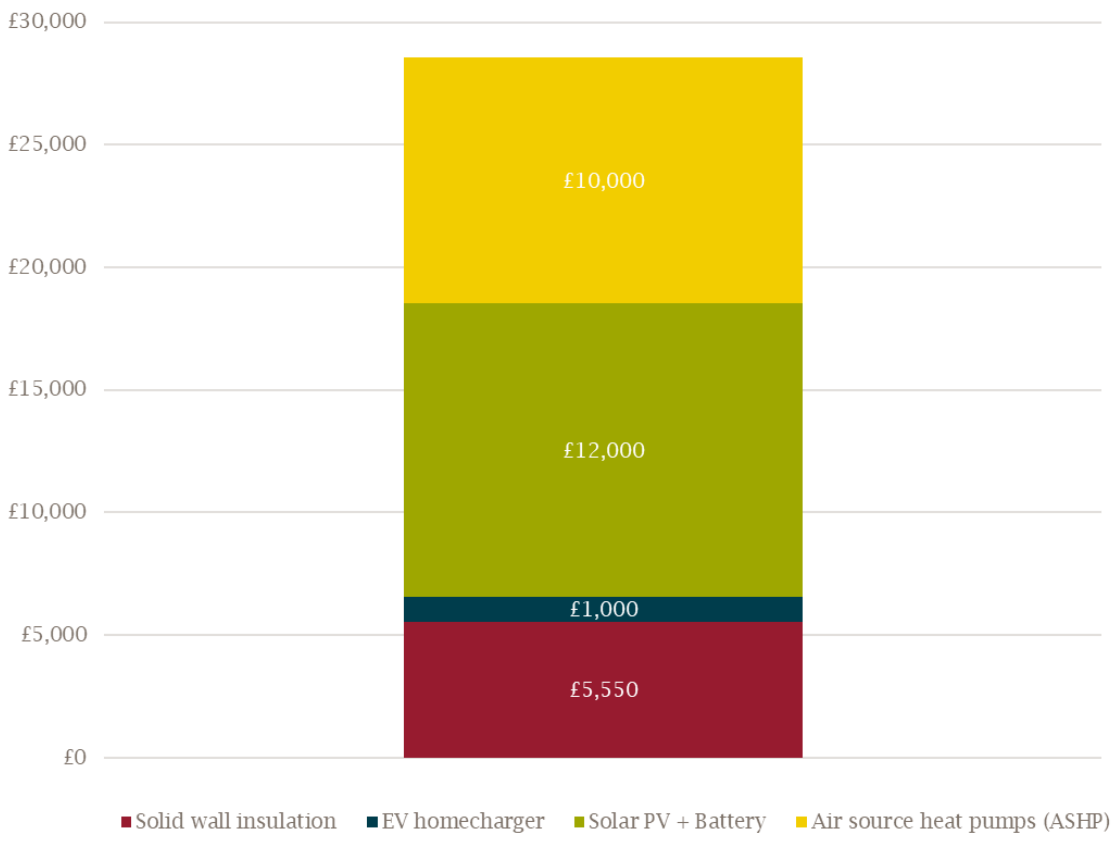
Our review has identified several cross-cutting barriers to these aspects of the net zero transition in the existing energy retail market. Further detail on specific barriers facing each individual transition can be found in WP2.

3.2.1 UPFRONT CAPITAL COSTS

Upfront capital costs are a key barrier to the uptake of heat pumps, energy efficiency measures, and domestic solar photovoltaic (PVs). Addressing this is key to enabling uptake of LCTs.

As shown in Figure 3, adopting LCTs is often expensive for customers. Whilst Government grants are available in some cases, this is limited and often they do not cover the whole cost of installation. Whilst other policies are being implemented to bring down the cost of heat pumps such as the manufacturer obligation, the impact of these policies remain uncertain. Furthermore, unlike EVs where there is a small but growing second-hand market, it is not possible to buy a second-hand heating system or PV at lower prices, nor are financing arrangements standard as they are for vehicle purchases.

FIGURE 3 ILLUSTRATIVE COST OF DIFFERENT LCTS FOR A DOMESTIC CUSTOMER IN THE UK



Source: Frontier Economics. Data sourced by BEIS (2017) What does it cost to retrofit homes?, EVCC website 'Evs and EV Chargepoints', Energy Saving Trust website 'Is home energy storage right for me?' and 'Air source heat pumps'

Note: Prices were taken as a mean when presented in ranges. Solid wall insulation costs assumes for a semi-detached home with a floor area of 90m2, wall area of 60m2, excluding VAT. Solar PV assumes a size of 4 kWp size, a battery with a size of 4 kWh and includes the cost of a inverter and installation. Cost of a ASHP includes the device and installation cost.

Even when LCTs are cost saving, this may be over 10+ year payback periods. Once installed, technologies such as heating systems, PV, and insulation are difficult or impossible to remove and companies providing finance face a default risk in the event that the homeowner moves out. Previous government schemes such as the Green Deal or market based solutions such as leasing rooftops for PV have tried to overcome these issues but with limited success.

3.2.2 INCREASING COMPLEXITY OF CHOICE AND HETEROGENEITY

Customer choice is becoming increasingly complex. The market will need to ensure that customers are presented with appropriate options and are able to make informed decisions on the best one for them.

Whereas customers could previously replace their heating and cars like-for-like, they are now faced with multiple options each with different features, costs and technical requirements. We also anticipate an increasing number of non-traditional energy companies involved in providing energy services (e.g. EV manufacturers and manufacturers of home energy management systems (HEMS)), which customers will need to compare. The best option may differ between customer segments and region and there may be no 'one size fits all' business model.

These new business models can bring benefits for customers. For example, bundled tariffs that offer separate EV tariffs reduce the hassle of arranging services individually and in some cases can help overcome the upfront capital cost issues with installation of new devices. However, bundled services are more difficult for customers to compare and price comparison websites are not currently set up to compare smart or bundled tariffs. In other cases customers may be unaware that tariffs are product specific. For example, Citizens Advice has reported that some customers have ended up switching onto a tariff that is not right for them and subsequently face high exit fees.[8]

3.2.3 NEED TO ADDRESS INCREASING REGULATORY COMPLEXITY

As the energy ecosystem and products offered become more complex, the regulatory model will need to support innovation and new business models.

For example, value-added services provided as part of bundled tariffs often fall outside of supplier licences and the emergence of 'as a service' models raise questions on how they interact with the existing supplier of last resort process. Ofgem's recent publication on EV charging regulation has highlighted the complexities of applying the current regulatory framework to EV charging with different prices, licences, and exemptions applying for each different EV charging scenario.[9]

These regulatory complexities can act as barriers to the growth of new business models require to efficiently deliver net zero by 2050. Ofgem has already moved to identify and address regulatory barriers in some areas such as electricity storage[10] and other areas are likely to benefit from a more streamlined, consistent, and in some cases simplified approach.

[8] Citizens Advice (2021). Innovation in the tariff market. Discussion paper on how new tariffs can work better for people

[9] Ofgem (2022). Taking charge: selling electricity to Electric Vehicle drivers

[10] Ofgem (2021). Transitioning to a net zero energy system. Smart systems and Flexibility Plan 2021

3.2.4 EVOLVING REQUIREMENTS FOR CUSTOMER PROTECTION

New business models have the potential to cause consumer confusion or harm and the market needs to adapt to ensure appropriate protection for customers.

Citizens Advice has already identified several gaps in regulation for new innovative tariffs that could lead to consumer harm.[11] Depending on the final technological solution for domestic heat, local or national monopoly hydrogen networks may also emerge which will require regulation to ensure that bills remain affordable, particularly early in the transition where hydrogen may be significantly more expensive than natural gas and a resulting increase in energy bills could increase fuel poverty. Other distributional issues associated with the transition may include customers who live in hard-to-treat properties where insulation may be particularly expensive, or low-income families who rely on the second-hand market for EVs which is still emerging and have no option but to remain on more expensive to run ICE cars.

3.2.5 FLEXIBILITY

The market is already evolving to accommodate greater use of customer flexibility via the DSO transition as well as the creation of the Virtual Lead Party (VLP) role. Looking forward, the sector will need to identify remaining barriers and facilitate new options to increase provision of residential flexibility.

DSR for domestic customers beyond basic static tariffs (E7, E9, and E10) is currently extremely niche with few aggregators engaging with the domestic market outside of EV charging and only a handful of dynamic time-of-use (TOU) tariffs offered by suppliers. Whilst the introduction of market-wide half hourly settlement (MHHS) is expected to sharpen supplier incentives to shift customer demand and increase the number of TOU tariffs, research has shown that customers are less likely to opt into dynamic rather than static TOU tariffs although the former have the greatest benefits for the system.[12] Other concerns such as interoperability, data security, and privacy can hinder customer confidence.

On the supply-side, there could also be barriers to expansion of aggregation due to misaligned incentives. For example, suppliers have previously called for independent aggregators to make compensation payments to suppliers when DSR reduces overall energy consumption or results in higher settlement costs for individual suppliers.

[11] Citizens Advice (2021). Innovation in the tariff market. Discussion paper on how new tariffs can work better for people

[12] Citizens Advice (2017). The Value of TOU Tariffs in Great Britain: Insights for Decision-makers.

