Energy Data Review

Summary Report

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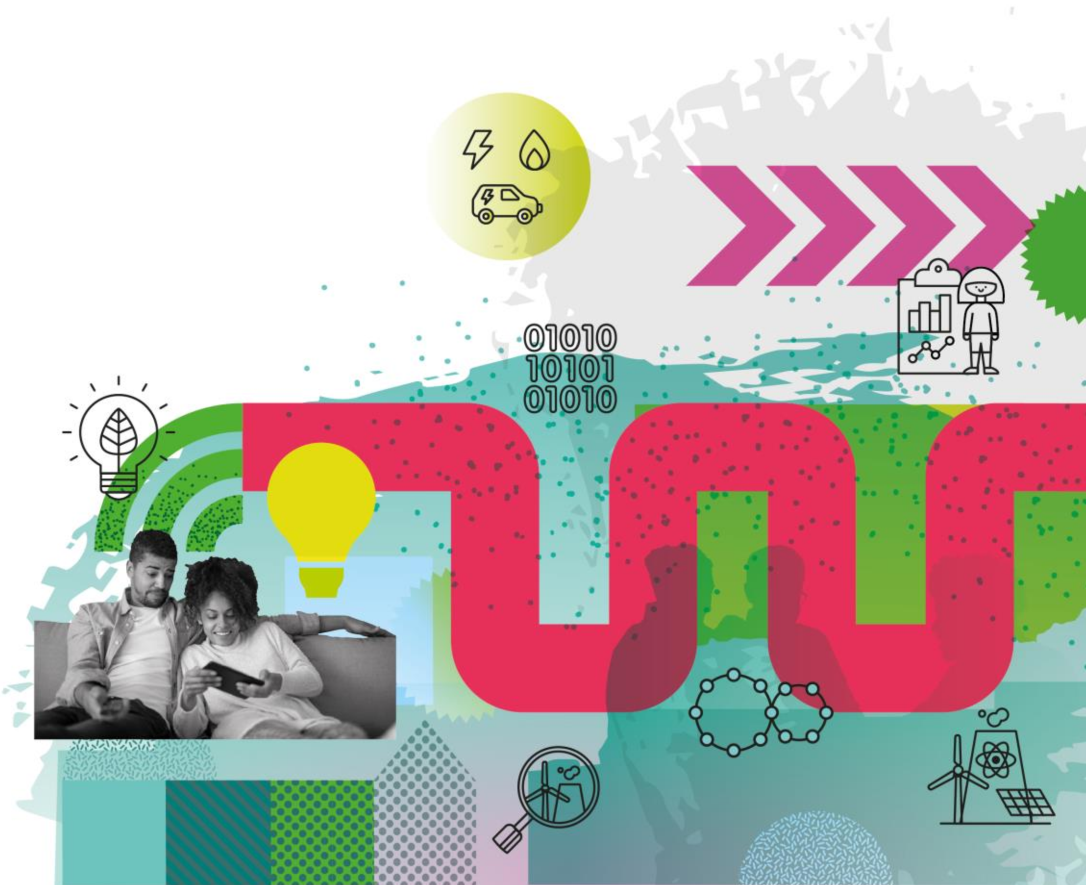


1. Introduction

Change is occurring in the GB energy sector, this is driven by decarbonisation, decentralisation of energy resources and increasing consumer expectations. There is an assumption that data and digital systems will support this change and deliver a flexible, low carbon, consumer centric energy system; although, it is unclear if this is feasible within the current technical landscape.

Key Drivers

Decarbonisation **Digitalisation** **Changing Consumer**

Many emerging energy system functions will require data to operate effectively. Substantial amounts of data will be generated by centrally governed functions of the energy market, particularly the roll out of smart meters. However, the digitalisation of consumer devices, buildings and lives represents the greatest potential growth in data and related services. When combined with data science techniques; digital systems and data offer an abundance of transformational opportunities. However, cyber security, data privacy and data protection are all significant risks that must be mitigated.

The energy sector needs innovators to create solutions and new business models to unlock the opportunities that data can offer. At present, many innovators (both within and outside of the sector) find the data landscape opaque; this impedes progress and increases the risk that the potential benefits of data and digital transformation will not be realised.

The principle aim of the Energy Data Landscape Review is to establish a baseline reference data landscape for the GB energy sector (electricity and gas) which is supported by critical insights. In combination, these can be used by innovators to inform, validate and refine business models that support the transformation to a future digital energy system.

