Digitalising our energy system for net zero

Strategy and Action Plan 2021

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Ministerial foreword

Harnessing the power of data and digitalisation is vital to reaching the UK's world-leading climate change target. Digitalising our energy system will ensure we can support competitive markets, seize economic opportunities, and capitalise on new low carbon technologies.

The government presents this strategy and action plan at a critical time for the UK as we build back better and greener after the pandemic.

This is a unique moment to demonstrate global leadership as we publish the UK's vision for digitalising the energy system as we transition away from carbon. We are already leading the way in science, innovation, technology and 'open data'. This strong foundation means that data and digitalisation can enable us to tackle climate change and benefit both the system and consumers.

The Rt Hon Anne-Marie Trevelyan MP

Minister of State for Business, Energy and Clean Growth

Ofgem foreword

The energy system needs to transform significantly to reach our climate change targets at the lowest cost. The cheapest and quickest way of getting there is using the energy that's already on the system, instead of building expensive new infrastructure. This means getting the millions of low carbon technologies across Britain talking to each other. Solar panels, wind turbines and battery storage, to heat pumps, electric vehicles and smart appliances, all have a role to play in a smart and flexible energy system.

Connecting these technologies digitally will create data with incredible value. Everyone can benefit from this technological revolution: better knowledge, insights and analysis will drive better quality products and services.

This is a genuinely exciting moment on our journey to a smarter future energy system that works for both consumers and our planet. The prize is huge: reaching a low carbon energy system faster and more cheaply, with lower bills for consumers. I am delighted to launch this shared vision and approach, setting out the concrete steps we will take alongside government and industry.

Jonathan Brearley

Chief Executive, Office of Gas and Electricity Markets

Executive Summary

Data and digitalisation are transforming economies across the globe, in sectors from banking to transport to healthcare. It is now the turn of energy, with digitalisation an essential enabler of the rapid decarbonisation we need to avoid catastrophic climate change.

In April, the UK government announced a world-leading climate change target (the sixth Carbon Budget) to reduce emissions by 78% by 2035 compared to 1990 levels, on a pathway to net zero greenhouse emissions by 2050. In the energy sector, we will need to deploy millions of low carbon technologies – including solar panels, heat pumps and electric vehicles. Electricity from the sun and wind will need to be balanced, second-by-second, with the energy demand from our homes, businesses, and vehicles. Electricity will be stored for when it is required. Consumers will be able to choose from a range of smart technologies, tariffs and services to maximise their use of renewable energy whilst keeping their bills low. The benefits of this future 'flexible' low carbon system are significant – faster and lower cost decarbonisation, and lower bills for consumers. However, it will only be possible if we harness the power of data and digitalisation across our energy system. We need to move quickly; it will be very difficult to achieve the deep power sector decarbonisation needed to achieve targets for the sixth Carbon Budget without significantly higher levels of system flexibility.

This strategy and action plan, the first of its kind in the UK and one of the first in the world, provides a vision, approach, and suite of actions for digitalising the energy system so that we can meet our net zero ambitions. It has been developed in partnership between the Department for Business, Energy, and Industrial Strategy (BEIS); Innovate UK;[1] and the energy regulator, the Office of Gas and Electricity Markets (Ofgem). It builds on the impressive progress already being made by the sector, the work of the independent Energy Data Taskforce, and extensive stakeholder engagement throughout 2020 and early 2021. This strategy is being published alongside the government and Ofgem's new Smart Systems and Flexibility Plan, which sets out how we will utilise technologies such as energy storage and flexible demand to integrate high volumes of low carbon power, heat and transport onto the energy system.

The strategy's Introduction explains why we need to digitalise the energy system, and the benefits of doing so for decarbonisation, consumers (including the most vulnerable), and the economy (the UK is a global leader in open data and smart energy systems). It also describes the journey so far and how this work programme is organised within the government and Ofgem, as well as other governance considerations.

The 'Barriers' chapter explains what the key barriers are to system digitalisation. These include the significant and complex scale of change; the lack of incentives needed to initiate the

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[1] Innovate UK is part of UK Research and Innovation (UKRI), a non-departmental public body funded by a grant-in-aid from the UK government. Innovate UK is referred to throughout this strategy as the primary delivery partner within UKRI. Innovate UK works closely and collaboratively across UKRI with the Research Councils. For the purposes of this strategy, Innovate UK is considered a part of the government.

cultural shift and investment needed to kick-start a digital transformation; and the absence of shared digital infrastructure, common practices and standards. It then describes broader strategic considerations including cyber security, data privacy, and data ethics and inclusion.

The 'What we will do' chapter describes the actions that the government, Ofgem and industry will take to tackle these barriers. These actions represent the next phase of policy; more will need to be developed as the system digitalises and decarbonises over the coming years and decades. To help us identify these, we are funding a new Energy Digitalisation Taskforce, led by Laura Sandys and the Energy Systems Catapult. We set out our approach to monitoring progress – so that we can adapt our approach in response to innovation and system changes – in the 'Delivering this Strategy and Action Plan' chapter.

We believe this strategy and action plan will provide the sector with a clear vision, direction and shared approach to accelerate our transition to a fully digitalised, net zero energy system.

Introduction: Why we need to digitalise our energy system

Our success in achieving net zero will rest on a decisive shift away from fossil fuels to using clean energy. This will require harnessing energy from low carbon sources to power our homes, businesses, and vehicles. To meet this challenge, millions of low carbon technologies – including solar panels, battery storage, heat pumps and electric vehicles – will need to be seamlessly integrated onto our electricity networks. Variable renewable electricity from the sun and wind will need to be balanced, second-by-second, with demand from our heating systems and cars. Smart technologies such as battery storage and smart heating systems will be deployed so that low carbon power is available in the right places and at the right times to meet our energy needs.

Consumers will be at the heart of this system. They will need to be provided with the right information so that they can choose the right tariffs and services that help keep their bills down whilst helping the system decarbonise. There will be more ways for consumers to actively participate in the energy market, including selling energy generated from their rooftops or using smart controls to shift their demand to periods of the day when prices are lower.

This will require an enormous step-change in the system's ability to understand and react to its increasingly complex energy flows. The success of this step-change relies on the digitalised exchange of data to facilitate an energy system which can accelerate, automate, plan, and anticipate processes far better than at present.

All parts of the energy system – demand, supply, markets, networks – need digitalising to create a more efficient 'whole system approach', but our current services are underdeveloped and inconsistent. A lack of incentives and a culture rooted in keeping network and asset information private have perpetuated an undervaluation or overprotection of data, leading to inaccurate and incomplete datasets, data silos and unnecessary data hoarding. These can act as blockers to data exchange. The sector has already taken good strides to overcome these barriers, but much more needs to be done.

We need to move quickly. Digitalisation enables the system to operate flexibly, optimising assets across our networks so that they can be integrated at least cost to consumers. It will be very difficult to achieve the deep power sector decarbonisation needed to achieve the sixth Carbon Budget (2033 to 2037) without significantly higher levels of system flexibility. We estimate that a flexible energy system could reduce system costs by £30-70bn between now and 2050.[2]

This strategy sets out the next steps we need to take. This includes looking beyond the energy sector. As we digitalise our energy system, it is vital that we use this activity to help improve

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[2] See the Introduction to the Smart Systems and Flexibility Plan, published alongside this strategy.

the use and integration of data across other sectors as well, since requirements for better data sweep across all parts of our lives and economic sectors. Only through doing all this will we unlock the full potential of data to deliver wider societal benefits.

The UK holds an enviable position of being a global leader in 'open data'[3] and in the smart technologies needed to integrate low carbon technologies onto the energy system. The UK's energy system is currently one of the most developed and successful anywhere in the world. Digitalisation can put the UK on course to lead development of the knowledge, tools, services, and workforce that are vital to every global economy.

This strategy is a key component of our broader work to tackle climate change and digitalise the economy. Digitalising the energy system is crucial to delivering the Prime Minister's Ten Point Plan for a Green Industrial Revolution,[4] which set out an ambition to building significant levels of low carbon infrastructure by 2030. The *Energy White Paper* set out the need to build world-leading digital infrastructure for our energy system.[5] Digitalisation is also a core priority in Ofgem's Forward Work Plan[6] and a core component and enabler of the new Smart Systems and Flexibility Plan published alongside this strategy.[7] The government's recent *National Data Strategy* highlights this area as an important case study for progressing its goals.[8]

Case study: National Data Strategy

The National Data Strategy sets out the government's vision to harness the power of responsible data use to boost productivity, create new businesses and jobs, improve public services, support a fairer society, and drive scientific discovery, positioning the UK as the forerunner of the next wave of innovation.

The measures the government is taking to realise these opportunities are framed around five priority missions:

- Mission one: Unlocking the value of data held across the economy.

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[3] World Wide Web Foundation (2018), 'Open Data Barometer - Leaders Edition', https://opendatabarometer.org/leadersedition/report/#table1
[4] HM Government (2020), 'The Ten Point Plan for a Green Industrial Revolution: Building back better, supporting green jobs, and accelerating our path to net zero', https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution
[5] HM Government (2020), 'Energy White Paper: Powering our Net Zero Future', https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future
[6] Ofgem (2021), 'Forward work programme 2021/2022', https://www.ofgem.gov.uk/publications-and-updates/forward-work-programme-202122.
[7] BEIS and Ofgem (2021), Smart Systems and Flexibility Plan, https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021
[8] DCMS (2020), 'National Data Strategy', https://www.gov.uk/government/publications/uk-national-data-strategy/national-data-strategy,

- Mission two: Securing a pro-growth and trusted data regime.

- Mission three: Transforming government's use of data to drive efficiency and improve public services.

- Mission four: Ensuring the security and resilience of the infrastructure on which data use relies.

- Mission five: Championing the international flow of data.

The National Data Strategy is not the final answer, but part of a conversation about the way that we support the use of data in the UK. We will continue to ensure a diverse range of perspectives inform the strategy's implementation. We will also continue to ensure the strategic importance of data is reflected in related government strategies and initiatives such as the forthcoming Cyber Strategy, Digital Strategy and Artificial Intelligence Strategy. It is with the above principles and objectives in mind that this Energy Digitalisation Strategy has developed and is being delivered.

What is data and what is a digitalised energy system?

Data is an asset. It is information that has been translated into a form that is efficient for movement or processing.