4 ALTERNATIVE MARKET MODELS

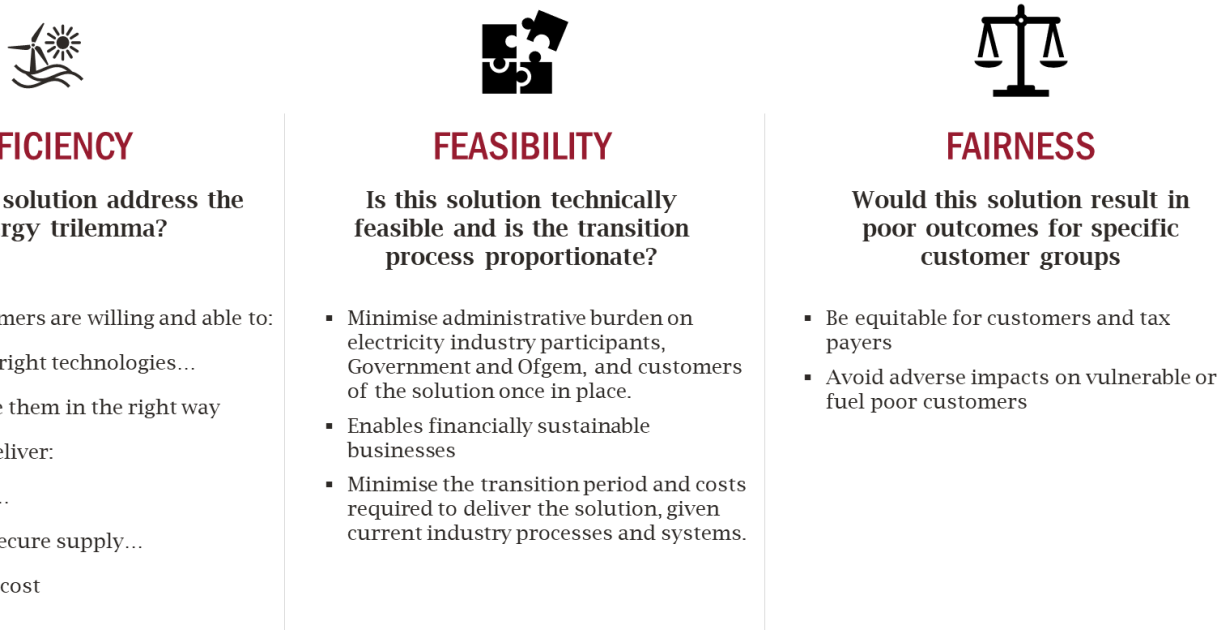
Section 3 set out the key customer-facing transitions for the net zero transition and the cross-cutting barriers facing these transitions. Whilst not all of these barriers may be wholly the result of the underlying energy market structure, changes to the current supplier hub model or other structural elements could help to overcome some of them.

In the following sections we will set out assessment criteria for what a 'good' retail energy sector should look like from the perspective of customers. We then set out three alternative market models and apply the assessment criteria. Finally, we describe the key transitions that would be required to deliver each of these alternative models. Further detail on the development and alternative market models can be found in the WP3 report.

4.1 ASSESSMENT CRITERIA

We build on the FES and previous work carried out by Ofgem and BEIS to define an assessment criteria centred around three themes: (1) efficiency, (2) feasibility, and (3) fairness.

FIGURE 4 ASSESSMENT CRITERIA



Source: Frontier Economics

Efficiency lies at the heart of any well-functioning market. The market structure should create the right incentives to address the energy trilemma, finding the right balance between security of supply, affordability, and sustainability. In practice this means asking whether the market structure provides customers with the ability to adopt new LCTs and to use them flexibly.[13]

The proposed market structure needs to be **feasible**, both with respect to the transition and at steady state. The electricity system is expected to decarbonise by 2035 and any significant changes will need to be

[13] The technologies described in the FES are designed to meet decarbonisation and security of supply standards so our evaluation of efficiency considers whether a market model can deliver these outcomes at the lowest cost to the system.

delivered at pace. Decision-makers will also need to consider associated costs although this should not deter the industry from thinking ambitiously about alternative models given the societal cost of failing to deliver net zero. The future market structure also needs to be feasible in steady state, minimising administrative burden on electricity industry participants, the government and the regulator, and ultimately customers once it is in place. It must enable financially sustainable businesses that are able to invest in their customers and develop new innovative propositions that enable the net zero transition.

At the same time, the retail market should be **fair** for customers. There are many different interpretations of fairness, some of which may contradict one another. For example, to some fairness could mean that all customers face similar unit costs despite their cost to service whereas for others it means that customers face cost-reflective bills based on their whole system costs. Other definitions focus on protecting specific groups such as vulnerable customers or the disengaged. It is outside the scope of this work to define fairness. Therefore when we assess models against this criteria we will consider implications against various definitions of fairness.

Given the importance of customer-side **flexibility** for decarbonising energy at the lowest cost, we have also carried out a more detailed assessment focused on risks associated with the provision of flexibility, the associated risks, and the impact that this would have on customers.

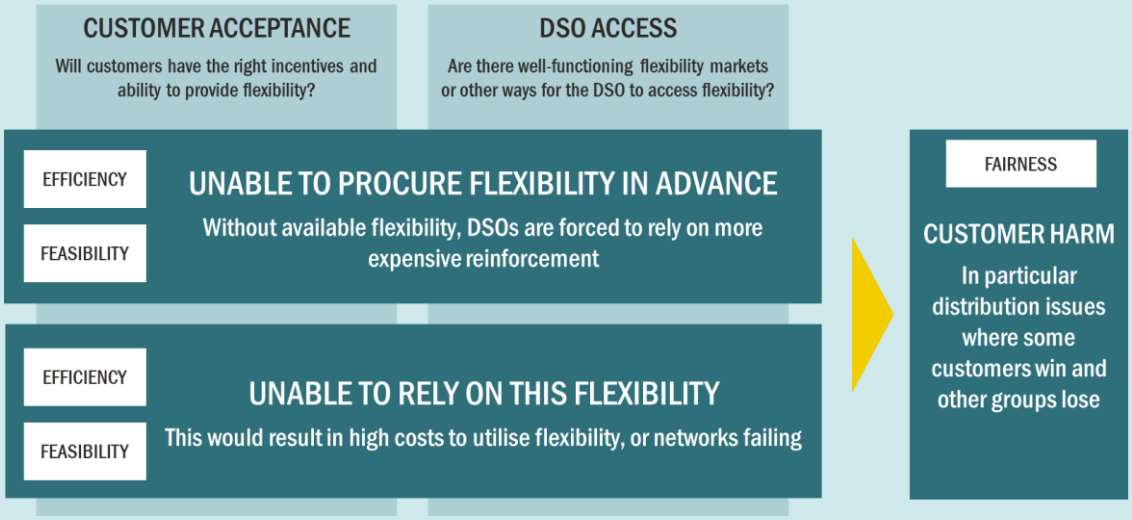
Flexibility risk assessment for DSOs

We have identified two broad categories of risk when it comes to provision of flexibility by DSOs:

- Being unable to procure flexibility in advance; and
- being unable to rely on this flexibility when called upon.

Both these risks raise costs for DSOs and reduce the benefits of flexibly compared to reinforcement.

Under the current regulatory framework, DSO allowed revenue is fixed in advance over the price control period (with a limited number of reopeners). In the short term any unexpected flexibility costs are likely be borne by the DSO rather than customers. In the longer term, it is likely that higher costs would raise the DUoS element of customer energy bills. We therefore assess the degree to which these costs could be socialised for each archetype.



4.2 ALTERNATIVE MARKET STRUCTURES

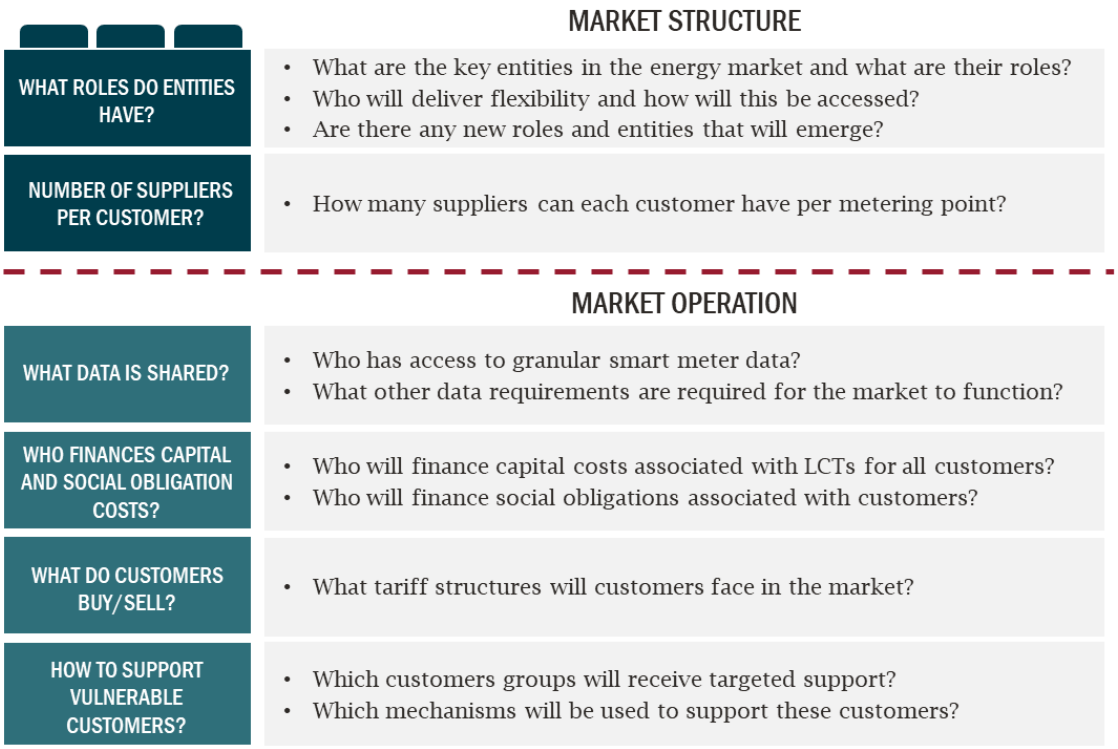
We have defined three illustrative alternative market structure archetypes:

- Extended supplier hub
- Multiple suppliers
- Customer-facing DSO

These archetypes were developed based on existing international examples, engagement with industry experts, and tested with a variety of industry participants and policymakers as part of the REDMAST workshop. Further details on how these models were developed and how they may help overcome some of the barriers described above can be found in WP3.

Each of these illustrative archetypes is structured around a set of 'building block' categories (Figure 5). We first identified three options for the fundamental market structures under the 'what roles do entities have' and 'number of suppliers per customer' building block categories. We then mapped dependencies associated with 'what data is shared' and 'who finances capital and social obligation costs'. Finally, we consider a number of decisions that are independent of the market structure such as the role of third party entities and tariff structures.

