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PROJECT REDMAST: EVALUATION OF MARKET STRUCTURES

Research and Development of Market Structure report WP3

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1 INTRODUCTION

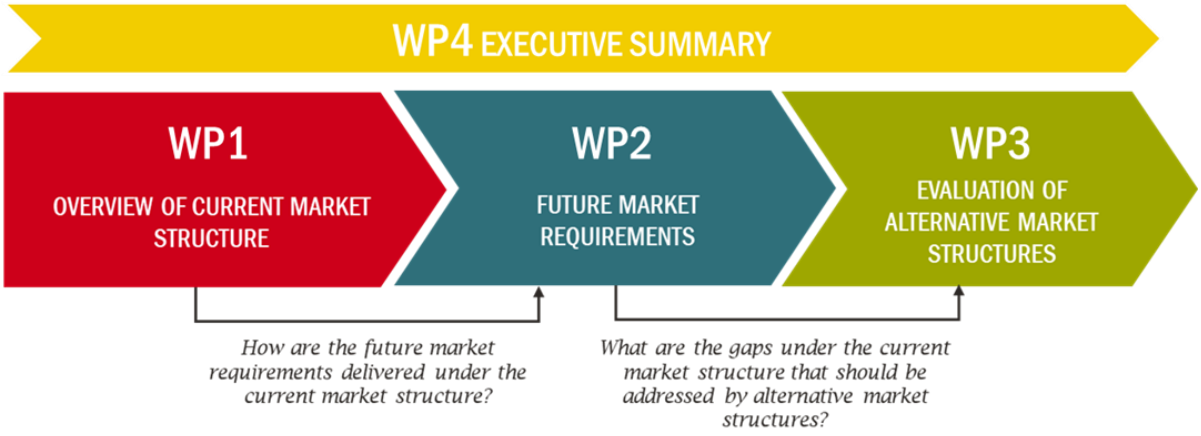
The UK has a legally-binding commitment to deliver net zero by 2050. To meet this target the Government's net zero strategy plans to fully decarbonise our power system by 2035.[1] This will rely on a series of transitions across the whole energy sector including decarbonisation of heat, electrification of transport, and greater demand-side flexibility.

In this context, it is time to review whether the current market structure and supplier-hub model remain the best option to meet these challenges or whether the market structure will need to adapt alongside our energy system.

1.1 PURPOSE OF THIS WORK

Western Power Distribution (WPD) has asked Frontier Economics to review the current structure of the market and evaluate this against future market requirements in the context of the net zero transition. This project, referred to as project REDMAST (**Re**search and **D**evelopment of **Ma**rket **St**ructure) will inform an evaluation of potential future market structures to understand whether the current structure needs to be adapted going forward. This is the third stage of this analysis.

FIGURE 1 INTEGRATION OF WORK PACKAGES



Source: Frontier Economics

The previous work package (WP2) identified key customer facing transitions required by the energy system to deliver net zero. It then assessed the current market structure against these requirements to identify cross-cutting barriers that currently exist to achieving this goal. These cross-cutting barriers consist of:

- upfront capital costs;
- limited incentives for domestic customer flexibility;
- regulatory complexity in the face of new business models;
- evolving requirements for customer protection to address new sources of customer harm from new business models; and

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

- complexity of choice and customer heterogeneity.

This work package focuses on designing and evaluating illustrative market structures that could help to overcome these barriers and enable the net zero transition. The purpose of Project REDMAST 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.

As part of this work, we carried out a workshop with industry participants including with network and system operators, suppliers, policymakers, and other members of the energy community. We also carried out several targeted interviews with industry experts. The findings from these conversations have informed our thinking in this work package.

1.2 STRUCTURE OF THIS DOCUMENT

The remainder of this document is organised as follows:

- Section 2 sets out the assessment criteria for evaluating the current and alternative market models. We set out what a 'good' retail energy sector should look like (from the perspective of customers) and use this to guide the assessment of models.
- Section 3 defines the individual 'building blocks' we have identified for alternative market models. These are different ways in which barriers to the net zero transition could be overcome and have been drawn from literature and international examples, engagement with market experts, and the industry workshop.
- Section 4 groups these building blocks into a number of choices that need to be made. These include:
  - a set of three illustrative market model archetypes, describing the structure of the customer facing part of the market (the focus of this work); and
  - a broader set of decisions (e.g. relating to how vulnerable customers are treated) which, while not the focus of this work, may still have interactions with the market structure.
- Section 5 sets out our assessment of these market model archetypes and the broader set of decisions, in relation to the assessment criteria.
- Section 6 lays out the key transitions required to reach the market models.
- Section 7 sets out our final conclusions.

Focus on flexibility

The way in which the market brings forward flexibility presents particular opportunities and risks, especially for DSOs (which may be reliant on highly local sources of flexibility). Throughout this report, we describe the role of flexibility in more detail in blue boxes like this one.

In addition to the main body of this report, we include an Annex which discusses the building blocks in more detail.

2 ASSESSMENT CRITERIA

This section sets out the assessment criteria we use to evaluate market models in this work and applies it to the current market structure.

2.1 THE ASSESSMENT CRITERIA

Our starting point was considering what a 'good' energy system looks like for customers. We build on WP2, the Future Energy Scenarios (FES)[2], and previous work carried out by Ofgem and BEIS to reach an assessment criteria based on three key themes: (1) efficiency, (2) feasibility, and (3) fairness. This assessment criteria will be used to evaluate alternative market models in this work. We explain each of these criteria below.

FIGURE 2 ASSESSMENT CRITERIA

EFFICIENCY

Does this solution address the energy trilemma?

- Ensure customers are willing and able to:
  - Have the right technologies…
  - …and use them in the right way
- In order to deliver:
  - Net zero…
  - ….and a secure supply…
  - at lowest cost

FEASIBILITY

Is this solution technically feasible and is the transition process proportionate?

- Minimise administrative burden on electricity industry participants, Government and Ofgem, and customers of the solution once in place
- Enables financially sustainable businesses
- Minimise the transition period and costs required to deliver the solution, given current industry processes and systems

FAIRNESS

Would this solution result in poor outcomes for specific customer groups

- Be equitable for customers and tax payers
- Avoid adverse impacts on vulnerable or fuel poor customers

Source: Frontier Economics

2.1.1 EFFICIENCY

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.

As with the rest of REDMAST, our focus is on aspects of the energy system that directly impact domestic customers (rather than, for example, the choice of generation technologies). This relates to both the technologies which are invested in (such as domestic heating and transport) but also how they are used. In practice, the FES described in WP2 are designed to meet decarbonisation and security of supply standards, so the relevant test is whether a market model can deliver these outcomes at lowest cost to the system.

As we discussed in WP2, customers will need to have the right ability and incentive to move away from gas-boilers and ICE vehicles to low-carbon heating technologies and electric vehicles (EVs), as well as installing

[2] At the time of drafting this document the FES 2021 was the latest iteration. Since then FES 2022 has been published and is available here. FES 2022 is consistent with 2021.

Photovoltaic (PV) and thermal efficiency measures. In addition to switching to LCTs, 'adopting the right technologies' includes adoption of smart devices, home energy management systems (HEMS), and batteries that allow customers to deliver flexibility.

Using technologies in the right way refers to increasing provision of residential customer flexibility. The energy system should create the right incentives and options for customers to use their energy flexibly, which may include storing energy in batteries to smooth reliance on the grid. This will include considerations on whether the model itself is attractive to customers as the provision of customer flexibility will ultimately depend on customers choosing to take-up a new model or change their behaviour. Whilst this will not be quantified, we will capture this in the qualitative assessment.

2.1.2 FAIRNESS

The retail market should be fair for customers. We recognise that there are many different interpretations of fairness, some of which contradict each other. During the workshop, we tested different definitions of fairness across the stakeholders.

- **Customers face similar unit costs despite their cost to serve**. For example, some customers may use hydrogen heating whereas others might switch to heat pumps. Even if these two fuels have different costs, a 'fair' outcome may require customers to face similar costs per kWh. Another example would be customers in capacity constrained areas facing similar costs to those in areas without capacity constraints.

- **Customers have cost-reflective bills based on whole system costs**. This is the opposite of the definition above and customers' bills would reflect the overall cost their consumption poses on the system. This means that if you had two customers who use the same amount of energy but just one of those customers adjusts their consumption in response to flexibility signals, that customer would face lower bills.[3]

- **Vulnerable customers receive support**. Irrespective of the bill structure, customers who are in vulnerable circumstances such as low-income households or those in fuel poverty are supported.

- **Disengaged customers are protected.** Customers who are either unable to engage with the market or choose not to engage do not face higher bills.

Whilst there was support across all four definitions, it was highest for 'customers facing cost-reflective bills based on whole system costs' and 'vulnerable customers receive support'. It is outside the scope of this work to define fairness. Therefore when we assess models against this criteria we will consider implications against all four of these definitions.

2.1.3 FEASIBILITY

Our last criteria relates to feasibility, both with respect to the transition and at steady state. Whilst the Government's economy-wide net zero target is 2050, the electricity system is expected to decarbonise by 2035[4] and therefore any significant transitions will need to be delivered at pace with a transition period

[3] Under a nodal pricing system where wholesale costs vary from location, this approach would also mean that customers face different unit costs depending on their zonal energy price.

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

that aligns with this target. Decision-makers should also consider the costs required to deliver any solution given current industry processes and systems. However, this should not deter the industry from thinking ambitiously about alternative models, particularly as the societal cost of failing to deliver against the industry's net zero target is likely to be significantly higher than the transition costs. We consider the transition path separately in section 6.

The future market structure also needs to be feasible in steady state. It should minimise administrative burden on electricity industry participants, the government and the regulator, and ultimately customers once it is in place. Furthermore, in order for any model to be feasible, 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.

2.2 APPLYING THIS CRITERIA TO THE CURRENT ENERGY MARKET STRUCTURE

In WP2 we discussed the current retail energy market structure and identified a number of cross-cutting barriers facing the net zero transition. We provide a recap of these findings below in the context of the assessment criteria used to evaluate alternative market structures in this report.

FIGURE 3 SWOT ANALYSIS OF CURRENT ENERGY MARKET STRUCTURE

STRENGTHS

Efficiency

- Customers have a single point of contact.
- Licence does not prevent suppliers from expanding into provision of low carbon technologies (LCTs) and associated financing where suppliers believe this will differentiate them to customers.

Fairness

- **Vulnerable customers receive support.** Energy company obligation (ECO) increasingly targeted at households most at need. Warm Home Discount (WHD) automatically matches eligible customers in core group.
- **Protects disengaged customers.** Default tariff cap (DTC) protects the disengaged and WHD protects vulnerable customers in fuel poverty.
- **Customers face similar unit costs.** The majority of customers are on flat tariffs. Those that are on tariffs subject to the default tariff cap face the same cap on the unit cost of energy regardless of when they consume this energy.

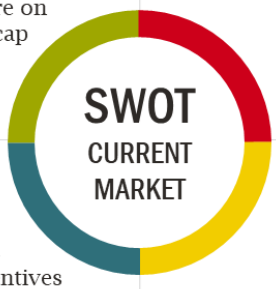
WEAKNESSES

Efficiency

- Suppliers have an incentive to sell more energy rather than promoting load shifting or energy efficiency. Even once this changes with MHHS, many customers distrust* their supplier to provide energy efficiency and heating systems advice due to perception of misaligned incentives
- Customers face high upfront capital costs and long payback periods for LCTs such as heat pumps. Suppliers have limited incentives to offer financing given emphasis on switching.
- Supplier licence and DTC could be barriers to more innovative tariffs like 'as a service**' that would support LCT uptake and reduce energy usage.
- Price comparison websites have limited ability to compare TOU tariffs and may struggle to compare more innovative tariffs like 'as a service'. Few TOU tariffs available to customers.
  - Limited domestic aggregation means customers have limited ability to sell flexibility

Fairness

- **Customers have cost-reflective bills.** Customers do not face cost reflective charges for capacity. Without ToU tariffs, bills are also not reflective of consumption profiles



OPPORTUNITIES

- Introduction of mandatory half hourly settlement (MHHS) means suppliers will face cost-reflective prices and should increase incentives to promote customer flexibility and time-of-use (TOU) tariffs.
- Rollout of smart meters should increase ability of suppliers to offer TOU tariffs.
- Regulatory changes currently being discussed to increase ability of virtual lead parties (VLPs) to offer flexibility and reward customers.

THREATS

- High and volatile cost of energy could leave customers worried that TOU tariffs would result in higher bills and cause them to choose flat tariffs which offer no flexibility incentives.
- If the price of LCTs such as solar panels, batteries, heat pumps do not fall, customers will continue to face high capital costs with limited financing options. This will limit customer uptake of LCTs, particularly in the short term with increasing cost of living.
- Changes to VLP access to wholesale markets currently under consultation and may not be approved that could limit commercial feasibility of independent aggregators in domestic sector.

*The Spring 2022 BEIS public attitudes tracker found just 19% of people would trust energy suppliers advice on which heating system to install in their homes
** Under an 'as a service' tariff customers pay based on the level of service they receive rather than kWhs of energy consumed e.g. pay per hour of heated room or pay by milage for EV charging

Source: Frontier Economics

2.2.1 ASSESSING FLEXIBILITY FOR DSOs

As we discuss in WP2, the FES assumes that customer-side flexibility will be key to decarbonising energy at the lowest cost. This has recently been reiterated in FES 2022 which calls for a demand-side strategy to incentivise more flexible consumption and greater use of storage.[5]

This will require changes in customer behaviour. While flexibility is only one component of the move to net zero, it may be harder to forecast than other transitions. For example, if LCTs such as heat pumps and EVs are being taken up insufficiently quickly, then policymakers should be able to observe this and make necessary changes to bring take-up back on track. However, if LCT take-up proceeds as planned but without the expected flexibility, then the resulting higher peak loads could impose significant costs on the system.

Given the importance of customer flexibility, we have carried out a more detailed assessment for each of the market archetypes focused on risks associated with the provision of flexibility.

2.2.1.1 THE 'FLEXIBILITY FIRST' APPROACH

In 2018 distribution network operators (DNOs) committed to a 'Flexibility First' approach as part of the transition to a distribution system operator (DSO) role. Under this, DSOs will consider flexibility solutions as an alternative to conventional network reinforcement. DSOs should move forward with whichever solution is more efficient, whether that be flexibility or network reinforcement. Whilst there will be a transition period as DNOs gain a better understanding of the benefits, costs, and risks associated with flexibility solutions compared to network reinforcement, overall the taking a Flexibility First approach should not lead to higher costs for the DSO or customers.

In this context, it is important that network companies consider the various sources of risk associated with flexibility when making these decisions. Furthermore, a market structure that can reduce the risks and associated mitigation costs to flexibility can lower overall costs to the system and customers alike.

2.2.1.2 RISKS TO THE DSO

Uncertainty surrounding customer flexibility is a particular issue for DSOs. DSO flexibility requirements are likely to be highly local, focused on areas where the network is constrained. At the same time, alternative solutions such as network reinforcement must be planned well in advance. This means that if DSOs rely on customer flexibility which is subsequently unavailable, they have limited options to fall back on.

We have identified two types of risks for DSOs: (1) Being unable to procure flexibility in advance, and (2) being unable to rely on this flexibility when called upon. These risks are driven by two common factors:

- First, the level of **customer acceptance** of flexibility will determine the number of customers willing to respond to flexibility signals or offer DLC. This increases the availability of flexibility that can be procured in advance and the reliability of this flexibility when called upon.
- Second, they are influenced by **DSO access** to customer flexibility. For example, even if customers are willing to engage with flexibility, under the current supplier hub model DSOs can

[5] National Grid ESO (2022). Future Energy Scenarios. We note that at the time of writing WP1 and WP2 the 2022 FES had not been published and therefore these documents reference FES 2021.

only access this flexibility if suppliers offer flexibility-oriented tariffs such as dynamic TOU tariffs or DLC, as well as engage with flexibility markets to make this available to the DSO.

Both these risks raise costs for DSOs. If DSOs are unable to procure flexibility in advance, they will be forced to rely on costly network reinforcement even under a Flexibility First approach. And if DSOs can and chose to procure this flexibility but cannot rely on it when called upon, they will be forced to find additional last-minute flexibility elsewhere. This could either be via sourcing additional flexibility amongst households, likely through higher price signals, or alternatively calling on additional flexibility in the I&C market which again comes at an additional cost. In the extreme, customers may be subject to involuntary disconnection.

While these costs could be very high for a given local area experiencing a constraint, we would not expect them to be seen across an entire license area. This is since:

- The utilisation costs of flexibility mean that it is typically used for a limited number of a years to *defer* reinforcement, rather than to avoid reinforcement altogether. Once a network is reinforced, this will typically add such a large amount of capacity ('fit and forget') that further flexibility is not required. It is therefore unlikely that a high proportion of the network will be reliant on flexibility at once.

- The principle of 'Flexibility First' is to only rely on flexibility if it is expected to be cheaper than reinforcement. If it turns out that flexibility is more costly or less reliable, then over time DSOs would amend their expectations to avoid procuring flexibility where it is likely to be more expensive than immediate reinforcement.[6]

Even if DSOs do not need to call on more expensive last-minute flexibility, if the reliability of procured flexibility is lower under certain market structures, this will lead to higher costs as DSOs may have to over-procure flexibility to build insufficient levels of redundancy.

2.2.1.3 IMPACT ON CUSTOMERS

As discussed above, risks associated with the procurement of flexibility come at a cost to DSOs (conversely, lowering these risks can reduce DSOs' costs). We now consider whether some or all of these costs could be passed on to customers via their energy bills, specifically the Distribution Use of System (DUoS) component of the bill. We note that much of this will depend on the form of the regulatory framework which determines the circumstances in which network companies can pass costs on to customers, and RIIO-ED2 is currently in the process of being finalised.

Under the current regulatory framework, DNO allowed revenues are fixed in advance over the duration of the price control period (subject to a limited number of re-openers in specific scenarios). This means that if the DSO faces unanticipated costs of flexibility, for example costs of calling on emergency flexibility, in the short-term these costs will likely be borne by the DSO rather than customers (although if disconnection is required, customers will clearly face a direct detriment). In the longer term, if the cost of flexibility is above what DSOs currently expect, we would this to be eventually be reflected in

[6] It is possible that a very low-probability event could cause the availability of flexibility to be severely reduced across many areas at once. For example, an exceptionally severe winter might lead to customers being unwilling to temporarily switch off heat pumps. However, even if this was not anticipated, it would not affect all areas of the network due to the limited reliance on flexibility described in the first bullet.

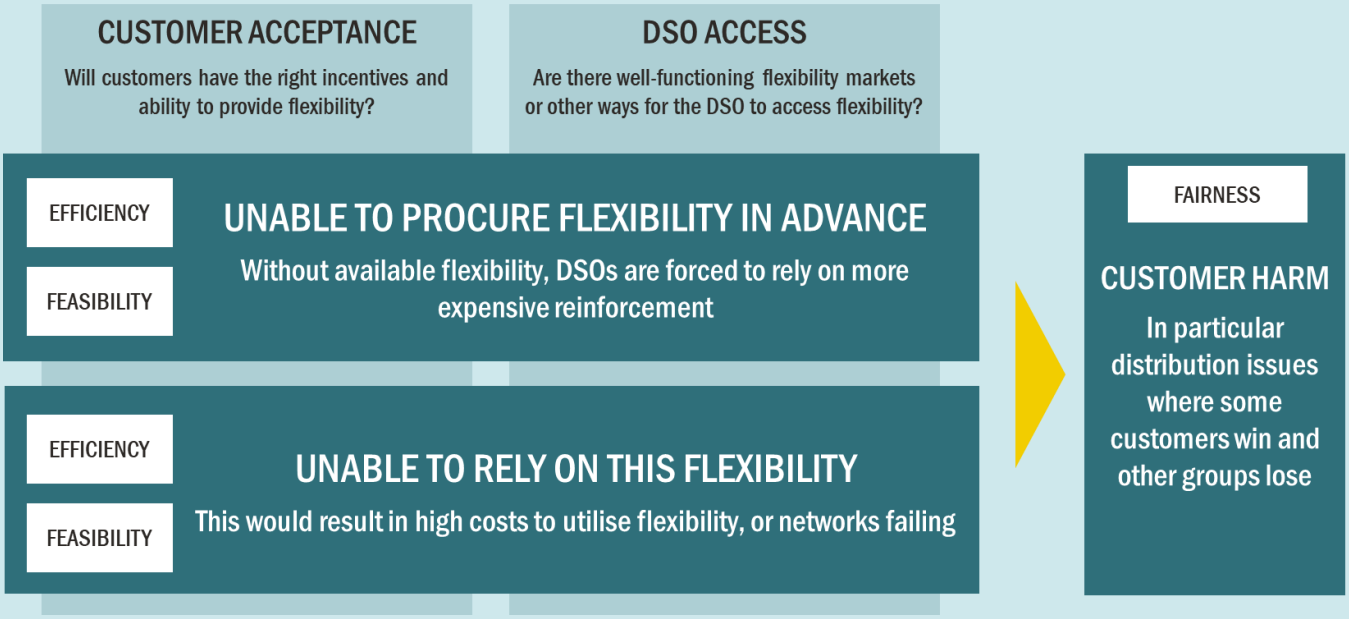
higher DUoS costs to customers. We consider the extent to which these costs might be socialised under each of the market structures archetypes in our assessment of each one.

2.2.1.4 FLEXIBILITY RISK ASSESSMENT FRAMEWORK

We apply the following flexibility risk assessment framework to the market structure archetypes considered in this report (Figure 4). We assess the degree to which each market archetype promotes customer acceptance of flexibility and enables DSO access. We also consider whether the approach for procuring flexibility under each option reduces or amplifies potential issues relating to customer harm.

A model that can both improve customer acceptance of flexibility and promote DSO access to this flexibility will reduce DSO costs and ultimately costs for customers. Where trade-offs between these two drivers need to be made, a model that distributes risk on those entities best placed to manage them will be most efficient and minimise costs for end-customers.

FIGURE 4 FLEXIBILITY RISK ASSESSMENT



Source: Frontier Economics

3 BUILDING BLOCKS

The starting point of our analysis is a set of 'building blocks' – different options for how the market could be structured, which could overcome at least one of the cross-cutting barriers identified in WP2. This section summarises the individual building blocks considered for each building block category. Annex A provides more detail on each building block, explaining how it might address the cross-cutting barriers identified in WP2, and identifies its potential limitations.

This list of building blocks draws on examples from several international markets including Spain, France, Norway, and the US, as well as looking across other sectors such as telecommunications and financial services to draw relevant parallels. We also reviewed previous literature on these issues and had several informal discussions with sector experts.

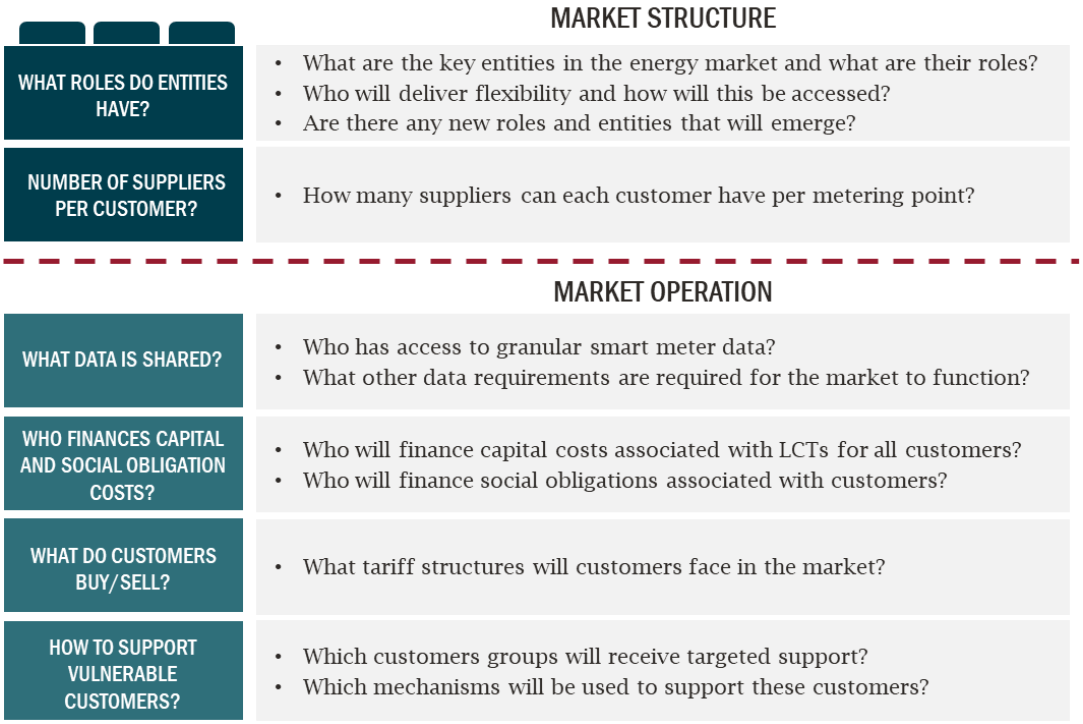
Figure 5 below summarises the different types of building block we have considered. The first two relate to the **market structure** itself – i.e. what role each type of entity has in relation to customers, and how they interact with one another. This is the main focus of this work, and our subsequent assessment concentrates on these issues.

Some of these building blocks change the roles and responsibilities of entities currently in the retail market. In order to avoid introducing unfamiliar terms we continue to use the current names of these entities:

- We continue to use the term 'supplier' throughout this report to refer to entities which purchase energy on wholesale markets and then sell to end-customers, regardless of whether they have more or fewer responsibilities than current suppliers.
- We also refer to distribution system operators (DSOs) rather than distribution network operators (DNOs) both to reflect the ongoing DSO transition and the fact that flexibility is a key part of the net zero transition. Again, some of the building we consider vary the role of the DSO beyond what is currently envisaged.

Overcoming the cross-cutting barriers identified in WP2 may also require changes to the **market operation** – e.g. the types of product that are sold, or the types of data which are transferred. We therefore consider a number of other building blocks, as illustrated below.

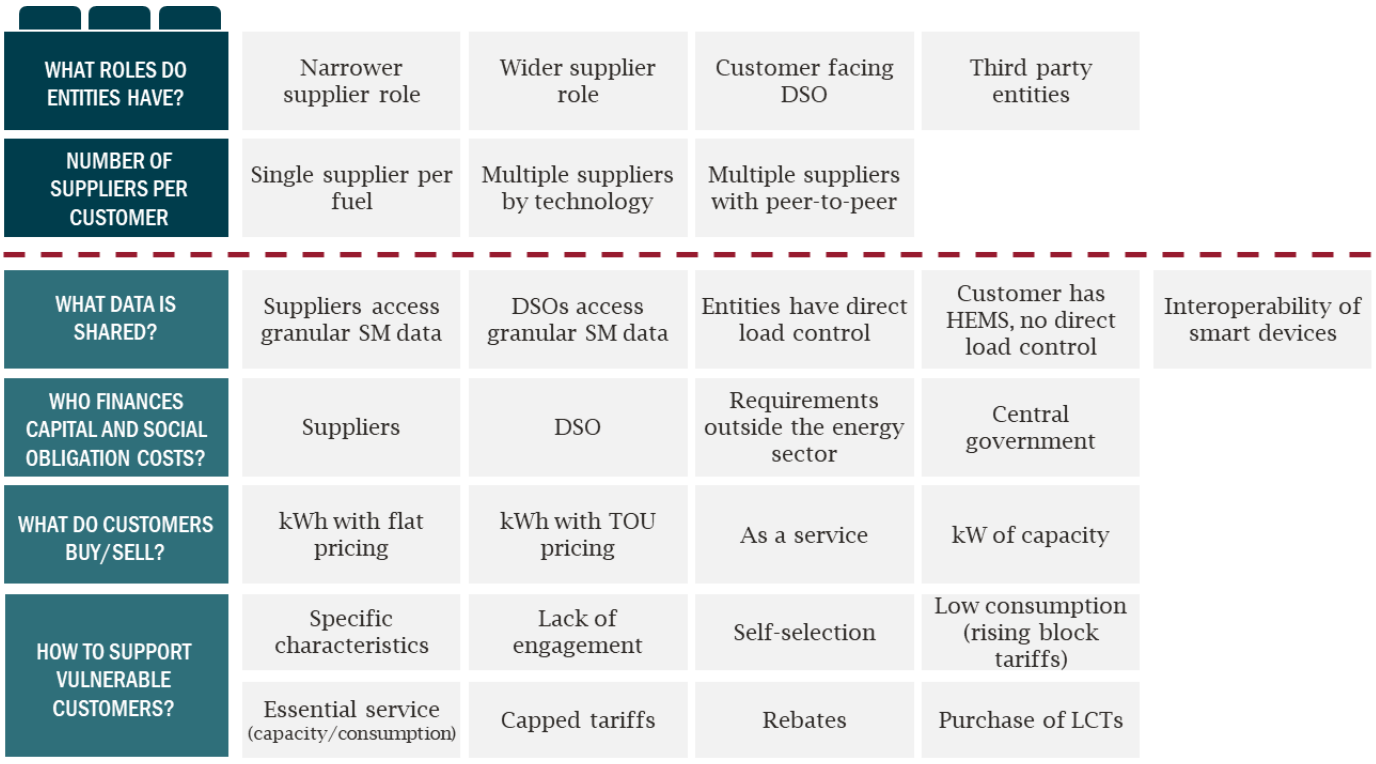
FIGURE 5 BUILDING BLOCK COMPONENTS



Source: Frontier Economics

Figure 6 below lists the building blocks which are explained in the following sections.

FIGURE 6 OVERVIEW OF BUILDING BLOCKS



Source: Frontier Economics

3.1 WHAT ROLE DO ENTITIES HAVE?

This building block component refers to the roles of different entities within the energy market. As this work is focused on the customer interface, we only consider roles that directly impact customers (e.g. the sale of retail energy products and services and billing).[7] Provision of support for vulnerable customers is considered separately under 'how to support vulnerable customers'.

The current market is structured around the supplier hub model where the supplier acts as the primary interface between customers and the energy system. Customers have a single contract with the supplier[8] which issues a single bill to pass on charges from the rest of the supply chain, as well as policy costs. We discussed this in detail in WP1.

In addition to the current status quo, we have considered the following alternative options in our work:

- **Narrower supplier role**: Moving some of the customer facing obligations of the supplier to other entities (e.g. DSOs or central Government). Removing these obligations could reduce barriers to entry, stimulate competition, and allow suppliers to focus on offering innovative services. The streamlined supplier licence could be similar in scope to the 'Licence Lite' that Ofgem introduced in 2015 without the requirement for exempt suppliers to have a commercial agreement with a licenced supplier.

- **Wider supplier role**: An expanded supplier hub which utilises the existing role of the supplier as a 'gatekeeper' to add additional obligations, for example relating to ensuring customers install low-carbon technologies (LCTs) and take-up flexibility services. For example, the Government's consultation on the heat pump manufacturer obligation considered placing a requirement on suppliers to provide customers with low-carbon heating technologies. Costs associated with the installations and maintenance would be passed through to customer's energy tariff.[9]

- **Customer facing DSO**: Customers have a separate contract (and potentially a separate bill) from their DSO. This approach is used in Norway where customers have a separate bill for network costs and France where customers have a separate contract with their DSO but still have a combined bill. This type of model could enable DSOs to have direct access to customer flexibility.

- **Third party entities**: Different types of third party entities could help market coordination, enhance co-operation among market participants, and promote customer flexibility. Three different types of third party co-ordinating entities have been identified (Figure 7):

    - An **'as-a-service' reseller** buys kWh from suppliers and potentially capacity from DSOs, bundles this into an 'as-a-service' offering (see 3.5) and offers it to customers as a package. 'As a service' resellers could be a separate organisation to the supplier, for example they could purchase units of energy from a supplier and use this to deliver a certain level of service to their customer while the supplier remains responsible for hedging, balancing,

[7] Some of the changes we discuss may require modifications to the parts of the market that are not customer-facing (e.g. the balancing and settlement systems). We describe the type of alterations which might be needed in the section on transition.

[8] Customers who export energy on a Smart Export Guarantee (SEG) tariff can have a separate contract for the export of energy with a supplier that is different from the one that supplies them energy.