Digitisation refers to the creation or conversion of information and/or data into a digital format, which is easily interpretable by machines and from which analytical insights can be drawn.

Digitalisation is the transformation of a business or industry by using digital technologies to improve its processes.

A **digitalised energy system** is one where:

- Presumption of data openness is the industry default;
- Data is adequate, standardised, and interoperable across the sector;
- The required infrastructure, processes, technologies and skills are appropriately deployed;
- The relevant rules and regulations, costs and benefits, and roles and responsibilities are clear.

*These definitions are not intended to be used as regulatory definitions.

This strategy focuses primarily on energy *system* data. This means data that relates to how the system operates, the markets that send signals to system users, and the physical infrastructure located on the networks. This data is fundamental to enabling the development of the products and services that consumers require to gain maximum benefit from the energy system. This strategy does not focus on energy data collected *about* consumer energy use, for example individual smart meter data, as that is the focus of other programmes. We are taking care to ensure that data at the interface between the two (e.g. de-personalised smart meter data[9] used for specific system planning and operations) does not fall between the gaps (see box below).

Consumer data (including smart meter data) – and its wider benefits

Smart metering represents a step-change in the volume and granularity of data on energy consumption. The smart metering programme has developed a comprehensive Data Access and Privacy Framework to enable proportionate access to data by authorised parties, whilst safeguarding consumer interests. As we move towards a digitalised system

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[9] Once smart meter (or equivalent) data is de-personalised, such as through data aggregation and/or anonymisation, the resulting information will not be considered personal data under UK General Data Protection Regulations (UK GDPR). This is much the same as the way gender pay gap information is reported for large groups of people – it provides a valuable insight about equality and fair treatment in our society, while protecting individuals' privacy about their finances and income. The UK GDPR is the UK's data privacy law that governs the processing of personal data domestically. The UK GDPR sits alongside the Data Protection Act (DPA) 2018.

this data is likely to offer wider benefits, which will need to be considered whilst ensuring consumer privacy is maintained.

For example: Ofgem's **market-wide half-hourly settlement** programme will require energy suppliers to securely process domestic consumers' smart meter half-hourly consumption data for settlement and forecasting, whilst enabling consumers to opt-out from sharing data for these purposes. Half-hourly settlement will incentivise suppliers to offer consumers a wider range of services, such as time of use tariffs, that will help consumers match their consumption to periods when energy is more abundant – and cheaper. This will help decarbonise the system whilst reducing consumer bills.

The **Public Interest Advisory Group** on access to smart meter data for a public interest purpose, coordinated by charities Sustainability First and Centre for Sustainable Energy, has been exploring how smart meter data, on an anonymised and aggregated basis, could support government and regulatory oversight of the energy transition and aid public policy making. The government and Ofgem welcome the collaborative work undertaken by the Advisory Group and will consider the recommendations outlined in the Group's final report, published in May 2021.[10]

The **Smart Energy Research Lab**[11] is a secure virtual facility to access granular smart meter data, with consumer consent, to conduct research. This is allowing energy researchers to carry out valuable public interest work.

Smart meter data supports **Distribution Network Operators (DNOs)** to efficiently plan and maintain the electricity network. Subject to approval of data privacy plans by Ofgem, DNOs can access half-hourly consumption data. As DNOs gain experience using this aggregated and anonymised data, there may be opportunities for it to be shared more broadly to support wider system benefits and public policy making. The government and Ofgem will continue to engage with industry to explore these opportunities.

Other relevant consumer data initiatives include **Smart Data**[12] and **Midata**.[13] Smart Data is the secure and consented sharing of consumer data with third parties who offer innovative services such as automatic switching and account management. Midata is a smart data initiative for the energy sector, led by Ofgem. Ofgem has paused work on Midata as it works through the synergies and potential overlaps with other programmes such as consumer switching and half-hourly settlement.

Digitalisation will require new standards, regulations, services, roles and possibly new institutions. The government and Ofgem are currently reviewing the governance of the energy

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[10] Public Interest Advisory Group (2021), 'PIAG Final Report – Phase 1', https://www.smartenergydatapiag.org.uk/
[11] The Smart Energy Research Lab (SERL), https://serl.ac.uk/
[12] BEIS & DCMS (2019), 'Smart data: putting consumers in control of their data and enabling innovation', https://www.gov.uk/government/consultations/smart-data-putting-consumers-in-control-of-their-data-and-enabling-innovation
[13] Ofgem, 'Midata in energy programme', https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/midata-energy-programme

sector, in particular the role of the system operator and through the energy codes review,[14] to ensure that we have the right governance framework in place to deliver the UK's net zero emissions targets. Ofgem has published its findings and a recommendation for an Independent System Operator.[15] The government is now consulting on this.[16] It may be appropriate to confer additional roles on the system operator, and new data and digitalisation roles is one area under consideration.

What are the benefits of a digitalised energy system?

A digitalised energy system will provide significant benefits: for decarbonisation, for the economy, and for consumers.

Decarbonising the energy system at least cost to consumers

To meet net zero we need to integrate millions of low-carbon technologies to displace the high-carbon technologies currently in use. These assets will need to be in the right places and used in the right way to decarbonise at least cost. Digitalised systems (and the artificial intelligence solutions that can be built on them) will facilitate this, supporting both the acceleration of a cleaner energy system and managing its complexity. Digitalisation will enable better visibility of renewable energy sources for system operators, and help markets to signal to users when to use the system, for example rewarding consumers who reduce consumption at certain times of the day. Shared data and digital infrastructure underpin whole-system coordination and are key to navigating its increasing complexity at lowest cost for consumers.

Improved data quality and data sharing will also enable much better planning and operation of our energy infrastructure. For example, it will help local authorities and network companies to work together to determine the best approach for decarbonising heat by combining information on the network with local knowledge of the buildings and citizens. When electric vehicle operators are planning where to install new chargepoints, data on network constraints could help them locate in the best places for both consumers and the network, thereby reducing network costs and therefore energy bills.

Creating a fair deal for consumers

Data and digitalisation will be fundamental to help and encourage consumers to participate and prosper from the transition to net zero by enabling more tailored services, including for those who are low income or vulnerable. Data-driven insights will have the power to identify and advise consumers – with their consent – on appropriate solutions such as tariffs and services.

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[14] BEIS & Ofgem (2019), 'Reforming the energy industry codes: consultation document', https://www.gov.uk/government/consultations/reforming-the-energy-industry-codes
[15] Ofgem (2021), 'Review of GB energy system operation', https://www.ofgem.gov.uk/publications-and-updates/review-gb-energy-system-operation
[16] BEIS and Ofgem (2021), Energy Future System Operator Consultation, https://www.gov.uk/government/consultations/proposals-for-a-future-system-operator-role

A digitalised energy system could support consumers in their daily lives by making it easy to find a free spot to charge an electric vehicle, set the right room temperature to arrive home to, and remotely switch the dishwasher on in the middle of the day (when there is more solar energy on the system) to take advantage of lower energy prices.

Everyone can benefit from the more accurate knowledge, insights and analysis that help deliver better quality and fairer products, services, and entrepreneurial opportunities.
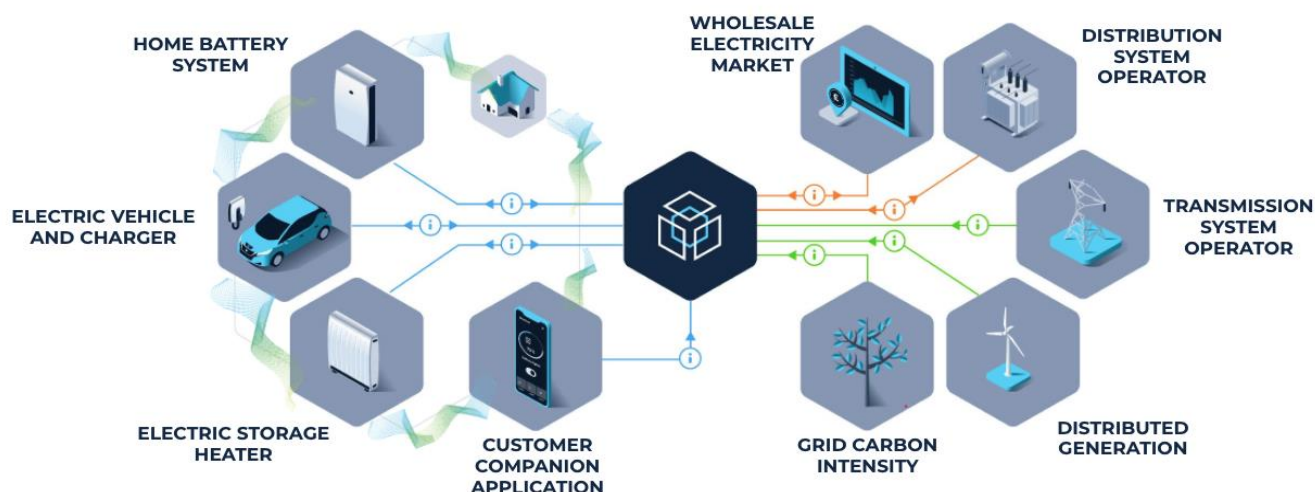
Case study: Kaluza's intelligent device charging

Integrating more renewable power onto the energy system is essential for the UK to reach net zero. However, times when the sun shines and the wind blows may not always correspond to times of high electricity system demand. Technologies like Kaluza demonstrate how we can control demand to ensure devices charge on cheaper, greener energy when there is lower demand on the grid.

Kaluza's software platform is built to connect to millions of smart devices like electric vehicles, electric storage heaters and home batteries owned by residential customers, and intelligently manage their charging.

Device owners use a mobile or web app to inform Kaluza, for example, when they want their electric car ready to drive. Kaluza's artificial intelligence and machine learning uses this information along with real-time data from the devices, electricity markets, retailers, the weather and system operators to forecast the needs of the electricity system as well as the combined capacity of connected devices to support the network.

Based on this minute-by-minute data, Kaluza dynamically controls devices to consume energy during periods of low system demand and periods of high renewable generation all while meeting customer needs. Additionally, Kaluza optimises home batteries and vehicle-to-grid chargers to export stored energy back to the grid, helping alleviate system stress at peak times and earning customers money.

