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An Everoze report.

A deliverable under
Core4Grid.



SWARM GOVERNANCE: FLYING TO A FUTURE OF DOMESTIC ENERGY-AS-A-SERVICE

Addressing demand-side
response barriers

CORE4GRID
PROJECT
CONSORTIUM



June 2019

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THE ROLL-OUT OF DOMESTIC ENERGY-AS-A-SERVICE FACES BARRIERS – SPANNING BOTH THE CUSTOMER JOURNEY AND INDUSTRY VALUE CHAIN.



Our domestic energy sector is entering a period of great innovation. In future, anyone will be able to be a producer and a consumer of energy. Industry is a hive of activity, busily seeking to convert domestic flexibility into a financial honeypot for the consumer.

This transition is as fundamental as the move to broadband – with implications for policy and regulation. Our energy system governance was designed for an era dominated by large generators. With coal and nuclear plants now closing, demand side response (DSR) has an important role to play in the transition. But without systemic change, consumers seeking to participate risk getting stung.

In this paper, we identify policy and regulatory barriers to domestic energy-as-a-service (EaaS), where consumers pay a fixed monthly fee for services such as comfort, lighting and mobility. The energy service provider installs hardware – such as PV, heating controls, battery, meter and chargepoint – and then manages these assets flexibly to help optimise energy demand, and balance with the consumer service requirement.

Our work forms part of the Core4Grid project. Core4Grid seeks to demonstrate current market and household acceptance of, and engagement in, the domestic flexible future grid via geo’s Hybrid Home™ system. It aims to involve 24 separate homes, and is led by geo, Upside Energy, EDF Energy, HACT, Everoze, UK Power Networks (UKPN) and Cambridge Energy.

BARRIERS TO DOMESTIC EaaS		
EASE OF RESOLUTION	<p>COMPLEX</p> <ul style="list-style-type: none"> • Low understanding – and trust in – EaaS solutions • Low trust in installers • Choice restricted to single, licensed supplier • Regulatory bias towards installing non-electric-based heating systems 	<ul style="list-style-type: none"> • Revenue stacking is hard • Inability to trade network capacity • Price signals too weak • Likely mystery Balancing Mechanism barriers • Unclear how to isolate readings for different services • Balancing mechanism & wholesale markets access restricted
	<p>MODERATE</p> <ul style="list-style-type: none"> • Smart meter rollout delay • Unclear rules if third party installs tech and consumer wants to switch 	<ul style="list-style-type: none"> • Lack of visibility on where flexibility is needed in future • Data access limited • Lack of interoperability • Technology bias is embedded in the Capacity Market • Trading period not sufficiently small • Metering requirements are inconsistent
	<p>STRAIGHTFORWARD</p> <ul style="list-style-type: none"> • Standards for large generation • Fiscal treatment of flexibility revenues is unclear • Smart Export Guarantee provides potentially low remuneration for export • Half-hourly settlement not the norm 	<ul style="list-style-type: none"> • Testing process for aggregators is onerous • Minimum bid sizes are too big • Flexibility service hierarchy is unclear • Baseline process is unclear • Building regulations don’t reflect smart functionality
	CUSTOMER JOURNEY	INDUSTRY VALUE CHAIN

We mapped policy, regulatory and market barriers to domestic EaaS, segmented across the customer journey and industry value chain. We reached a view on ease of resolution informed by a workshop ranking-exercise and subsequent peer review.

The root causes of these barriers seemed to point to a governance challenge regarding *the process of change*. This raised the question: **how might our policies and regulations respond more dynamically to our increasingly digitalised and decentralised power system?**

INSPIRED BY BEES, WE RECOMMEND DEPLOYING #SWARM GOVERNANCE TO UNLOCK DOMESTIC EaaS, USING 3 UNDERLYING PRINCIPLES.



Addressing these barriers is not a matter of making minor tweaks to existing contracts, regulations and regimes: it calls for something more fundamental. We need a more *dynamic* way of governing our energy system.

A truly decentralised energy system calls for decentralised energy decision-making: a more bottom-up approach.

Enter Swarm Governance.



The swarming of bees is a marvel of nature.

United by common purpose, bees exhibit a remarkable cohesion of activity, a 'group mindset' – but with no central direction, no single locus of power.

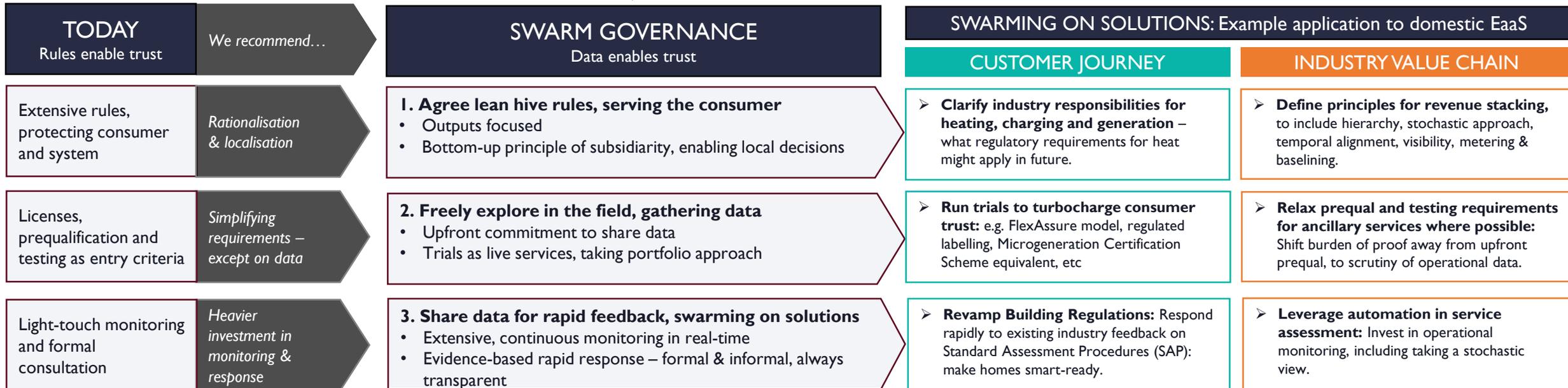
Swarm Governance is inspired by the activity of bees. The outcome is a living energy community: grounded in real data, nimbly responding and adapting – and flying to a future of decarbonised energy.

#SwarmGovernance

Is this a definitive set of findings? Of course not. Our energy sector is much more dynamic – and interesting – than that.

We'll gain new learnings through our Core4Grid customer trial, where we'll seek to interpret and implement the base principles of Swarm Governance with a view towards establishing a new modus operandi. We'll also learn through contributing to working groups, and through talking to experts such as yourselves.

This report represents the start, not the end, of a period of learning, adaptation and implementation. What we're offering is a framework for discussion, a declaration of intent, and most importantly – an invitation to embark on **#SwarmGovernance**.



THIS REPORT HAS THREE CHAPTERS – ENDING WITH AN INVITATION TO ENGAGE WITH THE **#SWARM GOVERNANCE** RECOMMENDATIONS.

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A close-up photograph of several bees on a golden honeycomb. The bees are in various positions, some facing the camera and others seen from the side. The honeycomb cells are clearly visible, creating a textured background.

#SwarmGovernance

Throughout this report, we'll draw an analogy with bees. We hope that this analogy helps emphasise our theme of **Swarm Governance** as we embark on our journey together to a future of domestic demand response.

THIS PAPER SEEKS TO IDENTIFY AND ADDRESS POLICY AND REGULATORY BARRIERS TO DEMAND-SIDE RESPONSE ROLL-OUT.



Our domestic energy sector is entering a period of great innovation.

In future, anyone will be able to be a producer and a consumer of energy. Industry is a hive of activity, busily trying to convert domestic flexibility into a financial honeypot for the consumer – both through accessing new income streams, and extending the life of existing network infrastructure.

Such demand response is one of a suite of flexibility solutions, which together could deliver net benefits in the range of £1.4-2.4 bn/year by 2030, according to Imperial College.*

This transition has implications for policy and regulation. The governance of our energy system was designed for an era dominated by large generators. But now our energy network is changing, with coal and nuclear plants coming offline.

More recently, we've seen an emphasis on distributed solutions – as evidenced by a surge in industrial & commercial (I&C) provision of demand-side response (DSR) and a battery storage boom. But flexibility at a truly decentralised *household* level remains elusive.