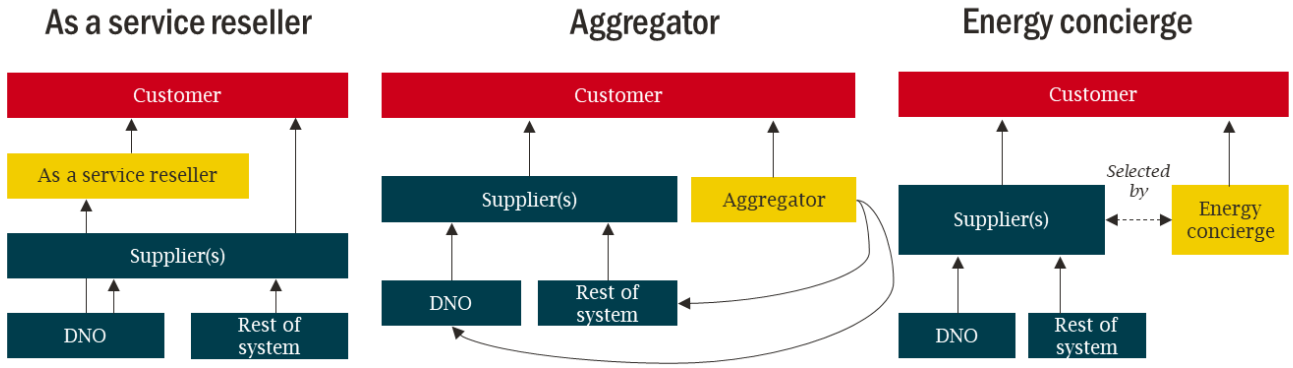
[9] BEIS (2022). A market-based mechanism for low-carbon heat

and social obligations. Alternatively they could be a supplier themselves and the 'as-a-service' tariff is part of a wider portfolio of tariffs offered.

- A **third party aggregator** contracts with customers to manage their electricity consumption, for example via direct load control (DLC) 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 (VLP)[10].

- 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 coordination 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 7 TYPES OF THIRD PARTY ENTITIES



3.2 NUMBER OF SUPPLIERS PER CUSTOMER

This building block category refers to the number of individual suppliers that a customer may have at any one time. We have considered the following alternative building blocks in our work:

- **Single supplier per fuel**: Under the current market model, customers are restricted to a single supplier per fuel per metering point (with some exceptions such as under the Smart Export Guarantee).

- **Multiple suppliers by technology:** Rather than having a single supplier per metering point for each type of fuel, customers could have multiple suppliers by technology. Under this model, customers would likely have a 'lead supplier' which would be responsible for providing a general electricity supply to a customer. Customers could then take 'secondary suppliers' to supply specific assets such as their EV or heat pump. The lead supplier would also be responsible for obligations relating to energy disconnection as well as potential new obligations similar to the existing supplier of last resort (SoLR) where a customer's lead supplier takes over supply in the event of a problem with the secondary supplier. A meter splitting solution to allow a customer to

[10] 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.

have multiple suppliers (P379) was discussed by Elexon and the industry from 2019 to 2011 although it was ultimately withdrawn.[11]

- **Multiple suppliers with peer-to-peer energy**: This option allows customers to have multiple suppliers per metering point but does not require this to be tied to specific devices or assets. Instead, customers could choose to use peer-to-peer networks to meet their energy demand when local generation is high and it is cheaper for them to do so, and fall back on their lead supplier when peer-to-peer energy isn't available.[12] This may help allow prosumers to trade renewable energy and encourage deployment of local generation and local flexibility markets. There are several community energy schemes that allow for peer-to-peer trading in the UK but this is not currently mainstream.[13]

3.3 WHAT DATA IS SHARED?

This building block considers data requests for smart meter data and DLC. We consider the options for both.

Different options for access to smart meter data:

- **Suppliers access granular smart meter data:** Under the current supplier hub model suppliers have access to smart meter data for the customers they serve. Customers choose the how frequently suppliers receive data, for example consumption per half hour, consumption per day, or consumption per month, although not all suppliers currently offer half hourly settlement. This will change once market-wide half hourly settlement (MHHS) is introduced in 2025 after which suppliers will have access to half hourly consumption data by default with the option for customers to opt-out and provide daily data instead. [14]

- **DSOs access granular smart meter data**: DSOs currently have access to aggregated smart meter data which is aggregated across customers in a local area and is used for network planning. If DSOs received more granular data this may help them better forecast demand and target flexibility and reinforcement. This is already the case in many countries where the DSO itself co-ordinated the smart meter rollout.

Different options for how customer smart devices are controlled:

- **Entities have DLC:** DLC means that customers no longer need to respond to flexibility signals such as time-of-use prices. Instead they hand over control of their devices to their supplier, DSO, or other third party.

- **Customers have HEMS, no DLC**: Rather than offering DLC, customers may instead choose to install a HEMS that manages the use of smart appliances and responds automatically to price signals for example turning on their EV charger when electricity is cheap. In the scenario where

[11] Elexon website. Accessed at: https://www.elexon.co.uk/mod-proposal/p379/

[12] We also considered a model where customers have a specified local and national supplier but do not explore this further as part of this work as it raises several questions around arbitrage and local bidding zones that are out of scope.

[13] Irena (2020). Peer-to-peer electricity trading. Innovation landscape brief

[14] Imperial College London (2022). Balancing privacy and access to smart meter data

DSOs and suppliers send flexibility signals, the HEMS could manage these signals and make the optimal choice for customers.

In addition to these options, we also consider the need for **interoperability requirements**. This would establish common standards for smart devices, allowing any entity communicating with smart devices, for example a supplier sending DLC instructions, to communicate with any device regardless of the manufacturer. This could allow entities to send signals or carry out DLC even if the customer switches suppliers or service providers, as well as allowing devices to remain compatible with a customer's choice of HEMS. It is our view that given customer flexibility is crucial in all of the FES scenarios (see WP2 for further information), interoperability for assets will be required irrespective of the future market structure. The government has already introduced common standards for EV chargers[15] and interoperability of heat pumps is being considered as part of the government's Net Zero Innovation Portfolio.[16]

3.4 WHO FINANCES CAPITAL AND SOCIAL OBLIGATIONS COSTS?

This building block category refers to the different financing methods that customers can use to cover for their upfront capital costs, such as acquiring a heat pump or domestic solar PV, if they are unable or unwilling to finance these costs themselves. It also refers to financing of social obligations such as the energy company obligation (ECO) scheme. We consider:

- **Supplier financing**: Suppliers would be responsible for financing capital costs for LCTs and other social obligations. This could be in the form of long-term financing contracts between a customer and a supplier. Alternatively, suppliers could socialise costs across their customers via energy bills, similar to the approach used for ECO. The Government has considered placing an obligation to achieve a threshold number of low-carbon heat installations on energy suppliers as part of the clean heat market mechanism consultation.[17]

- **DSO Financing**: DSOs would be responsible for financing LCT and flexibility technologies such as batteries or even HEMS within customer homes. Again, there is an option to socialise these costs via network charges or adding assets to the DSO's regulatory asset base. Alternatively the DSO might offer financing to individual customers for LCTs.

- **Central Government**: Central government already provides subsidies for LCTs including the Boiler Upgrade scheme and subsidies for installation of EV chargers (see WP2 for further details). However, this option would see some of the social obligations financed and managed by suppliers delivered by Central Government for example the Warm Home Discount or ECO, as well as a potential expansion of government support to target other technologies such as batteries.

- **Requirements outside of the energy system and other funding pots**: Solutions to address the issue of upfront capital costs are not limited to the energy sector or the government. Options could include interventions in the financial sector such as requiring provision of green financing at lower interest rates for LCTs. Funding for LCTs could also come out of other sector funding pots. For example, the boiler on prescription pilot identified patients suffering from Chronic Obstructive Pulmonary Disease (COPD) and provided them with energy and thermal measures 'on prescription'

[15] Electric Vehicles (Smart Charge Points) Regulations 2021

[16] BEIS (2021). Heat Pump Ready: Stream 3

[17] BEIS (2022). A market-based mechanism for low-carbon heat

including new boilers, double glazing and insulation funded by the Clinical Commissioning Group (CCG) i.e. NHS budgets.[18]

3.5 WHAT DO CUSTOMERS BUY/SELL?

This building block category refers to the final product or service that customers buy and the structure of their charges. Under the current market, customers purchase kWh of energy from their supplier. Whilst a proportion of customers may have a time-of-use (TOU) tariff (either dynamic or static)[19], the majority are on a flat tariff that does not differentiate pricing per kWh over time. We have considered several alternative options which we discuss in more detail below:

- **kWh with flat pricing**: Under the current market, the vast majority of customers are on 'flat' tariffs where the amount paid for a kWh of electricity or gas is constant over the day. This is easily understandable, but limits incentives for flexibility.

- **kWh consumed with TOU pricing**: Under these tariffs the cost per kWh varies across the day. This can vary from simple static TOU tariffs like E7, to more complex dynamic tariffs which reflect the whole system costs of delivering energy at any moment in time. Dynamic TOU tariffs require the customer to have a smart meter. Furthermore, to gain the benefits of TOU tariffs, customers need to engage with their tariff and adjust their consumption in response to price signals. Some countries such as Spain have an opt-out model for TOU tariffs. Spain introduced the Voluntary Price for Small Consumer (PVPC) tariff in 2014 which is a dynamic TOU tariff.[20] Specific suppliers are required to offer the regulated PVPC (known as reference suppliers) and non-reference suppliers compete with the PVPC. Around 40% of Spanish domestic customers are on a PVPC contract.

- **'As a service' models such as heat or milage As-a-service**: 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. 'As a service' models are not currently a mainstream business model for domestic heating or EV charging in the UK although there are limited examples of 'heat As-a-service' (HaaS). The Budget Warmth tariff introduced in 1985 was targeted at low-income households and promised to provide at least one warm room at all times. More recent, the Energy Catapult and Bristol Energy ran a pilot of HaaS tariffs. Countries such as the Netherlands and Denmark have been performing pilot projects on HaaS in recent years. For example, the Dutch energy supplier Eneco is trialling offering 20°C for a fixed monthly fee with heat pumps[21] whereas the Danish Government supports energy companies to offer HaaS tariffs by funding partially the cost of an air-to-water heat pumps

[18] Gentoo (2016). Boiler on prescription trial. Closing report

[19] Static TOU tariffs are determined in advance and do not vary with actual demand or supply conditions on the day, for example pre-set on-peak and off-peak hours. Dynamic TOU tariffs are set in real time based on actual system conditions.

[20] Every day at 20:15h, REE discloses this information for each hour of the next day. Every day at 20:15h, REE discloses this information for each hour of the next day.

[21] Delta-ee. Heat as a service infographic

installation depending on the actual number of contracts of a supplier. The Danish supplier pays for the reduced cost of installation of the heat pump and takes care of the maintenance of the heat pump while the homeowner pays a smaller connection fee as well as for the heat delivered from the heat pump.[22]

- **kW of capacity**: Rather than paying a flat standing charge to cover fixed network costs, customers could pay based on kW of capacity. While this tariff is not yet available in the UK, Endesa (a Spanish supplier) and others allow customers to choose the power rating they want to contract. In particular, suppliers advise to customers to contract power between 5 to 7kW, as they claim that anything less than 5kW might incur the risk of being in the dark while turning on the washing machine.[23] Spain has recently introduced new regulation that introduces a TOU element to the capacity charge. The default tariff now splits capacity charges into two time periods, between 8am to midnight where capacity is more expensive, and between midnight and 8am where it is cheaper.[24]

Whilst tariff structures are not the focus of this report and therefore we do not provide an exhaustive list, we note that there are other structures currently being discussed by the industry. One example is nodal pricing where the cost per kWh varies by area or 'node', reflecting constraints on the transmission network. All of the pricing models described above could in principle be compatible with nodal pricing.

3.6 HOW TO SUPPORT VULNERABLE CUSTOMERS?

This building block category considers options for which types of customers could be targeted by support schemes and the mechanisms for delivering this support. We discussed existing policies in WP2, which include Warm Home Discount (WHD), ECO and the default tariff cap (DTC).

We have identified three broad options for how customers could be targeted for support.

- **Customers with specific characteristics.** There are several ways to determine which customers are eligible to receive support. For example, vulnerability might be defined based on income (e.g. receipt of specific benefits), medical conditions (specifically those with higher medical electricity usage), or groups such as those with poor digital literacy who may require additional help to fully participate in the energy market. Vulnerability can also be temporary as change in personal circumstances occurs (e.g. temporary unemployment). Support mechanisms need to take into account these differences and be designed to provide the support that has been deemed to be appropriate.

- **Disengaged customers.** Protection is applied to customers that are identified as not being actively engaged with the market. Disengaged customers could therefore include both customers who are unable to engage with the market as well as customers who choose not to engage.

- **Self-selection.** In principle, a tariff might be designed in such a way that it appeals only to a subset of vulnerable customers – and can then be offered at a discount. For example, a 'no-frills' tariff

[22] Danish Energy Agency (2021). Heat as a Service

[23] Endesa website. What power rating should you sign up for? (https://www.endesa.com/en/blogs/endesa-s-blog/light/how-much-power-do-i-need-in-house)

[24] Red electrica website. Voluntary price for the small consumer (PVPC) (https://www.ree.es/en/activities/operation-of-the-electricity-systemvoluntary-price-small-consumer-pvpc)

could provide a limited capacity of connection, or involve a straightforward pass-through of wholesale costs without any hedging. However, in practice, it is difficult to construct a tariff which would offer the services and support required for vulnerable customers but would not have a wider audience. For example, the BT Light User landline tariff which offered a discount to customers with limited landline use was replaced by the means-tested BT basic tariff after Ofgem's research found that 40% of households on the Light User Scheme were not low-income.[25]

We then consider the following mechanisms for supporting vulnerable customers.

- **Essential service with a capped capacity or consumption.** Some or all energy suppliers could be required to offer a basic essential tariff which has a limited amount of capacity or consumption. This is different from an overall capped tariff (discussed below) which allows customers to access unlimited capacity and consumption subject to a capped unit price.

- **Capped tariffs.** Suppliers have a cap on the amount they can charge for their energy. The current DTC does this on a per kWh basis.

- **Low consumption rising block tariffs.** Rising block tariffs charge customers a price that increases with their consumption over the course of each billing period. They can be designed to charge a lower price for the minimal amount of consumption that is necessary for basic services (e.g. lighting and minimum house heating) and then a higher charge afterwards.

- **Rebates.** Government can give customers a direct discount on customer's energy bill. These can be given for some target customer groups or for the entire domestic market. For instance, WHD is a discount only applied to fuel poor pensioners and other fuel poor customers.

- **Purchase of LCTs.** In addition to schemes that provide financial support to all customers to enable uptake of LCTs, schemes can also specifically target support for financing LCTs to vulnerable customers. For example the ECO scheme is targeted to customers living in social housing or who claim certain benefits.

[25] The Guardian (2008). https://www.theguardian.com/money/2008/oct/18/internetphonesbroadband-consumeraffairs

4 ALTERNATIVE MARKET ARCHETYPES

Section 3 sets out a longlist of potential building blocks for alternative market models. An entire market model consists of a combination of a number of such building blocks. There are a huge number possible combinations, and it would not be possible to individually assess each one of them. It is therefore necessary to identify a smaller set of choices which can be assessed. We have carried this out in three steps:

- **Step 1: Starting Structures.** We first define a set of 'starting structures' based on 'what roles do entities have' and the 'number of suppliers per customers'. We identify any building blocks within these two categories that could co-exist with any of the others and set them aside as an independent decision (see step 3).

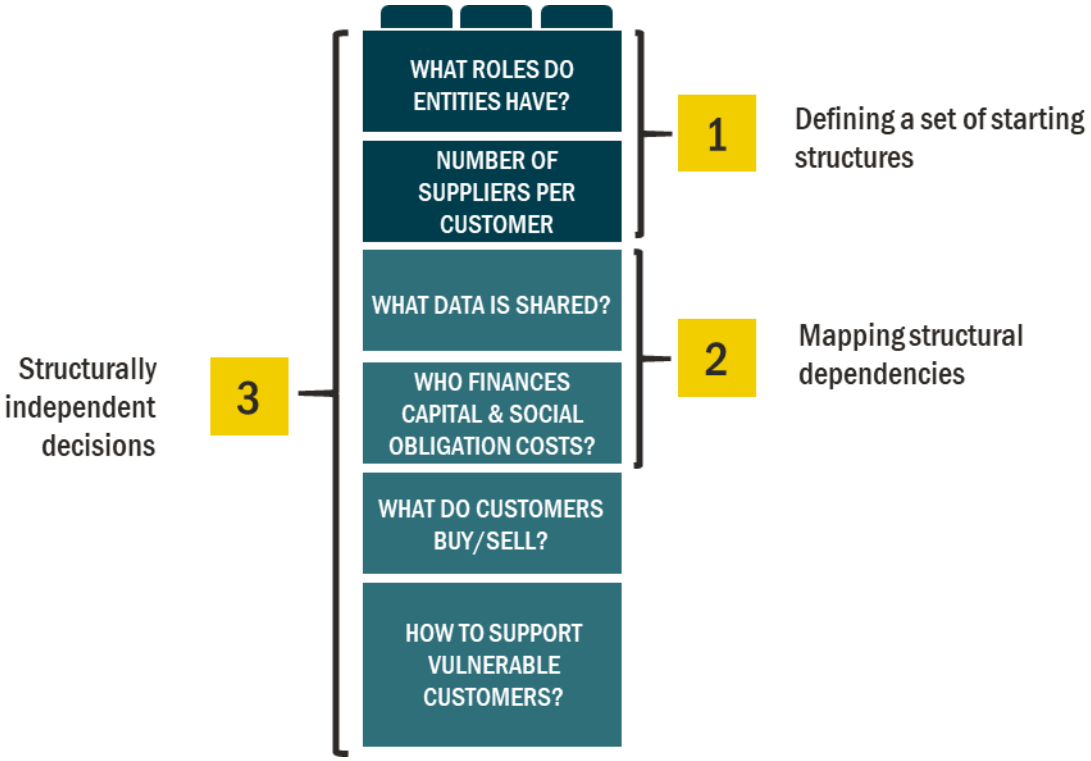
- **Step 2: Mapping structural dependencies.** Second, we map dependencies where these starting structures strongly suggest the type of data that needs to be shared across entities, as well as the entities which could finance upfront capital costs and social obligation costs.

Together, these first two steps produce three illustrative archetype market structures to be assessed.

- **Step 3: Structurally independent decisions.** In the final step, we have considered decisions that are independent of the starting structures. For example, different options for the support of vulnerable customers could be used alongside each market structure.

This process allows us to reach a set of decisions that will define the market that we assess in section 0.

FIGURE 8 APPROACH TO DEVELOPING ALTERNATIVE MARKET MODELS



Source: Frontier Economics

4.1 STEP 1: STARTING STRUCTURES

We begin by defining three starting structures for constructing market models. These are defined by 'what roles do different entities have' and 'number of suppliers per customer'. These structures were arrived at by considering which building blocks may most naturally fit together, described in more detail below. They represent very different visions for how increased flexibility and rollout of LCTs may be promoted.

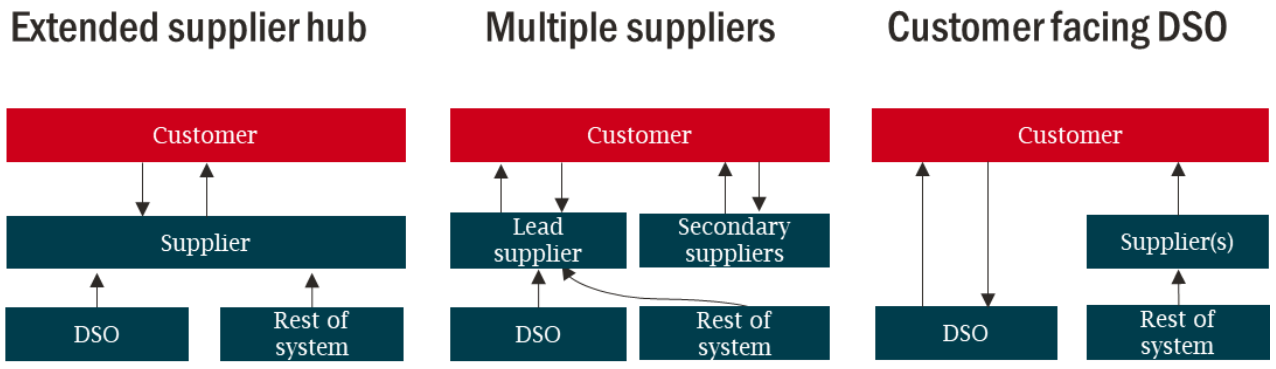
- **Extended supplier hub**. In this model, the supplier remains the key gateway for customers. The role of the supplier is enhanced with a wider set of obligations that include LCT take-up and provision of flexibility by their customers..
- **Multiple suppliers**. This model starts from the premise that LCTs and flexibility might be best provided by suppliers which specialise in certain types of technology (e.g. heating, or transport). It therefore combines multiple suppliers by technology with a narrower supplier role which is intended to help foster competition and innovation.
- **Customer facing DSO**. This alternative moves some of the 'gateway' role of the supplier to the DSO. Customers have a separate contract with their DSO, which interacts directly with its customers to send flexibility signals.

The existence of third party entities that work alongside DSOs and suppliers is compatible with all three of these models and is assessed as an independent decision in section 4.3.

For each of these starting structures we highlight the implications for provision of customer flexibility. Workshop participants identified flexibility as the second most important barrier to achieving net zero (the biggest being upfront capital costs). Whilst upfront capital costs can be addressed by policies outside of the energy market such as central government subsidy, we consider provision of flexibility to be an issue that needs to be addressed through the energy market and give it specific consideration.

Each of these starting structures moves the market away from the current supplier hub to varying degrees. We do not explicitly include the current supplier hub model as an option but use it as a benchmark for assessment in section 5. Of these starting structures, the 'extended supplier hub' is the closest to the current market as it retains a single supplier acting as the customer interface with the energy market whilst introducing additional obligations on suppliers as part of their licence.

FIGURE 9 STARTING STRUCTURES

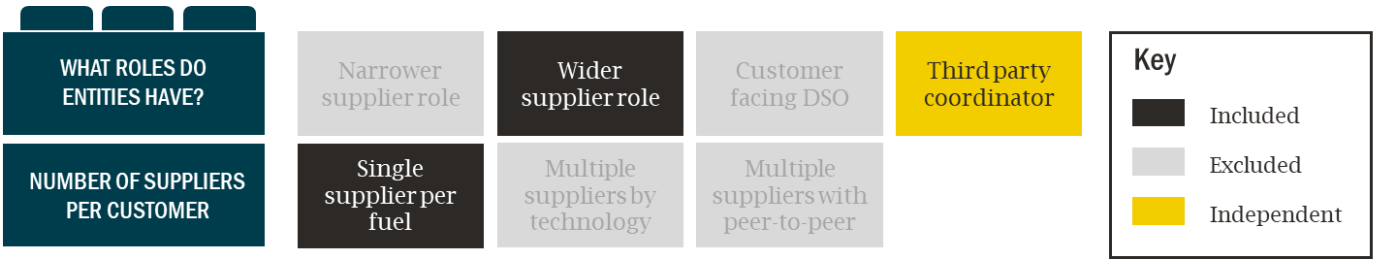


Source: Frontier Economics

4.1.1 EXTENDED SUPPLIER HUB

This starting structure is effectively an extension of the current supplier hub model, retaining a single supplier per fuel for each metering point but widening the role of the supplier include new responsibilities on promoting uptake of LCTs or encouraging their customers to act flexibly (Figure 10). This could include widening the supplier licence to include obligations such as offering at least one dynamic TOU tariff, LCT technology financing, or providing aggregation services.

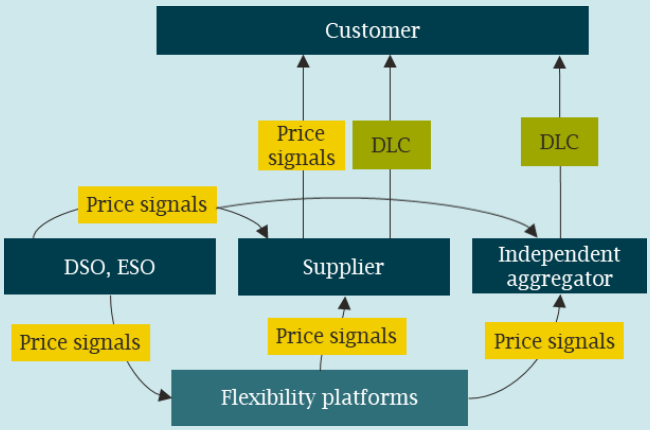
FIGURE 10 EXTENDED SUPPLIER HUB



Source: Frontier Economics

The reason we have paired a wider supplier role with a single supplier per fuel is to ensure that suppliers have the ability to deliver these additional social obligations. Allowing customers to have multiple suppliers would reduce the amount of consumption with any given supplier and therefore reduce the ability of suppliers to cross-subsidise across their customer base.

Provision of flexibility under extended supplier hub



Customers provide flexibility via two routes (1) via their supplier or (2) via an independent aggregator (or both). For example, a customer with a PV and battery may sign up for a TOU tariff from their supplier but give DLC of their battery to an independent aggregator.

Entities such as the DSO would procure this flexibility from suppliers and independent aggregators via price signals. These price signals could take multiple forms depending on need, ranging, from TOU pricing similar to current DUoS bands to bids for specific flexibility procurement products with availability and utilisation fees (similar to how flexibly is currently procured by DNOs from I&C customers). This could be done either using individual bilateral contracts or via a flexibility platform such as WPD's intraflex which could reduce transaction costs. 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.

Suppliers and aggregators then pass on these price signals to their customers, either via price signals in a TOU tariff or via DLC. In the long-run DSOs would pass on the costs of flexibility to their customers via DUoS charges – although as flexibility should only be procured where it is cost-effective, the overall effect should be a reduction in charges.

4.1.2 MULTIPLE SUPPLIERS

Rather than restricting customers to a single supplier by fuel, customers would be able to have multiple suppliers. This would allow customers to have technology specific suppliers e.g. a separate supplier for EV charging or to supply their heat pump, alongside a more general supplier for general electricity usage. Allowing customers to have multiple suppliers also facilitates peer-to-peer energy models. Customers would have a 'lead supplier' that acts like a backstop energy provider and is responsible for social obligations that remain with suppliers.

FIGURE 11 MULTIPLE SUPPLIERS

Source: Frontier Economics

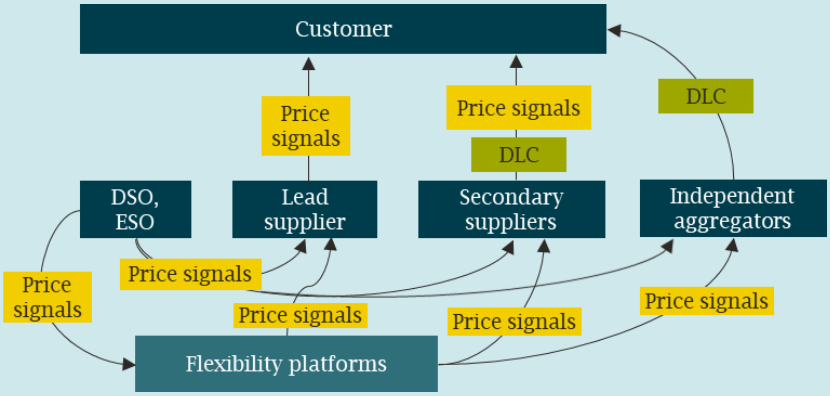
This model could help facilitate entry of specialist suppliers and new innovative business models that focus on specific technologies, for example car manufacturers offering EV tariffs with accompanying smart EV chargers. Allowing customers to have multiple suppliers per fuel is also key to unlocking community energy networks. Feedback during the workshop found that current limitations on multiple suppliers is a major barrier to peer-to-peer community based models as customers could not rely on peer-to-peer to fulfil the universal service obligation (USO) and disconnection requirements. Allowing multiple suppliers would overcome this barrier as customers would have a lead supplier alongside any peer-to-peer suppliers, strengthening the business case for local generation and storage.

This structure will require adjustments to the existing supplier obligations. If a customer has multiple suppliers, some obligations should only be placed on one of those suppliers to avoid double counting.[26] Intuitively this should be on the lead supplier to avoid deterring entry of new innovative specialist suppliers.

[26] Obligations such as the Renewables Obligation which are based on per unit of energy consumed rather than per customer can be pro-rated across suppliers.

Provision of flexibility under multiple suppliers

Under this model customers will 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.



In the long-run DSOs would pass on the costs of flexibility to their customers via DUoS charges – although as flexibility should only be procured where it is cost-effective, the overall effect should be a reduction in charges.

We expect that secondary suppliers and independent aggregators will 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, for example by automatically adjusting EV charging times and rates. We expect that 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. We expect that secondary suppliers that specialise in heat pumps or EV charging might act as integrated supplier-aggregators. However, there may still be independent aggregators, particularly for prosumers.

One limitation of flexibility under this model could arise if customers have interdependencies between that various flexible assets. For example, if a customer has both an EV and a heat pump, it may be optimal to charge the EV overnight when the network has capacity beyond what is required for milage the next day, and use this to power their heat pump during the day when the network is at capacity i.e. V2X utilising the EV as a battery. If customers have a separate supplier for DLC of their EV and heat pump, they may not be able to co-ordinate across these technologies (or may lack the incentive to do so).

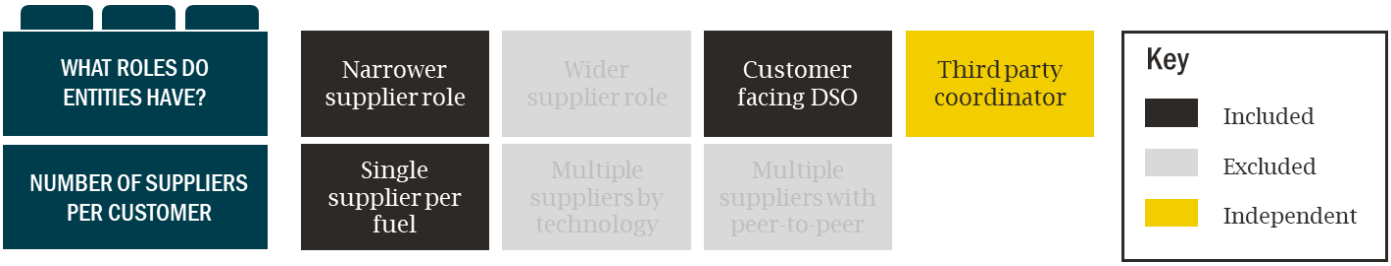
4.1.3 CUSTOMER FACING DSO

Under this model, DSOs have a customer facing role. Customers would have a separate contract with their DSO for capacity which would include the ability for DSOs to send direct flexibility signals to customers. This would be via price signals rather than DLC, for example a distribution TOU tariff. This is to avoid the customer receiving conflicting DLC[27] from their DSO and their supplier/aggregator.[28]

[27] 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, as discussed above, 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.

[28] 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.

FIGURE 12 CUSTOMER FACING DSO



Source: Frontier Economics

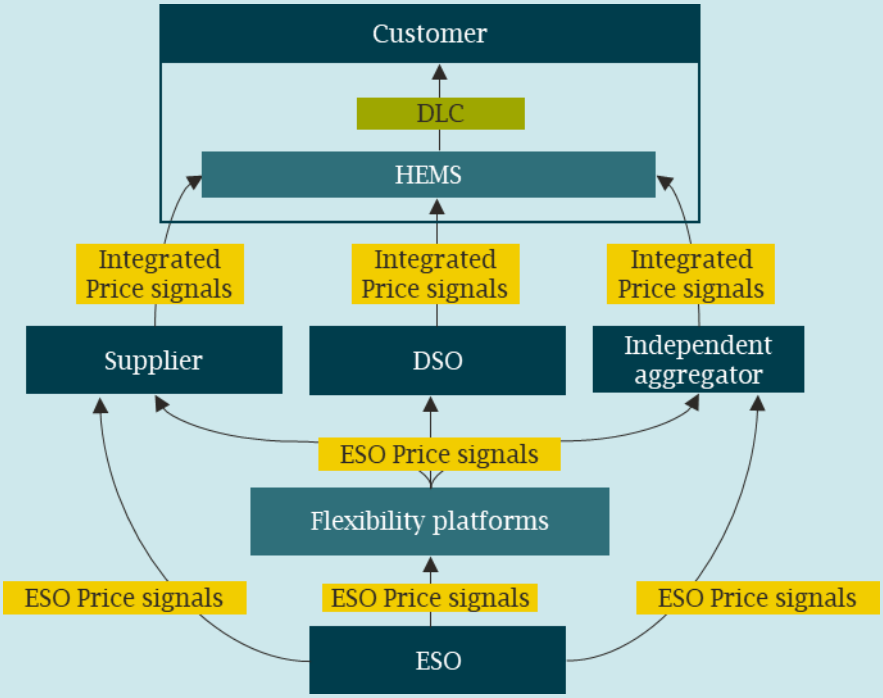
Giving DSOs a customer facing role also opens up the option to move existing supplier obligations onto the DSO. For example, DSOs could be responsible for delivering thermal efficiency upgrades currently delivered by suppliers under ECO and build the cost of doing this into DUoS charges. Both suppliers and DSOs should have an incentive to encourage thermal efficiency and flexible use of LCTs. For suppliers, it could reduce the amount of energy they need to purchase at higher cost during peak periods. For DSOs, thermal efficiency and flexibility should reduce peak demand on network and defer costly network reinforcement. However, as DSOs are regional organisations that work with all customers within their footprint and have no incentive to increase energy consumption by their customers, they may be better placed to address local flexibility or LCT requirements.