This document is a concise synthesis of the full report and is designed to present the key insights and recommendations in an easily digestible format for those involved in data policy and regulation. For more detail on any topic covered please refer to the full report.

2. Overview of Current Data Landscape

One of the key outcomes of the Energy Data Landscape Report was a model to represent the current state of data and associated processes and systems in the energy sector (electric and gas). This section provides a high-level summary of a few key processes within the energy industry considering the data which underpins them, and the roles taken by various organisations.

2.1. Energy supply

Energy suppliers are a central part of the energy supply chain; they own the relationship with the customer, forecast demand, purchase energy from the wholesale market, coordinate data flows, prepare energy bills and handle payments and credit.

Suppliers purchase energy from the wholesale market via bilateral contracts or energy exchanges. In the electricity system, suppliers and producers must submit notifications of consumption and generation to ELEXON at gate closure (one hour ahead). In parallel, operational data is submitted to National Grid along with price and volume data for Bids (to decrease generation or increase demand) and Offers (to increase generation or decrease demand) to deviate from their notified position. They also submit notifications of contracted positions to the settlement agent to facilitate balancing and settlement.

Energy suppliers hold a large amount of sensitive customer data (including banking and personally identifiable information), data used to support forecasting (weather, events, etc.) and some of the most granular energy consumption data (e.g. smart meter half hourly consumption) which is protected by GDPR and Data Access and Privacy Framework (DAPF). In addition, suppliers hold data concerning energy trading which is commercially sensitive and hence access is tightly restricted.

Tracking the assignment of meters to consumers, producers and suppliers is a critical enabler of accurate billing and switching. Within the electricity system this function is undertaken by ElectraLink and Xoserve perform a similar role for the gas system.

The following data sets have been identified as most critical to existing energy supply functions:

- **Transactional meter data:** including meter readings (possibly via smart meters)
- **Meter reference data:** including consumer, producer and supplier associated with a meter
- **Customer data:** including personal, financial, preference and contextual data
- **Price data:** including tariff, wholesale and auxiliary service pricing data

Smart Metering

The Government has instructed energy suppliers to offer all domestic and smaller non-domestic consumers a smart meter by the end of 2020. This enables suppliers to monitor energy consumption more accurately which in turn enables more accurate demand forecasting. However, the presence of multiple smart meters standards has caused complexity, especially when consumers switch supplier.

A communications hub creates a Home Area Network (HAN) allowing smart meters to link with an In-Home Display (IHD) to display near real time usage and costs. The HAN allows Consumer Access Devices (CAD) to access smart meter data to enable innovative use cases such as smart energy management or heating which responds to energy price signals.

Smart meter data resides on the meter itself (13 months of half hourly and 2 years of daily consumption for electricity and gas); there is no central database. Suppliers have the right to access monthly data; and the consumer must consent to higher resolution data. Other parties wishing to access the data need customer consent and authorisation from the Data Communications Company (DCC), who manage the smart meter communications infrastructure. Once a body has become an approved ‘DCC User’ the meter can be instructed to share data.

2.2. Balancing and Settlement

For the stable supply of energy, National Grid (as the System Operator) must maintain the balance of supply and demand on the transmission systems. Balancing applies to both the gas and electricity systems, this is particularly challenging for the electricity system which needs to be instantaneously and continuously balanced. National grid utilises a range of ancillary services (such as frequency response, reserve, black start and others) as well as Bids and Offers in a market known as the Balancing Mechanism to address it.

Balancing the system requires a mix of centralised data that enables reconciliation of bids and offers, and real-time telemetry (large generation only) that provides high levels of accuracy of instantaneous supply and demand. This is augmented with geographic, economic and demographic data to predict future supply and demand. These predictions inform the amount of ancillary service requirements, both local and national network capacity planning and attainment of emissions targets.

Settlement ensures that balancing costs are correctly apportioned between market participants. Data enables balancing costs to be allocated to parties active in supply and generation (including financial traders) according to the direction and size of their imbalance. ELEXON and Xoserve perform this process for the electricity and gas industries respectively. ELEXON relies on Supplier Agents, National Grid and ElectraLink to provide data to enable electricity system settlement whereas Xoserve are more self-sufficient.

Balancing and settlement are essential parts of the operation of the energy system, and participation through accession to governing industry codes, the BSC (Balancing and Settlement Code) for electricity and the UNC (Uniform Network Code) for gas, is a license requirement. As such, data requirements for these processes are centrally prescribed and governed.