This paper seeks to tackle energy governance barriers to domestic DSR head-on.

We address how the aggregation of residential flexibility can successfully participate in markets for balancing and ancillary services. Our scope is to identify barriers and propose solutions to help deliver the Core4Grid project, and to form recommendations for longer-term policy/regulatory change that could unlock the potential of domestic DSR in GB.

Our paper focuses on a specific manifestation of DSR: the energy-as-a-service (EaaS) model. Under this model, consumers pay a fixed monthly fee for services such as comfort, lighting and mobility. The energy service provider installs hardware – such as PV, heating controls, battery, meter and chargepoint – and then manages these assets flexibly to help optimise energy demand, and balance with the consumer service requirement.

Members of the Core4Grid consortium can be particularly well-placed to identify domestic DSR barriers due to their breadth of experience. Collectively within the consortium, we have the majority of the energy services supply chain represented – from supply through to aggregation through to metering and housing providers. As a result, our recommendations are informed by real world experience, rather than abstract reasoning. This report represents a range of views and is not necessarily reflective of the individual views of each consortium partner.

ABOUT CORE4GRID

Core4Grid seeks to demonstrate current market and household acceptance of, and engagement in, the domestic flexible future grid via geo's Hybrid Home™ systems.

It is a trial of domestic flexibility aiming to involve 24 separate homes, led by geo, with the wider consortium consisting of Upside Energy, EDF Energy, HACT, Everoze, UK Power Networks (UKPN) and Cambridge Energy.

geo's smart energy brain Core, will sit at the heart of new Hybrid Home systems, managing domestic flexibility assets such as solar PV and EV chargers in response to grid signals. The optimization of exactly how and when energy is used will provide benefit to households. Core4Grid will conclude on the market readiness and consumer demand following the trial.

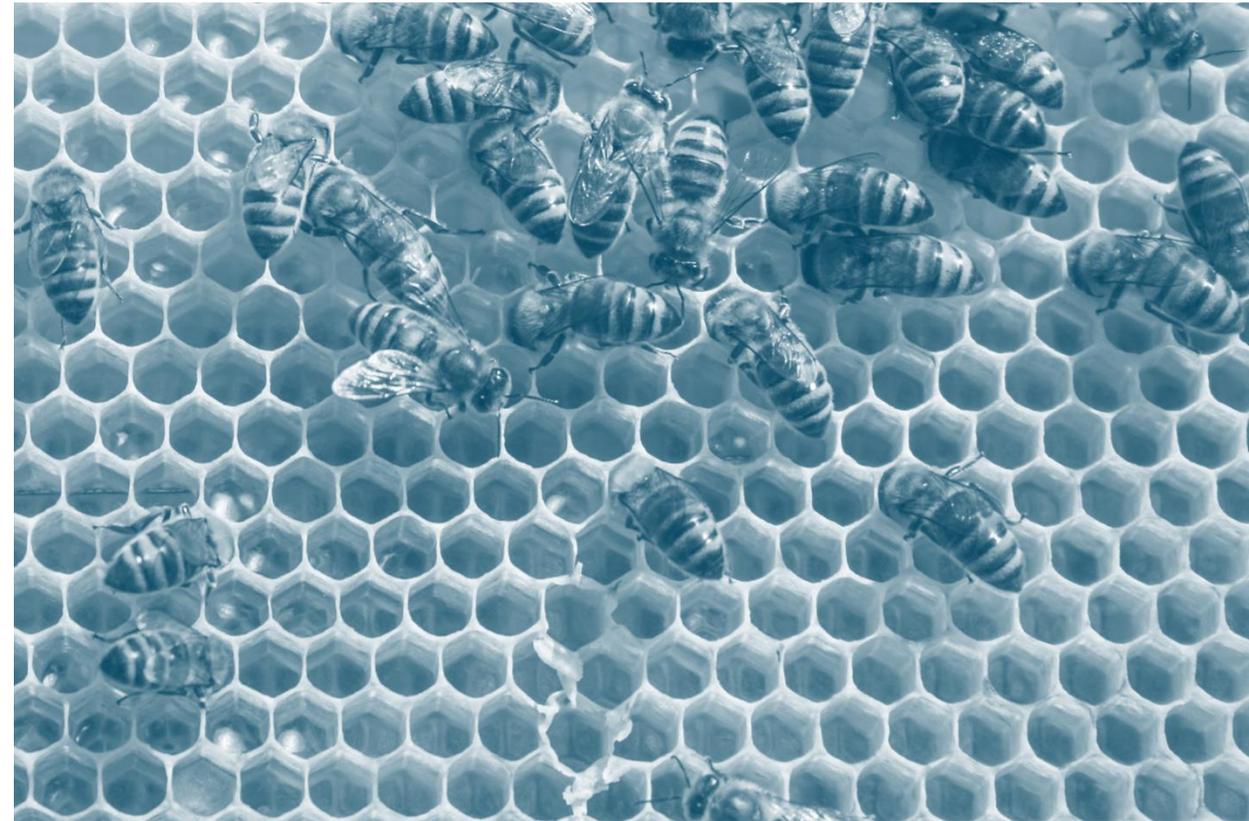
The trial is supported by the *Innovative Domestic Demand-Side Response Competition* by the UK Department for Business, Energy & Industrial Strategy.

This paper forms part of the first workstream on 'policy and regulatory specification'.

CHAPTER I

DOMESTIC ENERGY- AS-A-SERVICE

What it is, and
why it matters



THE CUSTOMER PROPOSITION WE ASSESS IS AN ENERGY-AS-A-SERVICE MODEL – WHEREBY HOUSEHOLDERS PAY A FIXED MONTHLY FEE FOR AGREED ENERGY SERVICES.

Given how quickly domestic DSR models are developing, it's important to define the customer proposition we're assessing. The wider Core4Grid project is trialling multiple tariff propositions, including a variant of domestic energy-as-a-service (EaaS)*.

Under an EaaS proposition, the consumer signs an EaaS agreement with an energy service provider who holds a supply license. The provider installs hardware such as solar PV, heating controls, battery, metering and an electric vehicle chargepoint as part of the service. The provider can manage these assets flexibly to help optimise energy demand, and balance with the consumer service requirement.

Consumers benefit from a convenient way to lower energy bills and carbon savings.

Domestic energy as-a-service

CUSTOMER PROPOSITION ASSESSED IN THIS PAPER

Home as the unit.

Energy bills are issued and paid at the household level – the home becomes the flexible interface in the future grid.

Electricity, heat and transport supply.

The billing spans three energy vectors, but with a focus on supply and demand balancing, rather than wider energy reducing infrastructure (e.g. energy efficiency retrofits are excluded for simplicity).

Single, fixed monthly fee for energy services.

Instead of paying for kWhs, subscription entails payment of a fixed fee for an agreed set of energy services such as comfort, light, refrigeration, cooking, and entertainment, etc. This will be subject to 'fair usage', and an additional monthly 'mobility' fee may be payable if the home wishes to charge an electric vehicle, depending on the tariff structure.

POSSIBLE WIDER MARKET DEVELOPMENTS (NOT ASSESSED IN THIS PAPER)

Individuals as the unit.

In future, billing may occur at the individual level, following people rather than buildings.

Energy efficiency wrapped in.

In the future, a more holistic approach may be taken which includes active steps to improve the energy efficiency properties of a building.

Monthly subscription to Smart Home services.

In future, multiple utilities – digital and physical – may be fused together and delivered for a wrapped fixed price, by a single provider. Energy services may be integrated with other utilities and home infrastructure – such as water, or the internet.

* This paper defines the domestic EaaS concept generally, and does not seek to represent the specific package that will be offered to customers under the Core4Grid trial.

ENERGY-AS-A-SERVICE OFFERS A SIMPLE CUSTOMER PROPOSITION THAT DELIVERS FINANCIAL BENEFIT AND CARBON SAVINGS.