This means that suppliers could have a narrower role, potentially reducing barriers to entry for new suppliers with innovative business models. This could include new tariff structures such as 'as-a-service' models or entry by non-traditional energy companies such as EV manufacturers. This would be further enabled by changes to the Balancing and Settlement Code (BSC) which would allow customers to have multiple suppliers for a single metering point (we discuss multiple suppliers in more detail in section 4.1.2)

As customers now have a separate contract with their DSO, they can either have a separate DSO bill or a combined DSO and supplier bill. There are benefits and drawback to each approach. Having a separate DSO bill can make it clearer to customers how they are rewarded for the provision of flexibility to their DSO, particularly if the price signal is small in comparison to their supplier bill. However, this comes at a cost of increased customer complexity and other countries are moving away from separate bills. For example, whilst customers in Norway currently receive a separate bill from their DSO, NordReg has proposed mandatory combined billing that means customers would only receive one bill from their supplier that includes both network tariffs and electricity consumption.[29] There may also be technical limitations to having separate DSO and supplier bills associated with the SMETS technical specification and wider settlement procedures (discussed further in section 6).

[29] Nordic Council of Ministers (2017). Nordic data hubs in electricity system. Differences and similarities

Provision of flexibility under customer facing DSO



Customers will receive price signals directly from the DSO, for example via a distribution TOU tariff which reflects when the network is constrained. Customers may also be receiving price signals from their supplier if they are on a dynamic TOU tariff for energy consumption, and potentially independent aggregators.

As customers are receiving signals from more than one entity, no single entity is expected to have DLC. This is because these signals may be conflicting. For example, if two entities have DLC for a customer's EV charging, there is no guarantee that they will co-ordinate to ensure that the battery is sufficiently charged overnight. Instead, separate price signals will be optimised by a customer's HEMS. The HEMS will then carry out DLC in a way that is optimal for customer bills.

For other entities such as the ESO seeking to procure flexibility, this could be done 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.[30] Suppliers and aggregators would need to be able to provide information back to the entities requesting flexibility on which requests were successful.

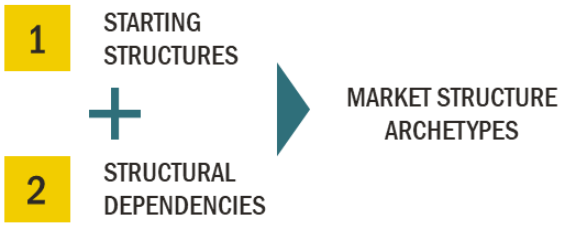
A dynamic, local DUoS charge for constrained areas represents a significant change from current charges (which do not vary by hour, or within a license area). These charges could be set in a way which is revenue neutral (in which case customers providing flexibility would gain at the expense of those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

[30] In principle the DSO could also contract with suppliers and independent aggregators for flexibility. However 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.

4.2 STEP 2: MAPPING STRUCTURAL DEPENDENCIES

For each of these starting structures we look across the set of potential building blocks within 'what data is shared' and 'who finances capital and social obligation costs' to identify key dependencies i.e. building blocks which would fit naturally with each of the three structures. Taken together with the starting structures, this leads to three market structure archetypes.

FIGURE 13 CONSTRUCTING ARCHETYPES

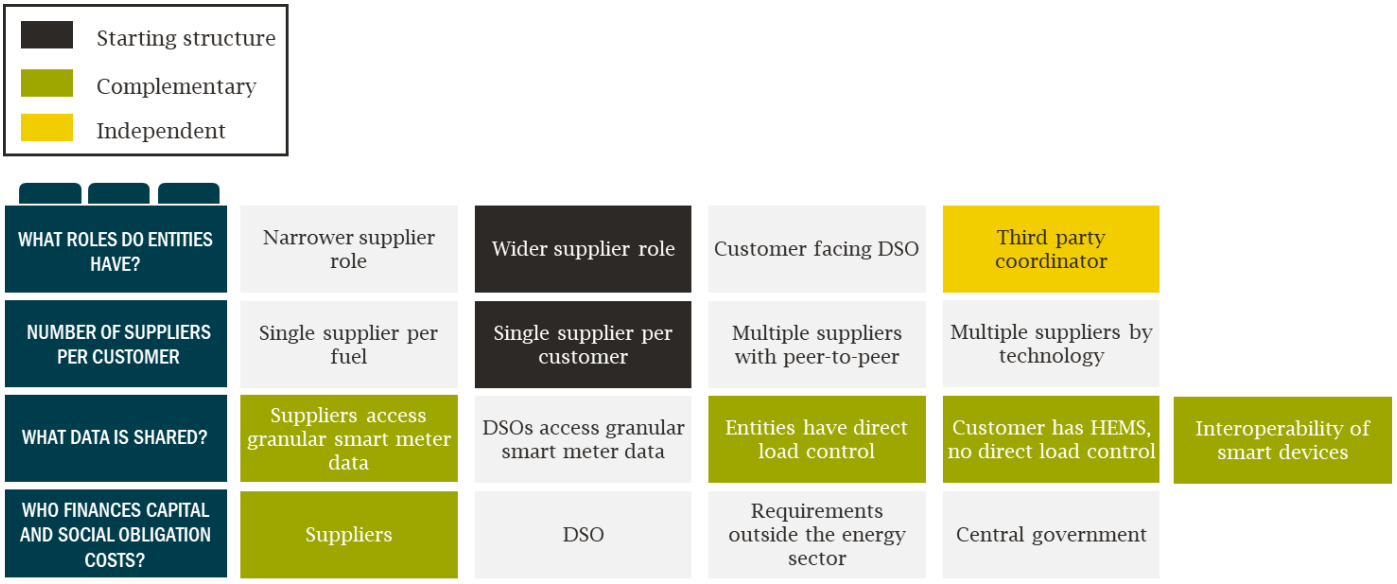


Source: Frontier Economics

Where individual building blocks have not been identified as complementary for a specific starting structure, this does not mean that they are incompatible with that starting structure. For example, DSO access to granular smart meter data is essential under a customer facing DSO in order to send direct flexibility signals to customers and therefore it is identified as complementary under this starting structure. However, DSO access to granular smart meter data could be beneficial under all three starting structures as it allows them to improve planning for reinforcement. However the benefits of DSO access to smart meter data for reinforcement planning is outside of the scope of this work

4.2.1 EXTENDED SUPPLIER HUB

FIGURE 14 DEPENDENCY MAPPING OF EXTENDED SUPPLIER HUB



Source: Frontier Economics

4.2.1.1 WHAT DATA IS SHARED?

Under this model suppliers are expected to take a leading role on promoting customer flexibility and uptake of LCTs with the corresponding data requirements.

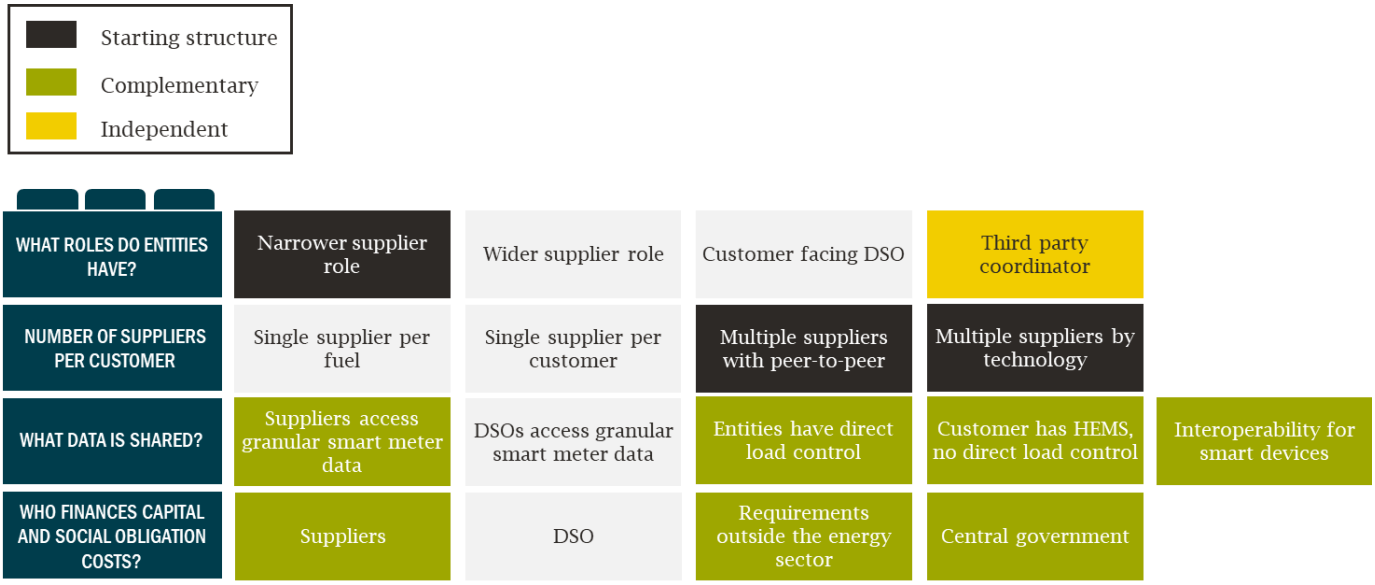
- **Suppliers access granular smart meter data**. Aside from requiring smart meter data for billing, suppliers will also need this to reconcile whether a customer has responded to flexibility signals (TOU tariffs) if they don't have DLC.
- **DLC for suppliers**. As suppliers are expected to take on a larger role in customer flexibility, this could include widespread use of DLC for smart devices such as EV chargers and heat pumps by suppliers. As the supplier is the only interface between customers and the wider market, they would be able to aggregate together price signals from entities such as DSOs, the ESO, and the wholesale market.
- **Interoperability for smart devices**. Interoperability will be key to preventing barriers to switching if suppliers offer DLC. Without this, a customer switching suppliers could lose the smart features of their EV charger or heat pump (similar to the issues with the first iteration of smart meters).

4.2.1.2 WHO FINANCES CAPITAL AND SOCIAL OBLIGATION COSTS?

Under this structure suppliers would remain the primary interface between customers and the energy sector. Customers continue to have a single supplier per metering point and suppliers should therefore have sufficient revenue to continue managing cross-subsidisation of costs across customers as part of social obligations as well as potentially financing additional support for customers, for example subsidisation of capital costs for some or all customers as part of ECO style LCT obligations.

4.2.2 MULTIPLE SUPPLIERS

FIGURE 15 DEPENDENCY MAPPING OF MULTIPLE SUPPLIERS



Source: Frontier Economics

4.2.2.1 WHAT DATA IS SHARED?

Customers can have multiple suppliers for an individual metering point under this model. If this is by technology, this will require specific devices to have a separate meter similar to the current approach for EV specific tariffs. Where customers can have multiple suppliers per meter that is not tied to specific devices, such as peer-to-peer trading, this will require other changes to the current Meter Point Registration System (MPRS) and settlement process. [31]

In addition to these changes, the system will have the following data requirements.

- **Suppliers access granular smart meter data**. As in the previous starting structure, suppliers will continue to require granular smart meter data for billing as well reconciling whether a customer has responded to flexibility signals.

- **Suppliers have DLC or customers have HEMS.** By allowing customers to have multiple suppliers, this market structure aims to create the right conditions for new innovative propositions to enter the market including technology specific suppliers. We anticipate that these suppliers may differentiate themselves through innovative smart automation solutions, for example automation of EV charging combined with a TOU tariff that either allows the supplier to have direct control over a customer's device. Alternatively this may be co-ordinated by a customer's HEMS.

- **Interoperability for smart devices**. We consider interoperability to be key across all potential market structures. In this case, customers can switch their supplier for specific devices and lack of interoperability may result in customer lock-in, for example a customer's EV charger will lose smart capabilities if they change supplier.

4.2.2.2 WHO FINANCES CAPITAL AND SOCIAL OBLIGATION COSTS?

Where suppliers have social and capital financing obligations, we expect the majority of these would be on the lead supplier to prevent barriers to entry for secondary suppliers and prevent double counting. However, the electrification of domestic heat and transport could mean that a customer's lead supplier makes up a relatively low share of a customer's total energy consumption, reducing their ability to cross-subsidise between customers or bear risk associated with capital and social obligation costs. For example, if a customer has a separate EV and heat pump secondary supplier, the lead supplier's total revenue for this customer may be insufficient to cover the default risk associated with providing capital financing to this customer or maintaining IT systems for delivering social obligations. It is important to ensure that the lead supplier is not exposed to policy costs which they are unable to meet.

This means that unlike the extended supplier hub model where suppliers may finance more social obligations, any additional financing of LCTs under this model would likely need to remain with central or local government who are better placed to spread these costs and risk across customers. For example, some councils already offer energy efficiency grants to households in their area and this could be expanded to replace delivery of ECO by the lead supplier.

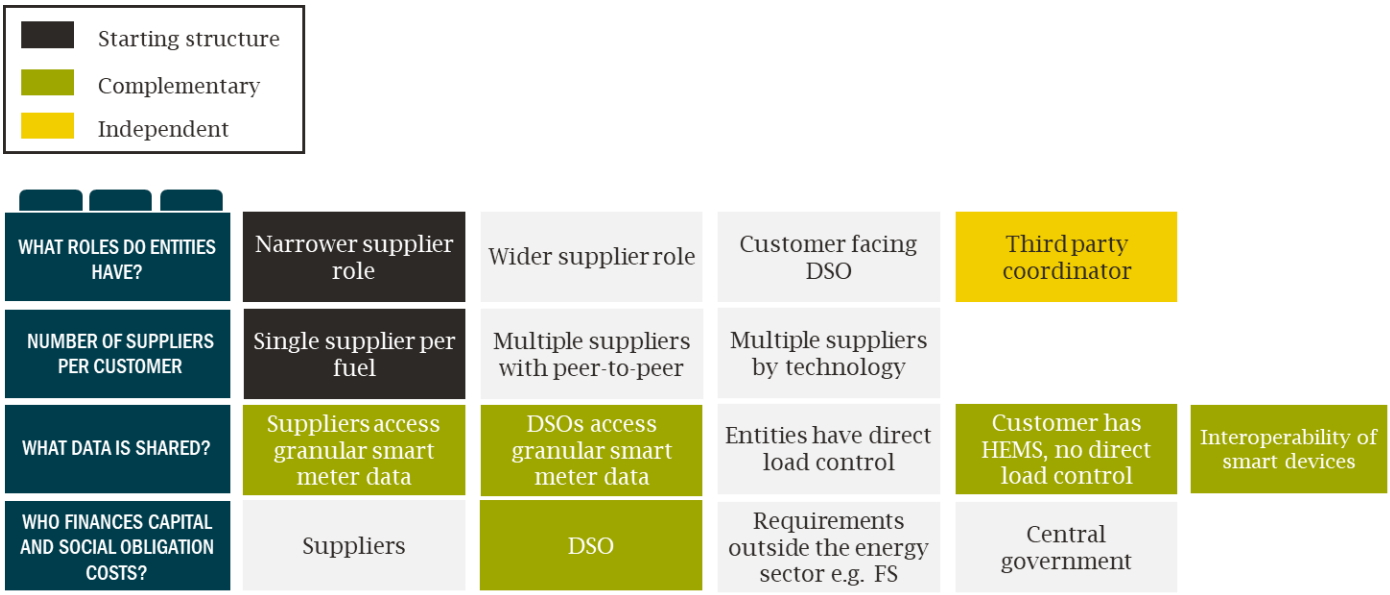
Furthermore, by allowing customers to have multiple suppliers, this should allow secondary suppliers to enter with new innovative business models that can help to finance capital costs via bundling. CEPA's impact assessment of specialist suppliers recognised that one of the key use cases for meter splitting is to enable a wide range of innovative business models, including those that bundle electricity supply with

[31] Ofgem (2019). Future enabling the market-wide settlement reform Target Operating Model (TOM)

another product or service.[32] For example, an EV supplier may bundle an EV lease agreement with the charging supply, smoothing the upfront cost. Secondary suppliers that offer HaaS could bundle heat pump electricity supply with energy optimisation and thermal efficiency, particularly as they have an incentive to minimise the amount of electricity the customer uses to deliver the agreed level of service. This model was discussed in the ReCOSTING energy report which draws parallels with the mobile phone contracts where customers buy a handset bundled in with an allowance for data, minutes and SMS.[33]

4.2.3 CUSTOMER FACING DSO

FIGURE 16 DEPENDENCY MAPPING FOR CUSTOMER FACING DSO



Source: Frontier Economics

4.2.3.1 WHAT DATA IS SHARED?

Under this model both DSOs and suppliers are customer facing and this has several implications for data sharing:

- **Suppliers and DSOs access granular smart meter data**. Both suppliers and DSOs would rely on granular customer level smart meter data to carry out their roles. Suppliers would continue to require this to bill customers for the amount of energy or level of service delivered. DSOs, who can now directly send flexibility signals to customers, would require this data to measure whether and how much flexibility a customer has provided and renumerate them in line with the customer's DSO contract.

- **Customer has HEMS, no entity has DLC**. Under this model, calling of flexibility for domestic customers is split between the DSO and supplier. Both entities can send flexibility signals to customers (as well as any independent aggregators they are signed up with). If more than one entity has DLC, this could cause issues for customers. For example, a customer's supplier could delay EV charging to overnight. However the customer's DSO may limit charging overnight for

[32] CEPA (2020). P379 impact assessment

[33] Challenging ideas (2021). ReCOSTING Energy

some reason and the customer is left with a flat battery the next day. Even without DLC, customers may receive conflicting price signals from their supplier and DSO, making it difficult to know how to respond and risking customer disengagement. In order for customers to actually deliver flexibility in this model 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 (similar to the current rollout of smart meters by suppliers).

- **Interoperability of smart devices**. In this model customers need to balance price signals from their DSO, supplier, and any independent aggregators they have signed up with. This is done via the HEMS and interoperability requirements will ensure that smart devices can interact with the HEMS for DLC.

The other major change that could be incorporated into this model is who has responsibility for the smart meter rollout. The UK smart meter rollout is currently supplier-led and the latest framework assumes full rollout should be completed by 2025. This differs from many other countries that have DNO-led rollouts. As we discuss above, we consider the widespread take-up of HEMS will be key to unlocking customer flexibility under this model as no entity is assumed to have DLC. To maximise take-up, DSOs are assumed to be responsible for HEMS rollout. This could be an opportunity to shift smart meter rollout responsibilities to the DSO. By the time the market is able to transition to this market, we expect that the majority of customers should already have a smart meter (assuming the current timelines are met), and there would be relatively few residual customers for whom their DSO would be responsible for installing a smart meter alongside a HEMS. This would be a major change with a wider set of benefits, costs, and feasibility considerations that are outside the scope of this work.

4.2.3.2 WHO FINANCES CAPITAL AND SOCIAL OBLIGATION COSTS?

Under the current supplier hub model, financing of several existing social obligations are managed by suppliers. However, under the customer facing DSO market structure, DSOs could take on new or existing customer facing social obligations, particularly where they are aligned with DSO incentives to reduce local peak demand, and/or would benefit from delivery by a local body which can co-ordinate activities across a given region. DSOs could finance these costs directly and socialise these costs across all customers via customer bills. Alternatively, DSOs could finance new social obligations such as subsidisation of LCTs for either some or all customers via their existing RAB model. This would free suppliers from these obligations, which may make it easier for a wider variety of suppliers to enter the market.

4.3 STEP 3: STRUCTURALLY INDEPENDENT DECISIONS

We have now defined three market structures and the associated dependencies for data and financing associated with each. However, there are several decisions that are not dependent on the choice of market structure:

- **Existence of third party entities?** Will aggregators, as-a-service resellers, or energy concierge organisations enter the market?

- **What do customers buy/sell?** What types of tariffs will suppliers offer the market?

- **How to support vulnerable customers?** Which customers should receive targeted support and what mechanism should this be delivered by?

We discuss these decisions below and how they might interact with each of the three market structure archetypes.

4.3.1 EXISTENCE OF THIRD PARTY CO-ORDINATING ENTITIES

In steps 1 and 2 we have defined three market structure archetypes: (1) Extended supplier hub, (2) Multiple suppliers, and (3) Customer-facing DSO. Each of these archetypes define a different set of roles and responsibilities for DSOs and suppliers.

However, there are other customer facing entities which can co-exist alongside DSOs and suppliers. We refer to these entities as third party entities and define these into three categories: (1) as-a-service resellers, (2) aggregators, and (3) energy concierges (Figure 7). We do not see any reason why the existence of any of these third party entities would be incompatible with the archetypes. Instead, we use the remainder of this section to describe how these third party entities might work under each one.

4.3.1.1 AS-A-SERVICE RESELLERS

'As a service' resellers could work in any of the three archetypes although they are probably most relevant to an 'extended supplier hub' archetype.

- **Extended supplier hub.** 'As a service' resellers could operate in a similar way to suppliers under the Licence Lite. A reseller could partner with one or more suppliers, purchase energy from these suppliers, package this into an 'As-a-service offering', then sell this on to customers.
- **Multiple suppliers** In principle a supplier lite archetype could also apply to technology specific suppliers. However, 'as-a-service' resellers may be less relevant under this archetype if secondary suppliers enter with their own 'as-a-service' offerings.
- **Customer-facing DSO.** 'As a service' resellers could exist although like suppliers, they may not have scope to do DLC. They could continue to offer other types of 'As-a-service' tariff such as charging £/warm hour rather than £/kWh.

4.3.1.2 AGGREGATORS

The purpose of this work is to consider alternative market structures that overcome existing barriers in the market, one of which includes flexibility. We therefore consider archetypes that ensure customers have the right incentives to behave flexibly even if they decide not to engage with an independent aggregator in addition to their supplier. However, we expect that there will be specific customers groups that will continue to benefit from independent aggregation services, for example prosumers.

Aggregators, both integrated and independent, are already established in the industrial and commercial (I&C) market and there are some examples of domestic aggregators such as Social Energy. We expect that domestic aggregators could continue to grow under all three market structures discussed although to varying degrees:

- **Extended supplier hub.** Under this archetype suppliers have stronger flexibility obligations which could push them to become integrated supplier-aggregators that offer DLC, particularly if they are receiving price signals from the DSO. We expect that there will continue to be customer groups that may be best served by specialist independent aggregators, for example prosumers, and independent aggregators can provide this flexibility to DSOs via flexibility platforms.

- **Multiple supplier hub.** By enabling customers to have multiple suppliers, integrated supplier-aggregators focused on specific devices can enter the market. Secondary suppliers for EV charging may be an area of particular potential if these suppliers can utilise EVs as a battery to provide power back to the grid. As before, independent aggregators may remain, particularly those targeted at specific customer groups such as prosumers.

- **Customer-facing DSO**. Under this archetype no entity is assumed to have DLC which could reduce the potential for independent aggregators. However, they could choose to send price signals to customers, particularly if they are also participating in national balancing markets.

4.3.1.3 ENERGY CONCIERGE

Energy concierge services are a natural extension of today's PCWs and auto-switching services, providing advice to customers on which deals (whether for energy, or LCTs) best meet their needs. They would function in a similar way under all three archetypes, operating independently from suppliers and the DSO to provide independent advice to customers. We expect there may be a greater demand for energy concierge services under a multiple supplier archetype to help customers navigate the additional choice they face.

4.3.2 WHAT DO CUSTOMERS BUY/SELL

There are a number of different ways in which suppliers (and potentially DSOs) can structure the tariffs available to customers. We do not think that any of the starting structures fully preclude any of the of these tariff structures, although 'as-a-service' tariffs may be more difficult to deliver under a customer facing DSO that sends flexibility signals directly to customers. Instead, we consider whether there are specific enablers and barriers that would encourage or prevent the market from offering these tariffs without additional policy interventions.

4.3.2.1 KWH WITH TOU PRICING

TOU pricing is not a new concept. Static TOU tariffs such as E7 and E10 have been around for many years. However, few suppliers currently offer dynamic TOU tariffs even though this is possible under current regulations. We consider the barriers and enablers to dynamic TOU pricing from two perspectives. First, whether suppliers are able and have an incentive to offer dynamic TOU tariffs and second whether customers have an incentive to take-up these tariffs.

Suppliers do not currently face cost-reflective prices. In fact, customers shifting their consumption away from the pattern assumed for hedging can actually result in losses for suppliers.[34] The introduction of MHHS should help to align supplier incentives and is expected to increase the number of TOU tariffs offered.[35] Another reason why there may be relatively few dynamic TOU tariffs currently on the market is the delay in smart meter rollout.[36]

From a customer's point of view, recent fieldwork carried out for Ofgem found that amongst non-TOU customers, some customers were uncertain around the potential savings from switching to a dynamic TOU

[34] University of Exeter Energy Policy Group (2019). Barriers to Independent Aggregators in Europe

[35] Ofgem website. Accessed at: https://www.ofgem.gov.uk/publications/distributional-impacts-time-use-tariffs

[36] CEPA (2017). Distributional impact of time of use tariffs.

tariff which was reinforced by uncertainty around their ability to load shift.[37] The same research found that for non-TOU customers, automation can increase the appeal of dynamic TOU tariffs and could encourage take-up, although there were concerns around cost of safety. Finally, dynamic TOU tariffs by their nature expose customers to fluctuations in the market. The recent rise in the cost of energy has led Octopus Energy to display a notice on its website page for its dynamic tariff that 'most homes will be better off staying on a standard fixed or variable tariff for the Winter', again deterring customer take-up.

In summary, the introduction of MHHS and smart meter rollout are key enablers to increasing availability of dynamic TOU tariffs, whilst automation will support customer take-up and response to price signals. Further engagement with customers will likely be required to build customer confidence and increase uptake, as well as revising the way that support is provided for customers that face higher bills under TOU tariffs.

4.3.2.2 AS A SERVICE TARIFFS

Whilst there are no distinct regulatory barriers that prevent companies from offering 'as-a-service' tariffs, the current regulations make it difficult. The energy supply licence requires suppliers to bill customers for units of energy used, and while suppliers can apply for a derogation in order to offer 'as-a-service' tariffs, this remains a major regulatory hurdle.[38] Furthermore, it is currently not possible to offer 'as-a-service' tariffs as the default tariff due to the structure of the DTC which constrains bills based on energy consumed. A supplier that reduced the cost of energy by investing in efficiency or flexibility for a customer under the DTC would not recoup this cost.

Beyond regulation, research has also found that businesses are still learning to deliver 'as-a-service' in a commercially viable way and the challenge of pricing offers that reflect the individual cost to serve for different customers. There is currently 'very little evidence business can draw on to design and deliver successful HaaS offers'.[39] However, there may be learnings from other sectors such the insurance market where companies have developed sophisticated offers over time to develop customer specific pricing.

'As a service' tariffs that bundle provision of assets such as heat pumps alongside a service contract may also require longer contract lengths and higher exit fees. This is a change from the current energy system which has recently focused on promoting switching rates. More generally, research on HaaS has found that there are gaps in solutions to address existing issues of trust between customers and suppliers required for 'As-a-service' tariffs.[40]

There are different types of 'as-a-service' tariffs and future choices on data and technology may limit the range of tariffs that can develop. One version of 'as-a-service' allows customers to pay a fixed fee for a level of service, for example a minimum temperature for specific rooms during specific times of the day, or a set number of miles available each day for EV owners. In order to manage risk in meeting these agreed service levels, and to ensure that these tariffs are commercially viable by minimising the cost of delivering this level of service, suppliers may require DLC of customer devices such as EV chargers and heat pumps. This means that the set of 'as-a-service' tariffs that can develop under the 'customer facing DSO' structure

[37] Ofgem (2020). Energy consumers' experiences and perceptions of smart 'Time of Use' tariffs

[38] Climate X Change (2021). The potential of Heat as a Service as a route to decarbonisation for Scotland

[39] Ibid.

[40] Britton, Jessica & Minas, Angela & Marques, Ana & Pourmirza, Zoya. (2021). Exploring the potential of heat as a service in decarbonization: Evidence needs and research gaps. Energy Sources, Part B: Economics, Planning, and Policy. 1-17. 10.1080/15567249.2021.1873460.

may be limited due to the fact no entity is assumed to have DLC under this archetype to prevent conflicting signals from DSOs and suppliers.

4.3.2.3 KW OF CAPACITY

This is an alternative tariff structure to the current fixed standing charge approach. Whilst the specific structure of tariffs is not the objective of this work, we have briefly considered it in the context of encouraging customer flexibility.

Ofgem carried out an initial assessment of different options for distribution and transmission charges in 2019 as part of its Access and Forward Looking Charges Significant Codes Review (Access SCR) which included considering an 'agreed capacity' and 'actual capacity' approach. Its assessment noted that it would be a 'significant administrative burden' for DSOs to manage individual capacities for domestic customers. Furthermore, DSOs are currently unable to access individual disaggregated domestic consumption data which limits their ability to calculate network charges and this would need to be addressed if customers are billed on an individual capacity basis.[41] These barriers would need to be overcome to introduce these type of tariffs.

4.3.2.4 OTHER TARIFF STRUCTURES

Reviewing options for tariff structures is not the focus of this work and therefore there may be other tariff structures that interact with the underlying market structure. In the case of locational tariffs such as nodal tariffs, we consider these to be compatible with all three of the market structures discussed in this report. Other tariff structures will need to be assessed separately to identify any conflicts.

4.3.3 HOW TO SUPPORT VULNERABLE CUSTOMERS

Most of the forms of support discussed in section 3.6 can be delivered under each of the three archetypes. However, depending on the structure of the market, who is responsible for delivering and funding this support may change (see 4.2, 'who finances capital and social costs'). For example, subsidising purchase of LCTs for vulnerable customers is more likely to be funded by the supplier, central government, and DSOs under the extended supper hub, multiple supplier, and customer facing DSO archetypes respectively. The exception is rising block tariffs that would have to be delivered via suppliers. Under a multiple supplier archetype the lead supplier may be responsible for a minority of a customer's total energy consumption so requiring them to offer rising block tariffs may not be feasible.

There may also be interactions between forms of support for vulnerable customers and the type of tariffs available in the market. This will depend on whether these new types of tariff require price regulation or replace flat tariffs as the default tariff. For example, if the default tariff changes to a TOU tariff, this will not protect vulnerable customers from fluctuations in wholesale energy costs and additional financial support may be required. In the case of 'as-a-service' tariffs, these may be more challenging to regulate as pricing can become highly personalised based on a customer's individual requirements and circumstances, for example their home energy efficiency. 'As a service' tariffs that bundle supply with the asset may also be challenging to regulate as customers are receiving more than one service.

[41] Ofgem (2019). Charge design options for distribution and transmission charges – discussion note

4.4 FINAL SET OF DECISIONS FOR ASSESSMENT

Based on the analysis above, we will assess two decisions that define the overall structure of the market:

- What are the roles of different entities (DSOs and suppliers)? We have identified three archetype structures: A customer facing DSO, extended supplier hub, and multiple suppliers.
- What are the roles of third party entities? Resellers, aggregators, and energy concierge services could all play a part in any one of these market structure archetypes.

In addition, we will describe two related decisions which, while independent of the market structure (and so not the focus of this report), are still important in terms of overcoming the barriers to net zero. These are involve:

- what is it that customers buy or sell; and
- which vulnerable customers should be supported and how.

5 ASSESSMENT

This section sets out an assessment of each of the key decisions identified above based on the assessment criteria discussed in section 2.

5.1 ASSESSING THE UNDERLYING MARKET STRUCTURE

We have set out three underlying market structures in section 4:

- extended supplier hub;
- multiple suppliers; and
- customer facing DSO

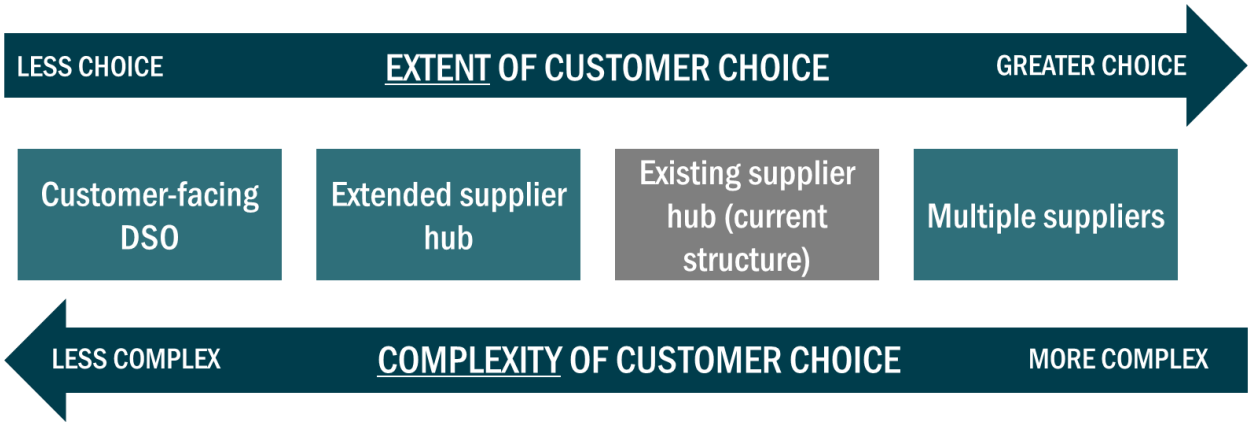
We have carried out a separate SWOT assessment for each of these underlying market structures which are presented below. Here, we draw out the key conclusions from that assessment.