Stimulating economic growth across all sectors

Digital technologies and the standards that underpin them will drive our future economic growth. New economic activity, jobs, businesses, products, services and trade opportunities are possible by opening up access to our digitalised energy system and its data to the rest of the economy. This cross-sectoral sharing and layering of data will integrate markets and create greater cohesion of products and services for consumers and citizens, for example with the health, construction, financial and transport sectors. This will be facilitated by new tools such as digital twins – realistic digital representations of physical things – which can be used to find innovative ways to design and build assets better, create more capacity from existing infrastructure and improve the services they were created to deliver.

The World Economic Forum estimates that digitalisation has the potential to unlock up to $1.3 trillion of value in the electricity sector globally.[17] The UK has led the way internationally in the development of open banking and therefore has a good blueprint and potential to do the same in energy. Our expertise and exports are in demand across the world, with the UK market in low-carbon goods and services expected to grow from £40-150 billion in 2015 to between £0.5-£1.4 trillion in 2050.[18] As nations confront the challenge of climate change, markets for new green products and services will spring up round the world. Taking action now will help position UK companies and our world class research base to seize the business opportunities which flow from it, creating jobs and wealth for our country.

Journey so far

In 2018 the government and Ofgem published a Progress Update to our 2017 joint *Smart Systems and Flexibility Plan.* This identified that energy data is a critical requirement for decarbonising our energy system, and launched the independent Energy Data Taskforce, led by Laura Sandys and the Energy Systems Catapult. The Taskforce reported back in June 2019 with five recommendations to lay the foundations for a digitalised energy system.[19] The recommendations include opening and sharing datasets in digital formats, making datasets more visible to stakeholders via a single searchable platform, improving the coordination of asset registration, and creating a map of system infrastructure.

Both the government and Ofgem formally endorsed the recommendations. BEIS, Ofgem and Innovate UK formed a partnership, called Modernising Energy: Digitalisation (MED) to work with the sector to implement them.[20] MED is a collaboration between policymakers, regulators

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[17] World Economic Forum (2016), 'Electricity: uncovering the value through digital transformation', http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-electricity-industry-white-paper.pdf
[18] Ricardo AEA (2017), 'UK business opportunities of moving to a low carbon economy', https://www.theccc.org.uk/publication/uk-energy-prices-and-bills-2017-report-supporting-research
[19] Energy Data Taskforce (2019), 'A strategy for a Modern Digitalised Energy System', https://es.catapult.org.uk/reports/energy-data-taskforce-report/
[20] Formerly the Modernising Energy Data programme

and innovation-funders that seeks to stimulate and accelerate change within the industry. Good progress has been made, set out in Chapter 2 | What we will do.

Through 2020 and early 2021 we conducted extensive engagement with the energy sector and other sectors to understand how to build on this progress and accelerate system digitalisation. We are extremely grateful to the many people and organisations who contributed their time, insight and expertise in helping us develop a vision, strategy and work programme. This joint strategy is a product of that engagement and sets out the next phase of work needed to ensure our future energy system has complete, accurate, accessible, and secure datasets available to all.

Our vision for a digitalised energy system

We have developed visions for a smart and flexible energy system, set out in our new Smart Systems and Flexibility Plan – including a vision for system digitalisation, which is repeated in Chapter 3 | Delivering this Strategy and Action Plan we will do. The vision is split into:

- what we aim to have achieved **by the mid-2020s**, for which we can have more confidence, and

- what we envisage needing **by 2030 and beyond**.

This strategy sets out broad areas of focus, and (where we have more certainty) specific actions, to lead us towards our vision. In many cases, further detailed policy development will be needed. It is likely that new evidence and opportunities will arise that indicate we need to do more in certain areas, which will be assisted by the development of our flexibility monitoring framework (see Chapter 3 | Delivering this Strategy and Action Plan). As and when this happens, we will adapt our approach.

Chapter 1 | Barriers

To realise the benefits outlined in the previous section, we need to identify and tackle the relevant barriers. During 2020 we conducted several stakeholder workshops and identified three core, high-level barriers. This chapter will set out how each of the barriers currently stifles progress towards a digitalised energy system.

Barriers

Scale of change

The scale of change needed to digitalise the energy system is significant. It requires the integration of millions of new energy assets, each with a potentially different owner, the collaboration of multiple large and sometimes competing organisations, and new infrastructure capable of not only managing trillions of secure data flows, but predicting them, too. Households and businesses are no longer passive consumers, with increasing opportunities to participate in the energy system. Digitalisation therefore needs to happen in a way that benefits a growing and diverse array of different interests. The system also sits at a junction between lots of other sectors, meaning that its management requires an understanding of many factors that sit outside its direct remit. The energy system is becoming considerably more complex.

Industry and wider actors understand the need for change, but the scale of investment needed is significant, the landscape is rapidly changing, and there are perceived potential first mover disadvantages, which can all lead to risk aversion. Businesses need confidence that their work is aligned to agreed goals and that investments will be rewarded. Without clearly aligned goals, a shared purpose and direction, and transparent governance, we are unlikely to see the scale and volume of individual investments needed to realise a digitalised energy system and good quality data.

Culture and incentives

Data is more valuable when combined with other datasets. Our national energy system is rich with opportunity for combining datasets, including system assets, the building stock, the physical network, the weather, system operation and data from other sectors.

However, without the right incentives, businesses will often default to hoarding data for their own use, denying consumers and other stakeholders the broader benefits that can only be realised when data is shared. The changes different organisations need to make internally to support digitalisation can be difficult, and the transformative benefits of sharing data are regularly overlooked, underestimated or resisted. When you do not know what data is collected, or could be made available, it is difficult to perceive all the opportunities for its use. This lack of understanding impairs decision making and leads to an undervaluation of the

benefits of digital and data investments, slowing progress. Even when the benefits of sharing are understood, a lack of incentives means that barriers to investments and solutions still exist.

Further, the energy sector is a critical infrastructure and whilst digitalisation will support us to decarbonise it, new challenges to maintaining a reliable energy system will emerge. Digitalisation will require radical change to a legacy energy system that is old and cannot be switched off.

Industry needs to be incentivised on this journey as it is often not in any individual actor's interest or capability to make many of the changes required. Policy and regulatory expectations need to be optimised to better support investment in data and digitalisation. Digital services and methods for handling data assets have different properties to traditional physical infrastructure services; analytical solutions that offer cheaper and more agile service alternatives need to be encouraged and rewarded appropriately.

Shared Infrastructure

An energy system that is built around shared digital infrastructure, from datasets to processes and platforms, can better manage the kinds of complexities that our energy system is currently facing, and is the foundation on which better data quality, visibility and access is dependent.

Shared digital infrastructure will facilitate better data exchange and utilisation. However, no one actor gains full value from investing in digital infrastructure, nor can they be confident about adoption of their shared infrastructure solution. This lack of agency can result in critical elements of practical digital infrastructure not gaining investment.
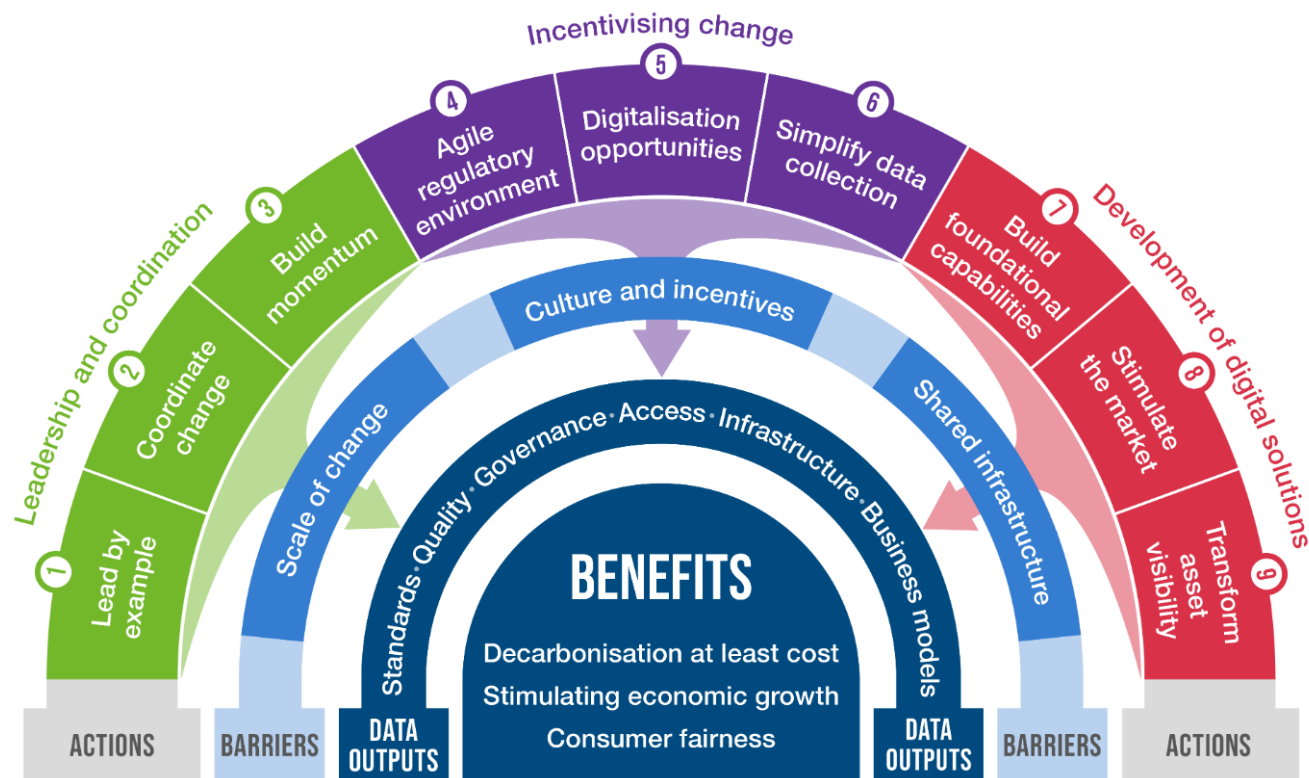
Our current energy system rarely treats data as a public asset; data is often underutilised or not collected in the first place. This results in energy system datasets that are commonly of insufficient quality to meet stakeholder needs. The datasets that do exist are mostly hidden from public view within large organisations, such that stakeholders do not know they exist or what they contain. Successfully navigating energy system data depends on highly specific knowledge and access rights which stifles ideas, innovation, and service improvements before they can begin.