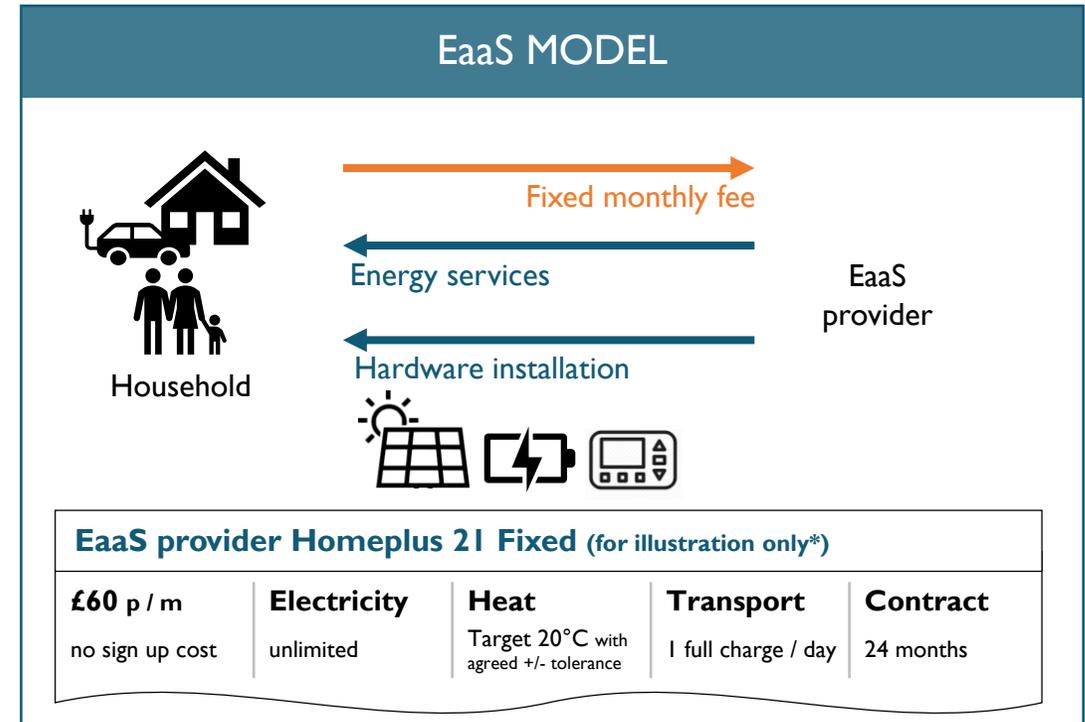
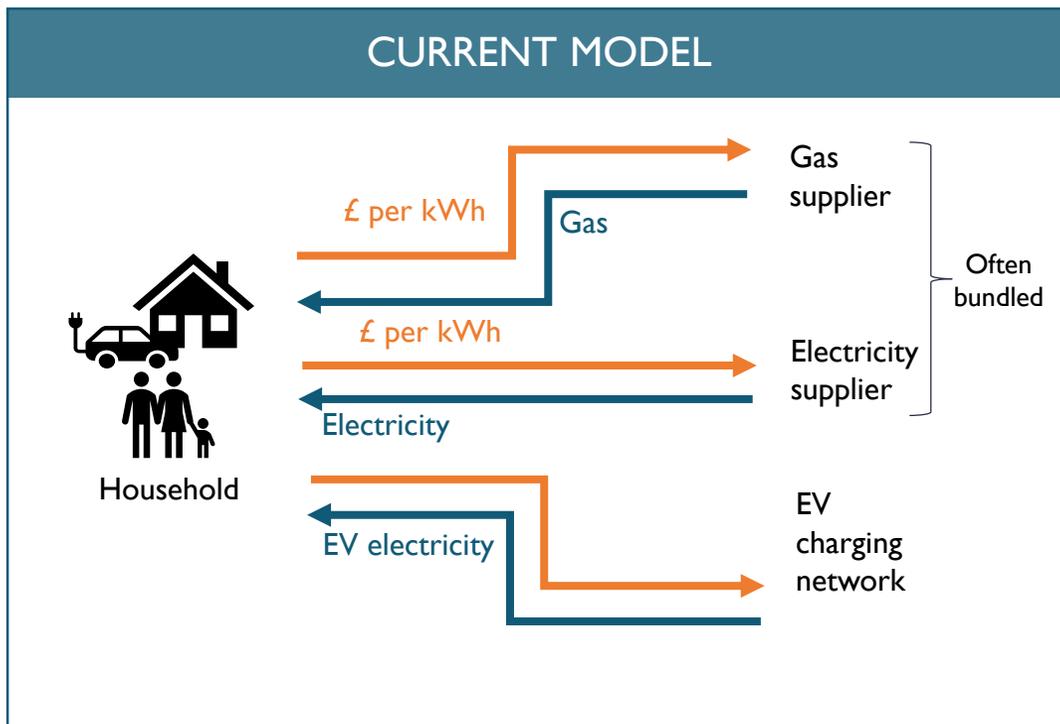
On most UK energy tariffs, consumers currently pay a flat rate per unit (kWh) of energy consumed.

A challenge with this model is that it is difficult to engage consumers with new revenue/bill-saving opportunities such as the provision of flexibility services to System Operators (SOs) and other parties. Behaviours can be hard to change, flexibility technologies such as batteries can be expensive and considered risky.

New tariff innovations can help address such challenges; for instance, time-of-use-tariffs. In this paper, we focus on EaaS as one of the more ambitious models, which differs most from current consumer tariff structures.

The EaaS model offers consumers:

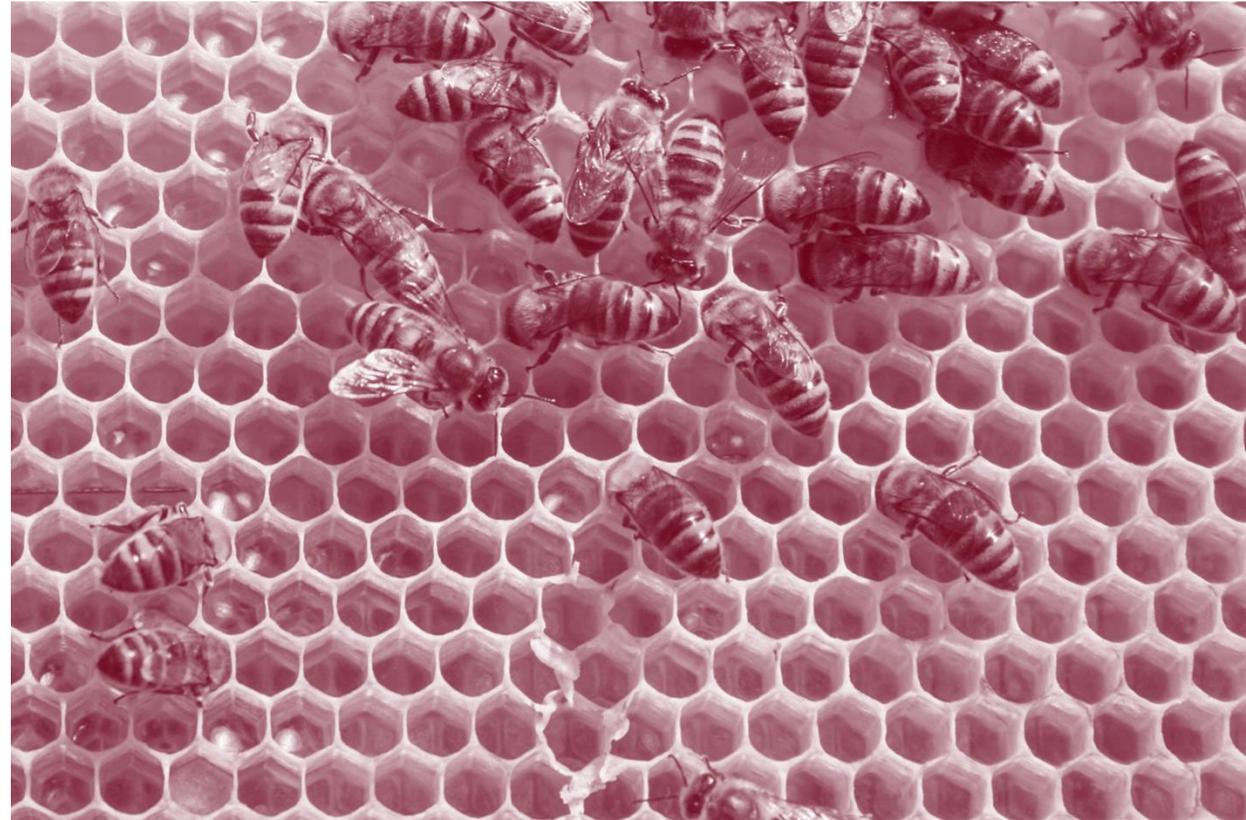
- ✓ **Lower energy bills:** through providing a hassle-free way for consumers to access new flexibility revenue streams – with the EaaS provider optimizing usage behind-the-scenes. Upfront finance is not necessarily required.
- ✓ **Decarbonised energy supply:** through retrofit of rooftop solar and greater self-consumption at the household level. In addition, energy usage can be optimized to maximise import during periods of high renewables generation at a system level. More generally, having more flexibility on the grid means that more renewable generation can be safely added.