5.1.1 EFFICIENCY

As described in section 2, efficiency relates to whether the market structure helps customers take-up the optimal low-carbon technologies, and use them in the optimal (flexible) way. However the structure which delivers this best will depend on how customers engage with the market.

If customers are willing and able to choose between highly differentiated services, then the ideal structure would allow different entities to compete to offer innovative packages of LCTs and the energy that powers them, with competition driving the market towards the forms of service most valued by customers. However, if customers are not willing or able to engage with such the market, it would risk the wrong choices being made. In this case, it may be preferable to limit customer choice, even if this risks blocking some innovations. Figure 17 outlines this trade-off, which we discuss in more detail below.

FIGURE 17 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 and requires customers can choose between multiple suppliers, which 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.[42]

- Within the **multiple supplier** archetype, customers need to choose between a wide variety of different businesses, all offering differentiated propositions, for different energy needs. For example, the structure of the contract offered by a company providing energy for heating purposes (potentially bundled along with a heating system) may be very different to those offering energy for mobility. However, if customers are able to make these choices, they should benefit from a wide range of options. This is as third party providers of LCTs would find it easier than at present[43] to offer energy alongside the assets themselves.

The optimal market structure will therefore depend on whether businesses can develop propositions which are compelling enough for customers to engage with. We discuss further in section 7 of how this might be assessed as part of an adaptive plan.

There is one other significant difference between the 'customer facing DSO' archetype and the other archetypes. This is the only option where DSOs have a direct means of procuring local flexibility from customers, rather than through suppliers. This might be an advantage if there is a very high value to DSOs of local flexibility, *and* there are barriers which mean suppliers would not pass on these signals to their customers. For example, if flexibility were only especially valuable in very localised areas, it might not be worth national suppliers providing highly differentiated offerings which can take advantage of this. However it is not currently clear that such barriers do exist.

5.1.2 FEASIBILITY

None of the archetypes described above can be ruled out on feasibility grounds alone:

- All of these archetypes impose regulatory obligations on at least one entity (government, the DSO, all suppliers, or the 'lead supplier' in the multiple supplier archetype).

- Given appropriate regulation, there is no reason why the entities in all of these market structure archetypes could not be financially sustainable.

- The customer facing DSO and multiple supplier archetypes require more changes to be made to current industry processes and systems than the extended supplier hub, and we discuss this in the

[42] Although some suppliers may offer these as services, not all do.

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

following section on the transition. However, as noted in section 2, this should not be a barrier to moving to a structure that could offer long-term advantages.

5.1.3 FAIRNESS

All of these market structures could be paired with different forms of intervention to assist 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.

Models such as the multiple supplier archetype could result in increasingly tailored offers available to customers, some of which may be targeted at customers with specific needs that are not currently well served by tariffs offered by the current market. For example HaaS tariffs for elderly people that ensure that at least one room is heated throughout the whole day without an increase in bills could reduce fuel poverty.

However, this benefit depends on whether these tariffs are commercially viable, are offered by the market, and critically whether customers are able to take-up these new offers. More generally, market structures that open the door to more innovative offerings will also require customers to choose between an increasing number and type of tariffs, including those offered by non-traditional energy companies. If customers are unable to make an informed choice, this could result in customer harm. Firstly, some customers may find it more difficult to engage with a more complex market, leading them to miss out on tariffs that would better meet their needs. Disengaged customers may also face higher prices (in the absence of measures like the current DTC).

Customer harm from these impacts is higher if vulnerable customers are more likely to be disengaged. Furthermore, whilst disengaged customers are currently protected by the DTC, 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 research from Citizens Advice found that some customers are already switching to EV tariffs without realising that they only apply to EVs and now face costly exit fees to switch.[44]

Supporting customers to make informed choices is therefore key to minimising the trade-off between efficiency and fairness. This will depend on how tools such as PCWs evolve over time as currently they do not include that majority of EV tariffs and find it difficult to compare more complex tariffs like TOU tariffs. The introduction of energy concierge services, potentially as a government-run entity, may be required if these tools do not develop via the market or are inaccessible to those who need them most, for example if they require a fee to access.

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

FIGURE 18 SWOT ANALYSIS: EXTENDED SUPPLIER HUB

STRENGTHS

Efficiency

- Introduces explicit requirements on suppliers to promote net zero enabling customer changes e.g. LCT uptake or customer flexibility.
- Recognisable single point of contact for customers to receive support on making the net zero transition.

Feasibility

- Builds on existing supplier-hub model

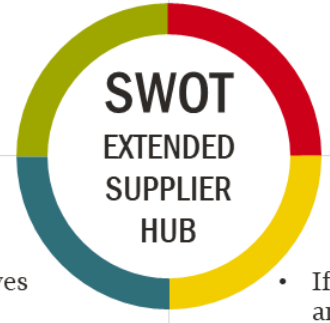
Fairness

- Retaining a single supplier per customer allows suppliers to fund social obligations and cross-subsidise costs across their customer base.

WEAKNESSES

Efficiency

- Extending the role of suppliers even further will make it more difficult for new entrants and could stifle much needed innovation in new business models that enable flexibility and uptake of LCTs
- Reduces competition for provision of LCT and flexibility including independent aggregators
- Requires DSOs to continue to rely on suppliers and VLPs to provide customer flexibility via a local flexibility market which may not emerge at the scale and pace required



OPPORTUNITIES

- Introduction of MHHS should align supplier and system incentives at a national level to promote load-shifting
- Increasing take-up of LCTs will provide scale for suppliers to offer aggregation services in the domestic market

THREATS

- If suppliers do not pass on flexibility signals from DSOs to customers for any reason, and the value of local flexibility is high, this model could result in lower-than optimal amounts of customer flexibility
- Low trust in energy suppliers to provide advice on energy efficiency and heating systems means that customers may not respond to supplier attempts to increase LCT uptake, flexibility, and particularly direct load control. This could be exacerbated by the current energy supplier crisis.

Source: Frontier Economics

FIGURE 19 SWOT ANALYSIS: MULTIPLE SUPPLIERS

STRENGTHS

Efficiency

- Maintains competitive market for provision of LCT and flexibility.
- Creates environment for greater innovation amongst energy suppliers
- Could allow customers to develop longer-term relationships, enabling these suppliers to offer financing deals for LCT take-up.
- Enables peer-to-peer networks and could encourage customer flexibility as well as growth of local networks, storage, and generation.

WEAKNESSES

Efficiency

- Additional complexity for customers who find it difficult to engage with multiple suppliers and choose the optimal products and tariffs for them.

Feasibility

- The technical requirements for allowing customers to have multiple suppliers may be challenging. Previous code modification P379 to allow meter splitting were not taken forward due to cost.

Fairness

- Multiple suppliers limits ability for any suppliers to finance social obligations which need to be delivered elsewhere.
- If customers can arbitrage, this will benefit sophisticated customers at the cost of more disengaged customers or customers that choose not to have an EV or heat pump

OPPORTUNITIES

- Rollout of smart meter and smart devices should increase ability of suppliers to offer device specific tariffs.
- Increased take-up of LCTs over time should offer sufficient scale for specialist tariffs to become more attractive to both customers and suppliers assuming it is technically possible to split the meter.

THREATS

- Secondary retailers do not offer high quality business propositions that are compelling to customers
- Price comparison websites struggle to compare secondary supplier tariffs, increasing risk of customer harm as they cannot choose the best tariff for them

Source: Frontier economics

FIGURE 20 SWOT ANALYSIS: CUSTOMER FACING DSO

STRENGTHS

Efficiency

- Allows DSOs to send direct flexibility signals to customers if suppliers do not pass on signals.
- Allows DSOs to adopt social obligations that are better aligned to system incentives including potentially financing LCT and battery adoption
- Narrower supplier role creates environment that supports innovation including new tariffs that could promote flexibility and LCT financing
- DSO access to smart meter data will allow it to target reinforcement and customer flexibility more accurately

Feasibility

- Aligns with existing DSO transition and increasing role of DSOs in flexibility
- Narrower supplier role could make it easier for companies to invest in their customers in the long-term e.g. provision of asset financing

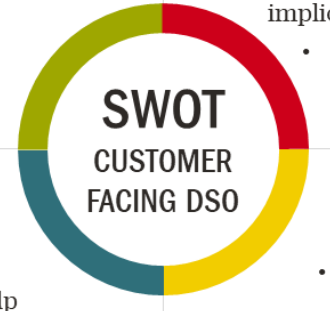
WEAKNESSES

Efficiency

- Monopoly provision of LCT and flexibility reduces competition from third parties including independent installers and independent aggregators
- Additional complexity for customers to engage with two (or more) organisations, may be unclear who to speak to for what.
- Highly dependent on HEMS rollout for automation. Limited HEMS could result in customers becoming disengaged with customer flexibility.
- Could limit innovative business models being introduced that rely on direct load control.

Feasibility

- Significant change to current supplier hub model
  - Requires changes to access to smart meter data which may have wider political implications
    - Any changes to DSO obligations and financing requirements will require adjustments to the RIIO-2 network price controls.



OPPORTUNITIES

- Ongoing consultation on establishing a Future System Operator could provide an opportunity to facilitate this transition and help to co-ordinate DSO flexibility signals

THREATS

- Current cost of living crisis and high energy prices means that any shift in social obligations need to be managed carefully to ensure that customers do not experience disruption in essential support.

Source: Frontier Economics

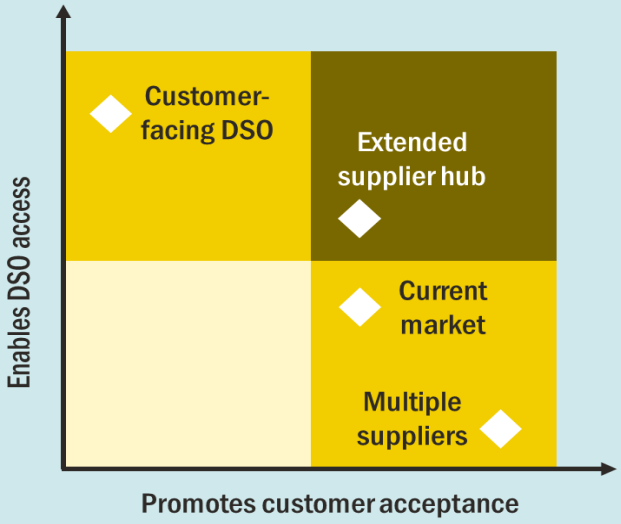
5.1.4 FLEXIBILITY RISK ASSESSMENT FOR DSOs AND CUSTOMERS

Risks around local flexibility can be caused by **lack of customer acceptance** of flexibility and the extent to which **DSOs have access** to that flexibility.

None of the archetypes discussed can fully mitigate the risks associated with customer flexibility to DSOs. What they can do is change the way in which risk is distributed, as illustrated in Figure 21 on the right. Some archetypes may be better at promoting customer acceptance of flexibility, for example via innovative new tariffs that make flexibility more attractive. Others will focus more on addressing DSO access issues, for example by removing barriers between DSOs and end-customers.

We summarise the main risks and mitigations of each archetype below. Further detail on the key risks associated with each model is summarised in Table 2 below.

FIGURE 21 HOW EACH ARCHETYPE ADDRESS DRIVERS OF FLEXIBILITY RISKS



Source: Frontier Economics

5.1.4.1 RISKS TO THE DSO

Under the **multiple supplier** archetype customers are more likely to accept flexibility-based incentives but there is a greater risk to DSO access:

- **Customer acceptance of flexibility**. Customers can choose between a wide variety of different business models that are better suited to their individual needs. They may be more willing to sign-up for DLC, for example via 'as-a-service' tariffs. This helps to address both the availability of flexibility and its reliability when called upon (the DSO will still need to provide appropriate incentives for reliability, such as penalty payments, but suppliers may have more ways of ensuring this reliability in practice). This archetype also utilises a flexibility market. Whilst this means DSOs do not have direct access to customers, it can make it easier for DSOs to understand where flexibility may be available to support planning as well support value stacking, aggregating different sources of value to make flexibility more attractive to customers.
- **DSO access**. As this model does not introduce regulatory obligations for secondary suppliers to engage with the flexibility markets, or indeed enter the market at all with new business models, it is reliant on market mechanisms to make flexibility available to DSOs. However, it is not possible to guarantee that this will be the case. For example, if flexibility is only valuable in a small proportion of areas, suppliers may not find it worthwhile to develop bespoke business models to support it. Furthermore, this archetype may result in a temporary increase in supplier entry and exits as companies learn how to make new business models commercially viable. If a supplier with a large amount of contracted local flexibility exits the market, the DSO may unexpectedly lose access to that customer flexibility.

The opposite is true under the **customer facing DSO** which uses direct engagement between DSOs and customers to bypass some of the DSO access issues at the cost of higher risk to customer acceptance of flexibility:

- **Customer acceptance of flexibility.** DSOs in this model will not have a contract with customers to deliver flexibility[45] and can only rely on price signals. If customers lack automation via HEMS or other technologies, these may need to be large for customers to respond. As the DSO is not the only entity sending price signals to customers, customers will need to be able to "stack" other sources of value from flexibility – perhaps through their HEMS systems. If this is not the case, the value of flexibility will not be fully reflected resulting in inefficient levels of load shifting.
- **DSO access**. The DSO does not rely on third parties and the flexibility markets to procure customer flexibility and has direct access to customers. This helps to mitigate the risk that suppliers choose not to offer flexibility-based tariffs to their customers. However, as discussed above, if customers are unable to stack other sources of value from flexibility, this could result in under-provision of flexibility available to the DSO.

The **extended supplier hub** model strikes a balance between customer acceptance of flexibility and DSO access:

- **Customer acceptance of flexibility.** The extension of supplier obligations may make it harder for innovative business models (potentially bundling energy supply with services such as heat and transport) which would otherwise encourage greater provision of flexibility. As in the multiple supplier model, this archetype utilises a flexibility market which can help to improve customer acceptance by aggregating various sources of flexibility value and using this to incentivise customer flexibility.
- **DSO access**. DSOs are still reliant on suppliers to offer customers flexibility-oriented business models but introduces new obligations to encourage this process, although this is mitigated in part by new obligations on suppliers to participate in the flexibility market.

When we consider these archetypes against the current market, once current initiatives such as MHHS and reforms to reduce barriers for VLPs participating in flexibility market are complete, the **current market** is similar to the extended supplier hub model. The key difference is that the extended supplier hub model includes additional obligations on suppliers to participate in flexibility markets, the absence of which might increase the risk that DSOs cannot access customer flexibility.

5.1.4.2 IMPACT ON CUSTOMERS

As we discuss in section 2.2.1, where DSOs face risks associated with flexibility, we expect that customers will be relatively insulated from these costs in the short-term. However, market archetypes that can lower the overall risk and therefore cost of flexibility will increase the benefits of these solutions compared to network reinforcement, increasing potential savings for both the system and customers in the long-run. Therefore 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, there may also be differences in the way that undesirable distributional impacts can be managed under each option.

- Under both the **multiple supplier model** and the **extended supplier hub**, any additional costs that can be passed through to customers in the short and long-run are done via the DUoS component of

[45] Since suppliers may separately be requiring flexibility, and so any contractual requirements or DLC could conflict.

the bill. Under the current network charging methodology,[46] this cost would be socialised across the DSO's licence area. This means that if a customer in a constrained area is unable to provide flexibility, they will not bear a disproportionally large share of the costs to mitigate this risk.

- In the **customer facing DSO**, DSOs would rely on sending real time price signals to incentivise flexibility rather than procuring flexibility in advance via suppliers or aggregators. This means that DSOs will need to move away from the current DUoS methodology and towards a tariff that incorporates a localised and time-varying component. This could result in some areas and customer groups facing more volatile prices, with higher bills for those unable to load shift. If vulnerable customer groups are less able to load shift, they could end up bearing the bulk of these higher bills. DSOs could introduce an element of socialisation to counteract this – for example spreading the costs of constrained areas across the wider license area. However customers offering flexibility would still need to earn more 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. Aside from these archetype-specific considerations, we do not consider any of these options to be incompatible with wider support for vulnerable customers, including those that address similar concerns surrounding the distributional impacts of dynamic TOU tariffs. This includes expanding the criteria for subsidies to customers that are unable to shift their energy usage, for example households with medical electricity usage or more children. A similar criteria is used for the Watersure social tariff.

5.1.4.3 SUMMARY

As explained above, none of the models can completely mitigate the risks associated with flexibility for DSOs. If realised, these risks will raise DSO costs either via increasing the amount that DSOs must spend on costly network reinforcement or the amount of expensive last-minute alternative flexibility.

If the current model is unable to deliver efficient levels of domestic customer flexibility due to low customer acceptance, a market structure such as the multiple supplier model may offer better outcomes in the long-run, reducing the risk that DSO are unable to procure flexibility in advance and improving reliability of this flexibility. Any market access issues could be addressed via regulation if necessary. The use of a flexibility market could also support value stacking, again helping to make flexibility more attractive to customers.

This will also benefit customers. Whilst customers are unlikely to bear the cost of flexibility risks in the short-term, a model that can reduce the cost of flexibility will reduce overall system costs and customer bills in the long-run via lower DUoS charges.

However, even if new business models emerge that mean that customers are more willing to offer flexibility in general, and DSOs are able to access this flexibility, there will still be residual risk associated with availability. For example, flexibility associated with heat pumps may be difficult to access during an extreme cold spell. If this risk is uncorrelated across customers within a local region, this could be managed via over-procurement by the DSO (at a cost). However, it sufficiently small areas these risks may be correlated between customers. For example, if extensive roadworks forced a large number of residents to temporarily move the vehicles, flexibility delivered via V2G may be temporarily

[46] A wide-ranging review of DUoS is due in 2023 – see Ofgem (2022). *Decision to descope the wide-ranging review of Distribution Use of System (DUoS) charges from the current Electricity Network Access and Forward Looking Charges Significant Code Review (SCR) and take it forward under a dedicated SCR with a revised timescale*

unavailable. Some events such as an extreme cold spell will impact large numbers of customers by its nature.

In these cases, the risk of loss of flexibility may be more challenging and regulatory best practice is to place risk with the entity best able to manage it. There are various options. DSOs could hold this risk and account for it when making network investment plans. Alternatively, if flexibility contracts between DSOs and suppliers are set up in a way that suppliers face a penalty for not providing contracted DSR, but suppliers cannot pass this on to their customers, this risk will initially fall on suppliers. Whichever entity holds this risk is likely to need to carry out detailed analysis on mitigation options and bear the cost of doing so (both direct costs and impacts on competition if this falls on suppliers).

TABLE 2 FLEXIBILITY ASSESSMENT OF MARKET ARCHETYPES

RISK TYPE	ARCHETYPE	CUSTOMER ACCEPTANCE OF FLEXIBILITY	DSO ACCESS TO CUSTOMER FLEXIBILITY
RISKS TO THE DSO — Unable to procure flexibly in advance	Extended supplier hub	× Potential issues around customer trust in permitting suppliers DLC. Lack of customer appetite for DLC would mean greater reliance on opt-in TOU tariffs. ✓ Utilising a flexibility market enables value stacking, creating stronger incentives for customer to deliver flexibility.	✓ Requires suppliers to develop flexibility-centred propositions for customers. Whilst there should be a revenue stream for doing so, this may be insufficient to incentivise investment into highly localised flexibility requirements. However, this risk could be mitigated as part of new obligations on suppliers to engage with flexibility discussed under this archetype.
	Multiple suppliers	✓ Customers may be more willing to accept DLC from more specialist or non-traditional energy suppliers. × On the other hand, there is a risk that only more "engaged" customers take-up secondary suppliers that offer flexibility-oriented propositions, reducing total flexibility offered. ✓ Utilising a flexibility market enables value stacking, creating stronger incentives for customer to deliver flexibility.	× This model relies on a market-based approach rather than regulation to encourage greater participation of suppliers in the flexibility market. It assumes that secondary suppliers are better suited and more able to participate in flexibility markets.
	Customer-facing DSO	× The DSO is sending price signals to customers rather than carrying out DLC and there is no contract between DSOs and customers that guarantees provision of flexibility. × Lack of value stacking for customers (if not delivered by HEMS) reduces customer incentives for flexibility.	✓ DSOs are not reliant on flexibility platforms and markets although they may still choose to engage with aggregators that do have DLC agreements with customers.
	Procured flexibility is unreliable or costly — Extended supplier hub	✓ If suppliers need to rely on TOU tariffs rather than DLC due to trust issues, provision of flexibility will depend on the response to prices and is more uncertain, particularly in the absence of widespread automation or HEMS (suppliers could be mandated to rollout HEMS in the same way they have led the smart meter rollout).	- DSOs must compete with other requirements for flexibility. However, if the market is operating efficiently, DSOs should be able to outbid others if local flexibility has the greatest value. × The risk of supplier failure, as demonstrated by recent events, could result in an unexpected loss of flexibility in the absence of a 'supplier of last resort' mechanism for flexibility. Customers may be less willing to allow DLC for an appointed SoLR compared to a supplier they have chosen.

RISK TYPE	ARCHETYPE	CUSTOMER ACCEPTANCE OF FLEXIBILITY	DSO ACCESS TO CUSTOMER FLEXIBILITY
	Multiple suppliers	✓ New innovative business models may lead customers to be more willing to sign up to DLC, improving reliability of flexibility (depending on the extent to which customers can override the DLC – e.g. if there is a particularly cold spell).	✓ DSOs will need to complete against other demands for flexibility. ✓ There could be a greater risk of supplier exits in the short run as businesses learn how to deliver new business models that are commercial viable. This increase the risk of loss of procured flexibility delivered by failed suppliers.
	Customer facing DSO	× `Lack of DLC between DSOs and customers means DSOs are highly reliant on HEMS or customers willingness to flex in response to price signals. These signals may need to be very high if customers are not willing or find it difficult to respond. × Additional risk of HEMS rollout issues such as those faced in the smart meter rollout.	✓ DSO is not reliant on external parties such as suppliers or aggregators for flexibility. × Effective market required to capture system-wide value of flexibility for value stacking and support DSO's ability to send price signals to customers.
Risks to customers	Extended supplier hub	× Distributional impacts will depend on the form of tariff. If suppliers need to rely on TOU tariffs or customers require payment for DLC, this could result in differential bills across customers, with customers more able to load shift or access 'as-a-service' contracts more likely to benefit. ✓ Any exceptional costs of managing flexibility risks can be across all customers in the licence area under the current duos charging methodology.	
	Multiple suppliers	× More engaged customers are likely to take-up secondary supplier contracts and benefit from flexibility payments (if customers are paid for flexibility). If disengaged households are disproportionately vulnerable, this could be regressive. ✓ Any exceptional costs of managing flexibility risks can be across all customers in the licence area under the current DUoS charging methodology	
	Customer facing DSO	× Lack of DLC means that price signals may need to be extremely high before customers are willing to shift load. If vulnerable households find this more difficult, this could result in significant consumer harm due to higher bill differentials. × Price shock risk compounded by the fact that DSOs will need to introduce a highly localised time-varying component to DUoS charges and there is a trade-off between socialisation of cost and strength of flexibility incentive.	

Source: Frontier Economics

5.2 ASSESSING THIRD PARTY ENTITIES

We have set out three types of third party entities that could emerge in the market. We now assess whether the existence of these third parties is desirable. We carry out a RAG rating analysis which we present below alongside threats and opportunities. For fairness, we indicate which of the definitions each of these options supports and which ones it undermines (grey indicates that it is agnostic to this definition).

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 entities can help to increase the availability and visibility of 'As-a-service' tariffs. As we have previously discussed, suppliers offering 'As-a-service' tariffs have an incentive to minimise the cost of delivering the agreed level of service, which will include minimising use of the network during times of constrained capacity and generation.
- **Domestic aggregators.** Expansion of aggregators to domestic customers will increase the opportunities for customers to deliver flexibility and be rewarded for doing so. Aggregators can also work with customers to help automate load shifting, for example by selling smart devices and batteries.
- **Energy concierges.** The primary benefit of an energy concierge is to support customer choice, helping them to navigate an increasingly heterogenous energy system. Without energy concierge services, customers may find it too difficult to compare different tariff structures, particularly in the case where customers can have multiple suppliers. This may help customers to switch onto new innovative tariffs such as dynamic TOU tariffs or 'as-a-service', helping to promote flexibility. Alternatively, energy concierge services should help to identify customers who would face higher bills under these tariffs, for example if they are unable to load shift or rent poorly insulated homes.

The introduction of these third party entities is likely to also introduce additional costs for customers, either directly or indirectly. For example customers may pay directly for the services for an energy concierge or suppliers may pay concierges a commission for generating leads with the cost of this socialised across their whole customer base. However we would expect that these business models would only be successful if the additional costs are justified by the benefits they bring.

5.2.2 FEASIBILITY

Whilst all three types of third party entities offer benefits to efficiency, they vary in the degree of change required to implement. Energy concierges are effectively an extension of today's PCWs, auto-switching websites, and energy efficiency advice websites. We have not identified any barriers that would prevent the entry of energy concierges in the future assuming that there is demand from customers for this service, and that the data required to make comparisons is available to these services, although this would require advances in programmes such as midata which would make it easier for customers to provide their smart meter data to third parties for price comparison.

However, price comparison websites currently struggle to compare TOU tariffs and EV tariffs and there is no consistent methodology for estimating annual electricity bills for comparison. The 'Smart Tariffs- Smart Comparisons' project by BEIS appointed Vital Energy in 2020 to pilot how this might work[47] which has developed a prototype tool although next steps for implementing this more widely across the market are unclear. Citizens Advice has made a number of recommendations for PCWs including the inclusion of EV tariffs and provision of tools that allow customers to model their likely bill on a specific tariff where it has more than one rate. The continuation of the midata in energy programme (which is currently paused) or similar functionality that allows customers to share their smart meter data with trusted third parties including PCWs is another initiative that will support the entry of energy concierge services whilst still protecting customer privacy and data. The sector could also learn from other sectors such as the Open Banking initiative in financial services that gives customers the right to ask third party providers to make payments on their behalf or access their financial data in a regulated manner that protects customers.

We have also identified no regulatory barriers that would prevent aggregators entering the domestic market, and there are already some niche examples such as Social Energy which sell batteries to domestic customers and uses aggregated capacity to offer DSR to balancing market and DSOs.[48] However, independent aggregators could face other challenges. For one, it requires customers to engage with another type of entity that is not a supplier and there is not yet evidence that a large proportion of customers would be willing to do this. Even in the case of integrated supplier-aggregators, low-levels of LCT uptake means there may not be sufficient domestic aggregation to be commercially feasible at the moment. We expect that this will naturally change over time based on existing policies in the market e.g. phase out date of ICE and hybrid vehicles and gas boilers, but other policies that help to promote uptake of LCTs and batteries will help to accelerate this transition and entrance of domestic aggregators.

Recent changes including the introduction of VLPs and the ongoing consultation on allowing VLPs to access wholesale energy markets should also help to encourage domestic aggregators. Our discussions with a domestic energy aggregator highlighted the challenges of aggregation prior to the creation of the VLP role, which required aggregators to hold a supply licence and deliver against the obligations within that licence.

In comparison, the introduction of 'as-a-service' resellers is likely to require more changes to the current market. 'As a service' resellers are likely to require clarification on how existing regulation applies (similar to the clarification document issued by Ofgem on EV charging models) and whether changes are required to create a more streamlined licence designed for resellers. The licence lite is a step in this direction but it 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.

5.2.3 FAIRNESS

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

[47] BEIS website. Accessed at: https://www.gov.uk/government/publications/smart-meter-enabled-tariffs-comparison-project-smarter-tariffs-smarter-comparisons/smarter-tariffs-smarter-comparisons-project-winning-bid

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

TABLE 3 ASSESSMENT OF ROLE OF THIRD PARTY ENTITIES

TYPE	STRENGTHS & WEAKNESSES			OPPORTUNITIES & THREATS
	EFFICIENCY	FEASIBILITY	FAIRNESS	
As a service reseller	As a service resellers can 'convert' £/kWh tariffs into 'As-a-service' offerings which creates incentives on them to both to load shift and to reduce overall energy consumption. As a service resellers could offer financing for LCTs. If as a service resellers are non-traditional energy companies such as car or heat pump manufacturers, this could increase customer trust.	Requires changes to the supplier licence to reduce barriers to tariffs that use alternative units to kWhs. Requires clarification on whether independent resellers are allowable under the market and the licence that they are subject to.	**Customers face similar unit costs.** Customers with higher system costs to deliver the same output likely to face higher bills. **Customers have cost-reflective bills.** Customers pay for the outputs they receive which will be informed by the cost to the system of delivering these outputs **Vulnerable customers receive support.** Can operate alongside targeted support schemes **Disengaged customers are protected.** Disengaged customers may not benefit from additional choice offered by resellers.	**Opportunities** Expansion of schemes such as ECO to installation of smart devices would enable 'as-a-service' business models. **Threats** Lack of interoperability standards between devices could leave customers locked into one provider and undermine competition, leading to high prices or low service quality.
Domestic Aggregators	Creates additional incentives for customers to provide flexibility and can work directly with customers to automate this process such as selling smart devices and batteries.	Aggregators already exist in the I&C market and changes to support VLPs in participating in the flexibility market	**Customers face similar unit costs.** Customers rewarded for using energy when it is cheaper.	**Opportunities** Agreed regulatory framework for aggregators to address concerns around supplier imbalances and lost revenue from

TYPE	STRENGTHS & WEAKNESSES			OPPORTUNITIES & THREATS
	EFFICIENCY	FEASIBILITY	FAIRNESS	
		should strengthen the commercial model for domestic aggregation.	**Customers have cost-reflective bills.** Customers rewarded for using energy when it is cheaper.	DSR events could remove regulatory uncertainty, provided this is proportionate.[49] Increasing uptake of LCTs, potentially funded via ECO for some customers, increase the number of customers who would benefit from an aggregator. **Threats** Duplication of flexibility signals adds additional complexity for customers, for example if a customer receives signals from their aggregator, supplier (via a TOU tariff), and the DSO. Customers don't want the complexity of engaging with another body on top of their supplier (in the case of independent aggregators). In the case of integrated supplier-aggregators, continued low trust between customers and suppliers could undermine willingness to react to DSR or allow DLC.
			Vulnerable customers receive support. Can operate alongside targeted support schemes	
			Disengaged customers are protected. Can operate alongside DTC and similar measures.	
Energy concierge	An energy concierge service should help customers to choose the best solution for them in the face of increasing customer heterogeneity and personalisation of tariffs.	PCWs do not currently allow customers to compare bespoke products like EV tariffs. Currently customers cannot consent to third parties accessing their smart meter data on their behalf. The midata programme was intended to address this and streamline tariff comparison.[50] The programme is currently	**Customers face similar unit costs**. Does not define the type of tariffs customers face.	**Opportunities** The provision of energy concierge services will be particularly valuable if suppliers offer more bespoke products for example by device or 'as-a-service'. The provision of a government sponsored not for profit energy concierge could support vulnerable customers specifically. **Threats** Failure of programmes such as midata that allow customers to share their smart meter data with trusted third parties will make energy concierge services significantly more difficult for customers to use.
			Customers have cost-reflective bills. Does not define the type of tariffs customers face.	
			Vulnerable customers receive support. Vulnerable customers may struggle to engage with energy concierges	

[49] European University Institute (2021). Working paper. The regulatory framework for independent aggregators

[50] Ofgem website. Accessed at: https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/midata-energy-programme

TYPE	STRENGTHS & WEAKNESSES			OPPORTUNITIES & THREATS
	EFFICIENCY	FEASIBILITY	FAIRNESS	
		paused. Ofgem was due to review when to recommence this programme in Spring 2022 but have not updated since.	but those who do may switch to better deals.	Poor regulation of energy concierge services that either fail to prevent customer harm (high margins, most favoured nation clauses) or alternatively are overly prescriptive and stifle innovation.
			Disengaged customers are protected. Disengaged customers may not use energy concierge services but those who do could receive better deals. Concierge services could also include auto-switching services that automate engagement.	

Source: Frontier Economics

5.3 ASSESSING WHAT DO CUSTOMERS BUY/SELL AND HOW TO SUPPORT VULNERABLE CUSTOMERS

Energy is an essential service. In 2020 13% of households were in fuel poverty in England alone[51] and the recent increase in the DTC means that low-income household are forecast to spend on average 18% of their income after housing costs on energy bills. This means that any future market structure will need to consider the impacts on customer protection.

With this in mind, we have chosen to assess 'what do customers buy/sell' and 'how to support vulnerable customers' together. Until now we have considered these two building block categories separately. However, they are closely linked and there are trade-offs between efficiency and fairness (customer protection) which we summarise here. We consider each option for 'what do customers buy/sell' and describe its impact on fairness below.