Even where stakeholders are aware of what data exists and where, the sector does not have cohesive or coordinated standards and infrastructure to facilitate easy data exchange. This is a critical issue,[21] as the value of data increases significantly when it is accessible and is joined with other data.

Within the energy sector and across sectors, collective agreement and adoption of data sharing practices must be reached, and standards agreed, so that data sets are visible,

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[21] Rhodes A (2020), 'Digitalisation of Energy: An Energy Futures Lab Briefing Paper'. Energy Futures Lab. https://spiral.imperial.ac.uk/handle/10044/1/78885

accessible, high quality and 'interoperable'.[22] Current burdensome processes, including varied and uncoordinated data storage methods, overprotective and bespoke data sharing agreements, and low adoption of open-source technologies prevent energy data from reaching its full potential.

Broader considerations

To fully realise the benefits mentioned above, we need to consider the following areas.

Cyber security and data privacy

The future energy system will become increasingly reliant on digital technologies, with millions of new connections forming a network of devices, organisations, and platforms. Increased connectivity across energy production, transmission and distribution provides new opportunities for cyber actors to exploit. Robust cyber security and data privacy practices will be crucial to the stability of the system, and to give consumers the confidence to engage with connected low carbon technologies. Furthermore, cyber security should be embedded into new systems by design, to reduce the need for costly retrofitting in future.

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[22] Interoperability is the ability of data services and products to interact and share data. The term tends to cover two main aspects: the digital protocols that allow for data exchange, and the data standards used to preserve compatibility while processing data. It is enabled through open or common technical standards, which create a shared protocol for the exchange of information.

Cyber security and data privacy have been core principles of the government's wider smart energy work since its inception, underpinning policy approaches to 'energy smart' appliances and smart electric vehicle charging. We will continue to integrate these core principles into our data and digitalisation work going forward, so that our policy approaches are not confined to specific assets and are developed with a vision to securing the system.

In addition, the Network and Information Systems Regulations 2018 provides a legal measure to boost the overall level of cyber security of network and information systems across our energy infrastructure. Increasing digitalisation, including of our existing infrastructure, increases the risk of cyber-attacks. The regulations place requirements on operators of essential services to ensure they have sufficient levels of cyber mitigations in place to withstand such cyber risks.

Digital inclusion and data ethics

Data and associated digital services are already growing into an integral part of all our lives – whether we engage with them directly or not. As digitalisation continues, it is presenting an opportunity to promote greater inclusion for people in society. The curation of data assets and the digitalisation of products and services are a chance to identify and rectify social inequality to promote greater fairness in how people are treated. However, we also recognise that widespread digitalisation also brings its own risks to digital inclusion, and ethical practices when using data must be understood and mitigated.

Among the ways a digitalised marketplace can bring about fairer and higher quality services for consumers is through enabling greater use of innovative technologies such as artificial intelligence, robotics, and machine learning. These tools help consumers make choices that are better value for money for them personally, but these technological capabilities must be used responsibly. They must be inclusive and responsive to peoples' variety of needs. Automated sifting and decision-making by AI must be applied in ways that reduce and remove prejudices in society and not introduce new issues. It is vital these new market services work for everybody – whatever their circumstances. In this vein, we will build on the work carried out by the Centre for Data Ethics and Innovation, and in particular its publication of the AI Barometer.[23]

We have an important *direct* role, too; a digitalised government and regulator can benefit from improved quality of information, analysis, and insights and at times we are the direct providers of digitalised public services. We need competence and understanding of topics such as data ethics to conduct our own more effective policy making, such as for our traditional work of identifying and predicting consumers' vulnerabilities. We will also need to solve new challenges, like assuring the ethical practices used by companies as they apply AI solutions. Digital inclusion and data ethics are challenges that span economic sectors so we will coordinate our efforts with those across government and with other stakeholders.

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[23] CDEI (2020), 'AI Barometer Report', https://www.gov.uk/government/publications/cdei-ai-barometer

Chapter 2 | What we will do

Vision

In the mid-2020s we will have standards and regulatory frameworks in place that ensure energy data collection and applications meet best practice and that data assets are treated as open and accessible by default while privacy and security is protected. There will be a significant step-up in the visibility of assets across the system and new digital services will make it easier for people to know what data exists and how they can gain access to it. These services will ensure datasets can be combined with minimum time and effort for the user. The next steps for digitalising the energy system will have been identified, including what new data governance, market frameworks and institutional designs need to be developed to ensure data privacy and cyber security while increasing market access and services.

By 2030 and beyond system operators will have visibility of all energy assets, making planning, forecasting and operations quicker, more accurate and cheaper. Greater data access in the marketplace will support new business models and services developing and new market entrants participating in the energy sector. These new entrants will be able to tailor energy services to consumers using sophisticated digital platforms, address system needs via software rather than hardware, and create predictive models that prevent issues before they happen. A digital energy system will provide a modern platform for entrepreneurs and innovators to revolutionise how we interact with and conceive the energy system and how it integrates with our wider national infrastructure and services. These capabilities will underpin a secure decarbonised energy system, create market opportunities and new markets for information services and insights, provide confidence to investors, support research and benefit consumers from new products and services.

This chapter details the actions we will take to digitalise the system. It also describes the work that has already happened. A more detailed actions table is at Annex A.

Leadership and coordination

The government and Ofgem will provide leadership and coordination by adopting and promoting a collaborative and partnership approach to delivering a digitalised energy system that works for everyone, developing a shared vision and an agreed approach for getting there. This will help overcome the scale and complexity of the challenge.

By examining the data and digitalisation processes in our own organisations we will **lead by example**. We will **coordinate change** by providing tools to better enable industry collaboration and by regularly engaging and monitoring progress to ensure efforts remain aligned. We will

build momentum through funding a new Energy Digitalisation Taskforce which will deliver new recommendations for the next phase of energy digitalisation.

The first step in providing leadership and coordination is the publication of this document, the **UK's first Energy Digitalisation Strategy,** to ensure that the energy sector has a shared vision so we can digitalise together in a transparent and efficient way.

What has been done so far

- We set up and supported the **Energy Data Taskforce**, which published its report in June 2019, with five recommendations to the sector which we endorsed and have been working to implement.

- BEIS, Ofgem and Innovate UK formed a partnership called **Modernising Energy: Digitalisation**, which has coordinated all the work we have delivered so far and defined our planned future actions.

<u>Lead by example:</u> BEIS, Innovate UK and Ofgem will review some of our most valuable energy datasets and data management processes. We will benchmark these datasets against our newly developed **Energy Data Best Practice guidance** (see below) to understand our own compliance with this guidance. We will act on the recommendations from the review to improve the quality and openness of BEIS, Ofgem and Innovate UK data and create a tighter feedback loop between innovation, regulation, and policy.

The government and Ofgem will ensure that our energy policies, regulations and innovation competitions are aligned to the goals of this digitalisation strategy. In the case of Ofgem, this will be delivered through its newly created Data and Digital Insights team. This team is now working to ensure delivery of the Ofgem **Strategic Change Programme for Data and Digitalisation**. The team will work in three ways: it will ensure Ofgem's regulatory requirements for the use of energy data and development of digital services are robust; it will ensure Ofgem's own external-facing digital services and access to data meet stakeholder expectations; and it will develop Ofgem's internal capabilities at using and gaining insight from data to ensure that its portfolio of regulatory decision-making benefits from the best possible evidence. Ofgem has already ensured alignment through this work, for example by requiring all successful projects in the RIIO-2[24] Strategic Innovation Fund to comply with Energy Data Best Practice.

The government will also align its policies to the principles of this strategy. For example, to improve the consumer experience at public electric vehicle chargepoints, the Office for Zero Emission Vehicles has consulted on mandating **open public electric vehicle chargepoint data**, including the use of the Open Chargepoint Protocol Interface as a standard in 2021. Open data will enable consumers to easily locate the right parking space for their charging

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[24] Revenue=Incentives+Innovation+Outputs. RIIO-2 is the price control framework for transmission networks. RIIO-ED2 is the price control framework for distribution networks.

needs and support the energy sector to easily identify where public electric vehicle charging assets have been installed.

The government and Ofgem are considering options for a framework for **localised mapping and planning** for energy decarbonisation to support improved understanding of local infrastructure, enable informed decision-making and facilitate local decarbonisation plans. Informed by this strategy, this framework will ensure local decision-makers have access to high quality energy data to build into their decarbonisation strategies.

Innovate UK will review how to give greater visibility of learning and findings from funded **energy innovation projects**, including embedding Energy Data Best Practice principles and publishing end-of-phase summaries.

Coordinate change: We will ensure communication channels are robust, using our position to convene and engage the sector and other interested parties to establish clarity and accountability.

To ensure that we all move in tandem towards a digitalised energy system, we will ensure effective communication channels are in place for stakeholders to share their plans and expectations of each other through open and honest dialogue. We have created an informal forum for discussion, called the **Data and Digital Service Providers forum**. This is run by Ofgem, and is used to test and share ideas, particularly amongst energy code bodies. We also support industry communication initiatives, such as the Energy Network Association's **Data and Digitalisation Steering Group**[25] on which the government and Ofgem sit, which meets monthly to discuss future digitalisation opportunities and raise early awareness of developments and risks.

The last couple of years has seen a surge in the number of digital and data projects in the energy sector. This is welcome, but it creates a complex and dynamic landscape of activity. We are working with EnergyREV and the Energy Systems Catapult to create a coherent view of energy digital and data projects to improve cross-sector engagement, the **Catalogue of Projects on Energy Data**. A prototype is expected summer 2021, at which point we will assess options for taking the project to a more formal solution.

Data literacy and skills will be needed at all levels of seniority in the businesses that we need to deliver a net zero energy system. From our engagement with the sector, we have identified a **data literacy and skills gap**, which includes the skills required to monitor and run a complex distributed network utilising modern data collection, data analysis and digital control systems. To ensure we have the skilled workforce to deliver net zero, the government launched the **Green Jobs Taskforce**, working in partnership with businesses, skills providers, and unions. This investigated the broader landscape of skills gaps ahead of net zero, which includes digital skills. The Taskforce delivered its report in early July 2021. We will conduct a gap analysis to understand the current skills landscape in the sector, including the qualification levels required

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[25] Formally known as the ENA's Data Working Group.

to improve digital skills in the energy sector and provide good green jobs across the country. This action is included in the new Smart Systems and Flexibility Plan as the skills gap is broader than digital skills.