The following data sets have been identified as most critical to balancing and settlement:

- **Long term investment plans:** to determine the future requirements of the system
- **Future demand and generations scenarios:** to inform investment and development plans
- **Service descriptions and volume required:** to enable investors to target specific revenue streams and stack commercial opportunity
- **Reconciliation of energy production and consumption:** ELEXON and Xoserve processes and industry data flows.

Implementation of policy initiatives

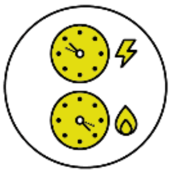
Separate from the settlement system, there are financial flows associated with policy initiatives introduced under the Government's Energy Market Reform (EMR) programme. The Low Carbon Contracts Company manages payments under the Contract for Differences and the Electricity Settlements Company manages payments due through the Capacity Market. Over time, each incremental policy addition has increased the requirements for data exchange between operational parties and increased the requirement for regulatory reporting. As policy is often driven by political priorities and timeframes, the implementation of these new flows has often been through tactical solutions which have increased complexity, resulting in a complicated system. As energy policy evolves and legacy initiatives are replaced or removed there will be a significant effort required to ensure that new data requirements can be integrated at low cost and in line with the wider transformation taking place within industry.

2.3. Emerging models for data use

Data is an integral part of the current energy system, enabling many of the core functions (such as those described above) but as digitalisation continues, new business models and propositions will emerge which require more detailed and timely data to enable their operation.

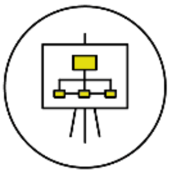
The current generation of emerging models and propositions can be broadly summarised into six key types described below. These models are interrelated and intersected; they are at varying levels of maturity (ranging from trials to early commercial products) and over time they are likely to evolve further. Data and insight is at the centre of all these models. In addition, the ability to collect and analyse data in order to continuously improve products is likely to become a key differentiator.

Time of use optimisation



Harnessing flexibility in the system (e.g. demand shifting, storage, flexible distributed generation, etc.) to respond to system constraints and energy prices.

Marketplace operations



New marketplaces may allow consumers to be matched to generators, disintermediating traditional suppliers. Possibly via 'distributed ledger' based peer to peer trading.

Efficient consumption

Utilising data to make consumer consumption more efficient, e.g. intelligent heating control systems.

Lifestyle products

Using data to enable consumers to tailor their home or work environments to their preferences.

Energy as a service

Supplying an outcome rather than just energy. E.g. paying for 'heat as a service' rather buying a boiler and gas.

Bundling

Packaging services together into a single proposition such as heating system, insurance and maintenance.

3. Issues with Today's Energy Data Landscape

As the electricity and gas industries have evolved, they have taken on additional roles and provided new services. To enable this, tactical solutions and point-to-point data exchanges have been developed which have resulted in an overly complex data system that is unsuited to future system requirements. There are several factors that inhibit the potential of data to enhance the performance and efficiency of the energy system, including:

- **Fragmented systems and organisations:**
    - There are many organisations involved in the transmission and storage of data, and in many case no centralised repository or coordinated data exchange methods. E.g. a lack of central record of distributed generation resources makes it difficult for DNOs to determine what flexibility is available in an area.
- **Inconsistent standards and protocols:**
    - Organisations have interpreted standards in their own way and created incompatible stand-alone systems. There is no body representing the energy sector as a whole with a clear responsibility for developing and maintaining data standards and interoperability frameworks. This problem has existed for many years and therefore considerable leadership and investment will be required for standardisation efforts to succeed.
- **Rigid data privacy rules:**
    - Rules to protect personal data place significant constraints on access or require explicit consent from the consumer. These constraints are over and above those in other industries for similar data types. E.g. half hourly energy consumption is strictly controlled but more granular broadband usage is significantly less robustly controlled.
- **Incomplete asset data:**
    - The volume of data captured concerning the operation of the energy system is increasing but, in some areas, data remains scarce or not accessible to legitimately interested parties. E.g. DNOs are unaware of capacity used to charge electric vehicles.