FIGURE 5 BUILDING BLOCK CATEGORIES



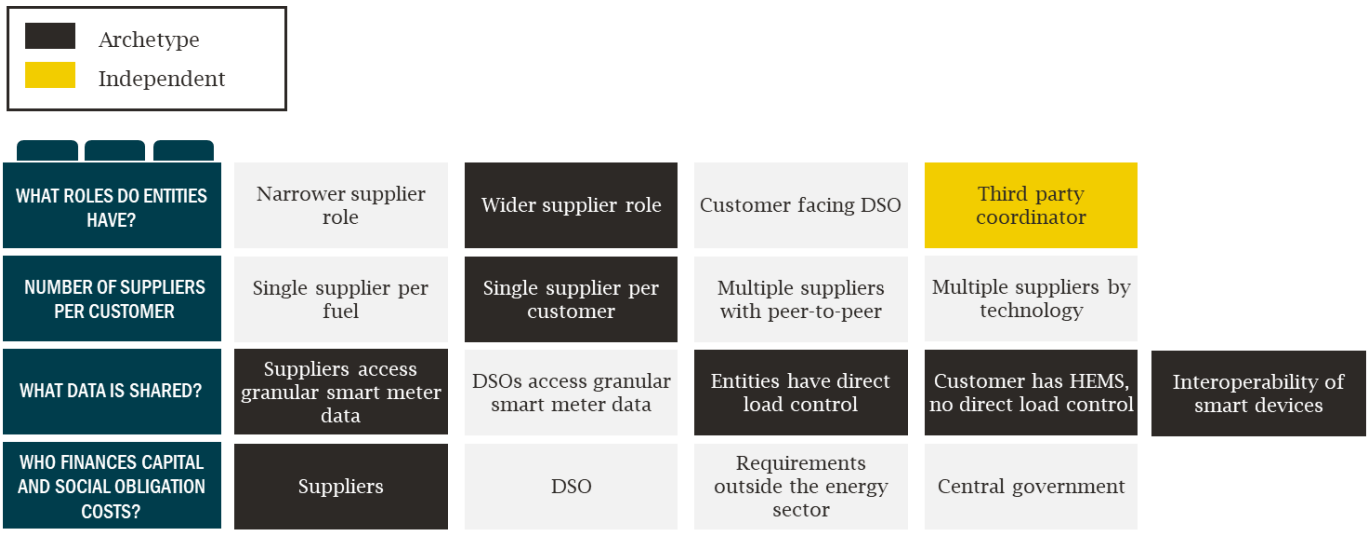
Source: Frontier Economics

4.2.1 EXTENDED SUPPLIER HUB

This archetype is an extension of the current supplier hub model, retaining the role of the supplier as the gateway for customers. The role of the supplier is further enhanced with a wider set of obligations that include LCT take-up and provision of flexibility by their customers, for example via obligations to offer at

least one dynamic TOU tariff, LCT technology financing, or providing aggregation services. Customers would continue to have a single supplier per fuel per metering point to ensure they can deliver these obligations. If customers have multiple suppliers per fuel, consumption with each supplier could be lower and reduce their ability to cross-subsidise across their customer base to finance new obligations.

FIGURE 6 EXTENDED SUPPLIER HUB ARCHETYPE

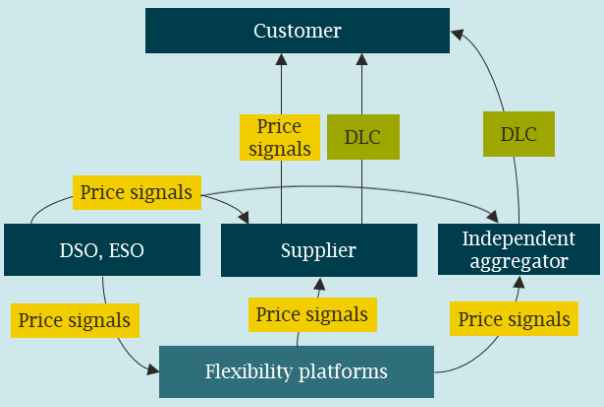


Source: Frontier Economics

Suppliers would continue to receive granular smart meter data. However, they may also now have direct load control (DLC) over customer devices as part of obligations to take a larger role in customer flexibility. As the supplier remains the only interface between customers and the wider market, they would be able to aggregate together price signals[14] from entities such as DSOs, the ESO, and the wholesale market. If this is the case, interoperability of smart devices will be key to prevent barriers to switching.

Provision of flexibility under extended supplier hub

Customers provide flexibility via their supplier or an independent aggregator (or both). Entities such as DSOs procure this flexibility via price signals (see footnote 14), either through bilateral contracts or a flexibility platform (which could reduce transaction costs). Suppliers and aggregators then either pass on price signals to their customers or carry out DLC.



Not illustrated here (and also relevant to the other archetypes) suppliers and aggregators would need to be able to provide information back to the entities requesting flexibility on which requests were successful.

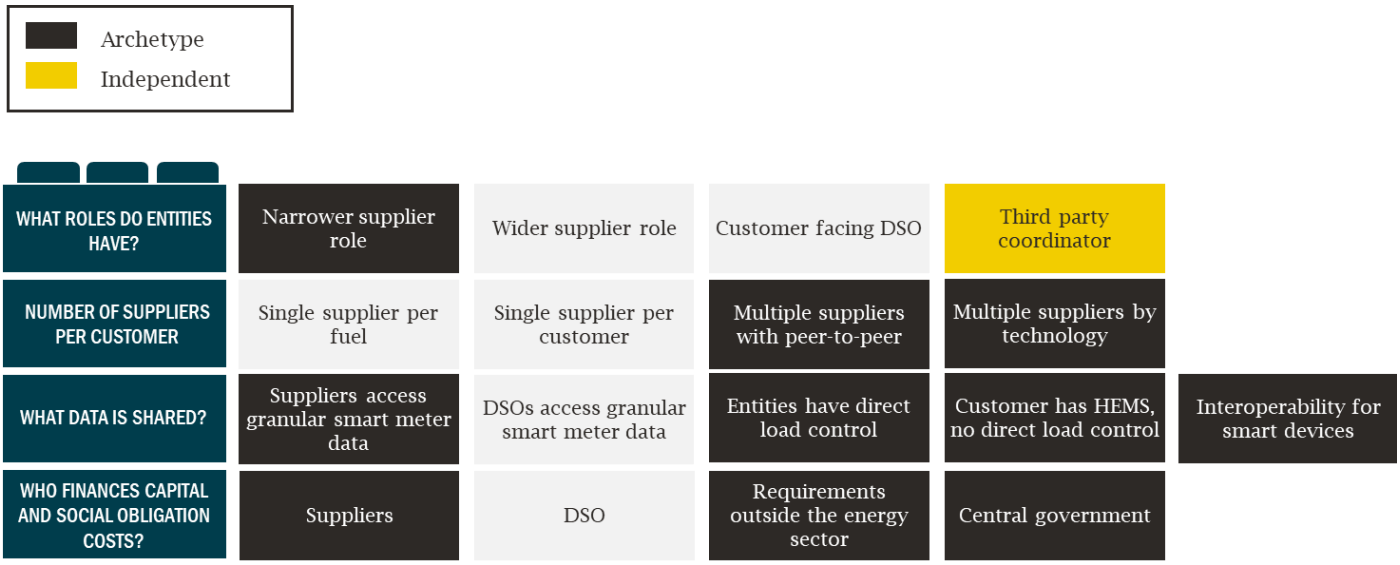
In the long-run, DSOs would pass on the cost of flexibility to their customers via DUoS charges. However, as flexibility should only be procured where it is cost-effective this should lead to an overall reduction in charges.

[14] Price signals sent by entities such as DSOs and the ESO could take multiple forms depending on need, ranging from TOU pricing similar along the lines of current DUOS bands, to bids for specific flexibility products with availability and utilisation fees, similar to how flexibility is currently procured by DNOs from I&C customers.

4.2.2 MULTIPLE SUPPLIERS

This archetype starts from the premise that LCTs and flexibility might best be provided by suppliers which specialise in certain types of technology, for example heating or transport. It combines multiple suppliers by technology with a narrower supplier role which is intended to help foster competition and innovation.

FIGURE 7 MULTIPLE SUPPLIERS ARCHETYPE



Source: Frontier Economics

Rather than restricting customers to a single supplier by fuel, customers would be able to have multiple suppliers. This would be split into two types:

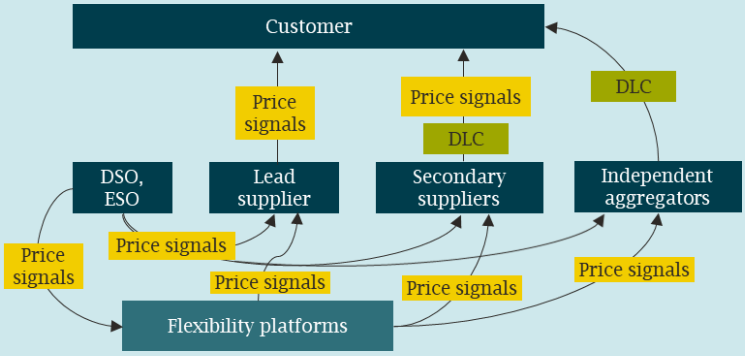
- **Lead supplier**. All customers would have a lead supplier which supplies energy for general electricity usage. The lead supplier would be responsible for the majority of obligations that remain with suppliers such as the smart meter rollout.
- **Secondary supplier**. Customers could choose to take out a contract with one or more secondary suppliers. These could be technology specific, for example an EV supplier or heat pump supplier. Alternatively, allowing multiple suppliers could also enable peer-to-peer energy trading.

Where suppliers have additional obligations, the majority of these would be on the lead supplier to prevent barriers to entry for secondary suppliers and avoid the risk of double counting. However, electrification of heat and transport could mean that a customer's lead supplier makes up a relatively low share of its total energy consumption, reducing their ability to cross-subsidise or cover the default risk associated with capital financing. Unlike the extended supplier hub model, this means that any additional financing of LCTs would likely need to remain with other entities such as central or local government which are better placed than suppliers to spread these costs and risks.

Provision of flexibility under multiple suppliers

Customers provide flexibility via their suppliers and/or independent aggregators.

The DSO, ESO, or any other entities looking to procure flexibility will send price signals to lead suppliers, secondary suppliers, or independent aggregators. This can be done either via a flexibility platform or bilaterally.