Build momentum: We will fund a new independent **Energy Digitalisation Taskforce (EDiT)**, run by Laura Sandys and Energy Systems Catapult, to continue building our shared knowledge of the barriers to system digitalisation, identify new priorities and give stakeholders confidence about how they can contribute to transforming the sector. This Taskforce is expected to provide the basis for further actions beyond this strategy and ensure that we continue to move at pace and be responsive to emerging governance questions and future bottlenecks. The Taskforce launched in May 2021 and is expected to deliver its recommendations in winter 2021/22.

Case study: BT Digital Twin

To reduce electricity usage, British Telecoms (BT) has created a digital twin that simulates the energy demand across its network. This was initially created to understand its network energy use and identify opportunities to save energy. However, BT is now looking to use it to make more sophisticated decisions about the future of its telecoms network. BT can use the twin to assess the impact of potential network changes on its future energy use, thus creating a feedback loop. This supports BT to make more efficient decisions, to understand how to manage its power infrastructure and to predict how its energy use will change in the future.

BT's energy twin enables it to correlate the energy use of specific pieces of equipment with their current utilisation. For example, it can reconfigure the network to remove under-utilised equipment. This programme has delivered benefits worth £40m in the past year, primarily from energy saving.

BT also has the second largest vehicle fleet in the UK which it wishes to migrate to all electric by 2030. Many of the larger vehicles need to be parked overnight at BT sites. The energy twin is helping BT to understand where they have spare electrical capacity – both now and in the future – to install electric vehicle chargers.

Actions

1 BEIS, Ofgem and Innovate UK will **lead by example** by improving the energy data practices within our own organisations, and align energy policy, regulation and innovation with the principles of this strategy. We will review some of our most valuable energy datasets and data management processes, with a first phase complete by the end of 2021. Ofgem will develop its Data and Digitalisation Strategic Change programme that will facilitate the digital transformation of the regulator.

2 The government and Ofgem will **coordinate change**. We will convene and participate in industry forums[26]. EnergyREV, Energy Systems Catapult and BEIS will develop a Catalogue of Projects on Energy Data prototype by summer 2021, with a view to seeking a more final product thereafter.

3 The government and Ofgem will **build momentum** by funding and supporting an Energy Digitalisation Taskforce, with recommendations expected winter 2021/22.

Incentivising change

We will ensure that the government's policies and Ofgem's regulatory expectations continue to challenge and stretch the sector to deliver more and better-quality investment in data and digitalisation and coordinate efforts across the sector. We will implement incentives for stakeholders, for example in the network price control frameworks, so that it is in their interest to adopt new behaviours, such as adhering to agreed standards for data and using shared digital tools. These behaviours are to ensure that each organisations' digital services work in harmony with each other and across sectors.

We will do this by adhering to an **agile regulatory environment** that builds digitalisation into incentive frameworks. We will make **digitalisation opportunities** available to all through a review of the data practices of networks and other monopolies. To ensure better visibility of small-scale energy assets on the networks, we will make sure network companies work with other industries to **simplify data collection** at the point of asset registration.

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[26] Ofgem's Data and Digitalisation Services Providers forum and Energy Network Association's Data and Digitalisation Steering Group

What has been done so far

- Ofgem has published **Energy Data Best Practice** guidance, developed with the Energy Systems Catapult and the government.[27] This guidance sets out eleven principles of data management best practice for the energy industry.

- Ofgem requested that energy network companies publish **Digitalisation Strategies and Action Plans** for how they are digitalising their energy networks using an iterative approach.[28] As part of RIIO-2, Ofgem has created **licence obligations** that require energy network companies to regularly update their Digitalisation Strategies and Action Plans, and that they comply with Energy Data Best Practice guidance.[29] Networks have responded positively and have published two versions ahead of the licence conditions applying. The next update to energy network companies' Digitalisation Action Plans will be in Summer 2021.

- The Energy Networks Association launched in June 2021 the Energy Data Request Tool and the Data Triage Playbook. These resources set out the industry's first standard approach to assessing the sensitivity of data and how to access it.

- In February 2021, Ofgem approved Elexon's **Balancing and Settlement Code modification proposal, P398.**[30] From June 2021, data held by Elexon relating to this code will now follow the "presumed open" data principle from the Energy Data Best Practice guidance.

- BEIS published in April 2021 step-by-step guidance for installers and consumers on **how to register new small-scale energy devices**.[31]

- The UK Geospatial Strategy[32] and the National Infrastructure Strategy[33] set out the economic opportunity presented by the creation of a **National Underground Asset Register**. The Register will allow digital access to data from across the water,

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[27] Ofgem (2021), 'Consultation on Data Best Practice Guidance and Digitalisation Strategy and Action Plan Guidance' https://www.ofgem.gov.uk/publications-and-updates/consultation-data-best-practice-guidance-and-digitalisation-strategy-and-action-plan-guidance

[28] Ofgem (2019), 'RIIO-2 Business Plans Guidance Document', https://www.ofgem.gov.uk/publications-and-updates/riio-2-business-plans-guidance-document

[29] Ofgem (2020), 'RIIO-2 Final Determinations for Transmission and Gas Distribution network companies and the Electricity System Operator, Final Determinations: Core Document', https://www.ofgem.gov.uk/publications-and-updates/riio-2-final-determinations-transmission-and-gas-distribution-network-companies-and-electricity-system-operator

[30] Ofgem (2021), 'Increasing access to BSC data (P398)', https://www.ofgem.gov.uk/publications-and-updates/p398-increasing-access-bsc-data

[31] BEIS (2021) 'How to register energy devices in homes or small businesses', https://www.gov.uk/government/publications/register-energy-devices-in-homes-or-small-businesses-guidance-for-device-owners-and-installation-contractors

[32] Cabinet Office and Geospatial Commission (2020), 'Unlocking the power of location: The UK's Geospatial Strategy', https://www.gov.uk/government/publications/unlocking-the-power-of-locationthe-uks-geospatial-strategy

[33] HM Treasury (2020), 'National Infrastructure Strategy', https://www.gov.uk/government/publications/national-infrastructure-strategy

electricity, gas, telecommunications and transport sectors. The Geospatial Commission is commencing work on a production platform in 2021.

Agile regulatory environment: Ofgem intends to ensure data and digitalisation expectations are included as part of the design of the **RIIO-ED2 price control** (the regulatory incentives regime for distribution networks). We expect this to include similar requirements as for transmission networks licensed under the RIIO2 price control, with the intention of requiring network operators to comply with Energy Data Best Practice and Digitalisation Strategy and Action Plan guidance[34]. Ofgem has already asked distribution companies to voluntarily adopt the guidance until such time as the new RIIO-ED2 price control is finalised and comes into force.[35] Ofgem will make sure that the methods Ofgem and energy networks use to exchange data between each other are modernised so that there is effective ongoing regulatory decision-making and oversight.

As part of its consultation to ratify Energy Data Best Practice and its guidance for Digitalisation Strategies and Action Plans, Ofgem will seek views for how these sets of guidance can have wider applications across its regulations, for example for **other licenced entities (e.g. generators, suppliers) and with industry codes**.

We recognise there are significant gaps in current distribution network and asset monitoring, and that enhanced monitoring and associated comms equipment are required to enable the active management of distribution networks, and for flexibility providers to bring forward commercial proposals to manage system and network constraints. Under RIIO-ED2, distribution network operators have been requested to bring forward network monitoring proposals for assessment where there is demonstrable value for consumers. The Open Networks Project, led by the Energy Networks Association, has been tasked with completing a cost benefit analysis of enhanced asset monitoring, which will report in December 2021.

Ofgem also intends to reform the Long-Term Development Statement, which is used to plan network improvements such as reinforcement, to extend and improve this visibility down to the lower voltage networks, significantly improving stakeholder's visibility of the infrastructure and assets and their capacity and utilisation rates.

Digitalisation opportunities: We recognise that a large part of the work to digitalise revolves around improving the planning and management of energy data that is held by data monopolies. Data monopolies exist where data can only be sourced from one organisation or service, therefore its access is not subject to competitive pressures driving improvements in quality or accessibility. Ofgem plans to conduct a holistic review in winter 2021/22 to identify and understand **new and existing data and digital monopolies** to understand the

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[34] Ofgem (2021), 'Consultation on Data Best Practice Guidance and Digitalisation Strategy and Action Plan Guidance' https://www.ofgem.gov.uk/publications-and-updates/consultation-data-best-practice-guidance-and-digitalisation-strategy-and-action-plan-guidance
[35] Ofgem (2020), 'RIIO-ED2 Sector Specific Methodology Decision: Overview', https://www.ofgem.gov.uk/publications-and-updates/riio-ed2-sector-specific-methodology-decision

implications for energy consumers, and to inform future response to market trends and facilitate the potential to adapt and change regulatory expectations on market actors.