- **Lack of data incentives:**
  - There are limited incentives for maintaining high quality data sets and responsibility for resolving information asymmetry between parties' remains with the regulator. There is a trend towards the 'lowest common denominator' of data (e.g. the Week 28 report exchanged between DNOs and National Grid) and little recognition of data value for organisations, energy system or consumers.
- **Separation of electricity and gas processes:**
  - Despite many similar operations taking place, systems for gas and electricity are separate, with legacy data challenges and well-established processes providing a barrier to closer integration and cross vector operation

These factors compound to create the following inefficiencies and limitations within today's energy system:

- **Inefficient system operation:**
  - The potential of data to enhance the efficiency of near term operation of the energy system (i.e. the continuous maintenance of a balance of supply and demand) is not yet being achieved at scale.
- **Inefficient investment planning:**
  - The potential for data to promote efficient long-term investment in energy network capacity is not yet being achieved. This also limits investment in distributed energy generation, energy storage and demand shifting capabilities.
- **Restriction of 'smart' product impact:**
  - Increased granularity and higher quality data are certain to enable new products that help consumers to save money, improve comfort and increase efficiency. Current arrangements restrict the development of these products, cause duplicate infrastructure to be deployed and limit the flow of useful data from smart products back in to the energy system.
- **Risk of cyber-attack:**
  - As digital systems and data proliferate, the energy system will become more reliant on them for normal operation. This in turn increases the risk of data and digital systems being used or tampered with for malicious purposes.

4. Use Cases of the Future

The transition of the energy system to a smart low carbon system will proceed in parallel with the transformation of the digital and data landscape. Digitalisation will take place throughout the energy system. Moving behind the meter opens a vast set of data concerning consumers' behaviour and preferences. This data often has no direct connection to energy and cannot be controlled or certified by traditional industry authorities. Realising the potential value will require energy system actors to embrace a range of new tools and techniques to automate processing, identify patterns and find relationships within complex data.

This section examines how data may be used in the future energy system through exploring a series of future use cases. These use cases are not intended to be accurate representations of specific future market operations or business models, but provide an illustrative view on how the system might work, so that the data flows, tools, analytics, and themes can be identified.

The table below describes the broad groupings of future use cases, these are not intended to be exhaustive nor distinct but give a flavour of possible data centric models that could exist in the future.

Gain insight / information

Data provides information and insight, rather than direct control. Energy system examples are forecasting, investment and balancing and examples outside of energy are security and transportation.

Optimise the energy system

Utilising data and digitalisation to coordinate top down optimisation of the energy system across vectors. Matching DER to local demand and utilising fuel flexibility for the benefit of the system.

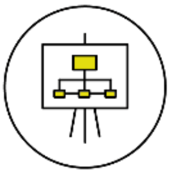
Provide a customer outcome / proposition

Service-based customer propositions will become more outcome based (e.g. comfort rather than heat), this requires a greater understanding of consumers and increasingly diverse data sources.

Optimise at community level

Local optimisation of community energy schemes and smart integration with the wider system. E.g. regional marketplaces to balance community generation and demand.

Facilitate new market models



Use cases that facilitate energy transactions across consumer / prosumer groups and see data exchanged increasingly lower down the system.

Optimise at consumer level

Consumer level 'behind the meter' optimisation, scenarios ranging from consumer managed systems using a limited number of data points, to third-party controlled systems that utilise big data from across the system.

4.1. Emerging themes from the use cases

The grouped use cases illustrate the different perspectives that the Data Landscape model can illuminate. By covering a broad set of future uses of the energy system, they help to identify key data themes in the near and long term. We have identified the following emerging themes:

- **Data availability and accessibility:**
  - Smart meter data can be the basis of much innovation, but access must be improved. In addition, more detailed contextual data will be needed to support the variety of advanced use cases; including use as proxy data in place of dedicated distributed sensor networks.
- **Data as a means of leveraging value:**
  - Data driven system operation will create value for balancing and flexibility at an increasingly local level. Energy data is likely to become increasingly valuable to non-energy organisations and propositions and multiple parties' may want to access customer data. Customers will need to understand the potential value in order to be willing share their data.
- **Governance, standards, and policy:**
  - Data standards and governance for smart devices and sensors will be required to ensure interoperability and support innovation. New customer protections may be required, especially where services are remotely controlled and for vulnerable, 'data poor' customers.
- **Cyber security and privacy and protection:**
  - Security and resilience will become complex as functions are increasingly disaggregated. Pragmatic, rather than prescriptive, approaches to cyber security and privacy may need to evolve to foster innovation. Application of provisions within GDPR to allow appropriate sharing of data need to be demonstrated to allow certain use cases to develop
- **Tools, techniques and methodologies:**
  - Automated systems will depend on AI. Furthermore, the use of non-energy data and AI / statistical techniques could remove the need for dedicated monitoring. Lastly, more frequent and precise price signals will need to be efficiently exchanged between actors.