*Not intended to describe the specific package offered to consumers under the Core4Grid trial.

CHAPTER 2 **BARRIERS**

What they are,
and how they're clustered



OUR FRAMEWORK FOR ASSESSING BARRIERS TO THE EaaS MODEL CONSIDERS BOTH THE CONSUMER JOURNEY AND THE INDUSTRY VALUE CHAIN.

In this chapter, we map out barriers to the EaaS model.

Specifically, we have focused on barriers which are largely external to the private sector – being driven by factors such as regulation, market design and system operator approach.

We developed a framework informed by the primacy of the customer. The EaaS model must inherently be *customer-centric* if it is to succeed. Thus, the lens of the customer, and their personal energy services journey, formed the starting point for our identification of barriers. We categorised customer journey barriers as follows:



In addition, we considered the barriers which are unseen to the customer. These are themes which run across the industry value chain. We categorised industry value chain barriers as follows:



Barriers are mapped on the following pages – with a focus on the ones considered most fundamental by the contributors.

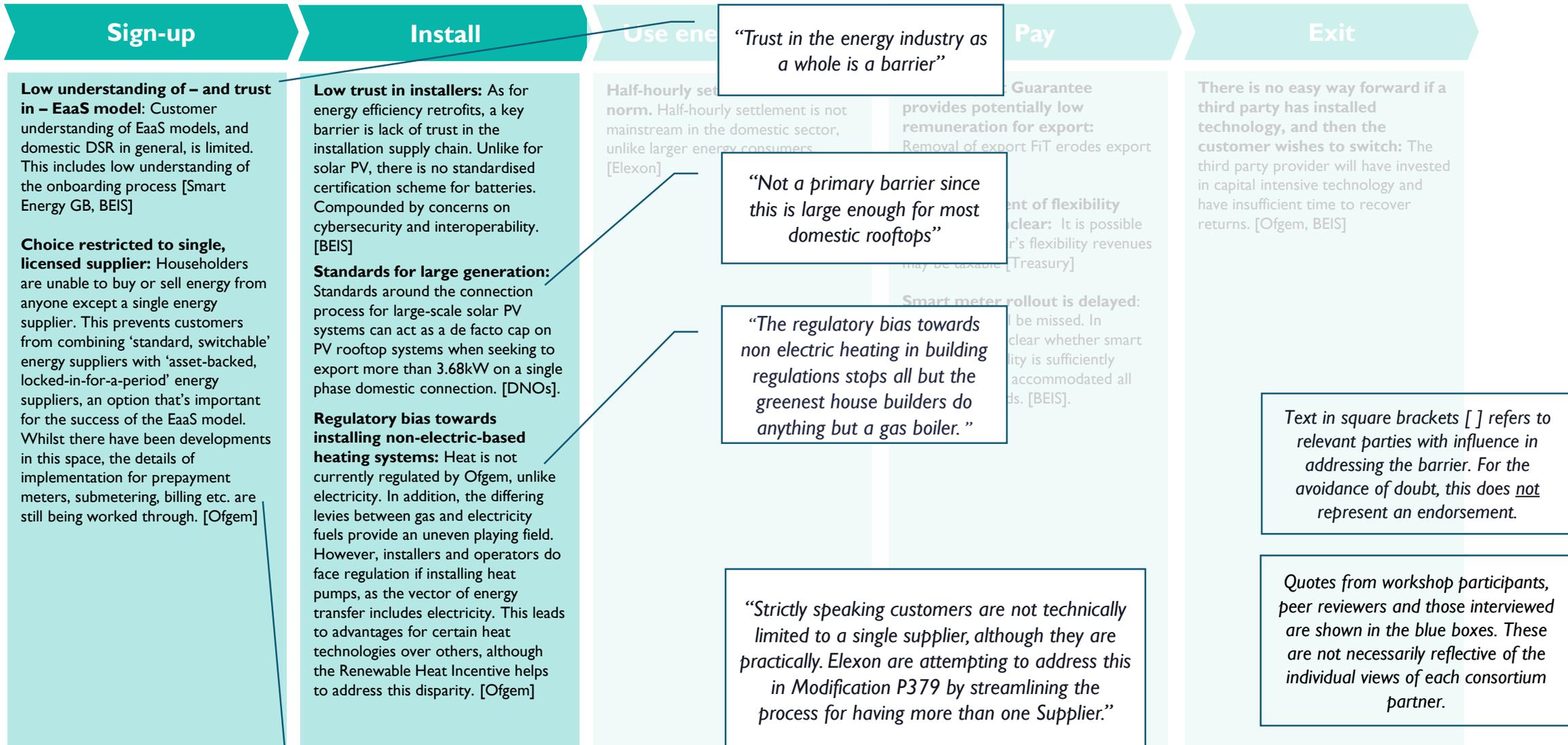


We tested the barriers through two workshops – one within the Core4Grid consortium, and one engaging three additional DSR experts. We followed up with a blog, social media engagement and a presentation at Westminster Energy Forum to solicit further feedback.

Our thinking was further developed through additional one-to-one discussions, through testing ideas in industry working groups, and circulating two early drafts for peer review. Contributors are acknowledged on the back page of this report.

A LARGE NUMBER OF BARRIERS IN THE CUSTOMER JOURNEY FALL UNDER CUSTOMER ACQUISITION.

CUSTOMER JOURNEY: BARRIERS



ONCE CUSTOMERS ARE ONBOARDED, THERE ARE OFTEN COMMERCIAL WORKAROUNDS FOR SUBSEQUENT BARRIERS FACED – ALBEIT THIS IS NOT ALWAYS OPTIMAL.

CUSTOMER JOURNEY: BARRIERS

“Elective half-hourly settlement is available to Suppliers, but many choose not to use it. The Market-Wide Half-Hourly Settlement programme will streamline the process, and make HHS the default unless customers opt out (under current proposals)”

“...but there are examples of some pioneering industry players offering attractive export values, which suggest this may not be a real barrier”

“...but there are commercial workarounds through netting this off the energy bill – especially in EaaS”

“However, the market’s flexibility needs are not fully known. Real-time smart meter data is available at a sub 10s resolution. So meters are theoretically capable of providing the data stream for management, dispatch and settling of most flexibility services - depending on the technology delivering the dispatch”

“However, there are options - meter asset providers are interested in financing the hardware for the sector, so the ownership sits neither with the household or the energy provider, but a separate third party.”



Half-hourly settlement is not the norm. Half-hourly settlement is not mainstream in the domestic sector, unlike larger energy consumers. [Elexon]

Smart Export Guarantee provides potentially low remuneration for export: Removal of export Feed-in Tariff (FiT) erodes export revenue [BEIS]

Fiscal treatment of flexibility revenues is unclear: It is possible that householder’s flexibility revenues may be taxable [Treasury]

Smart meter rollout delay: Concerns have been voiced by some that the smart meter rollout is delayed and 2020 targets could be missed. In addition, it is unclear whether smart meter functionality is sufficiently sophisticated to accommodate all flexibility market needs. [BEIS].

There is no easy way forward if a third party has installed technology, and then the customer wishes to switch: The third party provider will have invested in capital intensive technology and have insufficient time to recover returns. [Ofgem, BEIS]

WHEN IT COMES TO PLANNING, BUILDING AND OPERATING CAPACITY, INDUSTRY IS OFTEN UNCLEAR ON WHAT IS NEEDED AND/OR PERMISSIBLE.

INDUSTRY VALUE CHAIN: BARRIERS

Plan capacity

Lack of visibility on where flexibility is needed in the long-term. For instance some distributed energy sector players have said that regulatory changes such as the Targeted Charging Review (TCR) take incentives towards an unexpected direction [BEIS, TSO, DSO, Ofgem].