5.3.1.1 'AS A SERVICE' TARIFFS

'As a service' tariffs have the potential to support the net zero transition in two ways. Firstly, as suppliers would be paid on the basis of the output they deliver rather than the amount of energy consumed, they have an incentive to minimise the cost of delivering this output. This means both minimising overall energy consumption as well as using energy at times when it is cheapest, providing flexibility. Second, they can also support the uptake of LCTs, bundling the provision of LCT assets alongside a supply contract. For example, a HaaS provider has a direct incentive to promote the installation of thermal efficiency measures by their customers as it reduces the cost of heat of their home to any given temperature.

However, these tariffs (or the changes required to enable them) could leave some customers worse off. Broad price regulation may disincentivise the uptake of novel 'as-a-service' tariffs. As these tariffs all sell different products (e.g. miles of EV travel, days of heated home…) rather than simple kWh, it is much harder to set a price cap which permits all business models to make a normal level of profit. Even if price regulation were limited (e.g. to disengaged customers, like the current DTC), there is a risk that this discourages customers from taking up novel forms of tariff outside the cap

In addition, 'as-a-service' tariffs may themselves increase the risk of customer harm. For the same reasons that they are difficult to price regulate, these business tariffs may be more difficult to compare, and this leaves customers at risk of higher prices or services that don't meet their needs. HaaS contracts that bundle heating technology with energy supply may require longer contracts which could introduce other customer protection issues.

5.3.1.2 KWH WITH TOU PRICING

Similar arguments apply when considering a move towards TOU tariffs, particularly dynamic TOU tariffs. These types of tariffs send price signals to customers that reflect the status of the system. Assuming that customers adjust their behaviour in response to these signals, dynamic TOU tariffs should increase customer flexibility. However more complex dynamic TOU tariffs are potentially harder to regulate and compare. In addition, customers unable to shift their demand may face higher bills if they move onto dynamic TOU tariffs. Placing a price cap on these tariffs to protect vulnerable customers will dampen the strength of these signals, again representing a trade-off between efficiency and customer support.

[51] BEIS (2022). Annual fuel poverty statistics in England

5.3.1.3 KW OF CAPACITY

Under this model customers pay less if they use, or take the option to use, less capacity. Whilst this will lower bills for customers who are able to spread their consumption across the day, bills for customers who cannot do this could be higher. This could disproportionately impact households with young children or with medical electricity use. The pandemic has also shown that low-income workers tend to have jobs that cannot be done remotely[52] which could also limit their ability to spread consumption over the day.

5.3.1.4 SUMMARY

New tariff structures and business models such as TOU tariffs, 'as-a-service' and cost-reflective distribution tariffs have the potential to deliver significant benefits for efficiency, helping to promote LCT uptake and delivery of flexibility. However, low-income households or other types of vulnerable customers may be less able to respond to flexibility price signals or are less likely to adopt new tariff types, leaving them at risk of higher bills for an essential service.

It is possible that market will evolve so these novel business models can be offered without the customer protection issues described above – for example, the widespread use of energy concierge services could mitigate this issue. However if this is not the case, a policy decision will need to be taken whether to prioritise customer protection or efficiency.

52

UCL website. Accessed at: https://www.ucl.ac.uk/news/2020/may/low-income-workers-disproportionally-affected-covid-19

6 MAPPING THE TRANSITION

The previous section set out three archetype market structures: the extended supper hub, multiple supplier model, and customer facing DSO. We also described three types of third party entity which might co-exist with any of these archetypes: 'As-a-service' resellers, aggregators, and energy concierges.

Here we describe in broad terms what might be required to transition from the current supplier hub model to each of these archetypes. Using the maps of the market presented in the WP1 report as a starting point, we set out:

- changes in contractual services provided by and between entities in the market;
- changes in dataflows (both those involving the smart meter system, and other dataflows); as well as
- changes that will be required in how customers interact with the market.

6.1 EXTENDED SUPPLIER HUB

This archetype is an extension of the current supplier hub, introducing more social obligations on suppliers but maintaining the model of a single supplier per customer per fuel, with the supplier acting as the main interface to the market. Consequently there are fewer transitions associated with this archetype than the other two. We discuss these changes below.

6.1.1 CONTRACTUAL SERVICES

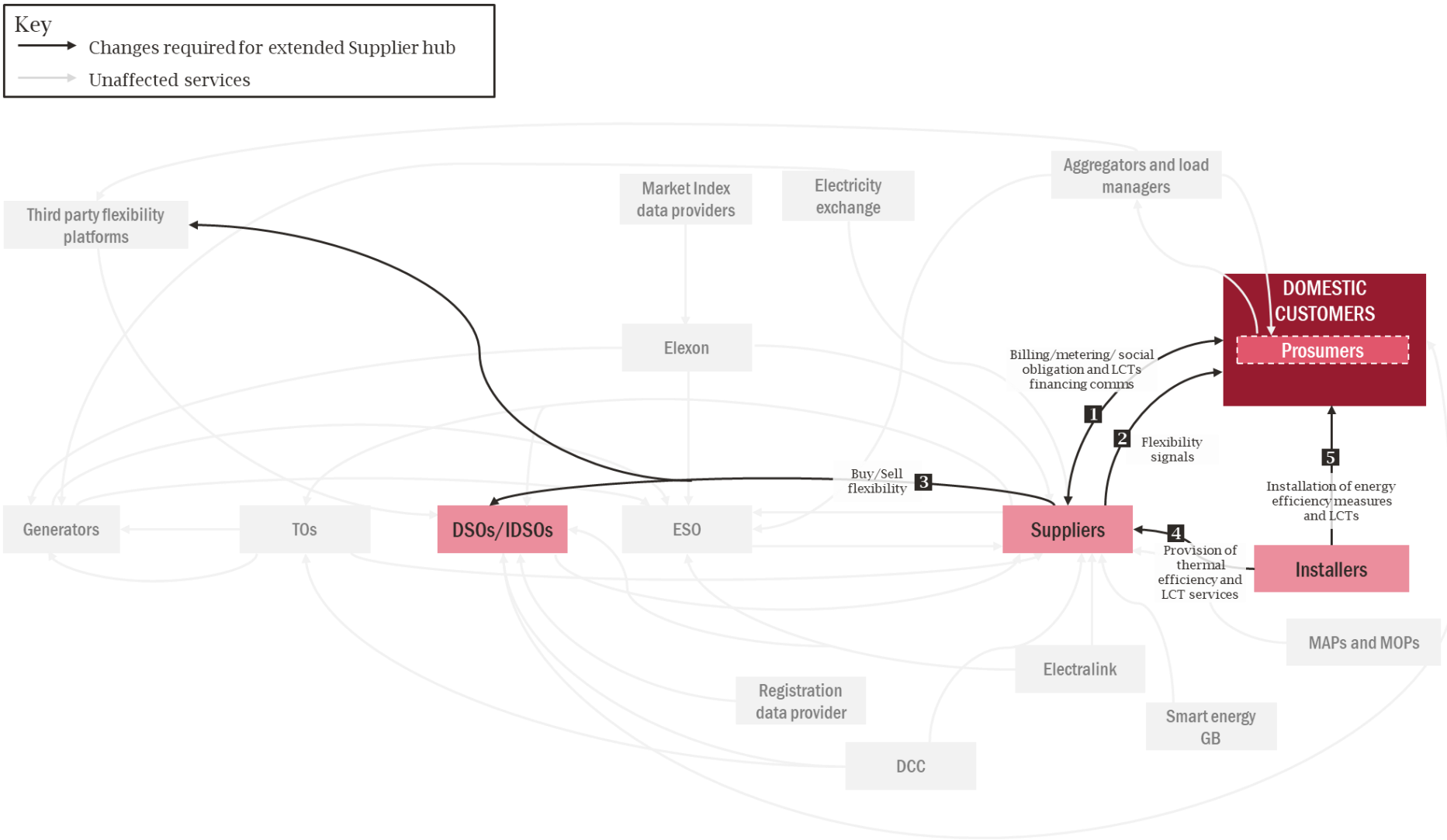
Figure 22 below shows the main changes to contractual services that would be required to enable the extended supplier hub business model. This diagram focuses on the electricity market but we assume similar changes would be required for gas.

- **Extension of obligations to support LCT uptake** *(Figure 22, arrows 1, 4, and 5)***.** Suppliers would have new obligations to support the uptake of LCTs, either for specific customer groups or for all customers. This could be in the form of direct subsidies or the provision of financing agreements. We expect that suppliers would contract out installation of LCTs to third party installers in the same way they current do for ECO.

- **Extension of obligations to flexibility** *(Figure 22, arrows 2 and 3)***.** Under this model the supplier licence would be extended to include obligations to promote customer flexibility. There are several options for how this might introduce that range from less prescriptive principle-based approaches such as the 'flexibility first' approach for DNOs under the RIIO-ED2, through to more prescriptive regulations such as ECO which places specific obligations and targets onto suppliers.

  Stronger obligations on customer flexibility could lead suppliers to transition towards becoming integrated supplier-aggregators for their domestic customers. Entities such as the ESO and DSOs would send flexibility price signals to suppliers, either directly via bilateral agreements or via flexibility platforms, which they would pass on to their customers. Suppliers could deliver this via a variety of ways, for example mandatory provision of dynamic TOU tariffs, or DLC. Suppliers may be obligated to provide customers with information and devices (for example HEMS) which help them respond to these signals, none of which are currently required as part of the supplier licence.

FIGURE 22 EXTENDED SUPPLIER HUB: CONTRACTUAL SERVICES



Source: Frontier Economics

6.1.2 DATA FLOWS

We expect that the majority of dataflows required under this model are already in place or are currently under development such as the introduction of MHHS due in 2025. This is reflected by the limited number of new arrows in Figure 23 and Figure 24:

- **Social obligation comms** (*Figure 23, arrows 1, 2 and 3*). Where suppliers have new social obligations around LCT uptake, they will be expected to communicate with relevant customers to promote uptake, as well as managing any third party contractors they use to deliver these obligations. Equally customers may be required to engage directly with their supplier in order to receive support from these social obligations, for example applications for LCT subsidies.

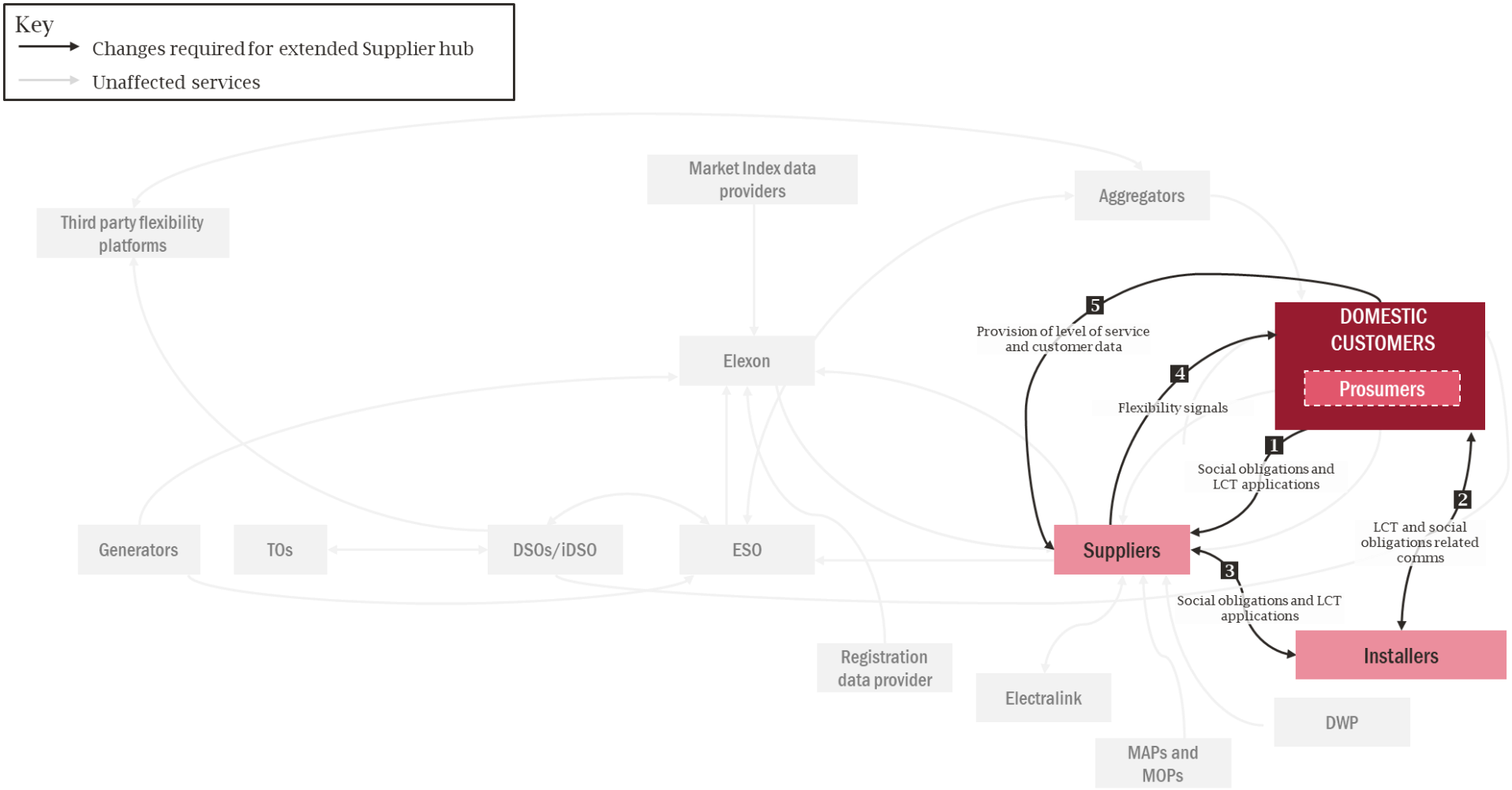
- **Flexibility comms** (*Figure 23, arrows 4 and 5)* As part of their obligations to promote flexibility, suppliers may have requirements to engage customers on how they can deliver flexibility, for example advising customers on options for DLC or dynamic TOU tariffs. Where suppliers have DLC, they may need to notify customers when they take control and adjust usage. Customers may also instruct the supplier on the level of service they expect to be delivered via DLC if they are taking an 'as-a-service' tariff, for example the times, areas, and temperatures they expect to be heated under a HaaS contract.

- **DLC** (*Figure 24, arrows 1, 2 and 3*). The current SMETS2 technical specification includes smart control facilities that allow suppliers to carry out remote load management. This is done via auxiliary load control switches that can be programmed to turn on or off based on schedules set by the supplier or on an 'ad hoc' basis. Suppliers send these signals to the DCC which then passes this on to the customer's smart device(s) (*arrows 1 and 2)*. However, this functionality is currently limited to on/off events only and more sophisticated DLC will likely require proportional load control.[53] This is currently planned for future versions of SMETS.[54] Some aggregators are currently carrying out DLC using their own networks rather than the SMETS2 auxiliary load control switches (*arrow 3)* due to technical limitations of the current SMETS specification and this could remain an alternative option for suppliers carrying out DLC in the future.

[53] Proportional direct load control refers to the ability to 'turn up' or 'turn down' energy consumption, for example halving the charging rate of an EV charger, rather than simply turn on/off.

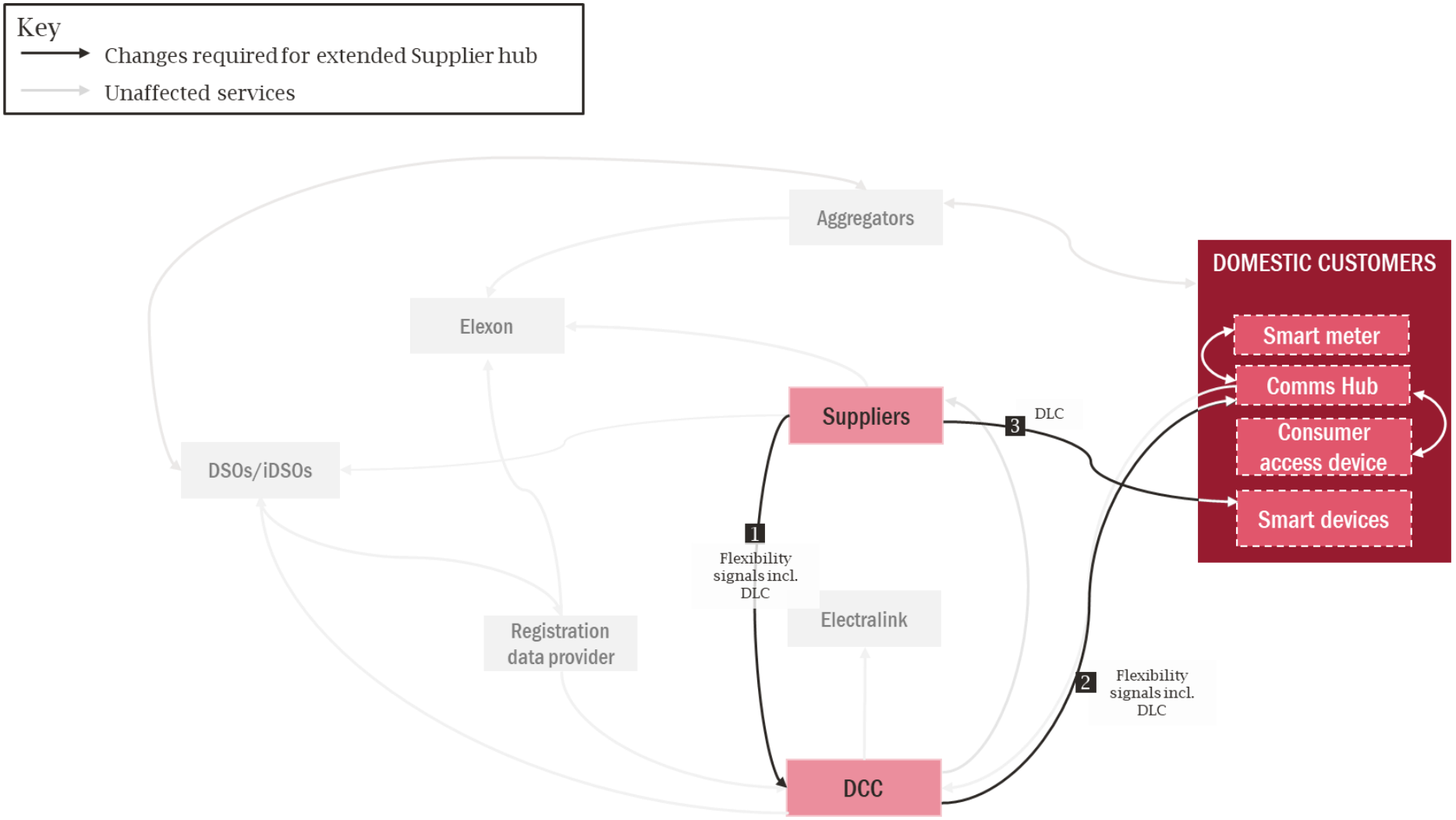
[54] Imperial College London (2022). Balancing privacy and access to smart meter data

FIGURE 23 EXTENDED SUPPLIER HUB: DATA FLOWS (EXCL. SMART METER DATA)



Source: Frontier Economics

FIGURE 24 EXTENDED SUPPLIER HUB: SMART METER DATA



Source: Frontier Economics

6.1.3 CUSTOMER BEHAVIOUR

Automation and DLC are key to maximising the potential of customer flexibility and suppliers will face stronger obligations to promote flexibility across this customer base. This may be in the form of price signals, for example increasing the number of available TOU tariffs, but could also include measures to help customers respond to price signals via DLC. However, this requires customers to trust their supplier enough to cede control of their devices and research has shown a link between levels of customer distrust and take-up of DLC services.[55] As we discuss earlier, trust between customers and their energy supplier is often low and building up customer trust will be key to a successful transition.

6.1.4 SUMMARY OF KEY TRANSITIONS

We set out a summary of key transitions required for an extended retailer hub below along with an initial high level assessment of the timescales and complexity required to deliver these transitions.

TABLE 4 KEY CHANGES REQUIRED FOR AN EXTENDED SUPPLIER HUB

KEY	
	Small changes to **existing** regulation and business processes, technology, customer behaviour etc. For example, extending the coverage of an existing licence condition, utilising existing dataflows, or making a small change to customer facing decisions.
	Significant changes to **existing** processes. For example, setting new types of obligations, extending existing technologies, or changing the types of services customers purchase.
	Entirely 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. This also includes changes that require customers to engage with unfamiliar markets or significantly change their current relationship with market entities.

DIMENSION	CHANGE	COMPLEXITY
Contractual relationships	Extension of obligations to flexibility	This will depend on how prescriptive these obligations are but the supplier licence already includes obligations to promote positive customer engagement[56] which could form a starting point.
	Extension of obligations to support LCT take-up	Government is already considering similar measures such as supplier obligations on heat pump uptake although any changes on obligations could require wider legislative changes.[57]
	Effective customer comms regarding	Again this will vary on the specific obligations. Comms on new subsidies for LCTs are likely to be

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

[56] Electricity Act 1989. Standard conditions of electricity supply licence

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

DIMENSION	CHANGE	COMPLEXITY
Data, technology and assets	new social obligations	faster and more simple to develop. Comms designed to support longer term changes in customer behaviour such as accepting DLC from suppliers will be more complex to deliver and customer buy-in 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/contracted 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	Again the degree of complexity will depend on the type 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

The multiple supplier model requires significant changes to the balancing and settlement code in order to manage settlement with more than one supplier behind the boundary meter. 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.

CEPA's analysis[58] as part of the cost benefit analysis concluded that a significant code review (SCR) would be required in order to finalise these changes due to the interaction with other existing codes. It should be noted that P379 was ultimately withdrawn due to the costs of implementing meter splitting being higher than expected.

6.2.1 CONTRACTUAL SERVICES

Figure 25 shows the main changes in contractual services that would be required to enable multiple suppliers. We describe these changes below.

[58] CEPA (2020). P379 Impact Assessment

We expect that allowing customers to have multiple suppliers will require Ofgem to split the current supplier licence into two separate options: a lead supplier licence and a secondary supplier licence. The majority of social and environmental obligations that are not moved away from suppliers altogether (for example to Central Government) would be delivered by the lead supplier.

- **Shifting delivery of social obligations.** *(Figure 25, arrows 1,2, and 3).* Some of the existing social obligations delivered by energy suppliers could be moved into central or local government. There are several options for doing this. For example, funding could be provided by the lead supplier via standing charge (although this risks being regressive), central government, or all suppliers could be obligated to collect funding based on MWh of energy supplied. Whoever takes on these obligations will need to engage with customers as well as third party installers.

- **Lead supplier obligations to customers** *(Figure 25, arrows 4 and 5).* Some social obligations may stay with the lead retailer. These should be defined in the new lead supplier licence and is likely to include obligations relating to disconnection as all customers will have a lead supplier.

- **Lead supplier obligations to secondary suppliers** *(Figure 25, arrow 13).* Under this model there is an option for policymakers to appoint the relevant lead supplier as the SoLR in the event that a customer's secondary retailer fails to minimise disruption to the customer.

- **Secondary supplier social obligations** *(Figure 25, arrows 5 and 10).* Whilst this model tries to minimise obligations on secondary suppliers to minimise barriers to entry and innovation, in some cases there may be social obligations that make sense to be delivered by certain types of secondary suppliers. For example while central government might fund ECO services, heating specialist suppliers may be best placed to actually deliver these obligations. For example, Government could contract out delivery of ECO services to secondary heating specialist suppliers although alternatively arrangements would be required for customers who are eligible but do not have a secondary supplier. Alternatively Government could make funding pots that target vulnerable customers available to access by secondary suppliers or other entities to make use of although again this may lead to issues in equality of access. These issues would need to be addressed as part of the detailed design stage of this market model.

- **Smart meter rollout obligations.** *(Figure 25, arrow 4).* The smart meter rollout will continue to be supplier-led but this obligation will apply only to lead suppliers as every customer requires a lead supplier but may not take a secondary supplier.

In terms of flexibility, whilst both the lead and secondary supplier can incentivise customer flexibility, we expect the majority of this will be delivered by EVs and heating, which may often by supplied by secondary suppliers who can manage flexibility on behalf of customers:

- **Provision of flexibility for the lead supplier** *(Figure 25, arrows 7 and 8).* Under this model it is possible for the lead supplier to deliver customer flexibility, either via DLC or via price signals in a TOU tariff. However, we expect that where customers choose to have a secondary supplier for their EV and/or heat pump, there may be fewer devices over which the lead supplier can exert DLC over.

- **Provision of flexibility for secondary suppliers** *(Figure 25, arrows 6, 7, and 8).* Secondary suppliers would offer DLC services to their customers to automate the operation of EVs, heat pumps, or other devices. They can provide this flexibility to DSOs or the ESO via existing flexibility markets and platforms.

Changes will also be required to technically deliver a multiple supplier solution. 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).

Whilst it is currently commercially and technically possible to split a customer's energy consumption between multiple suppliers using Supplier Volume Allocation (SVA) Metering Arrangements, in practice this is seldom done with examples being limited to community energy schemes. SVA requires each supplier to reach a commercial agreement with a default lead supplier which is the only supplier visible for settlement, as well as a degree of manual intervention between suppliers and the half hourly data collector. [59] Suppliers need to agree how volumes will be apportioned in advance and cannot be adjusted based on actual customer consumption. This means the default lead supplier has 'considerable market power, and this position in effect forecloses much of the potential market being opened up by demand-side and smart techniques.'[60] One potential model developed by the industry and ELEXON included changes to the BSC as well as appointment of a Calculation Entity (CE) to facilitate frictionless volume allocation.

- **Volume allocation by the Calculation Entity** *(Figure 25, arrow 9).* Each secondary supplier will need to send half hourly data for its sub-meter (meters associated with the specific devices it is providing energy for, similar to existing EV meters for EV tariffs) to a new Calculation Entity (CE). The CE is then responsible for apportioning consumption based on these readings and the boundary meter reading and apportioning settlement costs between the lead and secondary suppliers.

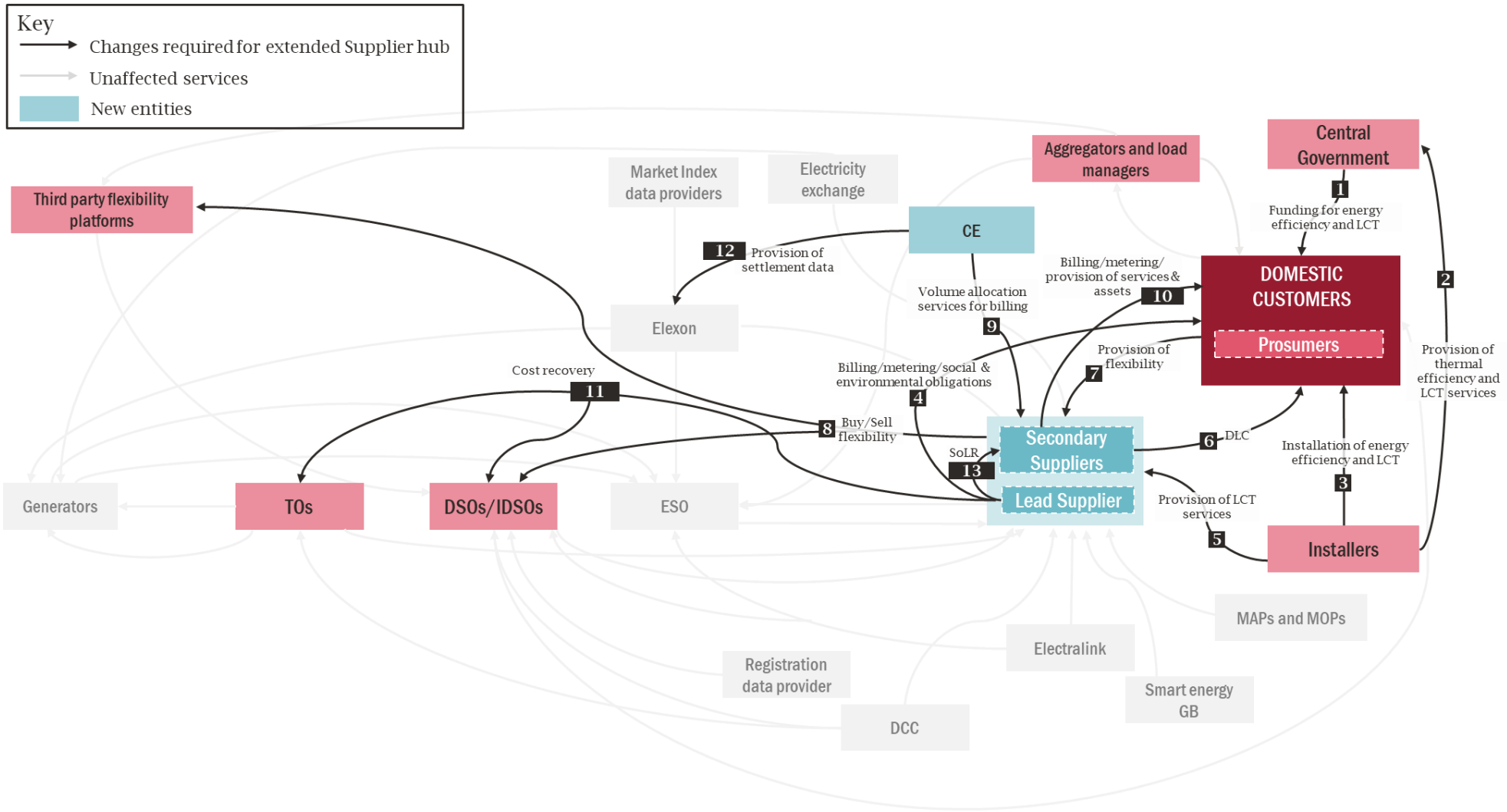
- **Billing and settlement** *(Figure 25, arrows 10, 11, and 12).* Once the CE has allocated volumes and associated settlement costs, this will be communicated back to each supplier and used to calculate final customer bills. The CE may also provide this data to Elexon if it is required for other code administration purposes. Each supplier will send their customer a bill for their relevant energy consumption, meaning customers with multiple suppliers will receive multiple bills. The lead supplier will also continue to carry out cost recovery services for network charges.

There are also questions around what happens in the event of customer default and disconnection in the event that a customer fails to pay some but not all of its suppliers. For example, if a customer has a lead supplier, heat pump supplier, and EV supplier and fails to pay its EV supplier bill, does this impact disconnection for its lead and heat pump supplier?

[59] Elexon (2019). P379 BSC Modification Proposal Form

[60] Ibid.

FIGURE 25 MULTIPLE SUPPLIERS: CONTRACTUAL SERVICES



Source: Frontier Economics

6.2.2 DATA FLOWS

Figure 26 and Figure 27 show the main changes required to non-smart meter and smart meter dataflows under a multiple supplier model. We describe these dataflows below along with any associated changes required in technical capacities or assets required to deliver the data flows. For example, a multiple supplier model may require suppliers to update their billing and settlement systems in order to handle allocated volume data. Again we focus on electricity but we assume similar changes will be required for gas.

Taking non-smart meter data first:

- **Social obligation comms.** *(Figure 26 arrows 1, 2, and 3).* Where the delivery of social obligations has changed as a result of the multiple supplier model, this will need to be clearly communicated to customers to ensure that they do not miss out on support during the transition. For example, if provision of the WHD is moved to DWP, customers who currently apply for the rebate to their energy supplier (the broader group) will need to know that they now need to apply to DWP.

- **DLC requests** *(Figure 26 arrow 4).* Customers that allow DLC from their supplier will provide service level information (e.g. the temperature they require for their home, or the minimum charge level for their EV) or other DLC requests to their supplier.

- **Apportionment of consumption data and billing**. *(Figure 26 arrow 5, 6, and 7).* As discussed above, the solution put forward by Elexon and the industry to deliver meter splitting involved a CE that reconciled sub-meter readings with the boundary meter reading (both provided by suppliers to the CE) in order to apportion consumption across suppliers and calculate settlement costs. These were then distributed to the individual suppliers for customer billing. These changes would also need to be supported by new IT billing systems and settlement systems that could provide accurate bills for customers with more than one supplier and make adjustments to settlement reconciliation processes.[61]

- **Other settlement and BSC dataflows.** *(Figure 26 arrows 8, 9 and 10).* The CE may need to send allocated settlement data to Elexon for wider BSC administration purposes. Other new dataflows such as the provision of secondary supplier data to Electralink will be required to support the central switching service under a multiple supplier model.

For smart meter dataflows, much of this will depend on the integration of sub-meters with the smart meter network and the DCC.