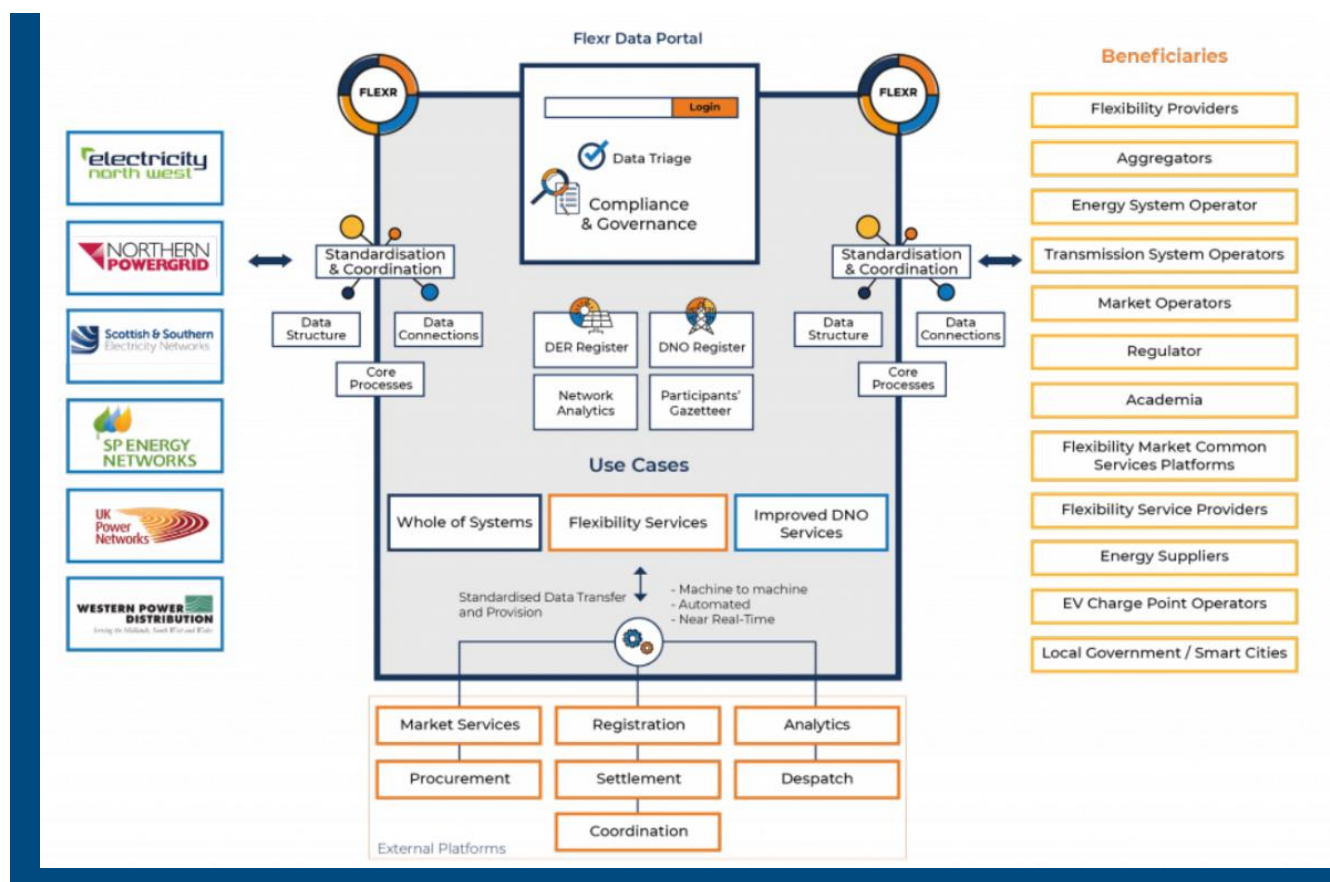## Case study: Flexr– the electricity network data sharing service

ElectraLink, the UK's energy market data hub, has created a service called Flexr which pulls data held by the networks and their distributed energy resource customers into one place making it easier to find and use.

Distribution network operator (DNO) data is currently available from six different DNO systems, often via spreadsheets. This leads to unnecessary cost and complexity for organisations wishing to innovate and provide value using DNO data. Flexr has therefore combined ElectraLink's technology, data management and governance expertise to demonstrate how it can support the networks in tackling the challenges they face in enabling a more flexible energy system. Flexr will also provide data in a consistent way to other energy industry data services, leading to greater levels of innovation and competition among data users.

Electralink delivered a prototype in February 2021 that included Electralink's register of distributed assets above 1 MW and a portal enabling accredited industry players to access network and asset data.

Flexr will provide machine-to-machine data access with highly granular and near real-time data access capabilities. In addition, Flexr will implement data triage for non-open data, whilst ensuring user-friendly access to open data.

Flexr will allow users to see all GB networks and their distributed energy resource data through a single access point. It will also allow networks to collaborate on how they build the embedded capacity register and access other datasets that support network visibility.

Simplify data collection: It is critical that system operators, network companies and other actors have visibility of the energy assets on the system, to support decisions on strategic investment that affect when and where network infrastructure is built, live network operations, and security of supply.

The government is developing a **coordinated asset registration strategy** for smaller scale[36] assets such as solar panels, electric vehicles, battery storage and heat pumps, which typically require registration by an installer. We have engaged with over 200 stakeholders across the government, industry and academia, and conducted a user journey mapping exercise. We have identified four key problems with small-scale asset registration:

- those responsible are unaware of their responsibilities (e.g., consumers and installers);
- the registration process is complex, with multiple forms requiring varying information being needed by multiple organisations;
- there are very few incentives or penalties associated with asset registration, and;
- where assets are notified, the data is collected and held by various systems that do not speak to each other, resulting in incomplete datasets.

BEIS will work across government and industry to simplify data collection of small-scale assets by **streamlining the registration process** to improve visibility, aiming towards a common

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[36] Assets in domestic and smaller non-domestic buildings

registration solution that benefits installers, consumers and network companies. We will develop options for how to achieve this over the second half of 2021, including for a **single asset register**.

We are looking to simplify data collection, including ways to align network company notification with Building Regulations requirements (which currently require separate notifications on the same installations). We will work with the Energy Networks Association to create a **standardised receipt of notification** across network companies that will allow customers, certification bodies or other organisations to encourage more installers to complete the registration process. We set out a related phase of this work in the section on digital solutions below.

Actions

4 Ofgem will implement an **agile regulatory environment**, integrating data and digitalisation obligations into relevant licences. Ofgem will continue to engage with industry on increasing network monitoring through price controls, and make sure that the methods Ofgem and energy networks use to exchange data between each other are modernised. The Open Networks Project will complete a cost benefit analysis of enhanced asset monitoring. Ofgem will seek views on wider applications of data and digitalisation across its regulations, for example for other licenced entities (e.g. generators, suppliers) and with industry codes.

5 Ofgem will work with industry to enable market participants and stakeholders to take advantage of **digitalisation opportunities**. Ofgem will conduct a holistic review in winter 2021/22 to identify and understand new and existing data and digital monopolies.

6 The government will work with industry to **simplify data collection** by streamlining small-scale asset registration processes, aiming towards a common registration solution. The government will look at ways to align the data collection processes for building regulations and distribution network operators. We will also set up a receipt of notification process for consumers, by the end of 2021, which network companies will then implement.

Development of digital solutions

We are working to ensure that data is treated as an asset and that it, and associated digital services, are transparent and accessible to all. We will stimulate the creation of new services and improve standards and access to data, thus enabling data interoperability. We will work with industry to fund and develop innovative system-wide digital solutions and architecture.

Through this, the UK will be better able to target its efforts towards end-to-end decarbonisation and a more comprehensive approach to ensuring consumers' needs are met.

To ensure the sector has the right tools to leverage data and digitalisation to its greatest effect, we will **build foundational capabilities** through innovative solutions. On the back of these solutions, we will **stimulate the market** to develop new business models and services. We will **transform asset visibility** through automation, thereby addressing the issues currently hampering asset registration.

What has been done so far

- In response to a recommendation by the National Infrastructure Commission's 'Data for the Public Good' report, BEIS has worked with the University of Cambridge – in a partnership called the Centre for Digital Built Britain – and our security agencies to develop a system for common tools and frameworks known as the **'Information Management Framework'**.[37] The Information Management Framework will establish a common language by which **digital twins** can connect and enable the efficient sharing and integration of data. BEIS has made funding available to continue the development of this Framework. Digital twins are already being developed in the energy sector, including by the electricity system operator.[38]

- Innovate UK launched the £2m **Modernising Energy Data Access** competition in October 2019 to create a data access and governance framework for the sector, the third phase of which has been won by Icebreaker One and its Open Energy platform.[39]

- As part of Innovate UK's **Local Energy Data Innovation initiative**, Regen conducted research to identify problems stakeholders are facing in their local energy system that energy-related data applications could help solve. The project concluded with an interactive publication that summarises the findings into 70 problem statements/use cases.[40]

- The £3m **Modernising Energy Data Applications** competition was launched by Innovate UK in October 2020 to prove the interoperability of datasets for local energy

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[37] CDBB (2020), 'The pathway towards an Information Management Framework: A 'Commons' for Digital Built Britain', https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme/pathway-towards-information-management-framework

[38] National Grid ESO (2019), 'Facilitating the transition to a flexible, low carbon energy system, https://www.nationalgrideso.com/document/158051/download

[39] Innovate UK (2020), Modernising Energy Data Access Blog, https://innovateuk.blog.gov.uk/2020/05/29/modernising-energy-data-access-and-the-winners-are/

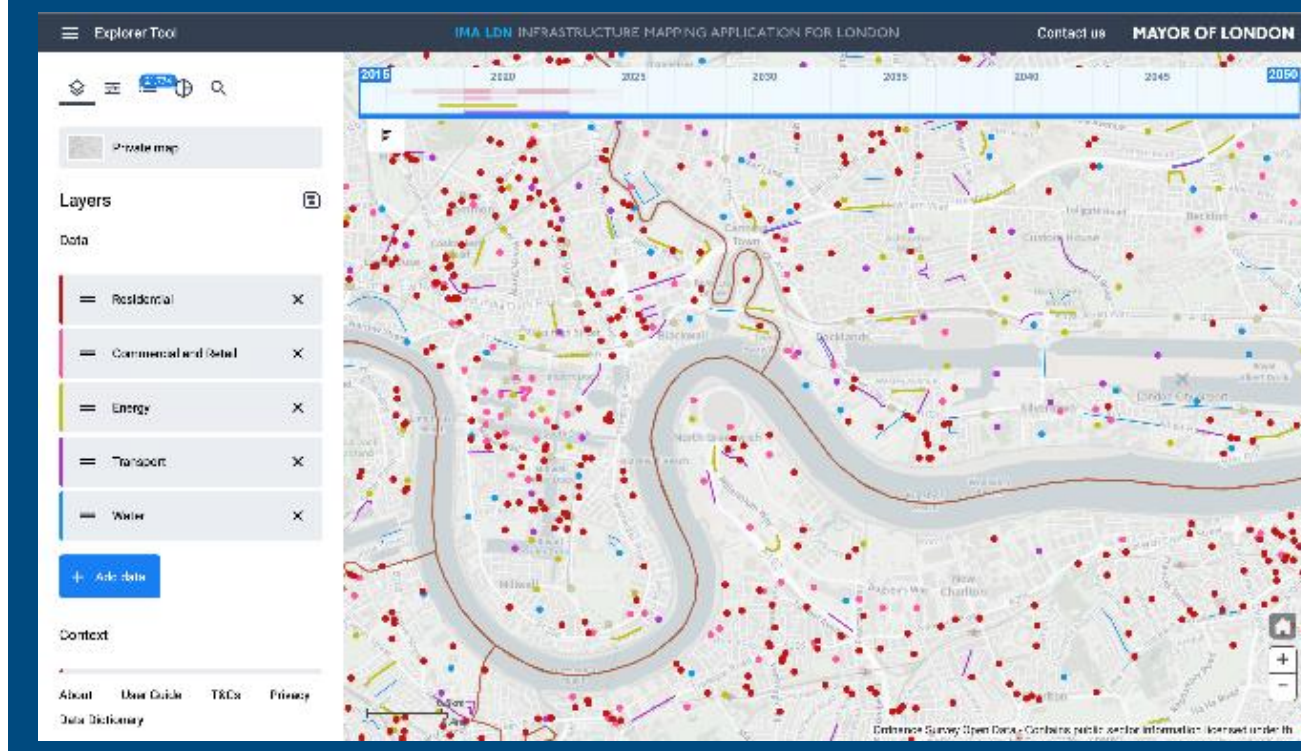[40] Regen (2020), 'Local Energy Data Innovation', https://www.regen.co.uk/project/open-data-for-local-energy-system-innovation/

initiatives using the Open Energy platform. Nine proposals were successful in the first phase of this work.[41]