Price signals too weak: Full externalities are not priced in.

Data access limited: DSO data is not easily accessible in a standardised way across GB, and can have quality issues. Consumer data privacy concerns require consideration [BEIS, all data providers].

Build & operate

Service hierarchy is unclear in operation: For instance, DSO services are not listed within the Capacity Market *Relevant Balancing Services* annex, which means that operational prioritisation is unclear in the event of simultaneous conflicting obligations. [BEIS, TSO, DSO, Ofgem].

Testing processes for domestic aggregated assets is unduly onerous. The lack automation and suitable simplifications for portfolios consisting of hundreds of assets. [TSO, DSO, Elexon].

Building regulations don't reflect 'smart' functionality: Standard Assessment Procedures (SAP) cover energy efficiency but do not value smart energy functionality. Also too prescriptive on technology. [Government].

Lack of interoperability: Absence of common framework for communications and IT risks inefficiency and creating barriers to consumer switching [BEIS].

Minimum bid size: For instance > 1MW [Elexon].

Trading period not sufficiently

"Include environmental externalities"

Current model doesn't allow for any trading of network capacity. [DNOs, Ofgem]

Likely 'mystery' Balancing Mechanism barriers: Not currently well understood.

Revenue stacking is hard: For instance, there is temporal misalignment in delivery and bidding. Between different services. Contractual interfaces are complex.

Technology bias in Capacity Market. CM is based on fixed technology buckets, fundamentally ill-

"Data is cheap. More is better"

"There are mixed signals and a siloed mentality...but platforms such as Piclo Flex help"

Balance

Balancing mechanism
The markets is registration of units

under either a Central Volume Allocation (CVA) or a Supplier Volume Allocation [Elexon].

"The old deterministic approach focused on individual assets is fundamentally ill-suited to small portfolios of distributed assets – where we're dealing with thousands of sites, which will change over time, and where performance varies with time of day, week and month."

it is unclear how to isolate readings for provision of

"Building regs focus on energy efficiency – but what about smart?"

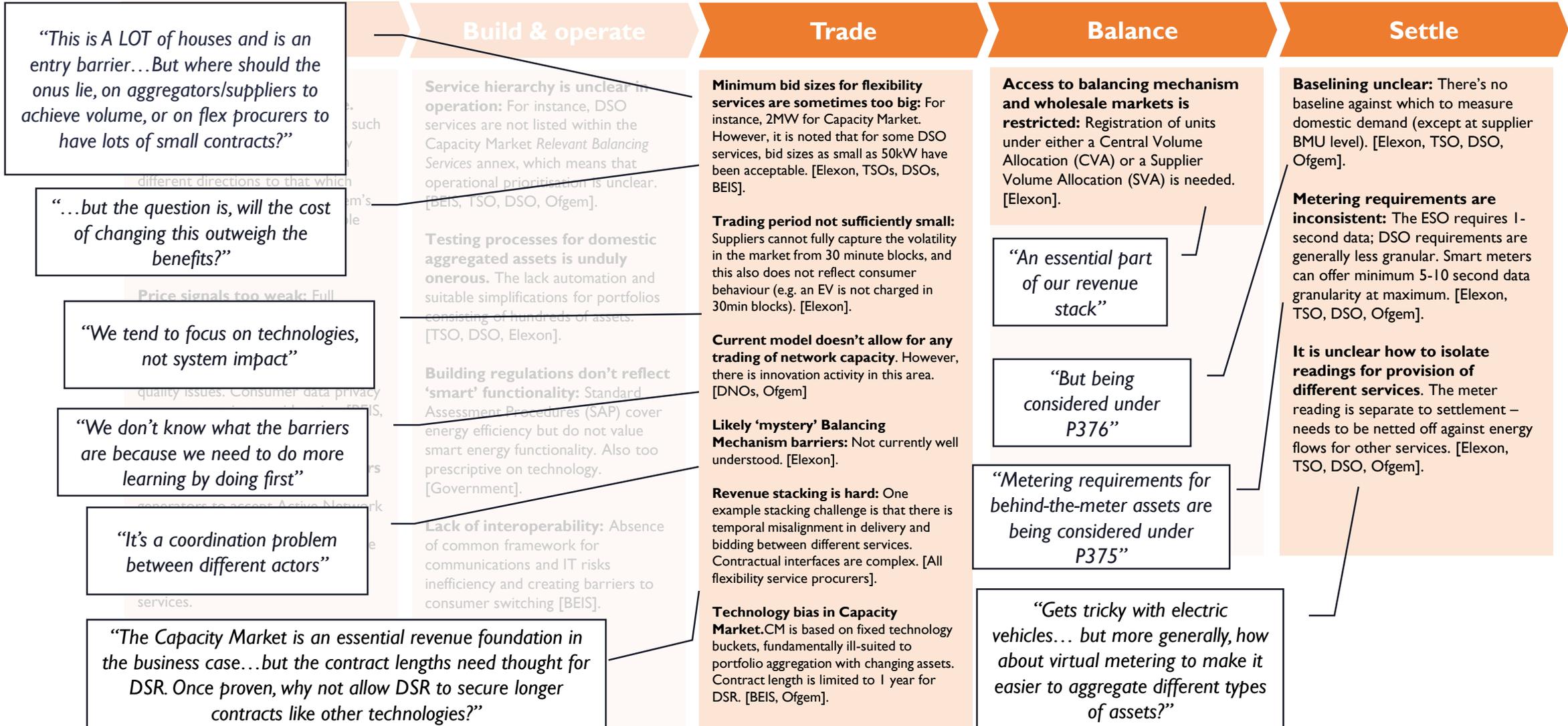
"Lessons from the smart meter industry are worth adopting, alongside principles being established by BEIS/BSI in their Publicly Available Specification (PAS) documents."

Settle

"What to do in the event of a service clash?"

MANY OF THE BARRIERS AROUND TRADING, BALANCING AND SETTLEMENT ARE WELL RECOGNISED – BUT THEIR RESOLUTION HAS BEEN SLOW.

INDUSTRY VALUE CHAIN: BARRIERS



SOME BARRIERS ARE COMPLEX TO RESOLVE – HINTING AT MORE SYSTEMIC CHALLENGES IN ENERGY SYSTEM GOVERNANCE.

When mapping barriers, we observed the following:

- 1. Large number of barriers:** There are a significant number of barriers with material impact on the business case – as mapped on the previous 4 pages.
- 2. Different views on prioritisation:** Everoze convened a workshop in attempt to formalise a ranking of the materiality of issues – but heard divergent views on which was most important. Those working with customers tended to prioritise the customer journey barriers; those working in the industry value chain barriers felt value chain barriers more acutely. Nonetheless, we secured general agreement on some of the core priority barriers.
- 3. Responsibility for resolving barriers is distributed:** Action is needed across multiple actors to resolve the issues raised. Responsibility sits in the hands of multiple parties, including BEIS, Treasury, Ofgem, Elexon, National Grid Electricity System Operator (ESO), DSOs, local government, industry, consumer advocates and more.

BARRIERS TO DOMESTIC EaaS		
EASE OF RESOLUTION	<p>COMPLEX</p> <ul style="list-style-type: none"> • Low understanding – and trust in – EaaS solutions • Low trust in installers • Choice restricted to single, licensed supplier • Regulatory bias towards installing non-electric-based heating systems 	<ul style="list-style-type: none"> • Revenue stacking is hard • Inability to trade network capacity • Price signals too weak • Likely mystery Balancing Mechanism barriers • Unclear how to isolate readings for different services • Balancing mechanism & wholesale markets access restricted
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<p>CUSTOMER JOURNEY</p>		<p>INDUSTRY VALUE CHAIN</p>

BUT WHY DOES DOMESTIC EaaS FACE SO MANY BARRIERS?

Right now the content of codes and regulations can be altered by any player in industry, based on a process of mutual consultation with fellow industry members, and signed off by energy industry regulator Ofgem. This is inherently consultative – so why does the regime present barriers to DSR? We consider this on the following page.

EaaS BARRIERS POINT TO FRICTION IN HOW OUR GOVERNANCE REGIME RESPONDS TO A HETEROGENOUS, DIGITALISED AND DECENTRALISED POWER SYSTEM.