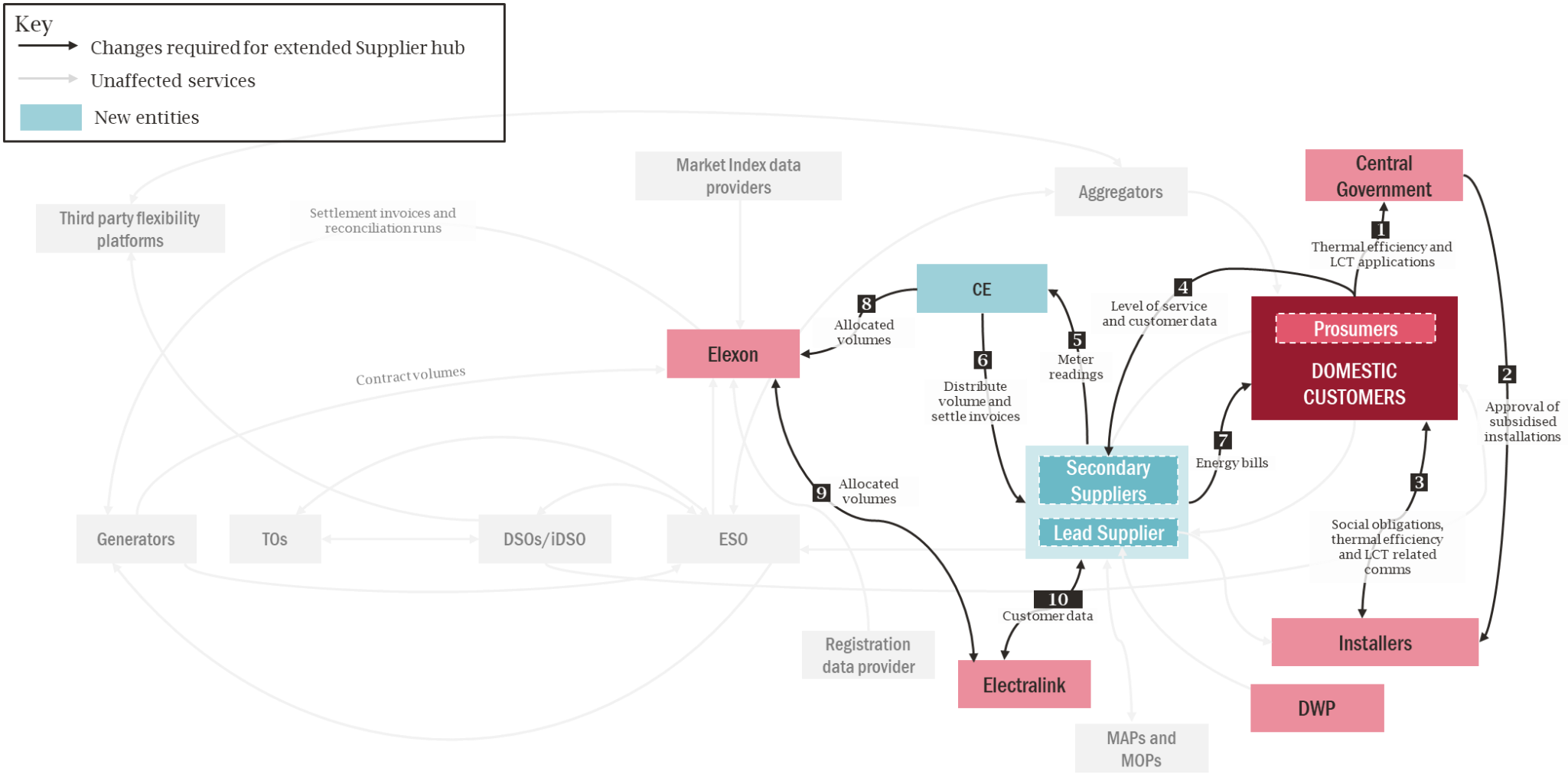
- **Direct load control.** *(*Figure *27, arrows 1,2, and 3).* One of the main motivations of this model is to allow the entry of asset-specific suppliers which could differentiate themselves via their automation offerings, particularly for EVs (that have an inbuilt battery ideal for flexibility) and heat pumps. These suppliers can carry out DLC either through the SMETS smart meter auxiliary load control switches, or through their own networks (as is currently the case for aggregators like Social Energy that do not use the SMETS2 network). The SMETS2 technical specification means that DLC functionality is currently limited to on/off rather than proportional load control. Whilst this is

[61] In the CEPA impact assessment of P379 this was identified as the major cost.

planned for future iterations, suppliers may prefer to use their own networks if they can introduce functionality faster.

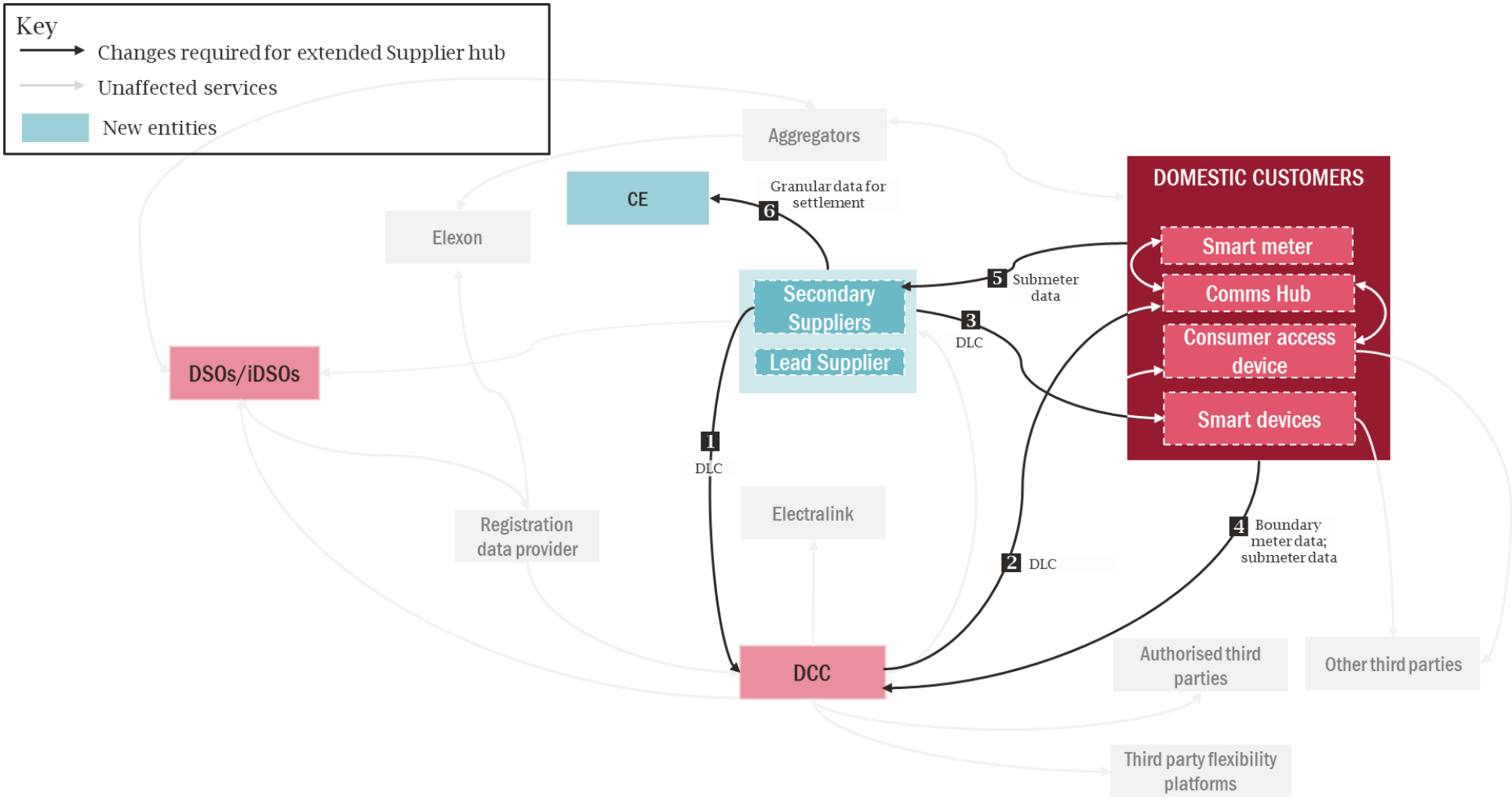
- **Half hourly data for sub-meter readings.** *(*Figure *27, arrows 4, 5, and 6).* In order to carry out half hourly settlement for multiple suppliers, the CE will need to receive half hourly data from both the existing boundary meter and each individual sub-meter. These sub-meters could be built into the underlying asset, for example as part of the EV charger or heat pump, and communicated either via the DCC or directly to suppliers. These are then passed on to the CE for volume allocation and settlement.

FIGURE 26 MULTIPLE SUPPLIERS: DATAFLOWS (EXCL. SMART METERS)



Source: Frontier Economics

FIGURE 27 MULTIPLE SUPPLIERS: SMART METER DATAFLOWS



Source: Frontier Economics

6.2.3 CUSTOMER BEHAVIOUR

From customers' perspective, there are two main changes. First, customers that choose to take multiple suppliers will need to manage multiple energy supply contracts. When it comes to switching, customers should be able to switch their asset-specific supplier in the same way that they currently switch energy suppliers, although contracts will become far more heterogeneous. For example, new business models could package a new asset with supply (similar to existing contracts for mobile phone handsets) or as part of vehicle lease agreements. This may also mean that customers will need to deal with a wider variety of types of companies for the supply of energy, for example car manufacturers, and not just traditional energy suppliers.

These changes are likely to mean that contracts become harder to compare. Very few PCWs currently display EV tariffs and they struggle to make meaningful comparisons with dynamic TOU tariffs. These tools will need to develop and keep pace with new tariff types in order to limit customer harm under this model. This could include progressing initiatives such as midata that allow customers to share their smart meter data with third parties like PCWs but is currently on hold with no recommencement date. We have described elsewhere in this report the potential role of energy concierge services in this respect.

Second, the underlying relationship between customers and their suppliers will need to change in order to maximise the impact of this model. For example, suppliers that bundle assets with a supply contract may require longer contracts in order to offer financing options.

6.2.4 SUMMARY OF KEY TRANSITIONS

TABLE 5 KEY CHANGES REQUIRED FOR A MULTIPLE SUPPLIER MODEL

KEY	
	Small changes to **existing** regulation and business processes, technology, customer behaviour etc. For example, extending the coverage of an existing licence condition, utilising existing dataflows, or making a small change to customer facing decisions.
	Significant changes to **existing** processes. For example, setting new types of obligations, extending existing technologies, or changing the types of services customers purchase.
	Entirely 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. This also includes changes that require customers to engage with unfamiliar markets or significantly change their current relationship with market entities.

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 PR379 workshops and other examples can be drawn from existing SVA arrangements.
	Introduction of secondary supplier licence and distribution	This will likely require legislative and/or regulatory change to create a new type of entity and associated

DIMENSION	CHANGE	COMPLEXITY
	of social obligations and metering obligations	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. The pace will depend on the degree of customer take-up which will determine whether secondary suppliers have sufficient scale to participate in flexibly market.
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 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.	This will depend on whether secondary suppliers use SMETS or other technological solutions to deliver DLC but several manufacturers are already delivering DLC for smart chargers. 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.

6.3 CUSTOMER FACING DSO

The customer facing DSO is the model with the greatest degree of change compared to the existing roles and contractual relationships. Due to the scale of change associated with this archetype, these changes 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. We discuss these changes below.

6.3.1 CONTRACTUAL SERVICES

Figure 28 below highlights the main changes to contractual services that would be required to enable this business model in black. This diagram focuses on electricity but we assume similar changes required be required for gas.

- **Rollout of smart meters and HEMS.** ***(****Figure 28, arrows 1, 4, and 6)*. The residual smart meter rollout could change from being supplier-led to DSO led. Whilst this is a major change, by the time this structure can be implemented we anticipate the majority of the smart meter rollout should already be complete (the current deadline for 100% coverage is 2025) and there should be relatively few households whose smart meters need to be installed by the DSO. The focus for DSOs will instead be the rollout of HEMS which we consider to be critical for this model so that customers can automatically optimise and respond to flexibility price signals from their DSO, supplier, and any potential independent aggregators they have signed up with. This also means that MAPS and MOPs will now work with the DSO rather than suppliers. The focus of Smart Energy GB might also move to promoting uptake of HEMS amongst customers, working together with the DSOs.

- **Billing and cost recovery.** ***(****Figure 28, arrows 1 and 5)*. This model places DSOs directly at the interface with the customer. This means that rather than customers receiving a single bill from their supplier, there is an option for customers to receive two separate bills, one from their supplier and one from their DSO. The DSO could also carry out cost recovery activities for TOs that are currently carried out by suppliers, incorporating transmission network charges into the DSO bill.

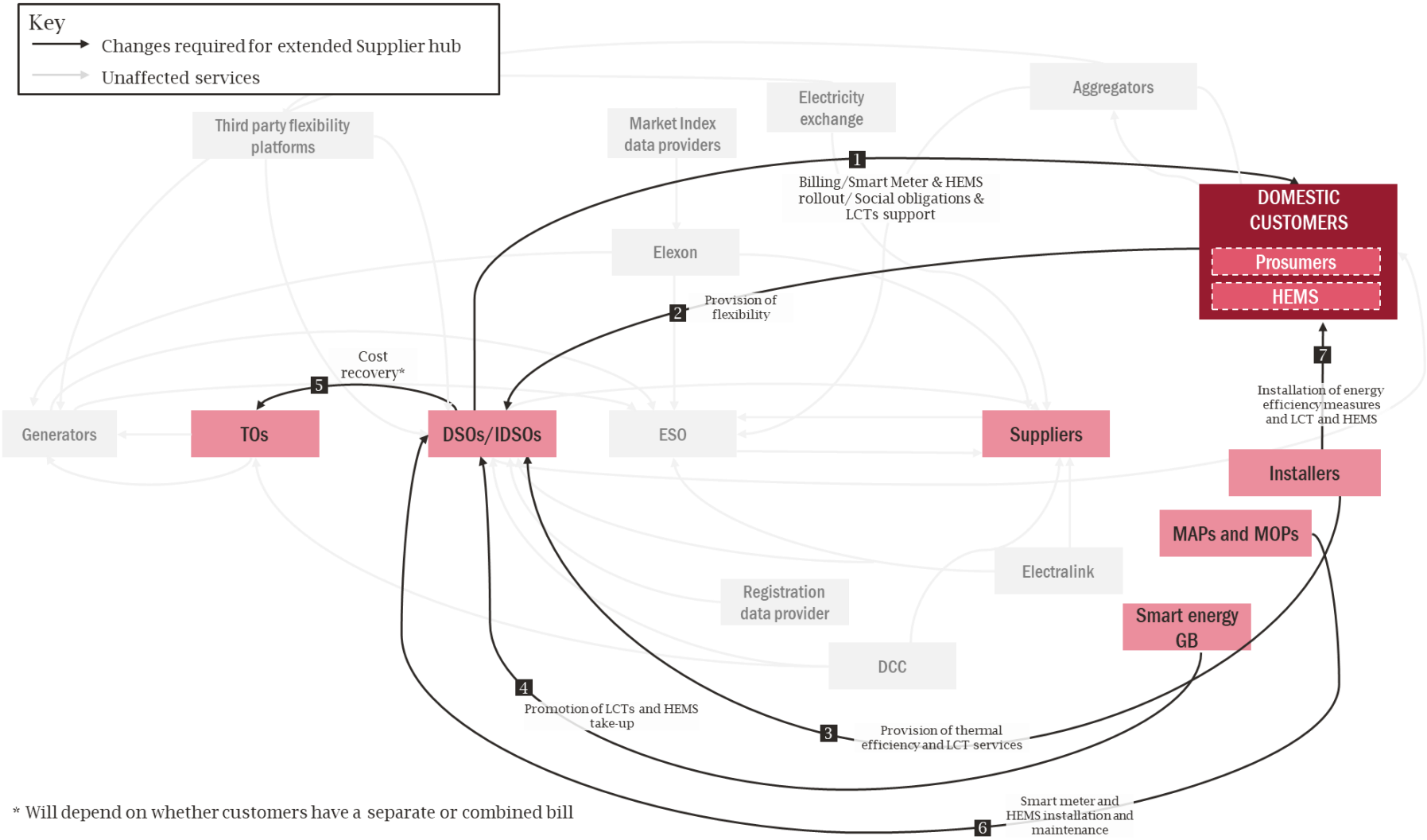
- **Social obligations and wider subsidisation of capital costs**. ***(****Figure 28, arrows 1, 3 and 7).* Under this model DSOs would inherit some of the social obligations currently delivered by suppliers, for example delivery of ECO, as well as new obligations such as financing of HEMS and other LCTs. DSOs will need to engage with customers on these services as well as third party installers they might contract to deliver these services on their behalf.

- **Provision of flexibility** ***(****Figure 28, arrow 2)*. Under this model, DSOs will send direct price signals to their customers. DSO price signals could take the form of contracts for flexibility which are then called on. Alternatively they could be part of the distribution tariff i.e. a highly localised TOU distribution tariff which would require the structure of network charges to be adjusted. These signals will be optimised alongside any other price signals they receive from suppliers (or independent aggregators) via their HEMS. We expect that there will need to be an industry-wide approach to the HEMS optimisation calculations that will need to be agreed between DSOs, suppliers, and potentially aggregators. The structure of DSO charges will need to be modified in order for it to be able to send price signals, for example TOU pricing for network charges.

Both the current supplier licence and the distribution licence will need to be modified to reflect these changes and so the scope of modifications will depend on the scope of existing supplier obligations that will be moved to DSOs along with the introduction of new obligations.

These changes will also have an impact on the regulatory framework for distribution companies which is set via RIIO-ED2. Under this model, the DSOs are expected to finance capital and social obligation costs associated with their new obligations such as the provision of LCT and storage. The associated costs (both direct costs and underlying costs such as IT systems) need to be accounted for as part of the DSOs' regulatory allowance.

FIGURE 28 CUSTOMER FACING DSO: CONTRACTUAL SERVICES



* Will depend on whether customers have a separate or combined bill

Source: Frontier Economics

6.3.2 DATA FLOWS

Figure 29 show the main changes required to non-smart meter and smart meter dataflows respectively under a customer facing DSO. This section will also cover associated key changes in technical capabilities or assets required to enable these new dataflows and processes. Again we focus on electricity but we assume similar changes will be required for gas.

Considering first non-smart meter data:

- **LCTs and social obligations related comms (***Figure 29, arrow 1)*. If DSOs take on existing social obligations such as the provision of ECO, they will need to engage customers to take-up these obligations. They may do this directly or via third party intermediaries. Customers will provide information back to the DSO or their contractors on the type of system sand installation process.

- **Eligibility group data (***Figure 29*, *arrow 4)*. Eligible customers for some social obligations are currently identified using data held by DWP, for example for the WHD. If these obligations are transferred to the DSO, this data should be transferred to the DSO.

- **Billing (***Figure 29*, *arrows 2 and 3)***.** If customers have a separate DSO bill, this will also need to be communicated to customers along with any associated debt support or other customer support initiatives. Alternatively if suppliers continue to maintain their revenue collection role to give customers a single bill, the DSO will need to tell suppliers how much individual customers are owed for providing flexibility as well as other cost impacts such as LCT financing costs (similar to the Green Deal arrangements).

- **Installation of smart meters and HEMS. (***Figure 29, arrow 2)* As we discuss under contractual flows, under this model responsibility for rollout of any residual smart meters along with the rollout of HEMS would move to a DSO led rather than supplier-led model. This means DSOs will need to engage with customers to encourage uptake of smart meters and HEMS as well as arrange installation dates and processes with customers.

We assume under this model that customers provide DSOs directly with flexibility via a TOU tariff for DSO charges rather than DLC. This requires new smart meter dataflows:

- **Granular smart meter data** *(Figure 29, arrow 1)***.** DSOs will need[62] to receive half hourly customer level smart meter data for customers on TOU distribution tariffs (assuming these are dynamic TOU tariffs). DNOs currently only have access to aggregated smart meter data. Whilst the provision of half hourly consumption data is technologically feasible as the DCC already provides this data to suppliers, DSOs will need to engage with customers to gain buy-in. This will require changes to the smart Meter Data access and Privacy framework which currently only allows network companies to access consumption data for periods of less than one month if they have obtained customer consent and have implemented Ofgem approved anonymisation procedures.[63]

[62] Regardless of whether this archetype is adopted, DSOs may still benefit from the use of granular smart meter data when planning their networks. However, as at present, such data would not strictly be required.

[63] BEIS (2018). Smart metering implementation programme. Review of the Data Access and Privacy Framework

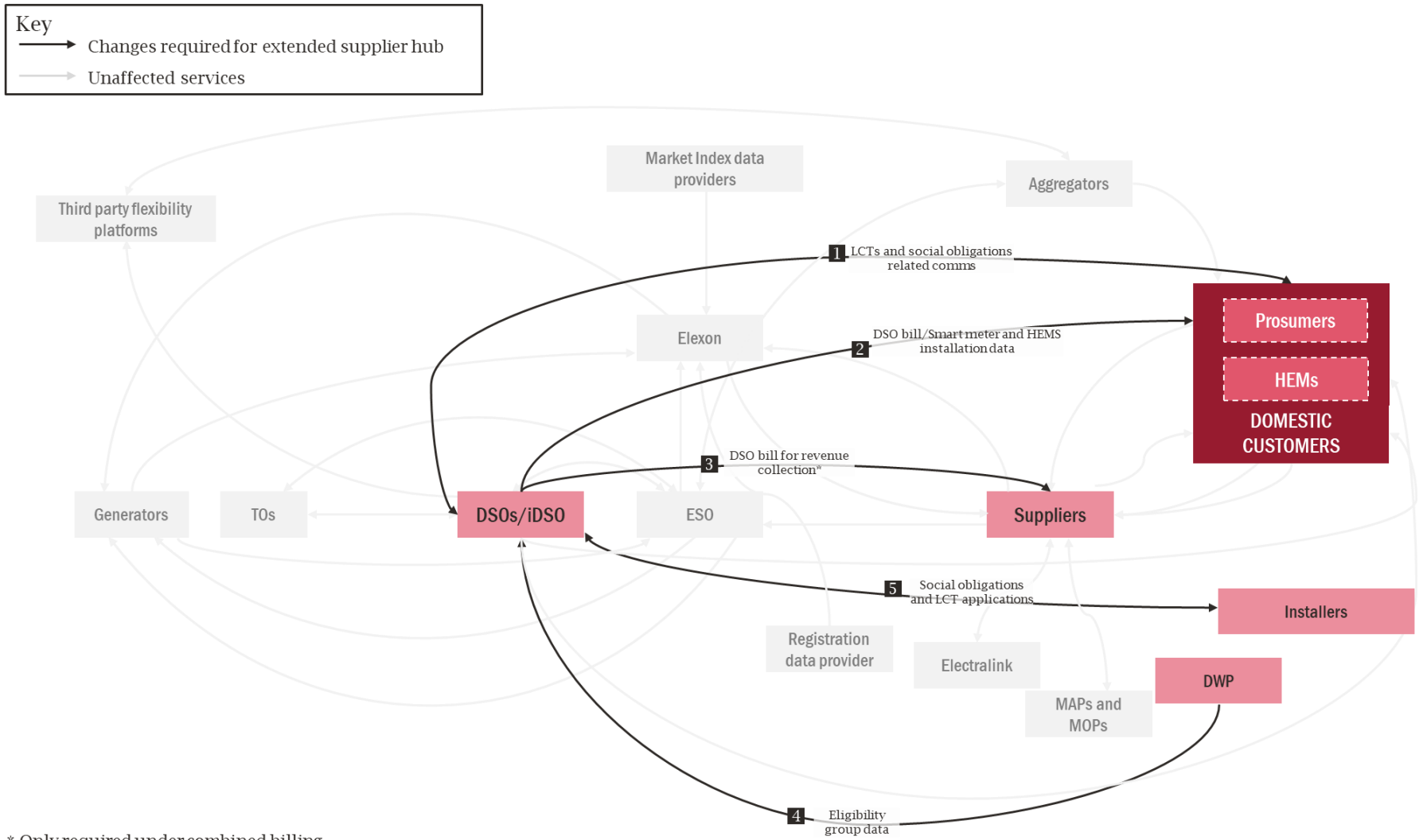
- **Tariff data** *(Figure 29, arrows 2 and 3)***.** Suppliers currently provide tariff data to the DCC which it uses to display real time bills via the customer's in-home device (IHD) (suppliers are required to offer customers a free IHD alongside their smart meter). If customers now face a distribution TOU tariff (or some other type of flexibility price signal from their DSO), DSOs will need to send this information to the DCC in order to compute the customer's final bill for the IHD. The DCC will also need to send this information to customers' HEMS in order to optimise across price signals the customers may be receiving from its DSO, supplier and independent aggregators.

- **SMETS2 technical capabilities and HEMS** *(Figure 29, arrow 3)***.** Integrating multiple tariffs, for example a TOU distribution tariff and TOU supplier tariff, under the current SMETS2 Technical Specifications may not be possible. Suppliers have reported issues with the IHD showing incorrect tariff information for customers on dynamic TOU tariffs or separate EV tariffs.[64] If the current SMETS2 specification cannot handle more than one tariff, this will likely be a barrier to HEMS that can automatically optimise between tariffs.

DSOs will need to establish the underlying IT systems and customer interfaces required to deliver new customer facing services including customer portals and contact centres for installation of smart meter and HEMS and selection of distribution tariffs. If customers have a separate DSO bill, this will require additional customer level billing services which may be complex and costly to establish as DSOs do not currently charge individual customers directly.

[64] Octopus website. Accessed at: The challenges of working on the cutting edge of smart energy | Octopus Energy

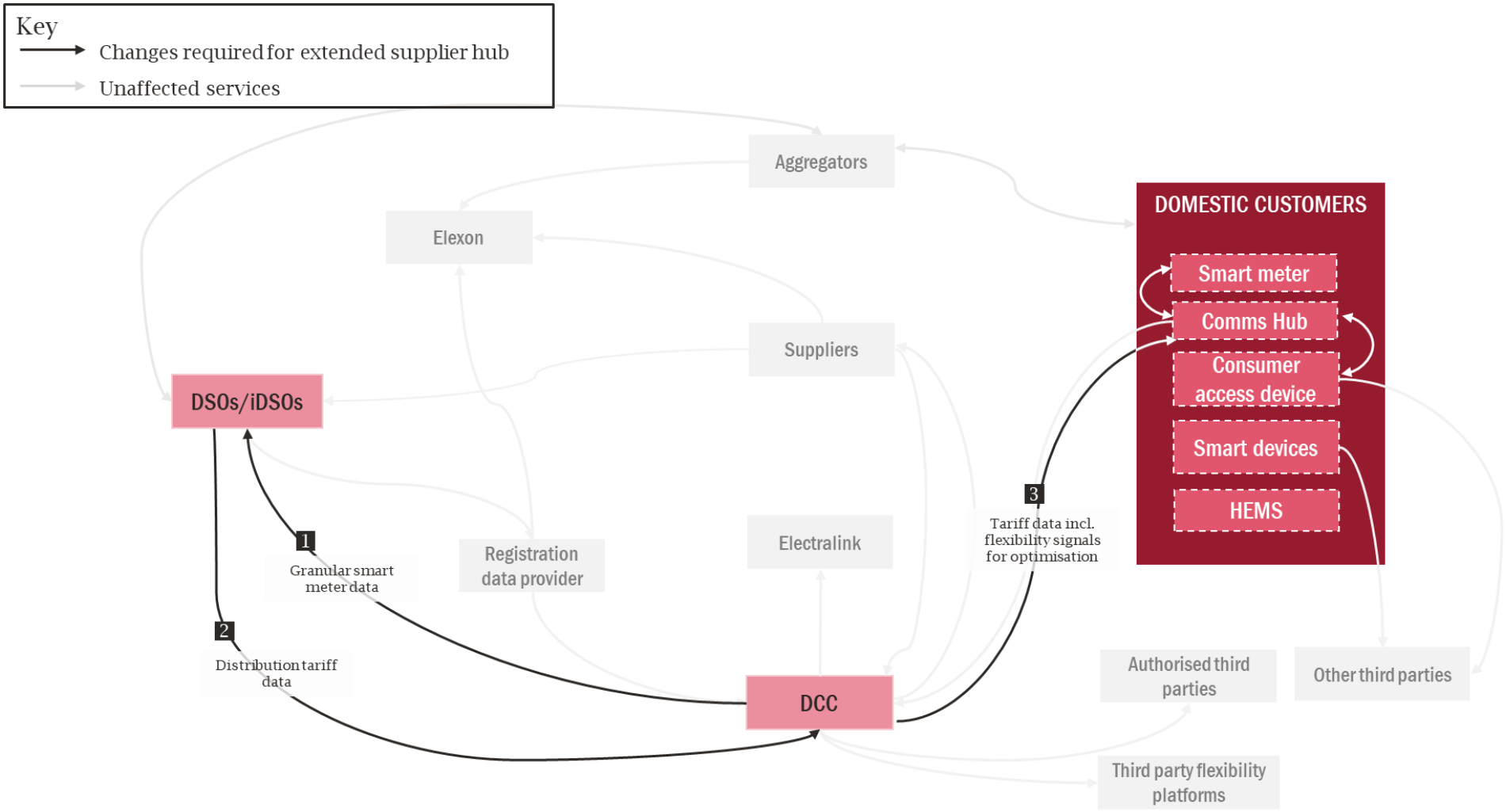
FIGURE 29 CUSTOMER FACING DSO: DATAFLOWS (EXCL. SMART METERS)



* Only required under combined billing

Source: Frontier Economics

FIGURE 30 CUSTOMER FACING DSO: SMART METER DATA FLOWS



Source: Frontier Economics

6.3.3 CUSTOMER BEHAVIOUR

This archetype is a significant change to the way customers interact with the energy market. Under the supplier-hub model customers rarely interact with their DNOs. The opposite is true under a customer facing DSO. We assume that DSOs will procure flexibility directly from customers via distribution TOU tariffs, as well as providing support to customers on uptake of LCTs or other social obligations. We also assume that DSOs will be responsible for rolling out HEMS to their customers to enable flexibility which will require customers to engage with DSOs in the same way they currently engage with customers for the installation of smart meters. Finally, customers will need to feel comfortable with DSOs accessing granular smart meter consumption data to settle their bill if they have a separate DSO bill. This may not be required if mandatory combined billing continues as the supplier can calculate relevant charges based on the customer's DSO tariff.

6.3.4 SUMMARY OF KEY TRANSITIONS UNDER A CUSTOMER FACING DSO

TABLE 6 KEY CHANGES REQUIRED FOR A CUSTOMER FACING DSO

KEY	
	Small changes to **existing** regulation and business processes, technology, customer behaviour etc. For example, extending the coverage of an existing licence condition, utilising existing dataflows, or making a small change to customer facing decisions.
	Significant changes to **existing** processes. For example, setting new types of obligations, extending existing technologies, or changing the types of services customers purchase.
	Entirely 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. This also includes changes that require customers to engage with unfamiliar markets or significantly change their current relationship with market entities.

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 the DSO and will require it to develop supporting tariff/reward structures as well as the supporting communications and IT systems. DSOs may need to extend their direct customer facing support, for example contact centres and online portals.
	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

DIMENSION	CHANGE	COMPLEXITY
		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.
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 are 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 more 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

DIMENSION	CHANGE	COMPLEXITY
		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 meters than [BEIS] anticipated'[65] and suppliers have reported spending large amount 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.

Source: Frontier Economics

6.4 THIRD-PARTIES

This section will discuss the key transitions associated with the entrance of third parties.

6.4.1 'AS A SERVICE' RESELLERS

Many of the key transitions associated with 'as-a-service' resellers are common to suppliers offering an 'as-a-service' tariffs more generally. We briefly cover these below and but then focus issues specifically associated with independent resellers and their role in the structure of the market.

One of the key transitions required to make 'as-a-service' tariffs a success is uptake of LCTs that allow service providers to have DLC. The Budget Warmth tariff introduced in 1985/86 used radio teleswitches to control electric storage heaters.[66] The modern day equivalent is the adoption of smart devices and sensors by customers which can be controlled by the service provider either via the SMETS auxiliary load switches or an alternative digital platform. Other transitions include improving regulatory clarity for what 'as-a-

[65] c

[66] Michael Fell (2021). The history of heat-as-a-service for promoting domestic demand-side flexibility: lessons from the case of budget warmth

service' tariffs mean in the context of the current regulations including billing regulations, assignment of rights, and switching rights.[67]

In addition to transitions associated with 'as-a-service' tariffs more generally, there are a number of key changes that will be required to enable independent 'as-a-service' resellers specifically which we cover below.

6.4.1.1 CONTRACTUAL SERVICES

One of the main barriers to 'as-a-service' more generally is lack of regulatory clarity on how these tariffs would operate in the current regulations. This is even more true for independent 'as-a-service' resellers. Ofgem will need to clarify whether an independent reseller requires a supplier licence. If so, it may need to introduce a different type of 'reseller' licence to reduce barriers to entry. This reseller licence could include customer facing obligations such as those relating to customer protection or billing but allow them to receive 'back-end' obligations from the supplier they are reselling from. This could be similar to Ofgem' existing 'licence lite' which allows new suppliers to partner with an existing supplier who will be responsible for some of the most expensive or technically complex parts of a supply licence.