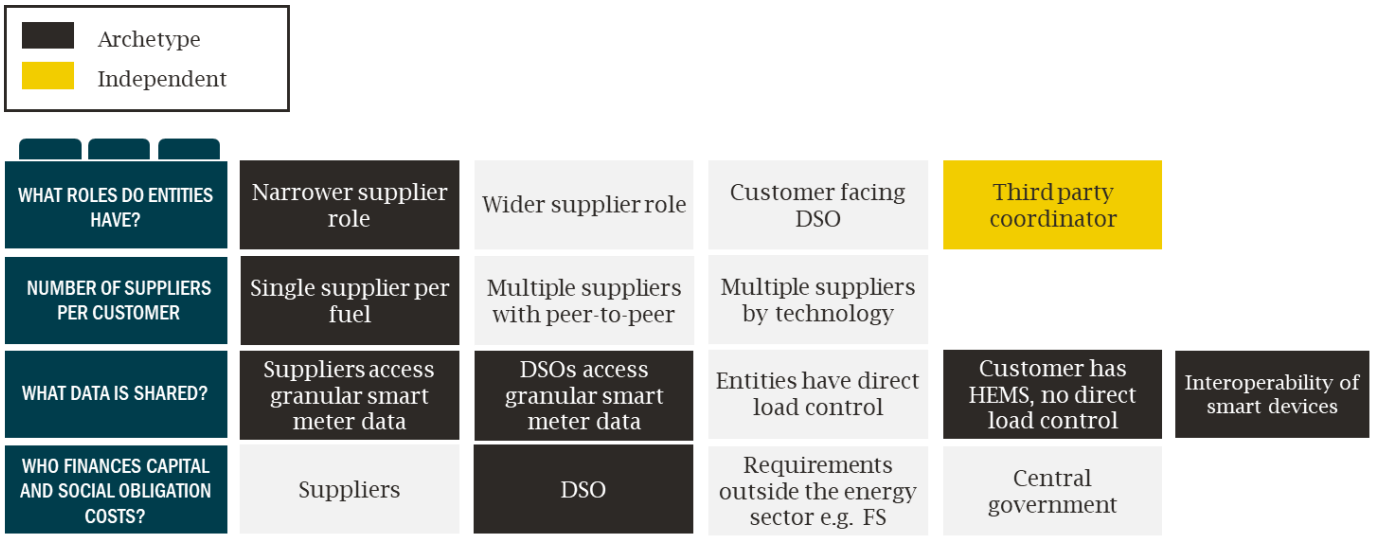
Secondary suppliers and independent aggregators act on these price signals either by passing them on to their customers (for example via a TOU tariff or one-off payments) or alternatively use them to co-ordinate DLC. We expect the lead supplier will need to rely on price signals rather than DLC if they are primarily supplying electricity for devices without smart functionality i.e. general electricity usage.

In the long-run DSOs would pass on costs of flexibility to their customers via DUoS charges. However, as flexibility should only be procured when it's cost-effective, overall this should be a reduction in charges.

4.2.3 CUSTOMER-FACING DSO

This archetype moves away from the 'gateway' role of the supplier and brings the DSO closer to the customer. Customers would have a separate contract with their DSO which would send them direct flexibility signals. This would be via price signals rather than DLC, for example a distribution TOU tariff. This is to avoid the customer receiving conflicting DLC[15] from their DSO and their supplier/aggregator.[16]

FIGURE 8 CUSTOMER FACING DSO ARCHETYPE



Source: Frontier Economics

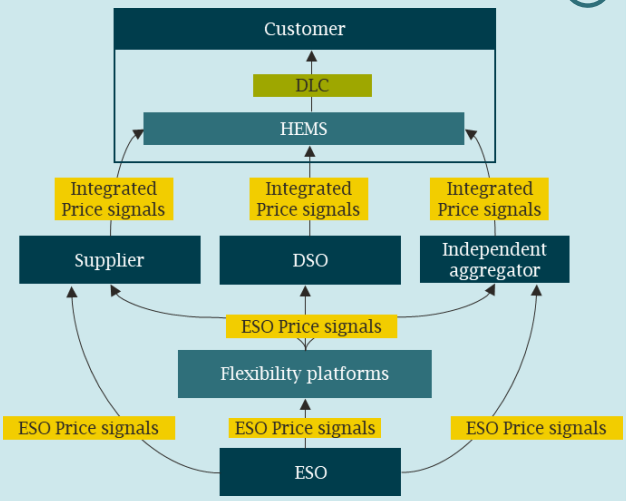
[15] This is distinct to the multiple suppliers model which does allow multiple parties to provide DLC, but each technology is controlled by one supplier. However the multiple supplier model could share this issue if some customers have interdependencies between their technologies – e.g. if the optimal use of their heat pump depends on how their electric vehicle is being utilised.

[16] In principle, the DSO could be the *sole* provider of DLC signals. However this would require the DSO to be aware of the customers' energy payments so it can adjust their consumption in line with any time-of-use tariff.

This archetype has several impacts on data and communications flows. DSOs will need to receive granular smart meter data to measure how much flexibility a customer has provided and renumerate them accordingly. This model also requires customers to have home energy management systems devices that can optimise flexibility signals and automate response via DLC.[17] Given the importance of HEMS to unlock the flexibility benefits of this archetype, we expect that there will be co-ordinated national rollout of HEMS led by the DSO, which may also take over any residual smart meter rollout. Finally, interoperability of smart devices will be key to ensure that consumer devices can interact with their HEMS and deliver flexibility.

Provision of flexibility under customer-facing DSO

Customers receive price signals[18] directly from their DSO which reflects when the network is constrained. They may also receive price signals from their supplier and potentially independent aggregators. As customers are receiving multiple signals, no single entity has DLC. Instead, separate price signals will be optimised by a customer's HEMS which will then execute DLC in a way that is optimal for the customer.



Other entities seeking to procure flexibility could do so via a flexibility market or bilateral agreements and either the DSO, supplier, or independent aggregator can adjust the price signals they send to customer HEMS, depicted as the 'integrated price signal' in the diagram above.[19]

A dynamic, local DUoS charge for constrained areas is a significant change from current charges which do not vary by hour or within a license area. These charges could be set in a way which is revenue neutral (customers providing flexibility would gain at the expense of those that do not). Alternatively, charges could include some degree of cross-subsidisation where customers in non-constrained areas pay for some of the cost. On average, customers would gain as the need for reinforcement is postponed.

[17] The customer will receive signals from the DSO, supplier, and any aggregators a customer has signed up with. If more than one entity has DLC, this could result in conflicting or poorly co-ordinated signals and create issues for customers. Even without DLC, customers may receive conflicting price signals making it difficult to know how to respond and risking customer disengagement (the importance of automation is discussed in WP3). These signals need to be optimised and automated via a HEMS which carries out DLC based on the optimal decision for the customer's preferences and bill. DSOs would be responsible for rolling out HEMS to maximise take-up.

[18] At their simplest, these price signals could be time-of-use network tariffs which rise to a very high level when the network needs demand to be constrained. However more complex arrangements might be needed to guarantee that flexibility can be called on reliably when needed. For example, HEMS units might advertise the availability and utilisation payments that are required, and market entities like DSOs could send signals to accept these offers.

[19] In principle the DSO could also contract with suppliers and independent aggregators for flexibility. We have not shown this for two reasons. Firstly, the purpose of this archetype is to overcome concerns that suppliers and aggregators fail to pass on DSO flexibility signals to customers. Secondly, there is risk that if a DSO is procuring flexibility from the same customer, both directly via price signals to the customer and indirectly via suppliers or aggregators, they may end up paying twice.

4.3 STRUCTURALLY INDEPENDENT DECISIONS

We have defined three market structure archetypes. However, there are several decisions that are independent from the role of network companies and suppliers which we discuss below.

4.3.1 EXISTENCE OF THIRD PARTY ENTITIES

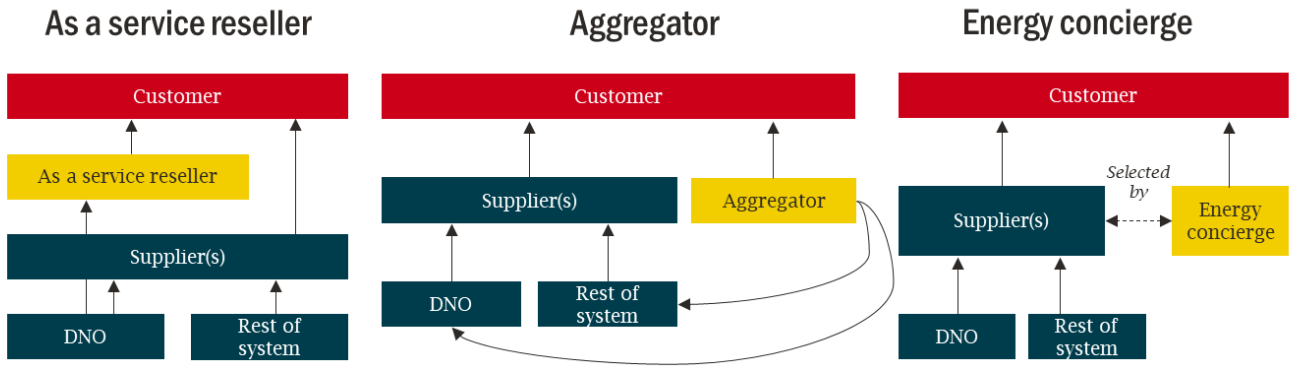
In addition to network companies and suppliers, there are options for new types of customer-facing third party entities to embed themselves into the energy market structure:

- An **'as a service' reseller** buys kWh from suppliers and potentially capacity from DSOs, bundles this into an 'as a service' offering[20] and offers it to customers as a package. For example, a home energy services provider may agree to provide a certain number of heated rooms and use DLC over a customer's heat pump to deliver this. They could exist under any archetype but are probably most relevant under the 'extended supplier hub' archetype where they can partner with one or more suppliers and offer 'as a service' tariffs without needing to deliver the whole set of obligations in the full supplier licence (similar to today's Licence Lite).

- A **third party aggregator** contracts with customers to manage their electricity consumption, for example via direct load control in response to flexibility signals. However it is still the supplier which ultimately sells the energy being consumed. This is similar to the current role being developed for a Virtual Lead Party[21].

- An **energy concierge** helps customers to choose the right bundle of products and services based on the level of service they want across heat, mobility, and other requirements. This is like current price comparison websites, but extended to cover the co-ordination of LCT retrofits and potentially services such as aggregators. The concierge service therefore helps the customer select these services, but does not sell them itself.

FIGURE 9 TYPES OF THIRD PARTY ENTITIES



Source: Frontier Economics

[20] Under an 'as a service' tariff customers no longer pay per kWh of energy consumed but instead the experience or final service they want. Customers might either pay a fixed fee for a service subject to acceptable use limits such as EV charging sufficient to drive up to a set number of miles per month, or pay per unit of output such as hours of heated home. The fee could also cover the rental or maintenance costs of an asset such as an EV or heat pump.