We found that the barriers fell into three core categories: 1. unclear rules, 2. lack of real-life exposure, and 3. failed feedback loops. When we trace each of these issues to the root cause, the barriers facing domestic EaaS point to more fundamental biases within our governance regime – albeit these are the result of historical accident more so than direct intention. This is shown in the table below.

In particular, the root causes point to a systemic governance challenge regarding *the process of change*. How might our policies and regulations respond more dynamically to our increasingly heterogenous, digitalised and decentralised power system?

BARRIERS (extracted from previous pages)	CUSTOMER JOURNEY	INDUSTRY VALUE CHAIN	ROOT CAUSE
<p>1. UNCLEAR RULES <i>‘We don’t know what’s allowed’</i> The rules of the game are unclear: they are too complex, or written with generation in mind. In addition, the rules and incentives provided by different organisations appear to conflict. This means that the permissible modes of innovation are not transparent in principle.</p>	<ul style="list-style-type: none"> Unclear rules if third party installs tech and consumer wants to switch 	<ul style="list-style-type: none"> Lack of visibility on where flexibility is needed in future Revenue stacking is hard Flexibility service hierarchy is unclear Likely mystery Balancing Mechanism barriers Baselining process is unclear It is unclear how to isolate readings for provision of different services 	<p>Rules originally framed with generators in mind, and revised through repeated amendments – not a fundamental review.</p>
<p>2. LACK OF REAL-LIFE EXPOSURE <i>“We haven’t got enough practical deployment”</i> There are insufficient projects and portfolios in the field to gain data and learn by doing. Onerous testing, prequalification and licensing barriers slow deployment. And where projects and portfolios do exist, they tend to have special pilot status, rather than treated as live projects – creating a gulf between innovation and business as usual.</p>	<ul style="list-style-type: none"> Low understanding – and trust in – EaaS solutions Low trust in installers 	<ul style="list-style-type: none"> Data access limited Testing process for aggregators is onerous Current model doesn’t allow for any trading of network capacity 	<p>Hurdles erected to protect vulnerable consumers, and also protect system against failure of large projects. Upfront conservatism needed because data was expensive and response to issues arising was slow. Energy supply is a national imperative.</p>
<p>3. FAILED FEEDBACK LOOPS <i>“We’ve got the data – but we’re too slow in using it”.</i> Industry is developing early evidence and datasets – but even when there is an emerging consensus based on lessons learned, we’re failing to implement the necessary changes quickly enough. Some issues are known but the feedback loop is too slow in following through. And we’re not leveraging the datasets being created.</p>	<ul style="list-style-type: none"> Choice restricted to single, licensed supplier Smart meter rollout delayed Large generation connections require complex standard approvals Regulatory bias towards installing non-power-biased heating systems Half-hourly settlement not the norm Smart Export Guarantee provides potentially low remuneration for export Fiscal treatment of flexibility revenues is unclear 	<ul style="list-style-type: none"> Price signals too weak Lack of interoperability Building regulations don’t reflect smart functionality Access to balancing mechanism and wholesale markets is restricted Technology bias is embedded in the Capacity Market Minimum bid sizes are too big Trading period not sufficiently small Metering requirements are inconsistent 	<p>Historic emphasis on investment certainty – creating a stable regime to attract low cost of capital for large capital investments, suited to a sector characterised by slow innovation in technology and models.</p>

CHAPTER 3 SOLUTIONS

Recommendations for action, and
an invitation to engage with
[#SwarmGovernance](#)



THE DOMESTIC EaaS PROPOSITION PROMPTS US TO CONSIDER A DYNAMIC APPROACH TO ENERGY SYSTEM GOVERNANCE.

So much so for the barriers – what about the solutions? In discussing these issues, it struck us that the barriers to domestic EaaS – and demand DSR as a whole – drive at the heart of energy system governance itself, and how we navigate a period of fast-moving change. As the University of Exeter persuasively argues in its iGov2 project, new entrants and non-traditional practices are driving new governance needs.*

Is it just that we need more ‘joined-up government’? We’re not convinced it’s quite this simple:

1. Firstly because ‘joined-up’ implies a kind of rigidity – whereas what we need is something more *dynamic, self-organised and agile*, ever-responsive to changing market and technology conditions.
2. Secondly, because there are *too many organisational entities* to join up. Organisations need to be in sync, but cannot be expected to be abreast of the whole market in full detail.

We’ve applied a *dynamic lens* on energy system governance. We believe that greater attention needs to be placed on *the process* of achieving energy system change. GB has a relatively advanced static model of governance – with clear articulation of who is responsible for decisions, and who is held accountable. But now rapid technology change challenges us to also sharpen up our *dynamic* processes on how decisions are made.

To some extent this challenge was recognised by Business Secretary Greg Clark in his speech in Nov 2018, when he introduced the Agility Principle: “*energy regulation must be agile and responsive if it is to reap the great opportunities of the smart, digital economy*”.

In the pages ahead, we propose a dynamic and organic model for governance, inspired by the swarming of bees, and framed around three core principles. This model for governance is outlined on the following two pages.

#SwarmGovernance

Is this a definitive set of findings? Of course not. Our energy sector is much more dynamic – and interesting – than that.

We’ll gain new learnings from embarking on physical trials, through contributing to working groups, and through talking to experts such as yourselves. This report represents the start, not the end, of a period of learning, adaptation and implementation.

What we’re offering is a framework for discussion, a declaration of intent, and most importantly – an invitation to embark on the **#SwarmGovernance** debate.

*University of Exeter, iGov2 webpage:
<https://projects.exeter.ac.uk/igov/>

OUR EVOLVING ENERGY SECTOR CAN TAKE INSPIRATION FROM THE SWARMING OF BEES.

The swarming of bees is a marvel of nature.

When workers grow a new queen, the hive splits and a swarm forms to find a new home. Scout bees will conduct tours of inspection, communicate this information and ‘debate’ this with their peers, in what has been termed by Thomas Seeley as ‘honeybee democracy’.

Amazingly, there is no one individual coordinating the hive’s activity. Whilst the queen bee is physically at the heart of operations as egg-layer, she does not dictate actions – instead, the hive colony is governed by the workers themselves.

United by common purpose, the bees exhibit a remarkable cohesion of activity, an apparent ‘group mindset’ – but with no central direction, no single locus of power. Their choreography is rooted in clear roles and self-organisation; through communicating with their neighbours and being empowered to act. Although individually each bee has constrained information, collectively as a whole they succeed in finding a new home.

We developed a theory of Swarm Governance, inspired by the activity of bees.

We’re not the first to consider swarm thinking in an applied domain; we follow in the footsteps of business theorists, mathematicians, artificial intelligence experts and others. On the next page, we define a theory of Swarm Governance rooted in three core principles. The outcome is a living energy community: grounded in real data, nimbly responding and adapting – and flying to a future of domestic DSR.

SWARM GOVERNANCE

The hive is governed by a simple set of unspoken rules – each bee in the hive has a defined role. The Queen is at the centre.

1. Agree lean hive rules, serving the consumer

- Develop a lean set of living principles which lay a firm foundation to coordinate market activity. Rationalise legislation, codes and supply license requirements.
- Serve the consumer as Queen bee. Regulate for consumer outcomes – the ‘what’, not the ‘how’.

NOT a slow, upfront process of developing a lengthy framework of codes, which specify how outcomes should be achieved.

Why? Rapid alignment – and the foundational certainty needed to invest.

Scout bees are trusted to fly out and explore new possible hive locations.

2. Freely explore in the field, gathering data

- Trust providers to get multiple trial solutions out into the field, testing new options, dynamically exploring and experimenting.
- Place strong emphasis on data collection from the start.

NOT top-down hierarchical planning or excessive upfront due diligence, with extensive testing, compliance or prequalification requirements – except regarding data.

Why? Quicker deployment of multiple innovations – unlocking the power of learning by doing, and efficiently gathering more operational data.

Each scout bee returns to the hive with its data on the landscape. This is ‘debated’ with other bees to inform the next action.

3. Share data for rapid feedback, swarming on solutions

- Use continuous, rapid, data-driven feedback loops to test performance and refine activity.
- Deploy processes to back out and learn from failing solutions.
- Take a portfolio view – converging on decisions informed by the portfolio of options.