If there is evidence to suggest few suppliers are willing to enter into these partnerships, policymakers could consider options to reduce market frictions. Interventions will depend on the source of the issue. For example, if it is due to the complexity of commercial agreements, Ofgem may work with industry to create a standardised model contract. Alternatively, if the issue lies with suppliers being unwilling to work with 'as-a-service' resellers due to competition concerns, Ofgem could introduce obligations requiring suppliers to provide these services to resellers, potentially at a regulated rate.

Further work is required to understand why 'as-a-service' resellers have not entered the market via the licence lite and whether this is to do with the structure of the market, limitations of the licence lite, or other non-structural factors. For example, the requirement to partner with an existing supplier under the licence lite could give that supplier significant power over the reseller and make it difficult for resellers to buy energy from more than one supplier to repackage and sell on. Alternatively, lack of 'as-a-service' resellers might be due to the wider uncertainties around the commercial viability and pricing for 'as-a-service' tariffs more generally.

6.4.1.2 DATA, TECHNOLOGY, AND ASSETS

The introduction of 'as-a-service' resellers will require the industry to agree a set of rules around code administration. For example, if a customer signs up with an 'as-a-service' reseller, a decision will need to be made on whether the customer's meter is registered to the reseller or the supplier from which it is buying energy. This is further complicated if the reseller purchases energy from more than one supplier. Other detailed design decisions will likely to be required including impacts on the settlement process and switching process, although this could be modelled on the supplier licence lite as a starting point.

6.4.1.3 CUSTOMER BEHAVIOUR

If independent resellers are permitted to enter the market, customers should not receive a different level of customer support or protection depending on whether they purchase energy service from a traditional supplier or an independent retailer. This principle exists in other sectors as telecommunications. Mobile virtual network operators (MVNOs) lease wireless telephone and data spectrum from one of the four major

[67] ClimateXchange (2021). The potential of Heat as a Service as a route to decarbonisation of Scotland

carries and resell this to customers, but customer receive the same level of service and protection regardless of whether they buy services from an MVNO or network operator.

6.4.2 DOMESTIC AGGREGATORS

Aggregators are common in the I&C market and there already exist some examples for domestic customers, most commonly related to the aggregation of domestic generation. To support growth of domestic aggregators, we identify the following key changes:

- **Contractual services**. Until recently, independent aggregators were unable to participate in many of the balancing markets without going through a supplier. This was addressed as part of the Wider Access programme which introduced the VLP role, allowing independent aggregators to participate in the Balancing Services and Capacity market. Additional changes to allow independent aggregators to access other sources of revenue will strengthen the commercial model and promote market entry. Work is currently ongoing to address this. Elexon is now consulting on code modification 415 which would allow VLPs to independently operate in the wholesale market. [68] This would allow independent aggregators to be rewarded for the flexibility they provide via the wholesale market and pass on some of this to their customers, potentially increasing customer take-up.

- **Data flows, technology and assets.** Increasing take-up of LCTs will be a key driver to growing domestic aggregation. Current low-uptake of LCTs across domestic customers means that domestic aggregators struggle to achieve the scale required to be profitable. In terms of dataflows, aggregators will need to be able to send DSR signals to their customers. This is already possible either via auxiliary load switches in the SMETS smart meter or via their own networks.

- **Customer behaviour.** The majority of domestic customers are unfamiliar with the role of aggregators. Aggregators will need to engage with customers to demonstrate the benefits of providing flexibility and potentially DLC. This will include addressing customer concerns around availability of services and privacy concerns.

6.4.3 ENERGY CONCIERGE

Energy concierge services are an evolution of today's PCW, auto-switching, and energy efficiency advice services and therefore there a few changes required for energy concierge services to operate. Where these exist they relate primarily to the provision of disaggregated smart meter data. Ultimately, we expect the main determinant of whether energy concierge services develop is customer demand.

- **Contractual services.** Energy concierge services could receive commission from suppliers in the same way that PCWs do today. Alternatively, customers may pay energy concierges a fee for their services. Energy concierges may need to set up new commercial relationships with independent LCT installers and aggregators.

- **Data flows, technology and assets.** Today's PCWs often fail to include EV tariffs and it is likely that they will struggle to compare 'as-a-service' tariffs'. Initiatives such as the midata in energy programme, which would allow customers to easily share their smart meter consumption data with third parties such as energy concierges, will be key to maximising the potential of energy concierge

[68] Elexon (20022). Facilitating access to wholesale markets for flexibility dispatched by VLPs

services. However this programme is currently on pause with no date for recommencement. Continuing this programme into its conclusions and options for widespread implementation if beneficial could help enable energy concierge services.

- **Customer behaviour.** We expect that customers will interact with energy concierge services in the same way that they currently engage with PCW, auto-switching services, and energy efficiency advice services.

7 CONCLUSIONS

The electricity sector has a challenge to decarbonise by 2035. This will require it to overcome several barriers in the existing market. High upfront capital costs limit the number of households that can afford to make the LCT transition and there are few incentives for customers to provide domestic flexibility. New innovative business models can struggle to navigate the existing regulatory system. Equally, customers can struggle to make the best decision for their needs, which are becoming increasingly heterogenous. We also cannot afford to overlook evolving requirements for customer protection that could arise due to the net zero transition.

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

The purpose of this work is to consider alternative market structures that can help to overcome these barriers and deliver a retail energy market that is efficient, feasible, and fair. Based on the barriers identified in WP2 we have identified a number of 'building blocks' for the future market. We combined these to reach three market structure archetypes: (1) extended supplier hub, (2) multiple suppliers, and (3) customer facing DSO.

Each of these 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 more market-based approach, creating an environment designed to promote new innovative business models that include LCT financing and flexibility. Any of these archetypes could therefore deliver an 'efficient' retailer energy market in theory, one where customers are able to adopt LCTs and use them in the right way.

FIGURE 31 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 – i.e. the extent to which they are willing and able to choose between highly differentiated services. This will in turn be influenced by customer heterogeneity and complexity of choice. If the current market model is unable to deliver efficient levels of domestic flexibility, a multiple supplier archetype could be the most efficient if customers are able to effectively choose between tariffs. This would be 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 archetype may be more appropriate. In addition, if there is reason to believe that suppliers are failing to pass on flexibility signals from DSOs to their customers, direct signals from DSOs to customers may be required under a customer facing DSO. 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.

The degree to which customers engage with the energy market will also play a role in the degree of fairness delivered, linking directly to the issue of evolving customer protection requirements identified in WP2. A multiple supplier archetype that exposes customers to greater complexity of choice risks disengaged customers losing out, which is a particular issue if vulnerable customers are disproportionately affected. Other issues arising from bundling may be more prominent under a multiple supplier model. On the flip side, market structures that enable greater innovation could lead to tariffs that are better tailored to specific vulnerable customer groups (assuming these are commercially viable).

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. However, if levels remains lower than optimal following the introduction of MHHS, scale up of LCTs and full smart meter rollout, this may be due to a lack of customer acceptance of flexibility, or barriers to market entities such as DSOs accessing flexibility.

Each of the market archetypes focuses on mitigating these two risks to a different extent. The best option that will be the one that removes these barriers (to an efficient level) at the lowest cost (accounting for distributional impacts). We anticipate that customers are unlikely to be best placed to manage these risks. Therefore options that enable business models that make flexibility attractive to customers – like the multiple supplier model – may be more successful as encouraging flexibility. This model also has the benefit that costs of managing flexibility can be socialised across a wider customer base via the current DUoS charging methodology.

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.

Further research is also required to understand what exactly is preventing desirable outcomes that are possible under the current market structure but have not been widespread to date. This includes uptake of the licence lite, domestic aggregation, and provision of 'as-a-service' tariffs. This work has begun to investigate these issues and has identified potential lack of clarity on whether resellers require a full

supplier licence as well as potential market frictions that prevent uptake of the licence lite. These issues should be explored further as only by understanding these barriers can the industry work together to address them. For example, if further research shows that the 'licence lite' does not enable 'as-a-service' resellers, a different type of licence may be required to reduce barriers to entry.

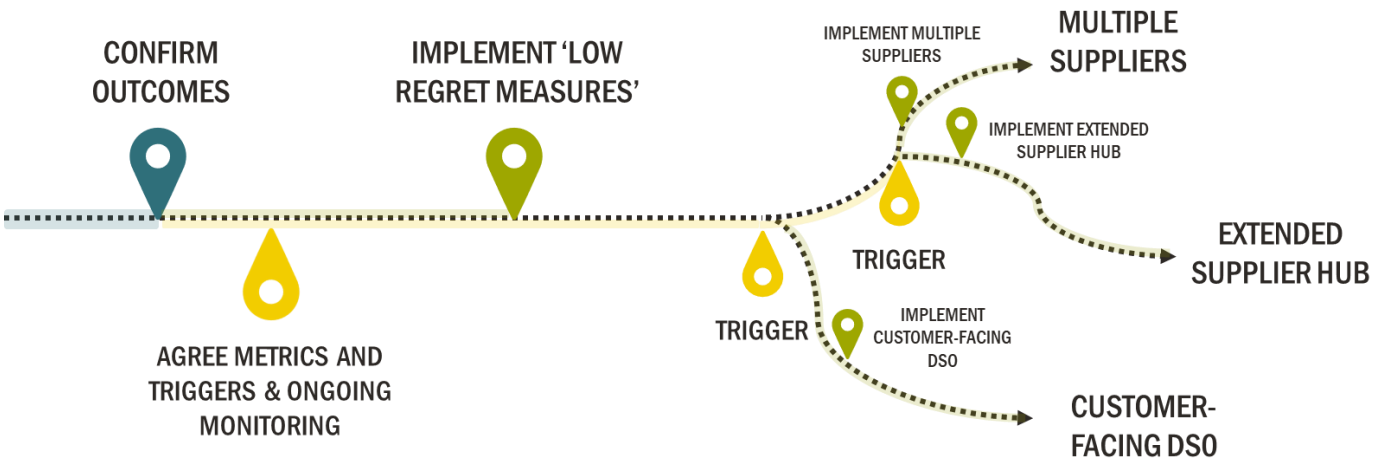
Finally, our review of the transition shows that there are significant steps involved in transitioning to each archetype. Whilst they are in feasible in theory, more work is required to provide greater certainty on which of these archetypes will work best in practice before committing to complex and costly changes.

POLICYMAKERS NEED TO DEFINE A CLEAR ADAPTIVE PLAN

Making policy decisions in the face of uncertainty requires taking a more adaptive approach to long-term commitments.

Whilst a model like the multiple supplier model might offer the greatest potential for the net zero transition *given the engagement of customers and firms*, policymakers need more confidence that the market is sufficiently 'ready' to deliver these benefits in practice before making costly changes. If innovative business models do not come forward that achieve customer engagement, another archetype may be more suitable.

FIGURE 32 ADAPTIVE PLANNING APPROACH



Source: Frontier economics

An adaptive plan helps to do this in a structured way:

- **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. This includes metrics to monitor progress on flexibility.

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.

We have set out a number of initial recommendations for 'low-regret' actions in Table 7 below, identifying where these are actions that would be beneficial under all market archetypes, actions that are too costly delay and are 'good bets', and actions that help to inform the decision between archetypes. This list is not exhaustive but we hope that it acts as an initial starting point for actions that can be delivered in the short-term. Rows highlighted in blue have particular relevance to the provision of flexibility.

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.

We identify some low-regret measures relating to flexibility in Table 7. These consist of:

- Improving consumer engagement on flexibility to improve customer acceptance irrespective of the final market structure and method for accessing this flexibility;
- Introducing new information requirements at the point of sale for large flexible assets such as EVs, heat pumps, and batteries so that customers are aware of their options for providing flexibility and the benefits of doing so;
- Co-ordinated effort across DSOs to gather data and best practice on procuring flexibility. This includes developing contractual structures that provide the right incentives for third parties such as suppliers and aggregators to provide reliable flexibility, and building in the right levels of redundancy to mitigate any remaining uncertainty. This process could be accelerated if DSOs deliberately procured flexibility in areas that do not require it immediately in order to get experience on assessing its reliability and improving risk management, although this would come at a cost-benefit assessment is required to understand whether the benefits of doing so outweigh these costs.
- Assess dependencies between domestic flexible assets to understand whether DLC for heat pumps, EVs and other technologies can be dispatched independently of one another and remain optimal.

The data and experience gathered by DSOs should underpin key monitoring metrics, acting either as 'warning signs' that levels of flexibility are lower than initially expected 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. For example, confirming whether flexibility can be made available to DSOs without a market model like the 'customer facing DSO' which does so directly.

TABLE 7 LOW REGRET ACTIONS

THEME	ACTION	
Beneficial under most/all market structures		
Thermal efficiency	Address upfront capital costs of thermal efficiency measures	As we have discussed in WP2, improving thermal efficiency is key to net zero. Not only does it reduce energy consumption and customer bills, it is also a necessarily pre-requisite for heat pumps to be efficient. However, upfront capital costs are a key barrier to thermal efficiency adoption which needs to be addressed. Options include introducing or expanding grants for thermal efficiency installation, new options for green financing for customers, and exploring options to incorporate thermal efficiency funding as part of other sectors where appropriate (for example funding 'boiler on prescription' schemes can save money for both the NHS and support net zero).[69]
Customer protection	Work with the industry to address potential areas of consumer harm from new business models	As we have discussed in WP2, work by Citizens Advice has identified potential issues associated with bundling of TOU tariffs with EV charger installation. In the future similar issues may arise if separate heat pump tariffs emerge irrespective of the market archetype. Pre-emptively addressing these issues will minimise the risk of consumer harm throughout the net zero transition. Potential solutions could be demand or supply-side and range from better information for customers through to review of licence conditions for areas that fall out of the supply licence.
Flexibility	Improve engagement with customers, particularly those with existing large flexibility assets such as EVs.	Customer flexibility is key across all three archetypes. It is a new concept for the majority of customers and the industry and government will need to rapidly build confidence amongst customers in enabling flexibility. This includes demonstrating the direct benefits flexibility can offer to households including potentially lower bills, as well as addressing potential privacy or other concerns associated with DLC or HEMS. This could be carried out by bodies such as SEGB.
	Information requirements on flexibility benefits to customers	Requirements to communicate potential benefits of providing flexibility upon purchase of EVs, heat pumps, PV and batteries. This could be delivered through manufacturers, bodies such as SEGB, or supplier obligations.
	Best practice for procurement of flexibility	DSOs should work together to understand best practice for procurement of flexibility, building on the Flexibility First approach. This should include developing a better understanding of flexibility risks and effectiveness of potential mitigations such as contractual arrangements that create the right incentives for third parties (suppliers and aggregators) to provide reliable flexibility.

[69] Centre for Health Economics and Medicines Evaluation (2016). Warm Homes for Health end of study briefing

THEME	ACTION	
	Pre-emptive procurement of flexibility	To accelerate the learning process around flexibility risk management, DSOs could consider procuring flexibility in areas that are not immediately capacity constrained. This means that DSO will have more experience and information to optimise decisions around flexibility to meet future demand, for example as the heat pump and EV transition progresses.
Data and technological initiatives	Continue open data initiatives for smart meter data between customers and third parties.	We have identified energy concierge services as beneficial under all three archetypes, helping customers to engage with the market and make the optimal choice for them. However, this could be particularly beneficial to support moving to a multiple supplier model which requires customers to be engaged to unlock benefits. Continuing initiatives such as midata and the BEIS Smarter comparisons trial is key to enabling energy concierge services and support customer decision making.
	Open data initiatives between suppliers/aggregators and DSOs	This would allow suppliers to better understand where they should focus flexibility efforts i.e. areas that are currently network constrained. This can be combined with customer data, for example factors that influence ability to load shift. This would help to encourage flexibility under the current market structure in addition to the extended supplier hub and multiple suppliers model.
	Standardised methodology for estimating customer flexibility	Creating a standardised methodology for measuring customer flexibility potential can be used to inform customers of potential savings of behaving flexibly, as well as provide a more realistic estimate to suppliers, aggregators, and networks. This could help to strengthen the business case for promoting flexibility amongst suppliers and aggregators as well as guide network reinforcement plans where potential for local flexibility is low. Initiatives such as the Octopus Crowdflex project[70] are already making progress in this space.
	Extend interoperability requirements	We have identified interoperability has a key dependency across all three market archetypes. Extending interoperability requirements for flexible assets beyond EVs, for example heat pumps, is key to future-enable DLC and HEMS. Work is currently ongoing for heat pumps.[71]
Promote domestic aggregation	Standardised vehicle-to-grid (V2G) export tariffs	As adoption of EVs increases, creating a standardised V2G export tariff will make to easier for customers to engage with flexibility. This could be similar to the approach taken to the feed in tariff and smart export guarantee for solar. Not only could this increase flexibility in the short-term, customer adoption can be used as a metric to inform appetite for the multiple supplier model.
	Removing barriers to participation	The ENA Open Networks Project could carry out further work to ensure that standardised flexibility service contracts can work with

[70] Octopus energy website, Energy consortium launches UK's largest domestic flexibility study. https://octopus.energy/press/energy-consortium-launches-uks-largest-domestic-flexibility-study/

[71] BEIS (2021). Heat pump ready: Stream 3

THEME	ACTION	
		domestic aggregators. We have discussed existing barriers in WP2 which include the lack of a framework for compensation payments between independent aggregators and suppliers and enabling access to flexibility revenue streams for VLPs.
	Understanding technological limits	Further engagement with technology providers to understand current barriers to flexibility and how flexibility products may be designed to overcome them. For example, sending an advance signal to a heat pump in advance of switching it off can give it time to pre-heat the home and allow it to be turned off for longer.[72]
	Engagement with the I&C sector	Whilst aggregation for domestic customers is still nascent, customer flexibility is better established in the I&C sector. Whilst customer engagement issues are different, learnings from experiences in the I&C market might help to identify barriers to domestic aggregation specific to technologies like heat pumps, and best practice in overcoming these issues. This requires a co-ordinated programme of engagement between the energy industry and business/local housing associations that already utilise heat pumps and EVs and therefore have the option to deliver flexibility. This can help to form a playbook for DSR for individual residential households.
Good bets for specific archetypes		
Multiple supplier model	Submetering for heat pumps	One of the pre-requisites for the multiple supplier model is sub-meters for assets with a specific secondary supplier. One option is to require EV charges and heat pumps to include sub-meters. Further consideration on the technical feasibility and cost benefit analysis of this proposal is required before moving forward. This includes understanding costs to manufacturers and whether this could hinder scale up of the heat pump market in the UK. However, early inclusion of submetering could help to avoid higher costs downstream and keep the option of the multiple supplier model open. Submetering for heat pumps and other assets may also be beneficial under the other market structure archetypes, allowing suppliers to offer separate heat pump tariffs on a TOU or DLC basis. This is similar to the current approach to separate EV tariffs that rely on a separate meter for EV charging.
Actions to support decision making		
Multiple supplier model	Large scale EV trial for separate suppliers	Many suppliers already have separate EV tariffs and sub-meters are built into smart charging infrastructure. It would be worth exploring whether there is a low-cost way to use EVs as a test bed for the multiple supplier model.
Assess dependencies between flexible assets	Determine whether LCTs such as heat pumps and electric vehicles could be dispatched independently of one another in most households	

[72] Delta EE for BEIS (2018), IEA HPT Programme Annex 42: Heat Pumps in Smart Grids

THEME	ACTION	
	Review of licence lite	A review of why uptake of licence lite has been limited. This will help to ensure that if a secondary supplier licence is introduced as part of a multiple supplier model, it does not repeat previous barriers.
	Further work on 'as-a-service' barriers	Several organisations have already carried out reviews into the potential for 'as-a-service' models, particularly HaaS. This includes the Energy Catapult which carried out a trial with Bristol Energy. However, Bristol Energy has since exited the market and it is important to ensure that this does not limit further research into existing barriers to 'as-a-service' models and why they are not currently mainstream. This should help to better understand whether the multiple supplier model can overcome existing barriers to 'as-a-service' models as we have theorised in this work or whether the current lack of these business models is due to issues beyond the market structure.

Source: Frontier Economics

We have also set out a list of examples for potential market monitoring metrics in Table 8 below. For each monitoring metric, the industry should agree a indicative threshold at which a decision is required on whether to proceed with or exclude options for the market structure. This requires a robust governance and decision making process to ensure that these hard decisions can be made when the time comes.

TABLE 8 MONITORING METRICS

METRIC	RELEVANT ARCHETYPE(S)	PURPOSE
LCT take-up	Multiple supplier model	This will help to inform whether secondary suppliers are likely to have sufficient scale to be commercially viable under a multiple supplier model
Customer adoption of separate EV or heat pump tariffs with the same supplier	Multiple supplier model	Whilst customers cannot have multiple suppliers, many suppliers are offering separate EV tariffs from general electricity supply on a TOU basis. Customer take-up of these separate EV or heat pump tariffs in the future could provide an indicator of customer appetite to manage multiple tariffs under a multiple supplier model.
Customer sentiment towards suppliers	Extended supplier hub	The BEIS Public Attitudes Tracker is just one example of a regular collection of data on public attitudes, including attitudes towards suppliers. Deterioration of customer trust suggests that an extended supplier hub model is less appropriate as customers may be reluctant to engage with their suppliers on LCT and flexibility even if suppliers have new obligations in these areas.
Availability of dynamic TOU tariffs or DLC	Customer-facing DSO	This will be a key metric to monitor post the introduction of MHHS. The degree to which suppliers pass on cost-reflective signals to their customers will help to inform whether suppliers

METRIC	RELEVANT ARCHETYPE(S)	PURPOSE
		can be expected to pass on flexibility signals or whether DSOs will need to provide these directly to customers under a customer-DSO model.
Supplier/aggregator participation in DSO flexibility markets	Customer-facing DSO	If participation in DSO flexibility markets does not grow at pace after the introduction of MHHS, this could be an indicator that a customer facing DSO model is required to engage customers in the provision of flexibility.
Monitor household characteristics of flexibility	All models (flexibility)	Understand whether customers with certain household characteristics are more likely to engage with flexibility and whether vulnerable customers are less likely to engage. This will be particularly key if policymakers choose to introduce cost-reflective DUoS costs in the future.
Customer adoption of V2G tariffs	All models (flexibility)	Customer uptake of V2G and other flexibility export tariffs can act as an indicator to overall customer acceptance of flexibility. Additional analysis to understand household characteristics can help to understand whether vulnerable customers are equally likely to benefit from flexibility payments.
Planned vs. expected flexibility	All models (flexibility)	Ongoing monitoring of actual vs planned levels of flexibility solutions, and underlying analysis of why these may differ. This data should form part of the work by DSOs on best practices for flexibility (discussed under low-regret actions).
Proportion of customers on default tariffs	All	As we discuss earlier, the right model will depend on the level of customer engagement with the energy market. Measuring the proportion of customers on default tariffs can act as one indicator of engagement although care will need to be taken to account for periods of high energy prices where the default tariff is the cheapest option for the majority of customers (as is currently the case).

Source: Frontier Economics

Finally, there are some key dependencies beyond the energy sector. Internet connectivity is likely to be increasingly important in enabling smart devices and flexibility via DLC but one in six people struggled toa afford broadband during the third pandemic lockdown.[73] New business models that combine supply with asset financing may require providers to partner with financial services institutions. Decarbonising the power sector cannot be delivered in a silo and policymakers should have a clear idea of cross-sector interactions to guide market monitoring and future interventions.

[73] Citizens Advice (2021). More than one in six struggling to afford broadband

ANNEX A - DETAILED DESCRIPTION OF BUILDING BLOCKS

This annex provides further detail on each of the building blocks discussed in section 3 above. For each one we:

- provide a description of what it involves and where appliable any examples from other countries or research papers;
- how it might help to address the cross-cutting barriers we identified in WP2; and
- any potential issues it may raise.

A.1 - WHAT ROLE DO ENTITIES HAVE?

This building block component refers to the roles of different entities within the energy market. As this work is focused on the customer interface, we only consider roles that directly impact customers i.e. the sale of retail energy products and services and billing. Provision of support for vulnerable customers is considered separately under the 'how to support vulnerable customers' building block category.

The current market is structured around the a supplier-hub model where the supplier acts as the primary interface between customers and the energy system. Customers have a single contract with the supplier which issues a single bill that passes on charges from the rest of the supply chain in addition to policy costs. We discuss this the supplier hub in more detail in WP1.

We have considered the following alternative options in our work:

- Narrower supplier role
- Wider supplier role
- Customer facing DSO (with a single bill or separate bill)

We have also considered the potential role of three different types of third party entity:

- 'As-a-service' resellers
- Aggregators
- Energy concierge services

A.1.1 - NARROWER SUPPLIER ROLE

Narrowing the supplier role would involve removing some of the existing obligations faced by suppliers in their licence and passing them to other entities. For example, the requirement to deliver ECO or to take on a revenue collection role for social obligations could be removed. Alternative arrangements would then be made for the delivery of these obligations, for example the DSO could take on ECO obligations and socialisation of policy costs could be carried out via general taxation.

By removing these obligations from suppliers, this could reduce barriers to entry, stimulate competition, and allow suppliers to focus on offering innovative services. Ofgem's 'License Lite' removes some of these obligations, but requires a supplier to partner with a fully licensed supplier.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

A narrower supplier role would reduce regulatory complexity for suppliers, potentially creating an environment which allows the entry of new innovative business models. This was noted by conversations with non-traditional energy companies, one of which told us that the number of obligations in the current supplier licence represented a significant cost and limited their ability to offer innovative tariffs based on PV generation, storage, and customer flexibility.

POTENTIAL LIMITATIONS

While narrowing the role of suppliers might help foster competition and new business models, the majority of existing obligations and responsibilities would still need to be picked up by other entities. For example, the ECO requires suppliers to commission the installation of measures such as insulation. If this were to be passed on to another type entity (e.g. local government or the DSO) they would need to be able to manage this procurement process. As customers do not choose their local government or DSO, there may also be less competitive pressure to carry out this function efficiently, potentially requiring additional regulation.

Suppliers currently deliver these services are they are a single point of contact which all customers will have. If these obligations are moved away from suppliers, then customers may find it difficult to engage with multiple providers of social obligations. It is critical that customers feel supported and are willing to move towards a different market model.

Some regulation of suppliers, while potentially onerous, may be necessary to avoid adverse outcomes for customers. For example, the SoLR scheme which mutualises the cost of failed suppliers helps protect customers' money, but may also incentivise suppliers to behave in an unsustainable way (such as offering fixed-term tariffs without buying sufficient energy in advance). Ofgem is currently examining wither *additional* prudential regulation needs to be brought into address these types of issue.[74]

Finally, whilst a narrower supplier role might help create the conditions for innovation, it is not a guarantee that new innovative business models that enable the net zero transition will emerge. There are diverse factors that influence business' decision to offer new products and services and having fewer obligations is only one facet of a successful innovative market. Careful design of the streamlined supplier licence will also be required to ensure that it does truly low barriers to entry. This is not a trivial exercise. For example, there has been very little uptake of the 'License Lite' (described above), and some organisations have reported that it 'may not have represented the 'lower barrier' route to market originally intended due to the complexity of the commercial arrangements necessary for a viable business model'.[75]

A.1.2 - WIDER SUPPLIER ROLE

Similar to the current market, customers would retain a single supplier per fuel and DSOs would continue to rely on suppliers to pass on flexibility signals. However the supplier licence would be broadened to a

[74] See for example Ofgem's Open Letter to Energy Suppliers of 29 Oct 2021

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

include *additional* obligations related to flexibility and LCT uptake amongst customers, for example an ECO style scheme to install LCT heating systems or batteries; requirements to offer dynamic TOU tariffs; provision of advice on financing for LCTs and/or how to run them in a cost-effective way.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Expanding the 'gatekeeper' role of supplier means that customers will keep the relationship with their preferred supplier who will not only provide energy but also guidance to their customers. This simplifies the complexity from a customer perspective as the supplier will continue to be their main interface with the rest of the market. There is no need to deal with other entities to provide flexibility or obtain LCTs.

Wider obligations could include provision of financing for LCTs (while recognising that the issues that the Green Deal faced would need to be overcome). New obligations might also require suppliers to ensure that customers are being supported on switching to and maintain LCTs and smart appliances.

Suppliers could have obligations to encourage customers to shift demand during peak time whether this includes requirements to offer dynamic TOU tariffs to improve availability, or explicit targets for levels of customer flexibility offered each year.

POTENTIAL LIMITATIONS

Extending the supplier hub could make it more difficult for new entrants and risks stifling innovation. Our conversation with energy market participants suggests that some companies already find obligations in the supplier licence onerous and deters them from taking a supplier licence. Extending this to include obligations on LCTs and flexibility would exacerbate these issues, which could limit the ability for specialist suppliers to enter with innovative business models.

Another risk is that this option fails to deliver significant improvements in LCT uptake and flexibility even with additional supplier obligations due to lack of customer trust between customers and suppliers. Research from Citizen Advice in 2014 found that half of customers do not trust their energy supplier[76] and the spring 2022 BEIS public attitudes tracker found that only 19% of customers would trust their energy supplier's advice on heating systems.[77]

A.1.3 - CUSTOMER FACING DSO

Under this building block, customers no longer have a single energy contract from their supplier but rather two separate contracts, one with their supplier and one with their DSO. This contract would cover the provision of capacity, and could also require DSOs to provide other services such as the provision of financing for LCTs or other social obligations. Under this option, customers could either have two separate bills, one from their supplier, one from their DSO, or continue to have a single bill via their supplier who would have a revenue collection role. The former approach is used in France whereas the latter approach is used in Norway where customers have a separate bill for network costs along with capacity based tariff structures. A customer facing DSO with a separate contract can send flexibility signals directly to

[76] Citizens Advice (2014). Lack of trust in energy suppliers a barrier to getting the best deal

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

customers, requesting them to adjust their energy consumption to reflect local network capacity, rather than having to rely solely on contracting flexibility via aggregators or suppliers.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Rather than relying on suppliers or aggregators to pass on flexibility signals, this model would allow DSOs to send signals directly to customers. A DSO would cover all customers in the relevant local network requiring flexibility whereas any individual supplier would only cover a proportion of these customers.

The DSO may be able to finance capital costs (which it can recoup through network charges – unlike the supplier, customers cannot switch away from the DSO). There is an option to socialise capital costs, e.g. adding them to the RAB.

Expanding the role of DSO into obligations currently covered by the supplier could help to reduce regulatory complexity for suppliers, allowing the supplier licence to be streamlined. This will reduce barriers to entry and enable innovative new business models which in turn may lead to tariffs that enable the net zero transition for example smart EV tariffs or 'as-a-service' offerings.

POTENTIAL LIMITATIONS

As discussed in WP2, one of the main barriers the current model faces is the complexity of choice and heterogeneity of customers. Introducing a customer facing DSO that can send flexibility signals directly to customers will increase this complexity and having two separate bills may make it more difficult for customers to understand the energy market.

A customer facing DSO that takes on social obligations could also have competition implications as customers are unable to switch to another DSO if they offer better services. This can be mitigated through the design of some schemes, for example customers can receive ECO support from any supplier not just their own, although this solution specifically may be less workable for DSOs which have a fixed geographical footprint.[78] Where this is not possible, regulation will be required. However, as a general rule regulation should be reserved for natural monopolies and where provision by a competitive market is possible this can help drive innovation and cost reductions in the delivery of those services.

Furthermore, there may be instances where supplier and DSO incentives conflict on load shifting and customers face conflicting signals. This means customers may require HEMS that help them to optimise between these signals. It also means that sometimes customers may act in way that leads to lower supplier costs but higher overall system costs.

Finally, there is a question of whether DSOs are better placed than suppliers to aggregate the value of flexibility across the value chain given that flexibility can be used to reduce national balancing and generation costs (as well as alleviating local network constraints).

[78] For example in healthcare, patients are able to choose where they receive treatment, including hospitals outside of the area where they live. This policy was introduced to promote competition across healthcare providers and increase quality of care. However in practice 55% of patient weren't aware of their right to choose a hospital, and the majority of patients choose their local provider. For more information see The Kings Fund (2010). Patient choice: How patients choose and how providers respond.

A.1.4 - THIRD PARTY ENTITIES

Different types of third party entities could help market coordination, enhance co-operation among market participants, and promote customer flexibility. Three different types of third party co-ordinating entities have been identified:

- 'As a service' resellers buys kWh and potentially capacity from suppliers and DSOs, bundles this into an 'As-a-service offering' and offers to customers as a package.
- A third party aggregator contracts with customers to manage their electricity consumption for example via DLC in response to flexibility signals. In this market, it does not need to go via the supplier. This is similar to the current role being developed for VLP.[79]
- 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.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Aggregation models are centred around the provision of customer flexibility. Aggregators may develop sophisticated HEMS and smart devices that automate provision of flexibility as part of their offering.

'As a service' resellers will also contribute to increasing flexibility as they have incentive to consume electricity when it is cheapest, and this typically coincides with times where there is excess generation and capacity.