[21] National Grid – A VLP is an independent aggregator that controls (potentially on behalf of a third party) power generation and/or electricity demand from a range of assets for the purposes of selling Balancing Services to National Grid ESO.

4.3.2 MARKET OPERATION

So far we have discussed options for the underlying structure of the market (i.e. the key customer-facing entities and the role that they play). However, many of the cross-cutting barriers discussed in section 3 can be also addressed via decisions on the operation rather than the structure of the market.

This includes decisions on 'what do customers buy and sell' as well as 'support for vulnerable customers'. For example, new innovative business models such as 'as a service' tariffs have the potential to promote customer flexibility as well as introducing new financing options for LCTs. Under this model, customers no longer pay per kWh of energy but instead pay for the experience or final service they want. Customers might either pay a fixed fee for a service subject to acceptable use limits such as EV charging sufficient to drive up to a set number of miles per month, or pay per unit of output such as hours of heated home. The fee could also cover the rental or maintenance costs of an asset such as an EV or heat pump. If suppliers have some control over customer demand (e.g. through DLC) they will have an incentive to use this to deliver the agreed level of service at the lowest cost possible, encouraging customer flexibility.

Whilst market operation is not the focus of this work, we discuss options for these building blocks in more detail in the WP3 report.

5 ASSESSMENT OF ALTERNATIVE MARKET MODELS

We now apply the assessment criteria discussed in section 4.1 to each of the market structure archetypes as well as evaluating options for third party entities.

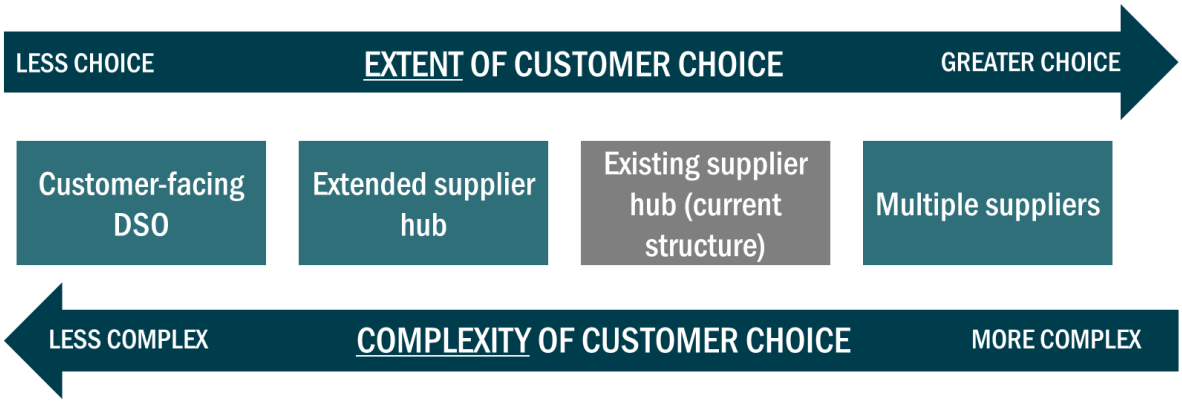
5.1 ASSESSMENT OF MARKET STRUCTURE ARCHETYPES

5.1.1 EFFICIENCY

Efficiency relates to whether a market structure helps customers to adopt the optimal LCTs and use them flexibly to minimise whole system costs. Each of the archetypes discussed in section 4 has the potential to strengthen efficiency of the retail energy market in theory. However, which of these is the best in practice will depend on the degree to which customers engage with the market.

If customers are willing and able to choose between highly differentiated services, then the ideal structure should enable entities to compete on new innovative business models for LCTs and flexibility. But if this is not the case, customers could struggle to make the right choice. This increases the risk of consumer harm as well as limiting improvement in the actual efficiency of the market. In this case it may be preferable to limit consumer choice even if this risks blocking the most innovative models. This is the trade-off between the extent and complexity of customer choice that influences efficiency.

FIGURE 10 TRADE OFF BETWEEN THE EXTENT AND COMPLEXITY OF CUSTOMER CHOICE



Source: Frontier Economics

- **A customer-facing DSO** is a local monopoly. If these entities are responsible for the rollout of certain LCTs (as well as encouraging flexibility) then customers will not need to choose an alternative provider. This archetype therefore requires the least customer engagement, but also offers the least choice and competition. If DSOs directly offer LCTs themselves, then this may also lead to barriers for other firms to offer LCTs.

- The **extended supplier hub** allows customers to choose between suppliers. These suppliers may compete on how to best provide LCTs and flexibility. However, competition may still be limited as suppliers are required to deliver a large number of other obligations, which may dissuade entry. And, as with DSOs, if suppliers are obliged to offer LCTs then this could present a barrier to other types of firm wishing to do so.

- By comparison, under the **existing supplier hub,** customers wishing to take-up LCTs need to engage not only in the energy supply market, but also with third party providers of heat pumps, insulation, and other measures. There may be greater choice, but also complexity.

- Within the **multiple supplier** archetype, customers need to choose between a wide variety of different businesses. However, if customers are able to make these choices, they should benefit from a wide range of options as third party providers of LCTs would find it easier than at present[22] to offer energy alongside the assets themselves.

The optimal market structure will depend on whether businesses can develop propositions which are sufficiently compelling for customers to engage with.

5.1.2 FEASIBILITY

None of the archetypes can be ruled out on feasibility grounds alone. Each option imposes regulatory obligations on at least one entity (government, DSO, all suppliers, or the 'lead supplier' in the multiple supplier archetype). Given appropriate regulation, there is no reason why these entities could not be financially sustainable. Both the customer facing DSO and multiple supplier archetypes require more changes to current industry systems and processes than the extended supplier hub (discussed in section 6). However this should not prevent moving to a structure that could offer long-term advantages.

5.1.3 FAIRNESS

Each of these market archetypes could be paired with different forms of support for vulnerable customers, although who will fund and deliver these interventions will vary across archetypes. However, as we have described above, there may be a trade-off between efficiency and customer choice, and this could have knock-on impacts for fairness if customers are not able to make informed choices.

Options such as the multiple supplier archetype could result in increasingly tailored offers for customers. Some of these could be targeted at customers with specific needs that are not currently well served by the current market. For example HaaS tariffs could ensure that at least one room is heated throughout the whole day without an increase in bills and reduce fuel poverty. However, this depends on whether these tariffs are commercially viable and whether customers are able to take-up these new offers.

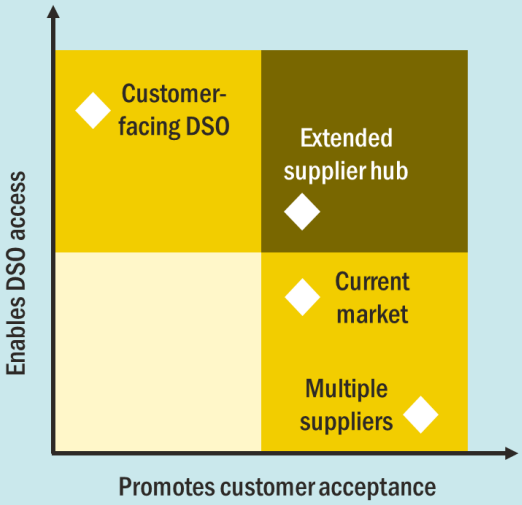
Market structures that enable more innovative business models will introduce greater choice complexity. If customers are unable to make informed decisions, this could lead to them choosing unsuitable tariffs [23] or facing higher prices due to disengagement. Customer harm will be higher if this disproportionately affects vulnerable customers. Furthermore, whilst disengaged customers are currently protected by the default tariff cap, it may be difficult to apply similar broad price regulation to differentiated archetypes such as 'as a service' tariffs. Even for customers who are engaged, some customers may struggle to choose the right tariff, for example customers switching onto inappropriate tariffs. Supporting customers to make informed choices is key to minimising this trade-off. This will depend on how like PCWs evolve to overcome current limitations such as the inability to compare TOU tariffs: The introduction of broader energy concierge services may help.

[22] Since a technology specific supplier would be under fewer obligations than todays' supply license.

[23] Citizens Advice. Innovation in the tariff market. Discussion paper on how new tariffs can work better for people

5.1.4 FLEXIBILITY RISKS FOR DSOS AND CUSTOMERS

Risks associated with local flexibility arise from **customer acceptance** of flexibility and degree of **DSO access** this flexibility. Whilst none of the archetypes can fully mitigate these risks, each one distributes this differently across entities:



- **Multiple suppliers** promotes an environment for new innovative business models that are attractive to customers, encouraging acceptance of DLC and improving availability and reliability of flexibility. However, it relies on market mechanisms for these business models rather than new regulatory obligations on suppliers to participate in the flexibility market. There may also be issues relating to supplier exit and loss of contracted flexibility.
- **Customer-facing DSO.** Direct engagement between DSOs and customers can address some DSO access issues. However this is at the cost of higher risk to reliability. DSOs can only rely on price signals and if customers lack automation via HEMS or other technologies, these may need to be large for customers to respond. It also requires customers to be able to 'stack' other sources of value from flexibility, potentially via their HEMS system, as the DSO is not the only entity sending flexibility signals. The absence of value stacking could result in under-provision of flexibility.
- **Extended supplier hub**. This strikes a balance between customer acceptability and DSO access. Extending supplier obligations to flexibility could help overcome DSO access issues. However, these obligations could limit innovation which would otherwise encourage customer acceptance.

Who is best to address flexibility risks and how will depend on the nature of these risks. If unreliability of flexibility is unsystematic i.e. uncorrelated across customers within a local region, this could be managed via over-procurement by the DSO (at a cost). However, if risks are correlated, this may be more challenging to manage. Further work is required to understand who is best placed to manage these risks at the lowest cost.

Impact on customers

In the short term customers should be relatively insulated from DSO flexibility costs due to the way network charges are set. However, a market structure that can lower overall risks associated with flexibility can generate savings for the system and customers in the long-run. **The model that reduces overall risk to the DSO without increasing it for other parties should also reduce the average impact on customers**.

Due to the way flexibility is procured under each archetype, there may also be differences in the way that distributional impacts can be managed:

- The **multiple supplier model** and **extended supplier hub** do not require changes to the current DUoS charging methodology which currently socialises any flexibility costs over the licence area. This means that customers unable to provide flexibility in constrained areas will not bear a disproportionately large share of the cost to mitigate this risk, whilst maintaining incentives for customers to provide flexibility.
- The **customer facing DSO** requires a dynamic local DUoS charge to send direct price signals. This could result in some customers and areas facing higher and more volatile prices. DSOs could introduce a degree of socialisation to counteract this but customers offering flexibility would still need to see a benefit to incentivise load shifting.