NOT upfront lengthy, slow, bureaucratic consultations before innovations have happened.

Why? Decisions that are quick and informed by data/evidence, not theory or speculation.

SWARM GOVERNANCE USES DATA, RATHER THAN RULES, AS THE MECHANISM FOR SECURING TRUST.

VISION: Decarbonised, secure, affordable energy system – which includes deploying domestic demand response

	GOVERNANCE TODAY Rules as the mechanism for trust		SWARM GOVERNANCE Data as the mechanism for trust
FOUNDATIONAL ARCHITECTURE	Extensive rules, protecting consumer <ul style="list-style-type: none"> Inputs and outputs focused Top-down flow of decision-making 	<i>Rationalisation & localisation</i>	Agree lean hive rules, serving the consumer <ul style="list-style-type: none"> Outputs focused Bottom-up principle of subsidiarity
GATEWAY TO PARTICIPATION	Licenses, prequalification and testing as entry criteria <ul style="list-style-type: none"> Extensive upfront licensing and compliance requirements Special derogations for trials 	<i>Simplifying requirements – except on data</i>	Freely explore in the field, gathering data <ul style="list-style-type: none"> Standardised datasets generated from any trial – standard data format Trials as live services, taking portfolio approach <small>[Retain selected compliance requirements where scale has material impact]</small>
FEEDBACK MECHANISM	Light-touch monitoring and formal consultation <ul style="list-style-type: none"> Light periodic monitoring Feedback through formal consultation, reliant on industry argument 	<i>Heavier investment in monitoring & response</i>	Share data for rapid feedback, swarming on solutions <ul style="list-style-type: none"> Extensive, continuous monitoring in real-time Evidence-based rapid response – formal & informal, always transparent
PROS	Stability Absolute consumer protection		Agility – including quicker uptake of beneficial innovations Evidenced-based solutions Rapid resolution of issues arising Decarbonised and flexible
CONS	Potentially slow rollout of beneficial innovations Bias towards parties who have the resource and access to participate		Lower investment certainty Risk of (short-lived) consumer/system negative impact
SUITABLE MARKET LANDSCAPE	Mature, homogeneous market Often larger players and/or projects		Immature and diverse market Large number of players and/or projects – often individually small

The move to principles-based regulation is regularly discussed in the energy sector – and was widely endorsed throughout our stakeholder discussions. But in practice it has not happened yet: licenses have been getting longer and more complex; the same applies for codes. A leaner set of market principles can address many of the Industry Value Chain barriers.

As a starting point, we believe that hive rules need to treat consumers as Queen bee, and to adopt the principle of subsidiarity.

Customer centre stage: Before we get caught up in technocratic discussions of revenue stacking interfaces and testing procedures, we need to remind ourselves not to lose sight of the single most important element: our customers. It's the people we are ultimately trying to serve and they should be the ones we consider first within energy system rules.

For instance, we recommend an inclusive approach to help ensure flexibility schemes can be taken up by all regardless of wealth or how informed we might be.

Principle of subsidiarity. The current governance of the energy sector is inherently top-down: EU legislation → primary legislation → secondary legislation → licenses → codes.

But a truly decentralised energy system calls for decentralised energy decision-making. If we are to empower greater field exploration and rapid feedback loops, we need to consider more bottom-up modes of governance.

Perhaps we can take inspiration from the Paris Agreement. This was a departure from the structure of previous international climate agreements. Instead of a 'top-down' structure with emissions reductions allocated to each country, the agreement is instead 'bottom-up' with countries determining their own emissions reductions. It required countries to set emissions reduction goals that are consistent with its 'highest possible ambition', and that are 'fair and ambitious in light of its national circumstances'.

Or imagine if the energy sector adopted the principle of subsidiarity – whereby system actors at national level do not unduly interfere with those at a local level, except where strictly necessary.

Energy would be supplied and balanced from within the closest possible local unit. Now that would begin to set the context for very substantive change.

#SwarmGovernance

Our swarmed solutions for domestic DSR so far include:

- **Clarify industry responsibilities for heating** – what regulatory requirements might apply in future.
- **Accelerate ongoing rationalisation and standardisation activity:** For instance, the Energy Networks Association's (ENA) *Open Networks*, Ofgem's *Capacity Market Review*, and BEIS's *Energy Codes Review*.
- **Define a comprehensive set of principles for revenue stacking.** This might be an evolution of the ENA's new Flexibility Principles for DSO services.
 - *Hierarchy:* A technical hierarchy for service provision in the event of conflicting obligations.
 - *Stochastic approach:* Agreement on a common stochastic approach to procurement across portfolios.
 - *Temporal alignment:* e.g. contract start and end dates, and using the same time block periods during bidding.
 - *Visibility:* On where services are needed, long-term.
 - *Metering requirements:* standardised across services.
 - *Baselining:* standardised across services (P376).
 - *Interoperability:* across IT systems.
- **Adopt Open Data presumption – with common data format:** for ESOs and DSOs – to include improved *accessibility* and *quality*. For inspiration, see Australia's Digital Twin approach ('network opportunity maps').
- **Pursue Balancing mechanism reform:** Explore solutions such as widening access (P344), providing market access guidelines, or developing a BSC party role appropriate to smaller providers (applicable parts of BSC, charges, rights etc). Where possible, favour overall simplification above special treatment.

CUSTOMER JOURNEY

INDUSTRY VALUE CHAIN

Sometimes there is no substitute for getting on and doing something. Stakeholders gave numerous examples of this in action. For instance, early DSO service provision was postcode-based only and secured low response. However, just by turning the postcodes into a map, participation increased.

Swarm Governance empowers providers to get multiple trial solutions out into the field, testing new options, dynamically exploring and experimenting.

Trials v business-as-usual

Our current energy system approaches novel models with distrust: new players must meet onerous qualification requirements before they can proceed. Workshop participants acknowledged that current 'sandbox' and 'funded trial' arrangements helped to get pilot projects going – often through regulatory derogations, or just special advice on how to navigate the complexity. But they pointed at the gulf between trial and business-as-usual – the challenge of scaling up after the special help has ended.

This raises the question: is it that special opt-outs are needed for trials, or is it that the fundamental architecture is just too onerous? And do we meaningfully test consumer engagement and take on the 'trust problem' if we frame innovations as mere trials?

Shifting where the burden of proof sits

Instead of relying on extensive pre-testing, let's trust innovators to get on and innovate – creating the right enabling environment.

This means shrinking prequalification and testing requirements to assume that any specific asset / portfolio of assets can be used to stack multiple services, unless proven otherwise. The onus is placed on the system to prove that it can't be used for a service, rather than vice versa.

This empowers innovators to get on and deploy in the field, to learn by doing. And it ensures that system operator decisions are grounded in real data, being truly evidence-based, rather than falling prey to unconscious bias.

Of course, it remains important to maintain system stability and keep the lights on. So any risk to system security needs to be mitigated by starting with small portfolios, by investing in rapid monitoring and response, and by overprocuring where necessary. We note that such overprocurement brings additional cost to consumers – but this cost should be viewed alongside the competitive benefits of enhanced market liquidity.

#SwarmGovernance

Our swarmed solutions for domestic DSR so far include:

- **Trial alternatives to turbocharge consumer trust:**
 - For instance, test the industry-led solution of the FlexAssure model on domestic DSR, based on The Association for Decentralised Energy's experience in developing a voluntary standard for Industrial & Commercial DSR.
 - Also test more government-led options such as labelling, or a flexibility equivalent to the Microgeneration Certification Scheme.
 - Continue to fund trials such as Core4Grid which test consumer market propositions.
 - Scale up the Energy Systems Catapult's Living Lab.
- **Relax prequalification and testing requirements by Systems Operators, where possible:** Shift the burden of proof away from upfront prequalification and testing, to scrutiny of operational data and a portfolio view. Encourage stochastic approaches as a way to increase system operator trust. Adopt common data standard.
- **Ensure the RIIO-ED2 price control process gives DSOs the right incentives to meaningfully experiment:** Create outputs-based incentives to turn Network Innovation Allowance and Network Innovation Competition projects from trials into live services. Place medium-term incentives on DSOs to scale up innovation. Linked to this, encourage DNOs to build network capacity markets.