Energy concierge services will directly support customers to choose the best products and services for their needs.

POTENTIAL LIMITATIONS

The presence of third party co-ordinating entities could have unintended negative impacts. First, care must be taken to ensure that customers are being protected in their interaction with these third party entities, and that they facilitate rather than hinder innovation. For example, regulation may be required to ensure that margins charged by energy concierges remain fair and that they do not bias customers towards options that are not optimal for them.

Second, there is a risk that only engaged customers use the services of third party entities whereas others don't benefit from these services. Finally, the introduction of third party entities into the domestic energy system may add additional complexity, increasing the number of organisations that customers need to interact with.

[79] 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.

A.2 - NUMBER OF SUPPLIERS PER CUSTOMER

This building block refers to the number of separate suppliers that a customer may have at any one time. We have considered the following alternative building blocks in our work:

- Single supplier per customer
- Multiple suppliers by technology
- Multiple suppliers for peer-to-peer energy

A.2.1 - CURRENT MODEL: SINGLE SUPPLIER PER FUEL

Under the current market model, customers are restricted to a single supplier per fuel per metering point. It is not possible for customers to have more than one supplier each fuel, for example a separate supplier to charge their EV at home alongside a separate supplier for general electricity use. Customers with domestic PV installed can choose to take a Smart Export Guarantee (SEG) tariff with a different supplier to their energy supply.[80]

A.2.2 - MULTIPLE SUPPLIERS BY TECHNOLOGY

Rather than having a single supplier per fuel per metering point, customers could have multiple suppliers by technology for example a separate supplier supplying a customer's EV, heat pump, and remaining electricity demand. Under this model, customers would likely have a 'lead supplier' who would be responsible for providing a general electricity supply to a customer. Customers could then choose to contract with additional suppliers for specific technologies, for example a separate supplier for their EV charging point or heat pump. Any supplier obligations would likely be held by the 'lead supplier' such as the universal service obligation (USO) and revenue collection role.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

This building block allows suppliers to differentiate themselves by technology specific offerings and deliver new innovative business models. These offerings could potentially overcome a range of cross-cutting barriers:

FLEXIBILITY

Allowing customers to have multiple suppliers opens the market up to innovation and entry by specialist suppliers including non-traditional companies. For example, an EV charging manufacturer may choose to become an EV specific supplier and differentiate itself by offering automated load shifting in response to a TOU tariff, lowering customer bills and increasing customer flexibility. Whilst these types of models already exist, for example Ohme partners with Octopus Energy, allowing technology specific suppliers would mean that non-traditional companies no longer need to partner with a supplier to enter the market, potentially removing barriers associated with the cost of these commercial arrangements.

[80] We did consider requiring a single supplier per metering point, which may be particularly beneficial for customers with hybrid heating systems who will need to optimise their use of electricity and gas/hydrogen. However requiring all suppliers to offer all fuels would stifle innovation. In any case, many customers are already used to dual-fuel tariffs and therefore would adopt these models even if they aren't mandatory.

Customers may prefer to purchase an energy contract with a non-traditional company. For example, their car manufacturer, if they like or trust the brand. Secondary suppliers could also introduce bundled tariffs, for example buying an energy supply contract alongside a new car lease, that some customers may find easier to understand.

Secondary suppliers could bundle asses with an energy supply contract, acting as a form of financing for LCTs (similar to mobile phone contracts that include the handset and a bundle of minutes/texts/data).

POTENTIAL LIMITATIONS

One key challenge of multiple suppliers is that it could increase the complexity of choice for customers. It also increases the difficulty in comparing different offers and could lead to customers choosing a tariff that isn't suitable for them. Another possible limitation is the distribution of fixed costs to the end-customer. Suppliers currently carry out a cost recovery role for network and policy costs. If a customer has multiple suppliers, attempting to allocate these costs across each supplier could result in customers being charged more than once. For this reason, the lead supplier will likely need to take on the revenue collection role for these changes. However, if the majority of a customer's energy consumption is not with their lead supplier, for example if they have a separate supplier for their EV and heat pump, the lead supplier may not supply enough energy across its customer base to meet the costs of delivering this role.

Finally, the introduction of meter splitting required to enable multiple suppliers is could to be costly. A previous cost benefit analysis on meter splitting concluded that the benefits are likely to outweigh the costs at the time of the study in 2020.[81]

A.2.3 - MULTIPLE SUPPLIERS WITH PEER-TO-PEER

Similar to the building block above, this option allows customers to have multiple suppliers per metering point but does not require this to be tied to specific devices. Instead, customers could choose to use peer-to-peer networks to meet their energy demand when local generation is high and it is cheaper for them to do so, and fall back on their lead supplier when peer-to-peer energy isn't available.[82]

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Allowing customers to have multiple suppliers will unlock peer-to-peer models which have previously struggled with the fact that customers need to have access to electricity even when local generation is limited. The main benefit of peer-to-peer models is the provision of local flexibility, allowing prosumers to trade renewable energy and encouraging deployment of local generation and local flexibility markets.[83]

[81] CEPA (2020). P379 Impact Assessment.

[82] We also considered a model where customers have a specified local and national supplier but do not explore this in detail as it raises several questions around arbitrage and local bidding zones.

[83] Irena (2020). Peer-to-peer electricity trading

POTENTIAL LIMITATIONS

One of the main drawbacks to peer-to-peer models is that they are very dependent on the local system. In some areas there may be an abundance of local generation opportunities, whereas this may be more limited in other areas resulting in geographical variation in energy bills. Setting up an effective peer-to-peer network also relies heavily on investment in PV, batteries and EVs, which face the challenge of upfront capital costs discussed in WP2.

A.3 - WHAT DATA IS SHARED?

This building block considers data requests for smart meter data, interoperability, and DLC. We consider the following options:

- Suppliers access granular smart meter data
- DSOs access granular smart meter data
- Interoperability for smart devices
- Entities have DLC
- Customers have HEMS, no DLC

A.3.1 - SUPPLIERS ACCESS TO GRANULAR SM DATA

Currently only suppliers have access to granular smart meter data for the customers they serve, although customers can choose the frequency that suppliers receive this data. Suppliers automatically receive daily data unless a customer objects, but must receive permission to access half hourly data. This will change as part of the introduction of MHHS and suppliers will receive half hourly data by default by 2025.

DSOs have access to aggregated smart meter data which is aggregated across customers in a local area and is used for network planning. Other entities can access individual data through the DCC only if they secure permission from the customer.

A.3.2 - DSOs ACCESS GRANULAR SMART METER DATA

Under this option DSOs would automatically access granular data for customers in their geographic areas rather than aggregated data.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

If DSOs are able to send direct flexibility signals to customers, they will either need access to individual level smart meter data to measure customer response, or rely on suppliers to provide this information for them. Increasing availability of smart meter data to DSOs may also improve their ability to forecast demand and support planning and reinforcement activity more generally.

POTENTIAL LIMITATIONS

The main trade-off relates to customer privacy. It is uncertain whether customers would grant permission to their DSO to share their personal consumption information which could be a major barrier to DSOs sending direct flexibility signals to customers and rewarding customers who respond.

A.3.3 - INTEROPERABILITY FOR SMART DEVICES

A variety of smart devices are essential for the success of net zero transition and to deliver flexibility. For example, smart appliances can automatically respond to flexibility signals and shift consumption away from peak periods. Because these technologies are key for the net zero transition and customers' flexibility, it is particularly important to ensure that they are interoperable across the energy market. There are already interoperability requirements on EV chargers but this could be extended to other devices, in particular heat pumps and smart boilers.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Ensuring that smart devices are interoperable will allow entities to send signals or carry out DLC even if the customer switches suppliers or service providers. Interoperability would also mean that all smart devices would be compatible with HEMS.

Interoperability requirements avoid the risk that customers are locked into a particular supplier or manufacturer i.e. their devices will not lose smart functionality if they switch or the manufacturer exits the market. This could also provide greater confidence to customers to adopt smart LCTs.

POTENTIAL LIMITATIONS

Interoperability requirements may limit incentives for companies to develop innovations on HEMS, either because they are not compatible with the common standard or because they cannot guarantee that they can recoup the costs of development if it is an open standard. Smart meters have a common standard that includes the ability to support up to five auxiliary load control switches (ALCS) intended to enable DSR and load control.[84] Whilst trials to use ACLS are currently ongoing, there seems to be limited use to date by smart devices and HEMS. Our discussions with a domestic aggregator suggests that the technical limitations of the current SMETS specification means that aggregators need to develop their own proprietary networks to deliver the range of flexibility services desired by customers.

Care should also be taken to avoid interoperability requirements leading to the lowest common denominator and leaving customer with products that only have basic functionalities and cannot support more innovative HEMS.

A.3.4 - ENTITIES HAVE DLC

With the rollout of smart meters customers will have near real time information on their energy consumption to help them control and manage their energy use. However, it is sometimes hard for a customer to manually shift their demand in response to price signals. DLC means that customers no longer

[84] BEIS. Smart Meters and Demand Side Response

need to respond to flexibility signals. Instead they hand over control of their devices to their supplier, DSO, or other third party.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Rather than relying on customers to manually respond to signals or invest in HEMS, entities that are granted permission to carry out DLC directly dispatch flexible sources of load.

POTENTIAL LIMITATIONS

Customers may be hesitant to allow third parties to control their devices, particularly if DLC is carried out by suppliers and customers are on a £/kWh tariff structure. Research has suggested that energy suppliers will need to work to improve trust almost their customers if they are to successfully offer DSR products, or alternatively allow other entrants to take on this role, for example DSOs or trusted brands from other sectors.[85]

A.3.5 - CUSTOMER HAS HEMS, NO DLC

Rather than offering DLC, customers may instead choose to install a HEMS that manages the use of smart appliances and responds automatically to price signals for example turning on their EV charger when electricity is cheap. In the scenario where DSOs and suppliers send flexibility signals, the HEMS could manage these signals and make the optimal choice for customers.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

HEMS will automate customer flexibility, allowing them to respond to price signals without any effort from the customer perspective (aside from setting up the HEMS initially) or needing to cede control of their devices to their supplier.

POTENTIAL LIMITATIONS

The HEMS market is still very nascent and the degree of customer adoption is uncertain. If customers need to purchase and set up these systems themselves, high upfront costs may be a barrier. Alternatively, if HEMS are funded and rolled out by the DSO, DSOs will need to engage with customers to ensure that they feel comfortable with having a HEMS installed and connect their devices to the HEMS.

Customers may also have concerns around privacy and their freedom to override any automation that reduces the amount of flexibility delivered.

A.4 - WHO FINANCES CAPITAL AND SOCIAL OBLIGATION COSTS?

This building block category refers to the different financing methods that customers can procure to cover for their upfront capital costs, such as acquiring a heat pump or domestic solar PV. It also refers to financing of social obligations such as the ECO scheme. We consider:

[85] Fell, Michael & Shipworth, David & Huebner, Gesche & Elwell, Cliff. (2015). Knowing Me, Knowing You: The role of trust, locus of control and privacy concern in acceptance of domestic electricity demand-side response.

- Supplier financing
- DSO Financing
- Central Government
- Requirements outside of the energy system and other funding pots

This building block directly addresses the cross-cutting barrier of upfront capital costs identified in WP2.

A.4.1 - SUPPLIER FINANCING

Suppliers would be responsible for financing LCT and flexibility technologies similar to the way in which suppliers currently finance social obligations such as ECO.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Suppliers already fund thermal efficiency initiatives for specific customer groups under the ECO and their customer facing role means that they may be better placed than other entities like DSOs to provide similar funding for LCTs.

POTENTIAL LIMITATIONS

Many customers distrust heating system advice from their energy supplier which could reduce customer take-up of supplier funded support.[86] Placing additional funding obligations on suppliers could also reduce competition and market entry, preventing new suppliers from offering more innovative tariffs like 'as-a-service' which would benefit customer flexibility.

A.4.2 - DSO FINANCING

DSOs would be responsible for financing LCT and flexibility technologies such as batteries or even HEMS within customer homes. DSO incentives are aligned with customer take-up of interventions such as energy efficiency or smart charging as it may allow them to avoid costly reinforcement activity in line with Ofgem's flexibility first approach to RIIO-2. DSO financing could extend to other social obligations such as installation of energy efficiency schemes currently delivered by suppliers under ECO.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

A DSO financing mechanism for LCT, batteries, and HEMS would address the problem of upfront capital costs currently facing customers. If the cost of delivering this was recovered either by the RAB or DUoS costs, this would lead to capital costs being socialised across all customers. Customers may also be more willing to accept advice from their DSO than their supplier.

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

As previously mentioned, wider uptake of LCT and HEMS is a key enabler of customer flexibility, particularly if these are smart devices that allow for automated response to flexibility signals. Widespread uptake of LCTs is also a key enabler of domestic aggregation, providing sufficient scale for aggregators to expand from the I&C sector to domestic customers and providing this flexibility to local and national markets.

POTENTIAL LIMITATIONS

DSOs do not currently have a customer facing role, which would need to be developed. If financing costs are recovered via DUoS or the RAB, this also results in a cross-subsidisation of costs across all customers, which may be regressive if customers receiving LCT financing can already afford to purchase these technologies.

This approach also risks limiting customer choice on the type of LCT if customers are not free to choose the type of product subsidised. This is particularly important as customers are expected to become increasingly heterogeneous and require more tailored solutions.

A.4.3 - CENTRAL GOVERNMENT

Central Government already provides subsidies for LCTs including the Boiler Upgrade scheme and subsidies for installation of EV chargers (see WP2 for further details). However, this option would see some of the social obligations financed and managed by suppliers delivered by Central Government for example the Warm Home Discount or ECO, as well as a potential expansion of government support to target other technologies such as batteries.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Moving obligations away from suppliers to Central Government could encourage customer take-up of subsidies. The latest BEIS public attitudes research found that just 19% of customers trust advice from their supplier on installation of heating systems compared to 36% who would trust official websites such as Gov.uk.[87]

An increase financial support of LCTs from Central Government could accelerate uptake and create the necessary scale required to encourage domestic aggregation.

POTENTIAL LIMITATIONS

Additional central government support will need to be financed, potentially via general taxation. Existing government subsidies for LCTs is somewhat limited. For example the Boiler Upgrade Scheme is limited to just 90,000 households and there may not be sufficient funding to extend social obligations further.

A.4.4 - REQUIREMENTS OUTSIDE OF THE ENERGY SECTOR AND OTHER FUNDING POTS

Solutions to address the issue of upfront capital costs are not limited to the energy sector or Central Government. The Government's Heat and Building Strategy includes several policies that target boiler manufacturers and mortgage companies to increase incentives for uptake of LCT and thermal efficiency.

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

Options could include interventions in the financial sector such as requiring provision of green financing at lower interest rates for LCTs.

There may also be ways to address other externalities that include provision of LCT using other funding pots beyond the energy sector. For example, poorly insulated and heated homes often can result in poor respiratory health, increasing costs to the healthcare system. In fact that NHS spends over £1bn treating illnesses that are caused and exacerbated by cold homes.[88] The boiler on prescription pilot addressed this by identifying patients suffering from Chronic Obstructive Pulmonary Disease (COPD) and providing energy and thermal measures including new boilers, double glazing and insulate funded by CCG funding (NHS budgets).[89]

Exploring these solutions is outside of the scope of this work which focuses on the retail energy sector. However, these solutions would likely sit alongside any other financing solutions and could offer significant benefits to overcoming the issue of upfront capital costs.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Utilising other sectors will help to increase options for customers to access financing for upfront capital costs where this is not possible via the energy market.

POTENTIAL LIMITATIONS

This will need to be assessed in the context of other sector pressures and feasibility. For example, extending NHS funding to provide thermal efficiency measures will need to conform with the existing appraisals process and other options such as new drugs and treatments may have a stronger cost benefit analysis, even if they do not contribute to the net zero transition.

A.5 - WHAT DO CUSTOMERS BUY/SELL?

This building block category refers to the final product or service that customers buy and the structure of their charges. Under the current market, customers purchase kWhs of energy from their supplier. Whilst a proportion of customers may have a TOU tariff (either dynamic or static)[90], the majority are on a flat tariff that does not differentiate pricing per kWh over time. We have considered several alternative options which we discuss in more detail below:

- kWh consumed with dynamic TOU pricing;
- 'As a service' models such as heat or milage As-a-service
- kW of capacity

[88] People lab website. Accessed at: http://www.peoplelab.energy/2020/07/21/warmth-on-prescription/

[89] Gentoo (2016). Boiler on prescription trial. Closing report

[90] Static TOU tariffs are determined in advance and do not vary with actual demand or supply conditions on the day, for example pre-set on-peak and off-peak hours. Dynamic TOU tariffs are set in real time based on actual system conditions.

A.5.1 - CURRENT MODEL: KWH WITH FLAT PRICING

Under the current market suppliers are free to offer TOU tariffs. However, as we discuss in WP2, the number of suppliers that offer dynamic TOU tariffs is low. Where TOU tariffs are offered, the vast majority of these are static rather than dynamic. The majority of customers will purchase their energy on a per kWh basis with a flat unit price regardless of the time of day.

A.5.2 - KWH WITH TOU PRICING

Under this tariff the cost per kWh varies depending on local system conditions. It is likely that overnight energy will be cheaper, so customers can chose to shift some of their consumption to those times, such as EV charging. Alternatively there may be times of the day where intermittent generation is high and the cost of electricity is therefore lower.

Dynamic TOU tariffs require the customer to have a smart meter. Furthermore, to gain the benefits of TOU tariffs, customers need to engage with their tariff and adjust their consumption in response to price signals. Some countries such as Spain have an opt-out model for TOU tariffs. The Voluntary Price for Small Consumer (PVPC) tariff was introduced in 2014 which is a dynamic TOU tariff.[91]. Specific suppliers are required to offer the regulated PVPC (known as reference suppliers) and non-reference suppliers compete with the PVPC, enabling them to design aggressive offerings or design customer-attracting campaigns. Around 40% of Spanish domestic customers are on the PVPC contract. In the UK, dynamic TOU tariffs are still limited. The majority of TOU tariffs are still static, such as Economy 7, 9 or 10. However, these type of static TOU tariffs make up only 14% of the GB market[92].

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

Dynamic TOU tariffs send price signals to customers designed incentivise them to shift their consumption to accommodate the status of the energy system.

POTENTIAL LIMITATIONS

The flexibility benefits of TOU tariffs can only be unlocked if customers respond to price signals. This is more likely if customers have installed HEMS that automate load shifting or have DLC rather than being required to manually adjust their consumption.

Another limitation of TOU tariffs is that customers may prefer a flat pricing option, limiting customer take-up. This is likely to be the case for customers who are unable to shift their load and would therefore face higher bills if they switched to a TOU tariff, but may also apply to customers who prefer a simpler and more predictable tariff. TOU trials found that in general customers have a positive experience with TOU tariffs and that initial scepticism regarding TOU tariffs may be overcome as these become more mainstream.[93]

[91] Every day at 20:15h, REE discloses this information for each hour of the next day. Every day at 20:15h, REE discloses this information for each hour of the next day.

[92] For more information, go to WP2 section 3.6.

[93] Citizend Advice (2017). The Value of TOU Tariffs in Great Britain: Insights for Decision-makers. Final report

Finally, dynamic TOU tariffs can leave customers exposed to wholesale prices. As these prices are being passed on directly to customers, this could result in significantly higher bills for some groups of customers. For example Spain has recently introduced a price gap on gas prices, including for customers on the PVPC, due to the recent rise in wholesale energy prices.

A.5.3 - AS A SERVICE

Under this model, customers no longer pay per kWh of energy but instead pay for the experience or final service they want. Customers can either:

- pay a fixed fee for a service subject to acceptable use limits such as EV charging sufficient to drive up to X miles per month or;
- pay per unit of output such as hours of heated home or miles driven.

The fee could also cover the rental or maintenance costs of an asset such as an EV or heat pump. Service providers could use DLC in order to deliver the outputs required by the customer (e.g. a comfortable house) while minimising cost and obtaining revenue from flexibility services.

- There has been a recent rise in interest surrounding 'as-a-service' models, in particular HaaS models.[94] The UK Energy Systems Catapult ran a HaaS Phase 2 trial from 2017 to 2019. Under this trial, participants could purchase 'warm hours' rather than paying for kWhs consumed. Warm hours allowed customers to choose hours to keep designated rooms at a specified temperature. However, despite policy interest, 'as-a-service' models are not currently a mainstream business model for domestic heating or EV charging in the UK. In the case of heating, HaaS models are not currently offered in the UK market and the closest examples would be tenancy agreements where energy bills are included as part of the rent.[95] Countries such as the Netherlands and Denmark have been performing pilot projects on HaaS in recent years. For example, the Dutch energy supplier Eneco is trialling offering 20˚C for a fixed monthly fee with heat pumps[96] whereas the Danish Government supports energy companies to offer HaaS tariffs by funding partially the cost of an air-to-water heat pumps installation depending on the actual number of contracts of a supplier. The Danish supplier pays for the reduced cost of installation of the heat pump and takes care of the maintenance of the heat pump while the homeowner pays a smaller connection fee as well as for the heat delivered from the heat pump. In the case of EVs, several suppliers current advertise EV tariffs with 'free miles' such as the Shell Recharge tariff which offers customers '2,000 miles of free charging'.[97] However in practice it provides customers with credit and actual free milage will depend on energy costs at the time.

[94] Britton, Jessica & Minas, Angela & Marques, Ana & Pourmirza, Zoya. (2021). Exploring the potential of heat as a service in decarbonization: Evidence needs and research gaps. Energy Sources, Part B: Economics, Planning, and Policy. 1-17. 10.1080/15567249.2021.1873460.

[95] Centre for Research into Energy Demand solutions (2021). The history of heat as a service for promoting demand-side flexibility: lessons from the case of budget warmth

[96] Delta-ee. Heat as a service infographic

[97] Accessed at Shell website here: Shell Recharge

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

'As a service' models are attractive for several reasons and were identified as one of the most promising building blocks by workshop participants. By moving the focus away from energy as a commodity and towards the final outputs it is used to deliver, it shifts incentives for providers to deliver the agreed level of service as the lowest cost possible. This in turn helps to address several of the cross-cutting barriers identified in WP2.

Under 'as-a-service models', service providers' margins rely on reducing energy consumption rather than selling incremental kWhs. This means that it is in the interest of the provider to provide their customers with asset leasing services or even deploy LCTs at subsidised costs. For example, under a HaaS model, it is in the interest of the service provider for its customer to install thermal energy efficiency measures or a smart heat pump.

These models give service providers an incentive to provide flexibility within the system, consuming energy to deliver the agreed level of service when it is cheapest, and reducing energy consumption when it is more expensive. It also shifts responsibility to change energy consumption patterns away from customers to the service provider, which has been a barrier to the effectiveness of TOU tariffs. DSOs would still need to procure this flexibility via flexibility markets.

Research carried out for Citizens Advice suggests that energy as-a-service models can help to 'simplify an increasingly complex future energy market', allowing customers to receive an agreed service level that they understand while granting companies the freedom to choose how to deliver this.[98]

POTENTIAL LIMITATIONS

Whilst 'as-a-service' models can help to overcome several of the barriers in the current market structure, they are not without their own limitations. 'As a service' models often rely on digital innovations including smartphone apps to access energy settings or receive alerts about usage. Low digital literacy, particularly amongst elderly or low-income customers, has been identified as a barrier.[99] These models also require customers to have a good understanding of their own needs and preferences, particularly if it is not easy for them to change the service level once it is set, for example if they are locked into a service contract for a set duration and exceeding this value results in high charges similar to the 'bill shock' phenomenon in mobile phone contracts.

Another limitation for HaaS models is that the ability of a home to deliver a certain level of comfort will vary based on a number of factors including the thermal efficiency of a building and heating technologies. Whilst this could provide suppliers with incentives to lease, finance, or subsidise low-carbon technologies

[98] Delta-ee (2019). How accessible are future energy supply business models? A report for Citizens Advice.

[99] Britton, Jessica & Minas, Angela & Marques, Ana & Pourmirza, Zoya. (2021). Exploring the potential of heat as a service in decarbonization: Evidence needs and research gaps. Energy Sources, Part B: Economics, Planning, and Policy. 1-17. 10.1080/15567249.2021.1873460.Britton, Jessica & Minas, Angela & Marques, Ana & Pourmirza, Zoya. (2021).

or thermal efficiency measures, it could also result in customers in hard to treat property types facing less choice, higher prices, or service companies may not guarantee outcomes for these customers.

Finally, 'as-a-service' models may require longer contract durations to unlock their full benefits, particularly if service suppliers finance low-carbon technologies that have long payback periods.

A.5.4 - KW OF CAPACITY

Rather than paying a flat standing charge to cover fixed network costs, customers would pay based on kW of capacity. This could be used either as an alternative or in addition to payment for energy consumption (as an alternative to the current standing charge). We focus on the latter of these two options as replacing payment for consumption altogether could lead to perverse customer behaviour with no incentive to reduce overall energy consumption.

A kW of capacity based charge could either be ex-ante i.e. customers choose how much capacity they want upfront, or ex-post i.e. customers are billed on their actual peak capacity over a set time period such as day.[100] This is similar to mobile phone tariffs where customers can choose how much speed and data they want to contract on a monthly basis.

While this tariff is not yet available in the UK, Endesa (a Spanish supplier) allows customers to choose the power rating they want to contract. In particular, suppliers advise to customers to contract power between 5 to 7kW, as they claim that anything less than 5kW might incur the risk of being in the dark while turning on the washing machine. In the UK, customer homes typically have a higher level of technical capacity and Ofgem has previously used 18kW as an assumed deemed capacity.[101]

Spain has recently introduced new regulation that introduces a TOU element to the capacity charge. The default tariff now splits capacity charges into two time periods, between 8am to midnight where capacity is more expensive, and between midnight and 8am where it is cheaper.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

KW tariffs introduce an additional price signal to customers to reduce their peak consumption. It may also marginally impact customer sentiment on thermal efficiency measures. The current rise in standing charges in the UK has led some customers to express an opinion that reducing their energy usage and installing thermal efficiency is pointless as they still face the same standing charge.

POTENTIAL LIMITATIONS

As with TOU tariffs, the benefits of this tariff will only be realised if customers engage with the price signals. However, customers can find it difficult to estimate the amount of capacity they need, particularly as customers in the UK rarely face capacity limits. Furthermore, this tariff does not encourage customers to reduce load during the network peak which is the main constraint facing the system. This would require

[100] We also consider kW of storage tariffs, where customers that generate enough energy could become a peer and a supplier of the market

[101] Ofgem (2018). Annex 4 – Assessing the options

customers to face a dynamic TOU tariff for capacity. However, paying for capacity on a KW basis may be a more equitable alternative to a completely flat standing charge to recover fixed network costs.

Another potential limitation is the risk that customers contract too little capacity which could result in customers being unable to use electricity for essential purposes, or alternatively facing large charges for exceeding their contracting capacity. This could undermine customer confidence in contracting lower amounts of capacity and limit the benefits of this tariff.

A.6 - HOW TO SUPPORT VULNERABLE CUSTOMERS?

This building block category considers options for which types of customers could be targeted by support schemes and the mechanisms for delivering this support. We discussed existing policies in WP2 which includes the WHD, ECO scheme and the DTC.

A.6.1 - WHICH CUSTOMERS TO TARGET?

We have identified three broad options for how customers could be targeted for support.

- **Customers with specific characteristics.** There are several ways to determine which customers are eligible to receive support, for example based on income, medical need, or poor digital literacy. Vulnerability can also be temporary as change in personal circumstances occurs (e.g. temporary unemployment). Support mechanisms need to take into account these differences and be designed to provide the support that has been deemed to be appropriate.

- **Disengaged customers.** Protection is applied to customers that are identified as not being actively engaged with the market. Disengaged customers could be either customers that are unable to engage with the market or customers who choose not to engage.

- **Self-selection.** In principle, a tariff might be designed in such a way that it appeals only to a subset of vulnerable customers – and can then be offered at a discount. For example, a 'no-frills' tariff could provide a limited capacity of connection, or involve a straightforward pass-through of wholesale costs without any hedging.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

New business and tariffs can cause customer harm. Identifying and supporting vulnerable customers helps to address 'customer protection' cross-cutting barrier identified in WP2:

CUSTOMER PROTECTION

Customers with specific characteristics. This approach attempts to ensure that support is targeted towards those who have the greatest need, taking into account the types of tariffs available in the market.

Disengaged customers. As customers become more heterogeneous and face a wider range of options for their energy supply, more customers may become disengaged. If vulnerable customers are more likely to be disengaged, this may act as a proxy for identify customers who require support without needing to define individual categories of vulnerability which is challenging.

Self-selection. Designing a self-selecting tariff could overcome some of the issues associated with the identification of the vulnerable customer groups. Customers that

cannot be automatically enrolled in a protected tariff due to data or identification issues have the chance to self-select themselves into it. In essence, customers that find themselves in a vulnerable situation can select a protected tariff, without the need to be first categorised as a vulnerable customer.

POTENTIAL LIMITATIONS

- **Customers with specific characteristics.** This approach requires defining vulnerable customers groups who require support. However, vulnerability has several dimensions and there is a risk that some customer groups will be missed. For example, defining vulnerability based on income alone may miss those with higher medical energy. It might also exclude families who have several children and are unable to shift energy consumption.

- **Disengaged customers.** If support is targeted at customers who are disengaged from the market (e.g. by not actively choosing a supplier or tariff) this risks limiting the incentives to engage. This would be a particular issue of tariffs design to promote flexibility, for example dynamic TOU tariffs or 'as-a-service' tariffs are opt-in.

- **Self-selection.** Designing a tariff that is only attractive to vulnerable customers can be extremely difficult and risks ending up either with a 'no-frills' tariff that doesn't protect customers, or a tariff that is attractive to most customers. Alternatively, a regulated flat tariff designed to protect customers who cannot load shift may also be attractive to customers that value simplicity but do have the ability to load shift, meaning that these customers no longer receive flexibility signals.

A.6.2 - SUPPORT MECHANISMS

We then consider the following mechanisms for supporting vulnerable customers.

- **Price caps.** A price cap places a maximum amount that energy suppliers can charge for their energy. This was already introduced through the default cap tariff by Ofgem in 2019. Ofgem reviews the cap twice a year, with changes coming into effect in April and October.

- **Essential service with a capped capacity or consumption.** Suppliers or DSOs could offer an 'essential tariff' which has limited capacity or a maximum amount of consumption for customers who cannot shift load and would otherwise face significantly higher bills on a TOU tariff.

- **Low consumption rising block tariffs.** Rising block tariffs may charge customers a price that increases with their consumption over the course of each billing period. They can be designed to charge a lower price for the minimal amount of consumption that is necessary for basic services (e.g. lighting and minimum house heating) and then a higher charge afterwards. For example in California, utilities used rising block rates with a complex rate structure, which led customers to opt-in installing PVs on their roof only to avoid the highest priced after a consumption threshold;

- **Rebates.** Government can give customers a direct discount on their energy bill. The WHD is a discount offered to fuel poor pensioners and other fuel poor customers. With recent energy prices increasing, the Government announced a discounts on energy bill for all domestic customers.

- **Purchase of LCTs.** Different energy market participants can help specific customers groups to purchase LCTs. Currently, there are targeted obligations on suppliers, such as the ECO, that aims to install energy efficiency measures for eligible vulnerable customers.

HOW MIGHT IT ADDRESS THE CROSS-CUTTING BARRIERS?

CUSTOMER PROTECTION

Price caps. Capped tariffs ensures that vulnerable customers (however defined) are protected against external risks and are able to pay their bills accordingly.

Essential services and rising block tariffs. These tariffs can help to ensure customers still have affordable bills for their essential energy consumption compared to bills they could face under a TOU tariff if they are unable to load shift.

Rebates. Rebates also help to ensure that vulnerable customers continue to have affordable bills.

Purchase of LCTs. Targeting customers that are not able to finance the uptake of LCTs could increase the total value of subsidy available to each individual customer and ensure that funding makes the greatest impact possible.

POTENTIAL LIMITATIONS

- **Price caps.** The structure of the price cap may inhibit innovation in the forms of tariffs that can be offered under it. For example, a 'flat' cap on price that does not dynamically vary might prevent suppliers to send price signals according to peak and off-peak demand hours. Under a cap based on a pass-through of wholesale costs, suppliers may also not be incentivised to invest in measures which could reduce consumption (or move it to cheaper hours of the day) since the investments cannot be recouped.

- **Essential service and rising block tariffs.** Some vulnerable customers may still need to consume a large amount of energy (e.g. due to having a poorly insulated house), which this type of tariff would not help with.

- **Rebates.** Identifying eligible customers to receive rebates might be difficult to implement in a self-selection process. Rebates need to ensure that helps and protects vulnerable customers only. Additionally, rebates does necessarily promote flexibility and a customer choice.

- **Purchase of LCTs.** The Government already provides grants to domestic customers and yet the uptake of LCTs is still slow. This is because alongside with the high costs of LCTs, long payback periods discourages customers in making long-term investments. There are also incentive mismatches between renters and building owners.

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