Ultimately the degree of socialisation will be a policy decision that should informed by an impact assessment to understand distributional impacts. *A more detailed assessment of flexibility risks can be found in WP3.*

5.2 ASSESSING THIRD PARTY ENTITIES

We now assess whether the each of the third party entities identified earlier is a desirable outcome.

5.2.1 EFFICIENCY

All three of these third party entities are expected to deliver efficiency benefits to the energy system, introducing more opportunities for customers to deliver flexibility (and be rewarded for doing so), or helping customers to navigate an increasingly complex set of options for their energy needs:

- **As a service resellers.** These can help to increase the availability and visibility of 'as a service' tariffs which benefits flexibility.[24]
- **Domestic aggregators** increase opportunities for customers to be rewarded for flexibility. They can also help automate load shifting, for example by selling smart devices and batteries.
- **Energy concierges** support customer choice by supporting customers to navigate an increasingly heterogenous energy system. Without these services, customers may find it too difficult to compare tariff structures, particularly in the case of multiple suppliers. They may also help customers to switch onto new innovative tariffs that promote flexibility as well as identifying customers who would face higher bills under these tariffs, reducing the risk of consumer harm.

The introduction of these third party entities may also introduce additional direct or indirect costs for customers. For example customers may pay directly for an energy concierge or suppliers may pay them a commission for generating leads with the cost of this socialised across their whole customer base.

5.2.2 FEASIBILITY

The three types of third party entities vary in the degree of change required to implement:

- Increasing the number of **as a service resellers** may require further clarification from Ofgem on how existing regulation applies to reselling[25] as well as considering whether a more streamlined reseller licence is required. The existing licence lite is a step in this direction but has low take-up. It is currently unclear whether this is due to demand or the way it is set up, for example requirements to have a bilateral agreement with a fully licenced supplier.[26]
- We have not identified any regulatory barriers that would prevent **domestic aggregators** entering the market and there are already niche examples such as Social Energy. [27] Recent changes to open balancing and wholesale markets to VLPs should help further encourage domestic aggregation. However, independent aggregators require customers to engage with a new type of entity and there is limited evidence on their willingness to do so. Low-levels of LCT uptake means there may

[24] Suppliers offering 'as a service' tariffs have an incentive to minimise the cost of delivering the agreed level of service which includes minimising use of the network during constrained capacity and generation.

[25] Ofgem recently released a clarification document on EV charging models and applicable regulation for reselling energy.

[26] Element energy (2019). Licence lite evaluation

[27] https://www.greentechmedia.com/articles/read/u.k-distributed-energy-aggregator-social-energy-raises-cash-plans-expansion

not be sufficient scale for domestic aggregation to be commercially feasible although this should change over time as customers transition to LCTs.

- **Energy concierges** are effectively an extension of today's PCWs, auto-switching websites, and energy efficiency advice websites. We have not identified any regulatory barriers that would prevent the entry of energy concierges in the future assuming that there is demand from customers for this service. However, PCWs currently struggle to compare TOU and EV tariffs, and would probably face the same issues with 'as a service' tariffs. Work is required to establish a consistent methodology for estimating bills for these tariff types[28] as well as making it easier for customers to provide their smart meter data to third parties for comparison purposes.[29]

5.2.3 FAIRNESS

We consider the introduction of third party entities to be largely independent from the overall structure of the market. We do not consider any of these to be incompatible with the various ways in which vulnerable customers can be supported.

[28] The 'Smart Tariffs- Smart Comparisons' project by BEIS appointed Vital Energy in 2020 to pilot how this might work which has developed a prototype tool although next steps for implementing this more widely across the market are unclear.

[29] Midata is an Ofgem co-ordinate programme that allows customers to share their smart meter data with trusted third parties including price comparison websites. This programme is currently paused with no recommencement date.

6 MAPPING THE TRANSITION

All three of the archetypes defined have the potential to support the net zero transition. We therefore consider the broad changes that may be required to transition from the current supplier hub model to each of these archetypes. We also consider changes required to introduce third party entities.

6.1 EXTENDED SUPPLIER HUB

As this archetype is an extension of the current supplier hub, there are fewer changes to deliver this market structure compared to the other two options. The main changes relate to the introduction of new social obligations on suppliers relating to flexibility and LCT uptake which lie at the heart of this model. The exact transitional arrangements will depend on the form of these obligations, with options varying from more principles-based approaches such as the 'flexibility first' approach taken by DNOs all the way to more prescriptive regulations such as the ECO that place specific obligations and targets on suppliers to subsidise LCT uptake or provide LCT financing. Specifically for flexibility, options include mandatory provision of dynamic TOU tariffs or DLC, and obligations to provide customers with LCT advice or devices such as HEMS (further detail on technological requirements can be found in WP3). Changes in supplier obligations will need to be clearly communicated to customers to promote engagement and uptake.

If suppliers choose to meet new flexibility obligations by offering 'as a service' tariffs with direct load control, and this is done via SMETS, this is likely to require updates to the current SMETS2 technical specification to enable more sophisticated DLC.[30] Some aggregators are currently carrying out DLC using their own networks rather than the SMETS2 auxiliary load control switches due to technical limitations of the current SMETS specification and this could remain an alternative option for suppliers carrying out DLC in the future.

Finally, customer engagement will be required to build trust between customers and their suppliers. The benefits of this model will only be unlocked if customers trust their suppliers enough to accept LCT and flexibility advice from them, and to cede direct load control for automation of flexibility. Research has shown a direct link between levels of customer distrust and take-up of DLC services.[31] However, current levels of trust between customers and suppliers of low with only 19% of customers stating that they would trust their energy supplier's advice on heating systems compared to 36% who would trust official websites such as Gov.uk. [32]

TABLE 2 KEY CHANGES REQUIRED FOR AN EXTENDED SUPPLIER HUB

KEY	
	Small changes to **existing** regulation and business processes, technology, customer behaviour.
	Significant changes to **existing** processes.
	Novel changes such as creating a new entity, rolling out a new type of technology or requiring costly and time-intensive changes such as new IT systems, and significant changes to ongoing customer behaviour.

[30] The current technical SMETS2 technical specification includes smart control facilities for remote load management. This is done via auxiliary load control switches that can be programmed to turn on or off based on pre-set schedules or on an 'ad hoc' basis. However, this is currently limited to on/off events only and more sophisticated DLC will require proportional load control. This is currently planned for future versions of SMETS.

[31] Maxine Frerk (2018). Consumer attitudes to Demand Side Response and Direct Load Control

[32] BEIS (2022). BEIS Public Attitudes Tracker: Heat and Energy in the Home Spring 2022, UK

DIMENSION	CHANGE	COMPLEXITY
Contractual relationships	Extension of obligations to flexibility	This will depend on how prescriptive these obligations are but obligations can be incorporated into the existing supplier licence which provides a legal framework.
	Extension of obligations to support LCT take-up	Government is already considering similar supplier obligations on heat pump uptake although any changes on obligations could require wider legislative changes.[33]
Data, technology and assets	Effective customer comms regarding new social obligations	This will vary by obligation. Comms on new subsidies for LCTs are likely to be faster and simpler to develop. Those designed to support longer-term change in customer behaviour, for example accepting DLC, will be more complex and will require well-designed engagement that addresses customer concerns (similar to the engagement campaign needs for smart meter uptake).
	DLC and support for proportional load control for SMETS	The SMETS protocol already allows for on/off DLC and proportional DLC is already planned for the next specification.
Customer behaviour	Customers engage either with their supplier/third party installers of LCTs	This is likely to build on the existing process for ECO. Furthermore, as this is a 'one-off' change for customers this should be simpler to deliver.
	Customers engage with their supplier for the provision of flexibility	Suppliers will need to work with customer to overcome concerns relating to TOU tariffs. Where suppliers are proposing DLC as part of flexibility obligations this may require even more customer engagement for customers to feel comfortable in ceding control of their devices.

Source: Frontier Economics

6.2 MULTIPLE SUPPLIERS

This archetype requires significant changes to the balancing and settlement code (BSC) in order to manage settlement with more than one supplier per metering point. A meter splitting solution was discussed by the energy sector from 2019 to 2021 (code modification P379) and we use this analysis to inform our view of the transitions required, recognising that there may be alternative approaches to implementing a multiple supplier model.

We expect this model would require Ofgem to split the current supplier licence into two options: a lead supplier licence and a secondary supplier licence. The majority of social and environmental obligations that are moved away from suppliers altogether, with those remaining delivered by the lead supplier and codified in the lead supplier licence. The lead supplier would also continue to be responsible for smart meter rollout. Policymakers could also introduce new obligations on the lead supplier, for example obligations to act as the supplier of last resort for customers in the event that a customer's secondary retailer fails to minimise customer disruption.

Whilst this model tries to minimise obligations on secondary suppliers to reduce barriers to entry and innovation, there may be some social obligations that align with specific types of secondary suppliers. In

[33] BEIS (2021). A market-based mechanism for low-carbon heat

these cases, secondary suppliers may be required to deliver these obligations even if they do not fund and finance them. For example, Government could contract out delivery of ECO services to secondary heating specialist suppliers.

Aside from regulatory changes, this model is likely to require several changes to existing data, technology, and assets. At a minimum, customers will require sub-meters to separate out energy consumption between different suppliers. This could be built into the relevant asset which is the currently approach take for EV specific tariffs, and is often the case for heat pumps (in relation to the heat meter used for the renewable heat incentive). The solution developed by Elexon also established a new role, the Calculation Entity (CE) who is responsible for reconciling meter readings across the boundary meter and sub-meters and allocating volumes and settlement charges across suppliers.

From a customer's perspective, this archetype brings two main changes. First, customers that choose to take multiple suppliers will now need to manage multiple energy supply contracts as well as a wider variety of types of companies that supply energy and tariff types. For example, a car manufacturer may choose to enter the market and bundle a set number of miles with a car leasing contract as part of an 'as a service' tariff. Second, the underlying relationship between customers and their supplier will need to change in order to maximise the benefits of this model. Customers will need to feel comfortable to offer DLC to their supplier as well as enter into long-term contracts to enable suppliers to bundle asset financing alongside supply.