Case study: Greater London Authority's Infrastructure Mapping

The Infrastructure Mapping Application (IMA) is a digital map created in 2015 showing the possible futures of London in terms of construction, utilities, transport, and growth in general. It is managed by the Greater London Authority and funded by Transport for London's Lane Rental scheme. The map brings together and displays data on around 50,000 future infrastructure projects across London, sourced directly from utilities and residential construction projects. It also includes over 100 data layers on social, environmental and other contextual data including from Transport for London, the Department for Transport, the Environment Agency and the Greater London Authority. All of London's major energy providers share data with the IMA.

The map is publicly available, but a more secure site with additional sensitive data is available to infrastructure providers and local authorities who have signed a legal agreement to keep the data secure and use it only for infrastructure coordination.

The map is currently used, for example, to find opportunities for utilities and the highways authorities to team up for street works, reducing costly disruption to London's streets, and by organisations to better understand changing capacity and environmental requirements across London, so they can plan for growth in a more coordinated manner.

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[41] UKRI (2021), Modernising Energy Data Applications, https://www.ukri.org/news/ukri-announces-net-zero-driven-energy-data-application-winners/

Build foundational capabilities: Many datasets across the sector sit in hidden silos, resulting in poor visibility of what energy datasets exist and where they are held. We will transform the way energy data is shared in the UK and create an **energy data ecosystem** that works for everyone. Since 2019 the government has funded the **Modernising Energy Data Access** competition, designed to create a common data architecture and enable energy data to be publicly accessible for the benefit of society. The £2 million innovation competition, won by Icebreaker One, will complete its beta stage in summer 2021, when we will consider next steps.[42] Their approach includes:

- Creating an open energy **standard for data sharing** in the energy sector;

- Building the technology to enact the open energy **governance platform**.[43]

The government will work with the sector to improve the **discoverability** of data by funding an **Energy Data Visibility Project**. The project will develop an energy data tool to search for published energy data that meets specific requirements. This tool will hold the metadata for datasets across the sector, signpost how to gain access to it, and provide a mechanism for data users to offer feedback on the service and the datasets it surfaces. Over time, this will drive improved data quality and standardisation. Datasets listed as "open" will mean a user can directly click through to view them (no data will be held directly on the platform). If the data is listed as "shared" then it will only be accessible through user verification. The competition was won by a consortium of Icebreaker One, Arup and Hippo Digital. The alpha-phase tool will be delivered by summer 2021. At that point BEIS and Ofgem will consider whether further action is required.

The work to make data more visible will support the development of system maps, such as Northern Ireland's Demand Flexibility Map.[44] The Energy Networks Association is developing a **National Energy System Map** for mainland GB that will align and integrate network data (both electricity and gas) as a priority, making this information publicly available in the form of a digital map. The Energy Networks Association will deliver a proof of concept in Q4 2021.[45] This will demonstrate energy networks' ability to integrate and geospatially present energy system information across Great Britain as well as to establish the longer-term approach required to align, integrate and drive quality and consistency of data assets.

Ofgem and Innovate UK are also working in partnership to deliver the new **Strategic Innovation Fund** (formerly Network Innovation Competition). One of the first funding calls to launch in Q3 2021 will focus on data and digitalisation.

Stimulate the market: As well as developing the architecture for making data more searchable and accessible, we will demonstrate how it can be used in real-world scenarios.

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[42] Icebreaker One (2021), 'Open Energy,' https://icebreakerone.org/tag/open-energy/
[43] Icebreaker One, 'Open Energy Directory', https://energydata.org.uk/directory/
[44] Northern Ireland Demand Flexibility Map, https://niflexmap.web.app/
[45] ENA, National Energy System Map, https://www.energynetworks.org/newsroom/new-digital-system-map-to-harness-the-power-of-data-to-deliver-net-zero

Innovate UK has launched a £3m competition to deliver **Modernising Energy Data Applications,** that address the challenges faced by organisations and individuals to deliver net zero local energy systems. Each of the nine selected participants will be expected to utilise the data architecture solution identified through Modernising Energy Data Access and to take advantage of specific use cases, informed by those identified through the Local Energy Data Innovation initiative. As well as the direct benefits of these applications, this approach will ensure interoperability between the services created by all the successful initiatives.

The current phase, which is the first of two, involves research and development of prototype services to demonstrate technical feasibility of the proposed solutions. Projects from phase one will be invited to apply for phase two in the latter half of 2021, where successful applicants will be funded to further develop their services for up to nine months.

Transform asset visibility: Whilst we have set out plans (above) to streamline the asset registration process, it is our view that a more fundamental transformation to improving asset visibility is possible. By creating a simple and intuitive asset registration process that is well-communicated to asset owners and installers alike, we will be able to collect comprehensive and accurate data on assets to support system stability and flexibility and remove the hassle factor for consumers and installers. We will work with industry and innovation bodies to identify a long-term, enduring solution to asset registration to improve the quality and visibility of data on low voltage energy assets.

We are investigating ways to utilise technology to reduce human time spent registering energy assets. For example, we are looking into options for **auto-registration of assets,** such as smart chips in new devices that can self-register, or software that can 'detect' the installation of a new device. We will work with the sector over the coming months to identify the best options and assess how these could be implemented.

Actions

7   The government and Ofgem will **build foundational capabilities** that enable sector-wide visibility of and access to data.

- We will open up access to energy data by working with industry to integrate a common data architecture across the sector. Innovate UK's £2m Modernising Energy Data Access competition aims to create a standard for data sharing and a governance platform for user verification. Icebreaker One, the winner of the competition, will deliver a beta-stage platform in summer 2021;

- We will improve the visibility and searchability of energy datasets by delivering an Energy Data Visibility Project, which will also help standardise energy system metadata, with an alpha-phase ready by summer 2021;

- The Energy Networks Association will improve the visibility of energy assets via the procurement of a National Energy System Map, with a proof of concept delivered by winter 2021/22;

- Ofgem and Innovate UK will design the Strategic Innovation Fund for networks by autumn 2021 including a challenge on data and digitalisation.

8. The government and Ofgem will **stimulate the market** and deliver real-world solutions; Innovate UK's £3m Modernising Energy Data Applications competition winners will complete their phase one research and prototyping by summer 2021.

9. The government will look to **transform asset visibility**; the government will work with industry to identify an enduring solution to small-scale asset registration.

Chapter 3 | Delivering this Strategy and Action Plan

We have, to date, adopted a transparent approach to policy making by working across BEIS, Ofgem, Innovate UK and stakeholders across the energy sector. Over the course of 2020 and early 2021 we have conducted comprehensive stakeholder engagement and co-creation. Developing the strategy is the first stage; delivering our actions is the next important step. We commit to maintaining an open dialogue and, to ensure this collaboration continues, we will review the purpose, membership and Terms of Reference of the Smart Systems Forum following the publication of this strategy.

Cross-sectoral collaboration

Energy data is not only valuable to the energy sector, but across many other sectors of the economy and economies internationally; all sectors rely on the energy system to function, and data easily crosses borders. The success of our actions is enhanced by their ability to be interoperable across many different sectors and countries.

We plan to share our learnings to encourage digitalisation in other sectors, ultimately enhancing the delivery of wider pan-UK data initiatives including the National Data Strategy. For example, we are working closely with the Geospatial Commission, aligning with the vision set out in the UK Geospatial Strategy, that by 2025 the UK will have a coherent national location data framework. We are collaborating internationally through the Mission Innovation 2.0 programme (a global initiative working to accelerate clean energy innovation) to unlock the benefits of digitalisation to realise high shares of variable renewable energy in power systems across the world. We are co-leading a new Mission[46] to demonstrate how developing affordable and reliable variable renewable technologies, flexible markets and data & digitalisation techniques can accelerate the transition to a renewable-powered and fully integrated power system of the future. This will ensure greater interoperability, better integration and more secure digital energy systems.

Innovation projects in data are increasingly cross-sectoral, often involving interaction with transport, buildings, agriculture, and other sectors. We will coordinate innovation funding related to data and digitalisation across funding streams in BEIS, Ofgem and Innovate UK, particularly through Innovate UK's Prospering from the Energy Revolution Fund and Ofgem's Strategic Innovation Fund.

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[46] Mission Innovation (2021), 'Green Powered Future Mission', http://mission-innovation.net/missions/power/

Ofgem is also working with the Data Standards Authority to explore ongoing opportunities for how Ofgem's regulatory guidance on data and digitalisation might be enhanced by wider government work and vice versa.

Monitoring

The actions in this strategy are based on our current understanding of markets, technologies, and consumer behaviour. However, the energy system is constantly evolving, new markets are developing, new technologies are entering the markets, and consumers will have new options to interact with these technologies and markets. Data and digitalisation will be a key enabler of this evolution. As new data, markets and technologies develop, our approach to digitalisation will need to adapt.

Monitoring is an essential part of the policy cycle.[47] It allows the government and Ofgem to establish whether intended outcomes have been achieved and enables corrective action to be taken where necessary. Monitoring will enable us to assess the impact of the actions in this strategy, and to understand whether digitalisation is progressing fast enough to meet our ambitions. It will identify where actions have been successful, as well as areas where further measures are needed. The learnings from monitoring provide a timely and consistent source of evidence to inform future policy design.