5. Recommendations

5.1. Consumers should be incentivised to share their data via propositions which offer enhanced utility, improved experience or reduced cost

Key points:

- Consumer data is a valuable resource and consumers understandably expect value (monetary or some other benefit) in return for sharing their data.
- New energy propositions should be clearly explained in terms of the value (monetary, environmental, socially, etc.) they offer the customer and wider community.
- Propositions which require customer data should clearly articulate why this is needed and the customer should be given confidence that organisations will use it appropriately.

A future smart energy system cannot exist without the participation of consumers. Their data is required to build and test new business models, consumer demand will help innovators prosper and ultimately their participation (either actively or passively) will deliver the benefits envisaged in the UK Smart Meter Programme business case.

However, the public at large should not need to understand the granular changes to the energy landscape. Instead, consumers should be offered compelling propositions which utilise their data (from various sources) to create differentiated services that enhance utility, improve experience or lower cost. In lieu of an available product, the promise of future proposition value may be enough to incentivise data sharing for some consumers.

Organisations should clearly explain why data is required for a proposition, demonstrate that they can be trusted to use it appropriately and share the benefits fairly. A key challenge, not considered here but highly relevant, is how to ensure that future, highly differentiated business models do not leave more consumers in vulnerable or financially precarious positions.

Where data sets are identified that may enable multiple innovative products it may be beneficial for centralised projects to facilitate easier and more open access to data. If coordinated by a trusted body, this may help unlock innovation and re-frame an industry that suffers from low levels of trust.

A smart, data rich energy system is a key enabler of a low-carbon energy system; flexible demand enables utilisation of renewable energy to be maximised and consumption of carbon / pollutant intense energy to be reduced. This is a key benefit of a smart energy system and should be articulated to consumers.

Actions:

- Propositions need to be developed which present consumers with a good reason to share their data. This could be direct consumer benefit (e.g. lower energy bills) or societal benefits (e.g. increased utilisation of renewables and lower emissions). Note, consumers may be willing to buy into a vision rather than a fully formed product if it is compelling enough.
- Policy and regulation should be used to broker simple data access and sharing agreements where data has many use cases
- Investigate how the right behaviours towards consumer engagement can be fostered across the industry and what incentives (or other stimuli) this may require.

5.2. Consumer willingness to share data can be increased by simplicity, transparency and robust protections

Key points:

- Simple access to consumer data is essential to unleash innovation; existing energy data management has taken an approach which restricts data access.
- Consumers may be willing to share more data if they understand why it is required, who will use it and how they will be protected. Consumers should be able to provide consent in a simple way that unlocks innovative propositions.
- Transparency and traceability is key to building consumer confidence. Consumers should be able to easily see who is using their data and for what, with the facility to simply retract their consent if they wish.
- Much of the data required to enable innovation can be anonymised and a representative sample should be made available for innovators to explore and experiment with.

There is a tension between safeguarding customer privacy and providing access to data to enable new propositions and maximise efficiency. At present, the current guidance is weighted towards privacy with organisations defaulting to closed data unless compelled otherwise. The UK's Smart Metering Programme is a focal point for this discussion, rollouts in other countries have offered a variety of different solutions which enable customers to control their data. The UK could be judged to have taken the most restrictive approach, without central data access and with a market structure that puts smart meters in the hands of energy suppliers rather than energy distribution network operators.

Consumers' appetite to share data is an underexplored element of the current privacy debate, it may be that consumers are willing to share more data so long as they have sufficient control and receive a fair share of the benefits. The foundation of this would need to be transparency; backed up with a simple mechanism to enable the consumer to provide (and remove) consent, control what granularity of data is available and see what purposes it is used for. Combined with robust consumer protections this could alleviate many of the perceived consumer fears.

Many future use cases rely on consumer data, including both historical and real time measurements. However, initial development of business models and products may be possible with a representative sample of appropriately anonymised data rather than that of individual consumers. Technology firms utilise anonymisation approaches which preserve much of the value of data whilst ensuring complete anonymity of individual customers, this could be a suitable approach for the energy industry.

Actions:

- A cross industry mechanism should be established to enable consumers to easily provide consent and control access to their data. This could also include traceability of who has utilised their data, for what and the ability to easily retract their consent.
- Campaigns should make consumers aware of the protections that exist when sharing their data and which organisation is responsible for monitoring data usage in the energy sector.
- Ofgem should make a representative sample of anonymised energy sector data publicly available to increase innovation.