TABLE 3 KEY CHANGES REQUIRED FOR A MULTIPLE SUPPLIER MODEL

KEY	
	Small changes to **existing** regulation and business processes, technology, customer behaviour.
	Significant changes to **existing** processes.
	Novel changes such as creating a new entity, rolling out a new type of technology or requiring costly and time-intensive changes such as new IT systems, and significant changes to ongoing customer behaviour.

DIMENSION	CHANGE	COMPLEXITY	
Contractual relationships	Agreement on volume and cost allocation methodology		Work has already been carried out to agree a volume and cost allocation methodology as part of the P379 workshops and other examples can be drawn from existing supplier volume allocation (SVA) arrangements.
	Introduction of secondary supplier licence and distribution of supplier obligations		This will likely require legislative and/or regulatory change to create a new type of entity and associated licence, along with distribution of existing supplier obligations.
	Participation of secondary suppliers in flexibility markets		Suppliers can already participate in flexibility markets and we expect this would continue for secondary suppliers. Pace and scale will depend on customer take-up of secondary suppliers.
Data, technology and assets	Update of supplier billing and settlement systems to support volume splitting		High costs identified as part of the P379 impact assessment which ultimately led to its withdrawal although

DIMENSION	CHANGE	COMPLEXITY
		alternative solutions that are less cost intensive may have emerged since.
	Smart meter data sharing protocols for volume splitting	This may require engagement with customers on data privacy if their smart meter and sub-meter data is processed by a new entity not covered in the current Data Access and Privacy framework.
	Engagement activity to make customers aware of changes in accessing support due to changes to supplier obligations	If obligations are moved away from suppliers to central government or other organisations, this will need to be clearly communicated to customers and arrangements put in place to ensure that customers do not lose critical support during the transition.
	DLC from secondary suppliers either via SMETS or other technological solutions.	Depends on whether secondary suppliers use SMETS or other technological solutions to deliver DLC. If they use SMETS, the technical specification will need to be clear on establishing who owns which switch.
Customer behaviour	Customers need to manage multiple electricity supply contracts which may be bundled into their asset purchases	Whilst some customers are used to handling separate contracts for gas and electricity, this model will be a significant change in the way that customers interact with the market and the types of entities that might supply electricity.
	Customers have a long-term relationships with secondary suppliers which provide bundled assets and supply contracts with financing	This may require customer engagement to gain buy-in due to current low trust rates between customers and suppliers, and the recent focus on switching rates in the retailer energy market.

Source: Frontier Economics

6.3 CUSTOMER-FACING DSO

Due to the scale of change associated with this archetype, it may require more extensive changes to the legislative framework as well as significant work to establish the more detailed rules via the licence conditions and industry codes.

One of the major changes is the national rollout of HEMS and smart meter rollout. The residual smart meter rollout could also change from being supplier-led to DSO led, although by the time this archetype can be implemented we anticipate the majority of the rollout should be completed. The focus for DSOs will be the rollout of HEMS which is critical for this model. This also means that metering asset providers (MAPs) and meter operators (MOPs) will now work with the DSO rather than supplier, and the focus of Smart Energy GB may move from promoting smart meter uptake to HEMS. Other obligations beyond metering may also shift from suppliers to DSO such as those relating to energy efficiency.

Another key change will be the customer relationship with their DSO. Customers will now have a separate contract with the DSO, although they could still receive a single bill from their supplier under a combined billing approach. They will also receive direct price signals from their DSO which should be optimised by their HEMS. This could be via ad hoc flexibility signals. Alternatively they could be part of the distribution

tariff itself, for example a highly localised TOU distribution tariff. This option would require the structure of network charges to be adjusted.

Finally, this model means that DSOs will need to access granular smart meter data for individual households to calculate whether customers are responding to flexibility signals. This will require changes to the existing smart meter data access and privacy framework which currently only allows network companies to access aggregated data.

Both the current supplier licence and distribution licence will need to be modified to reflect these changes. It will also impact the regulatory framework for distribution companies which is set via RIIO-ED2 which will now need to reflect the cost of delivering new obligations as part of the regulatory allowance.

TABLE 4 KEY CHANGES REQUIRED FOR A CUSTOMER-FACING DSO

KEY	
	Small changes to **existing** regulation and business processes, technology, customer behaviour.
	Significant changes to **existing** processes.
	Novel changes such as creating a new entity, rolling out a new type of technology or requiring costly and time-intensive changes such as new IT systems, and significant changes to ongoing customer behaviour.

DIMENSION	CHANGE	COMPLEXITY	
Contractual relationships	Provision of flexibility via DSO price signals directly to the customer		Providing direct signals to domestic customers is new to DSOs and will require it to develop tariff/reward structures as well as the supporting communications and IT systems including direct customer-facing support.
	Rollout of smart meters and HEMS by DSOs		This will be a significant programme, similar in scale to the smart meter rollout and will require similar technical development and customer engagement, particularly as the HEMS will offer DLC which may require greater customer-buy in. Transfer of the smart meter rollout from suppliers to DSOs will also be a major change even if the number of outstanding smart meters is low by the time this model is implemented.
	Billing and cost recovery		This will depend on whether customers have a combined bill or a separate DSO bill. However, under both options we expect that DSOs will need to adapt their IT systems in order to calculate customer level bills, including rewards for providing flexibility which is likely to be cost and time-intensive.
	Social obligations and wider subsidisation of capital costs		Provision of in-home devices and other customer-facing social obligations will be new to the DSO and will require changes to the distribution licence as well as potentially wider legislative change and changes to regulatory allowances.

DIMENSION	CHANGE	COMPLEXITY
Data, technology and assets	Engagement activity to make customers aware of changes in accessing support due to changes to supplier obligations	If obligations are moved away from suppliers to DSOs, this will need to be clearly communicated to customers and arrangements put in place to ensure that customers do not lose critical support during the transition.
	Eligibility group data (incl. supporting IT systems)	If the DSO takes on social obligations such as the WHD that is based on existing eligibility group data, this will need to be provided to them as supporting IT systems may be required to process this information. DSOs do maintain a priority services register to support vulnerable customers in the event of a power cut which could include some of the functionality required to provide support for other obligations.
	Billing	If customers have a separate DSO bill, the DSO will need to invest in direct billing infrastructure which will include contact centres, communications, and online billing portals.
	Suppliers and DSO balancing comms	Suppliers and DSOs sending flexibility price signals may need to co-ordinate with one another to ensure that they are not sending directly conflicting signals or incentivising customer behaviour that leads to significant costs to the system overall.
	Improvements in SMETS2 capabilities	If the HEMS DLC utilises the SMETS auxiliary load switches this may require additional capabilities to be added to the SMETS technical specification, for example proportional load control. Improvements are regularly included in each specification update and DSOs could feed their requirements into the existing process.
	Development of HEMS specification	The HEMS will need to optimise across flexibility signals and translate this into DLC. This capability would need to be part of the HEMS technical specification. This specification would likely need to be agreed across industry to ensure optimisation of signals is fair.
Customer behaviour	Customer uptake of HEMS and associated DLC smart devices	Customer behaviour 'has proven to be more of a barrier to mass uptake of smart meter than [BEIS] anticipated'[34] and suppliers have reported spending large amounts of resources to get customers to accept smart meter installations. There is a risk DSOs will face similar issues with HEMS rollout, particularly as HEMS requires more customer involvement to use than smart meters, for example connecting new smart devices to the HEMS when purchased.
	Customer engagement with DSOs for network tariffs and other social obligations	Customers will need to adapt to interacting with their DSO directly which could include signing up for flexibility-based network tariffs and accessing other social obligations.

[34] NAO (2018). Rolling out smart meters

Source: Frontier Economics

6.4 THIRD PARTY ENTITIES

The entrance of new types of third party entities will also require changes in the energy market although as a general rule these are on a smaller scale than those associated with the market structure archetypes. We summarise these changes in Table 5 below.

Beyond the changes we have identified, further work is required to understand why these entities are not already operating at scale in the energy market as we have no identified any regulatory barriers that would completely rule these out (section 4.3.1). Understanding these reasons will help policymakers to identify the right interventions to remove existing barriers and enable the transition effectively.

TABLE 5 KEY CHANGES REQUIRED FOR THIRD PARTY ENTITIES

DIMENSION	'AS A SERVICE' RESELLERS	DOMESTIC AGGREGATORS	ENERGY CONCIERGES
Contractual relationships	Greater regulatory clarity on how 'as a service' tariffs would operate in the current regulations Clarity on need for resellers to have a licence and potential introduction of new reseller licence.	Majority of changes already ongoing as part of changes to the VLP role including code modification 415 which would allow VLPs to independently operate in the wholesale market.	Establish commercial models, either commission driven from suppliers or fee-paying from customers. May need to set up new commercial relationships with independent LCT installers and aggregators.
Data, technology and assets	Updated BSC rules to reflect role of resellers on switching, settlement, and meter registration.	Increasing uptake of LCTs to provide sufficient scale for aggregation. More sophisticated DLC options for SMETS (if aggregators use this instead of their own networks)	Consistent methodology for comparing new tariff structures such as TOU and 'as a service'. Making it easier for customers to share their smart meter data with third parties.
Customer behaviour	New rules to ensure customers do not receive a lower level of service or protection when taking energy supply from a reseller vs. supplier.	The majority of customers are unfamiliar with aggregators, which will need to engage with customers to build trust and take-up.	No significant changes. Customers should interact with energy concierge services in the same way as they currently engage with PCW, auto-switching services, and energy efficiency advice websites.

Source: Frontier Economics

7 CONCLUSIONS AND NEXT STEPS

The electricity sector has a challenge to decarbonise by 2035. This will require overcoming several barriers in the existing market at pace. We have set out three alternative market structure archetypes that could help to overcome these barriers, as well as potential third party entities that could further address these issues. Our subsequent assessment found that whilst each of these options has the potential to address the cross-cutting barriers, the best option will depend on the degree of customer engagement.

WHILST EACH MODEL MAY HELP ADDRESS THE CROSS CUTTING BARRIERS, THE OPTIMAL CHOICE DEPENDS ON THE LEVEL OF CUSTOMER ENGAGEMENT WHICH CAN BE ACHIEVED

Each of the archetypes could help to overcome the barriers identified in WP2 but do so in very different ways. Both the extended supplier hub model and the customer-facing DSO aim to address high upfront capital costs and limited flexibility by intervening directly in the market, placing new obligations on suppliers and DSOs respectively. In comparison the multiple supplier model takes a market based approach, creating an environment designed to promote new innovative business models that include LCT financing and flexibility.