We are publishing, alongside this strategy and the new Smart Systems and Flexibility Plan, the first iteration of our monitoring framework. The monitoring framework provides a systematic approach for identifying the outcomes we expect to deliver and selecting monitoring indicators to measure progress. The first iteration of the monitoring report focusses on the intended outcomes of the actions in the new Smart Systems and Flexibility Plan; however, we expect that actions in this strategy will be key enabling factors for many of these outcomes. For example, improved accessibility of local network constraint data will help developers to locate their projects in the most beneficial part of the network and allow them to offer flexibility services into local markets. Our monitoring framework includes indicators to track the development of local flexibility markets, and identify which assets are participating in these markets.

We recognise that this is the first step to an effective monitoring strategy. Our indicators will need to adapt to the changing landscape. Future iterations of the framework will look to identify specific indicators for digitalisation, where outcomes are different to the other actions in the 2021 Smart Systems and Flexibility Plan. For example, indicators that could track the number of datasets that have been made available by different organisations and how often access to datasets is requested by users. Other indicators could monitor the proportion of distributed assets (e.g. electric vehicles, heat pumps) that are registered in databases, or gather stakeholder feedback on their use of new services enabled by improved data exchanges.

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[47] BEIS (2020), 'BEIS Monitoring and Evaluation Framework', https://www.gov.uk/government/publications/beis-monitoring-and-evaluation-framework

Annex A: Full list of actions

Leadership and coordination	
	Issue: The scale of change needed to digitalise the energy system is significant, the system is increasingly complex, the landscape is rapidly changing, and there are perceived potential first mover disadvantages. **Outcome:** The sector has clearly aligned goals, a shared purpose and direction, and transparent governance. This will provide confidence to businesses to invest in digitalisation.
1.	BEIS, Ofgem and Innovate UK will **lead by example** by improving the energy data practices within our own organisations, and align energy policy, regulation and innovation with the principles of this strategy. We will review some of our most valuable energy datasets and data management processes to help us comply with Energy Data Best Practice, with a first phase complete by the end of 2021. Ofgem will develop its Data and Digitalisation Strategic Change programme that will facilitate the digital transformation of the regulator and that will deliver clarity and leadership for the sector. Innovate UK will review how to give greater visibility of learning and findings from funded energy innovation projects, including embedding Energy Data Best Practice principles and publishing end-of-phase summaries.
2.	The government and Ofgem will **coordinate change.** The government and Ofgem will convene and participate in industry forums to maintain regular communication channels with the sector. EnergyREV, Energy Systems Catapult and BEIS will develop a Catalogue of Projects on Energy Data prototype by summer 2021 to provide visibility of the current landscape of energy data and digitalisation projects, with a view to seeking a more final product thereafter.

3.	The government and Ofgem will **build momentum** by funding and supporting an Energy Digitalisation Taskforce to identify next steps and priorities towards digitalisation, with recommendations expected winter 2021/22.
Incentivising change	
	Issue: Without the right incentives, businesses will often default to hoarding data. The transformative benefits of sharing data are regularly overlooked, underestimated or resisted. Even when the benefits of sharing are understood, a lack of incentives means that barriers to investments and solutions still exist. **Outcome:** The necessary incentives and regulatory expectations are in place to ensure that the sector is appropriately encouraged to invest in digitalisation and make their digital services work in harmony with each other.
4.	Ofgem will implement an **agile regulatory environment** regarding data, digitalisation, and its market design. Ofgem intends to ensure data and digitalisation expectations are included as part of the design of the RIIO-ED2 price control (the regulatory incentives regime for distribution networks), with the intention of requiring network operators to comply with Energy Data Best Practice and Digitalisation Strategy and Action Plan guidance. Ofgem will make sure that the methods Ofgem and energy networks use to exchange data between each other are modernised so that there is effective ongoing regulatory decision making and oversight. Ofgem will continue to engage with industry on increasing network monitoring through the RIIO-ED2 price controls, where it has demonstrable net value. The Open Networks Project, led by the Energy Networks Association, will complete a cost benefit analysis of enhanced asset monitoring, which will report in December 2021. Ofgem also intends to reform the Long-Term Development Statement, which is used to plan network improvements such as reinforcement, to extend and improve this visibility down to the lower voltage networks, significantly improving stakeholder's visibility of the infrastructure and assets and their capacity and utilisation rates.

	As part of its consultation to ratify Energy Data Best Practice and its guidance for Digitalisation Strategies and Action Plans,[27] Ofgem will seek views for how these sets of guidance can have wider applications across its regulations, for example for other licenced entities (e.g. generators, suppliers) and with industry codes.
5.	Ofgem will work with industry to enable market participants and stakeholders to take advantage of **digitalisation opportunities**. Ofgem will conduct a holistic review in winter 2021/22 to identify and understand new and existing data and digital monopolies to understand the implications for energy consumers, and to inform future response to market trends and facilitate the potential to adapt and change regulatory expectations on market actors.
6.	The government will work with industry to **simplify data collection** by streamlining small-scale asset registration processes to improve visibility of system assets, aiming towards a common registration solution that benefits installers, consumers and network companies. We will develop options for how to achieve this over the second half of 2021, including for a **single asset register**. The government will look to simplify data collection, including ways to align the data collection processes for building regulations and distribution network operators. The government will set up a receipt of notification process for consumers, by the end of 2021, which network companies will then implement.
Development of digital solutions	
	Issue: Our current energy system does not have the digital tools, services and standards needed to facilitate data exchange. Where they do exist, they are not transparent and accessible to all. No one investor gains full value from investing in digital infrastructure, nor can they be confident about adoption of their shared infrastructure solution. **Outcome:** The sector has standards and tools to support data and asset visibility, system maps and architecture that will underpin a future digitalised energy system. The potential for new digital services is clear to market participants who will then have the confidence to develop them.

7.	The government and Ofgem will **build foundational capabilities** that enable sector-wide visibility of and access to data. We will transform the way energy data is shared in the UK and create an energy data ecosystem that works for everyone. We will work with Ofgem and industry to open up access to energy data by integrating a common data architecture across the sector. Innovate UK's £2m Modernising Energy Data Access competition aims to create a standard for data sharing and a governance platform for user verification. Icebreaker One, the winner of the competition, will deliver a beta-stage platform in summer 2021, when we will consider next steps. We will improve the visibility and searchability of energy datasets by delivering an Energy Data Visibility Project, which will also help standardise energy system metadata. This tool will hold the metadata for datasets across the sector, signpost how to gain access to them, and provide a mechanism for data users to offer feedback on the service and the datasets it surfaces. The alpha-phase tool will be delivered by summer 2021, when we will consider next steps. The Energy Networks Association will improve the visibility of energy assets via the procurement of a National Energy System Map, with a proof of concept delivered by Q4 2021. The map will initially present datasets shared by network companies but is intended to grow and evolve through increased sharing and overlaying of other energy sector data and potentially other sector data. Ofgem and Innovate UK will design the Strategic Innovation Fund for networks by autumn 2021, with one of the first funding calls focusing on data and digitalisation.
8.	The government and Ofgem will **stimulate the market** and deliver real-world solutions. Innovate UK's £3m Modernising Energy Data Applications competition winners will complete their phase one research and prototyping by summer 2021, and a decision will be made about which projects will proceed into phase two, where successful applicants will be funded to further develop their service for up to nine months.
9.	The government will look to **transform asset visibility.** The government will work with industry and innovation bodies to identify a long-term, enduring solution to asset registration to improve the quality and visibility of data on small-scale energy assets. We will look at various options, including auto registration of assets.

Annex B: Glossary

In this document, the following terms have the following definitions:

To avoid the creation of multiple definitions for the same terms, where possible, definitions have been re-used or developed from the Energy Data Taskforce Report* and the National Data Strategy**.

Term	Definition
(Energy) Asset	Physical components of the energy system, including networks, energy generators and storage units.*
Data	Is an asset. It is information that has been translated into a form that is efficient for movement or processing.
Data triage	Sorting and allocation of data for security, privacy, negative consumer impacts and commercial issues*.
Digitalised energy system	Is one where: • Presumption of data openness is the industry default; • Data is adequate, standardised, and interoperable across the sector; • The required infrastructure, processes, technologies and skills are appropriately deployed; • The relevant rules and regulations, costs and benefits, and roles and responsibilities are clear.
Digitisation	Refers to the data or information that has been created in or converted into a digital format, which can enable analytical insights to be drawn.
Digitalisation	Is the transformation of a business or industry by using digital technologies to improve its processes.

Data (and digital) Infrastructure	Data infrastructure is a broad concept that indicates the data assets and processes that are significant to acquire knowledge and take action about a specific context. This consists of data assets, such as datasets, identifiers and registers, the processes to acquire these assets, and the support process, including the people, standards, and technologies used, which can be both digital and non-digital. This also includes the policies that guide curation, access, management, and use of the data infrastructure. The infrastructure on which data relies – The virtualised or physical data infrastructure, software, systems and services that store, process and transfer data. This includes data centres (that provide the physical space to store data), peering and transit infrastructure (that enable the exchange of data), and cloud computing that provides virtualised computing resources (for example servers, software, databases, data analytics) that are accessed remotely.**
Interoperability	The ability of data services and products to interact and share data. The term tends to cover two main aspects: the digital protocols that allow for data exchange, and the data standards used to preserve compatibility while processing data. It is enabled through open or common technical standards, which create a shared protocol for the exchange of information.**
Metadata	A set of data that describes contextual information on another set of data. It helps to organise, find, understand and manage data.
Open Data	Data is open if it can be freely accessed, used, modified and shared by anyone for any purpose subject only, at most, to requirements to provide attribution and/or share-alike. Specifically, open data is defined by the Open Definition and requires that the data be A) legally open: that is, available under an open (data) license that permits anyone freely to access, reuse and redistribute B) technically open: that is, that the data be available for no more than the cost of reproduction and in machine-readable and bulk form.*
Open data standards	Agreed rules made available to the public, developed, or approved, and maintained via a collaborative and consensus driven process.
Personal data	Information relating to a natural person who can be identified directly or indirectly from the information in question.

Presumed Open	The principle of "Presumed Open" for the energy system means that, by default, data are open unless there is a security, market, or commercial risk.*

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