5.3. Leadership is required to initiate and enforce wider data sharing and ensure the Smart Meter Programme business case is realised

Key Points:

- Lack of access to high quality data is a barrier to more integrated planning and operation of the energy system, as well as innovation.
- GDPR and DAPF are oft cited as reasons for not sharing data but there are likely to be commercial and political factors influencing the closed data environment
- Strong leadership is required to unblock the data sharing landscape and ensure the energy systems moves toward the smart, flexible and integrated solution GB requires.

Across the energy landscape there is data that is underutilised and therefore not supporting the transition to a smart energy system. Examples include the half hourly data for distributed generation not being made available to the System Operator, and the lack of a common and comprehensive register of EV charging infrastructure, generation and storage capability connected behind the meter.

The barriers to greater sharing of data are often cited as limitations of Licence Conditions (which tend to maintain the status quo) and data privacy (including GDPR and DAPF). However, data is a valuable asset which enables companies to derive powerful insights, optimise costs and find commercial advantage. Sharing of data increases market disruption by enabling others to innovate and potentially undermines business models. Combined, these factors limit enthusiasm to share data as the perceived risks may appear to outweigh the potential benefits for a particular organisation.

Lack of data is likely to cause the most acute issues where smaller players and new entrants lack the relationships, influence, financial resources, or awareness to push for change and secure information that would ultimately support a better customer outcome. The challenge is also common across information exchanges between commercials parties, and those that could be described as in the public interest of broader value to the whole system (drawing parallels with Open Banking initiatives).

It is important to understand that whilst it may be advantageous for some data to be open and freely shared with all, other data will naturally need to be tightly controlled; shared with a limited group of trusted parties to maximise benefit to the system whilst minimising organisation and consumer risk.

A consensus for data catalogues, standards and interfaces should be established across the industry. Where possible, data aggregation and anonymisation should be shared or centralised to avoid duplication of effort and increase return on data investment. This may mean that central actors (such as DCC) need to provide processing services rather than just facilitating access to raw data.

Actions:

- Strong leadership is required to unblock the data sharing landscape and ensure the energy system moves toward the smart, flexible and integrated solution GB requires. Interests of the current sector and innovators should be balanced, and external challenge welcomed.
- A framework defining what data should be shared and how this evolves over time is required. This should be supported by simple and pragmatic governance that considers privacy considerations but is not led by them.
- The ability for industry organisations to offer central data processing should be considered.

5.4. Data standards and interoperability frameworks are needed to enable the greater exchange of data

Key Points:

- Interoperability between energy system components and the wider digital world is key to enabling the broadest range of benefits across all consumers types and industry participants
- Consumers derive a high degree of value from having choice and flexibility and not being tied to a specific vendor or technology.
- Decentralisation of the energy system comes with a risk of enabling multiple standards to proliferate, which may not be able to interact with each other
- A framework for leading, coordinating and governing the development of data standards and interoperability would act both as an accelerator for innovation, and a safe guard against a high cost, highly fragmented energy system emerging

Energy data is being produced at an ever-increasing rate and from a wider variety of sources than ever before, e.g. consumer IoT sensors and devices. This is already resulting in a proliferation of data 'standards' and lack of interoperability. This often means the consumer faces the prospect of losing data when switching platforms (perhaps driven by existing products being discontinued and therefore unsupported) and increased duplication e.g. energy monitoring hardware being installed alongside a smart meter.

A standard framework for energy data could help to mitigate these risks. Standards for data format, quality and exchange would be specified to ensure that systems are interoperable, whilst still allowing innovation to enhance user experience and system efficiency. The standards would need to be sufficiently flexible to accommodate new functions and growth of existing ones.

A unified framework is unlikely to develop organically given the sheer breadth of roles and requirements across the energy landscape. However, the market for devices and services wishing to integrate energy data is still developing and there is therefore opportunity for the energy sector to become more open and interoperable; enabling innovators to integrate and creating benefit for the energy system and consumers. Such an effort would require leadership to develop, establish and maintain a standards framework. It is not clear that there is currently a body which represents the whole energy industry, or with the necessary capacity, to undertake this role. The requirements of a framework need to be developed, consulted on and ultimately driven forward by a suitable organisation.

Actions:

- Identify / develop / establish an organisation who have the mandate and industry support required to establish energy sector data standards and interoperability standards.
- Investigate existing data standardisation and interoperability projects as a starting point for future work. Either learning from their mistakes or developing their work.
- Consider wider (non-energy industry) requirements which may improve consumer propositions and increase uptake.

Energy Systems Catapult supports innovators in unleashing opportunities from the transition to a clean, intelligent energy system.

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