FIGURE 11 HOW DO THE MARKET STRUCTURES ADDRESS THE CROSS-CUTTING BARRIERS?

	EXTENDED SUPPLIER HUB	MULTIPLE SUPPLIER MODEL	CUSTOMER-FACING DSO
UPFRONT CAPITAL COSTS	Obligations on suppliers to finance LCTs	Enabling new business models that include LCT financing bundled with supply	Obligations on DSOs to finance LCTs
DOMESTIC FLEXIBILITY	Obligations on suppliers to promote flexibility e.g. more availability of TOU tariffs or DLC	Enabling new business models centred around flexibility e.g. 'as a service'	DSOs send direct flexibility signals to customers which are optimised via their HEMS
REGULATORY COMPLEXITY	More interventionist approach could lead to greater regulatory complexity for suppliers	More market-based approach could help streamline regulatory complexity for secondary suppliers although will require additional regulatory processes to manage meter splitting	Lower regulatory complexity for suppliers as they face fewer obligations although it imposes several new functions onto DSOs
CUSTOMER PROTECTION	Stronger obligations on suppliers could deter entry and reduce customer outcomes	Greater complexity of choice and bundling could increase risk of customer harm if customers are not able to effectively choose between tariffs	Bringing HEMS and flexibility into monopolies could reduce innovation and outcomes
COMPLEXITY OF CHOICE	Less complexity of choice as customers no longer need to engage with independent installers and aggregators for LCTs or flexibility	Greater complexity of choice with a wide variety of different businesses models and differentiated propositions	Less complexity for customers as customers no longer need to choose a LCT provider

TRADE-OFFS

Source: Frontier Economics

Which of these will be most efficient in practice will depend on the degree of customer engagement, which in turn is influence by customer heterogeneity and complexity of choice. If the current market model is unable to deliver efficient levels of domestic flexibly, a multiple supplier model could be the best alternative if customers are able to effectively choose between tariffs, supported by digital comparison tools (e.g. an 'energy concierge') that can take account of individual customer consumption patterns and other customer-specific factors. However, if this is not the case, the extended supplier hub model may be more appropriate.

Finally, if there is reason to believe that suppliers are failing to pass on flexibility signals (including via direct contracts) from DSOs to their customers, direct signals from DSOs to customers may be required under a customer-facing DSO model. However, this comes at the cost moving competitive and innovative areas of the net zero transition into a monopoly, including development of HEMS systems, and could stifle innovation in those areas.

FLEXIBILITY: THE MULTIPLE SUPPLIER MODEL MAY BE BEST PLACED TO UNLOCK CUSTOMER ACCEPTANCE

Whether the current market structure is sufficient to deliver customer flexibility remains to be seen. Whilst current levels are low, this may be due to reasons beyond the market structure. Several initiatives are currently in progress that are intended to encourage flexibility. If levels remains lower than is optimal following MHHS, scale-up of LCTs and full smart meter rollout, this may be due to (1) a lack of customer acceptance of flexibility; or (2) barriers to market entities such as DSOs accessing flexibility.

Each of the market archetypes focuses on mitigating these two flexibility risks to a different extent. The best option will be the one that removes these barriers (to an efficient level) at the lowest cost. Therefore options that enable business models that make flexibility attractive to customers – like the multiple supplier model – may be more successful as encouraging flexibility. Where DSO access issues remain, these could be addressed via regulation or other access incentives, assuming any risks associated with these interventions are effectively managed by larger energy market entities or other third parties. This will lower costs to the system and ultimately customers.

However – as noted above – this model does rely on the development of innovative business models that can bring forward customer engagement, and this is currently far from certain.

POLICYMAKERS NEED TO DEFINE A CLEAR ADAPTIVE PLAN

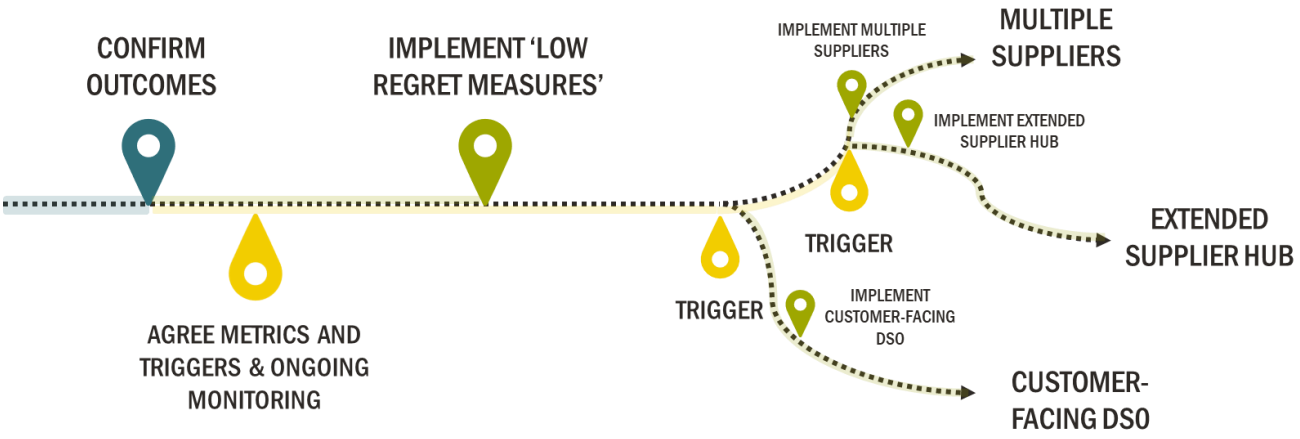
Our review of the transition shows that there are significant steps involved in transitioning to each model. Whilst they are in feasible in theory, more work is required to provide greater certainty on which of these archetypes will work best in practice before committing to complex and costly changes. This requires policymakers to take an adaptive planning approach which will provide greater confidence that the market is sufficiently 'ready' to unlock the benefits of any archetype in practice before making costly changes:

- **Confirm the outcome you want to deliver.** First policymakers must be clear on the criteria for a 'successful' market. The criteria we have used here is a starting point but there are a number of areas that need to be clarified, for example the definition of 'fairness'. This could also include setting a 'vision for HEMS' which will define the outcomes that HEMS systems should facilitate, how they can do this, and how the market for HEMS might develop.

- **Implement 'low-regret' actions**. Policymakers should then identify 'low-regret' actions that (1) would be beneficial across all market structures, (2) 'good-bets' that are too costly to delay or require preparatory actions to keep future options open, and (3) can help to inform the decision between archetypes.

- **Agree key metrics to monitor the market and trigger points.** Policymakers should define a set of key metrics and indicative thresholds that will be used to determine whether or not to proceed in a specific direction.

FIGURE 12 ADAPTIVE PLANNING APPROACH



Source: Frontier economics

This adaptive approach will allow policymakers make decisions in the face of uncertainty on customer and private sector response, helping to unlock opportunities for new business models and transform the customer experience while delivering the net zero transition.

MONITORING THE FLEXIBILITY MARKET

This adaptive planning approach should include low-regret measures and key monitoring metrics around flexibility. Given the relatively nascent state of domestic flexibility and the degree of reliance on flexibility in the FES net zero pathways, it is important that the industry rapidly improves its understanding of how much flexibility can be accessed in practice, risks associated with flexibility, and options to mitigate these risks. This information should then be used to make decisions on the market structure that can best unlock flexibility, as well as the extent to which flexibility is likely to be cost-effective in any given area.

Potential low-regret measures include improving customer engagement on flexibility to improve acceptance, new informational requirements at the point of sale for large flexible assets, and a co-ordinated effort across DSOs to gather data and best practice on procuring flexibility. For example, this could include understanding the optimal spread of risk across DSOs, suppliers, and customers in the face of unreliable procured flexibility, and who is best placed to mitigate this risk at lowest cost. A better understanding of the relative costs and risks of flexibility should also help to understand what is the efficient level of domestic flexibility.

This could be accelerated if DSOs deliberately procured flexibility in areas that do not require it immediately, although this would be an additional cost and a cost benefit analysis should be carried out before moving forward.

The data and experience gathered by DSOs should underpin key monitoring metrics, acting either as 'warning signs' that levels of flexibility are lower than expected or the cost of flexibility is higher, or alternatively that customer attitudes or DSO access are better than anticipated. This information can then be used to inform the final direction of travel for the market structure.

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POTENTIAL LOW REGRET MEASURES

BENEFICIAL UNDER MOST/ALL MARKET STRUCTURES

Thermal efficiency

- Address upfront capital costs of thermal efficiency measures including exploring options to incorporate thermal efficiency funding via other sectors where there are co-benefits

Customer protection

- Work with industry to address potential areas of consumer harm

Flexibility

- Improve engagement with customers, particularly those with existing large flexibility assets such as EVs;
- Information requirements to communicate benefits of flexibility upon purchase of EVs, heat pumps, EVs and batteries;
- Develop best practice for procurement of flexibility amongst DSOs such as contractual arrangements and optimal balance of risk;
- Sufficient trials and shared learnings to better understand uncertainties

Data and technological initiatives

- Continue open data initiatives for sharing smart meter and flexibility data
- Standardised methodology for estimating customer flexibility
- Extend interoperability requirements

Promote domestic aggregation

- Standardised vehicle to grid export tariffs (similar to smart export guarantee)
- Removing barriers to VLP access to flexibility revenue streams

GOOD BETS FOR THE MULTIPLE SUPPLIER MODEL

Technological initiatives for sub-metering

- Further consideration of technical feasibility and cost benefit analysis of sub-metering requirements for all heat pumps to keep the multiple supplier option open as heat pump rollout ramps up

ACTIONS TO SUPPORT DECISION-MAKING

EVs as a test case

- Large scale EV trial for separate suppliers for EVs. This may be more feasible as many EV chargers already have submeters and customers can already take a separate EV tariff (with the same supplier as their general electricity supply)

Review of licence lite

- Understand reasons for low adoption of licence lite to ensure that if a secondary supplier licence is introduced, it does not repeat previous barriers

Developing 'as a service' tariffs

- Continue to advance 'as a service' business models including understanding existing barriers to assess whether new market structures would lead to growth in these tariff structures

Assess dependencies between domestic flexibility technologies

- Determine whether LCTs such as heat pumps and electric vehicles could be dispatched independently of one another in most households

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