CUSTOMER JOURNEY

INDUSTRY VALUE CHAIN

Continuous, rapid, data-driven feedback loops would transform our energy sector. We can deploy processes to scale up successes and back out and learn from failing solutions.

We define 'data' here in the holistic sense – spanning extensive empirical datasets such as granular DSR performance data – but also qualitative data and feedback too. This is about quickly picking up on emerging issues and having processes in place to respond quickly.

For system actors – rigorously analyse operational performance data, and retune

Slimming down pre-testing can only be accepted by system operators if it is matched by increasing scrutiny of operational data.

So let's rigorously collect data at system, portfolio and asset level, so we can assess what systemic impact the portfolio is having, and how the assets are contributing to portfolio performance.

Let's use the data to constantly adjust the portfolio, e.g. tuning its performance, steering it towards a proven, reliable, economic service. If performance is strong, let's enable the portfolio to scale. If performance is poor, let's interrogate why.

This means including clear arbitration / restriction of service requirements where trials fail to deliver. There would be a clear process of ensuring a subsequent trial does not fail in the same way – or at least that the impacts of their failure are brief and inconsequential.

Adopt real-time engagement techniques to collate qualitative data

Technology and business models are moving quickly: policymakers, regulators and regulated entities need to catchup. This means embracing immediate, regular and transparent communication.

We've arguably hit 'peak consultation': our current overly formal process of consultation, with multi-month response periods is unduly bureaucratic and alienates innovators. It's time to adopt direct, real-time platforms for engagement and to embark on meaningful conversations. This is not about supplanting the traditional consultation methods entirely – but rather deploying them more selectively, and supplementing them with more continuous, modern and transparent communication.

#SwarmGovernance

Our swarmed solutions for domestic DSR so far include:

- **Revamp Building Regulations:** Respond to the known issue that Standard Assessment Procedures (SAP) need to better accommodate energy flexibility – for instance through a smart readiness indicator. Where possible, focus on the outcome (e.g. carbon) rather than specifying specific technologies.
- **See social media as a hub of consumer and industry engagement:** Supplement formal consultation channels with informal yet transparent real-time communications – to help emerging issues be swiftly addressed.
- **Leverage automation to remove rules biased towards big projects.** Invest in operational monitoring rather than upfront prequalification, testing and administration such as needing to register constituents in asset portfolios. Technology and automation provide solutions if we choose to adopt them. The ESO's experimentation in closer-to-real-time procurement models for frequency response may deliver important empirical data that we can learn from.
- **Accelerate ongoing processes:** For instance, opening up behind the meter competition under P379.
- **Sharpen price signals** while making them more cost representative. This means factoring in environmental externalities and creating a level playing field.

CUSTOMER JOURNEY

INDUSTRY VALUE CHAIN

WE HAVE CONSIDERED THE COUNTERARGUMENTS, AND BELIEVE THAT THE SWARM GOVERNANCE CONCEPT STANDS UP TO SCRUTINY.

1. Agree lean hive rules, serving the consumer

Q: Isn't this already happening? There are numerous 'rules rationalisation' processes ongoing.

A: Yes it is – and now's the time to accelerate them.

Q: What is the risk of oversimplification? Aren't rules there for a reason?

A: To some extent, the complexity reflects the impact of continual tweaking/amendments over time, and a system that is built around traditional structures struggling to accommodate innovators too. The risk of oversimplification is mitigated by rapid feedback (Principle 3). It will be a guiding principle that any issues arising are swiftly responded to, informed by empirical data.

Q: But what if we strip out important protections? What if lighter rules mean that consumers suffer?

A: We believe that 'serving Queen bee consumer' should be at the heart of hive rules. More generally, consumer protection under the Swarm Governance model comes through swift response to issues arising, moreso than upfront requirements.

Q: Isn't this approach biased towards DSR? What about the rest of the energy system?

A: Scrutiny of DSR barriers reveals the underlying dynamic governance challenges in our energy system, but really it is the emergence of data – rather than DSR – that is the gamechanger. Empirical data is the neutral arbiter between technologies and solutions.

2. Freely explore in the field, gathering data

Q: Doesn't this risk system security? If the power system is in an emergency scenario, then it's too late to find out if a service can be delivered or not. That's why we need upfront due diligence.

A: This is mitigated by keeping each individual experiment small, and taking a system-wide *portfolio* view. If the system operator finds that a provider repeatedly fails to deliver, then it can use that data under Principle 3 to respond accordingly – which might mean revisiting testing requirements. We note that the portfolio view brings costs – such as requiring overprocurement – but believe this is justified by the enhanced market liquidity.

Q: Isn't it inefficient to pursue multiple options in parallel?

The inefficiency argument has been a classic one against agility in software development. It was argued that it was more efficient to do analysis in a block then design, then coding, then testing. In practice, the analysis is rarely perfect, this tends to be discovered a long way down the track, at which point you need to go back and change it. But changing it then has cascading effects on other items, you get bogged down and the pace of change becomes glacial.

Lean theory argues to do things in smaller chunks and with tight feedback loops. Lean design accommodates multiple parallel explorations of different design ideas. It looks inefficient to do something multiple times in parallel and then throw away all but the best solution, but this is actually a much faster way to converge on a better solution.

Q: Doesn't diversity in consumer propositions bring price obfuscation? The market becomes less efficient because customers are less able to compare heterogeneous products.

A: We agree that we need to keep consumers front-of-mind. But how can we figure out what is the best model (for consumers and climate) unless we test different service packages? With data, intermediaries such as price comparison websites will be able to compare different offerings, to help consumers make good decisions.

3. Share data for rapid feedback, swarming on solutions

Q: Aren't feedback loops slow for a reason? To ensure formal, fair approaches are adopted?

A: In system operation, the feedback loops of performance monitoring are slow due to lack of resource – with more effort placed on prequalification instead. In policymaking, procedure-heavy, slow and formal consultations risk giving greater influence to large incumbents with inhouse knowledge, resource and access. Transparency and keeping all communications public domain can help to ensure fairness.

Q: Doesn't rapid feedback make the investment climate much less certain?

A: The need to decarbonise our energy system, and the emergence of multiple technology solutions and models, is creating genuine uncertainty in the future direction of our energy system. Under the Swarm Governance model, this risk is mitigated by explicitly stating Agility itself as Principle. Service providers then understand that certainty comes from their ability to continually learn and evolve. Macro certainties exist, and rapid prototyping will unearth the most viable paths most quickly.

Q: Consumers haven't asked for this. Aren't these new models being pushed by industry, not pulled by consumers?

A: Whilst consumers might not be directly asking for EaaS, the UK is committed to decarbonisation targets under the Climate Change Act. Analysis by Imperial College cited earlier in this report highlights the importance of system flexibility to achieve the low carbon transition cost-effectively. In this context, it is important to explore new models. Energy suppliers are innovating to achieve this energy transition, whilst also finding new ways to keep consumer bills low. EaaS is one possible model to consider within a wider suite of flexibility options.

“When was ever honey made with one bee in a hive?” Thomas Hood

We hope you enjoyed this report. For us, writing it has been a useful way to collectively frame our thoughts – but our ultimate goal is to *address* the barriers identified. We’re more interested in *verbs* (the doing) than *nouns* (our report): we want to influence, collaborate, test, learn, implement, refine and more.

So we’re seeing this report as the start of something, rather than the end. We’re envisaging demand response emerging as a testbed for a more dynamic mode of governance, helping us to achieve a fully decarbonised grid.

Let’s work together.

#SwarmGovernance



WITH THANKS TO OUR CONTRIBUTORS

GEO: Thomas Whiffen, Mark Penhaligan

EDF Energy: Akshat Gupta, John Mason

Upside Energy: Graham Oakes, Mitchell Curtis, Rachel Jones

UK Power Networks: Lynne McDonald, Romina Arefin, Daniel Saker

HACT: Jay Saggarr

Cambridge Energy: Jason Palmer, Nicola Terry

The Association for Decentralised

Energy: Rick Parfett

BEIS: John Hasar, Navdeep Gujral

Elxon: Peter Frampton

Energy Networks Association: Randolph Brazier

University of Exeter: Rachel Bray

Energy Systems Catapult: Tim Stiven

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AUTHORS & REVIEWERS

Authors: Felicity Jones, Benjamin Lock, with substantial contributions from Graham Oakes.

Reviewers: Paul Reynolds, Joe Phillips.

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