FLEXFORUM

FlexForum Insights

A digitalised electricity system is needed for flexibility to fully play its part in electrification and decarbonisation

21 April 2023

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Main points

The FlexForum is an industry-led association of organisations from across the electricity ecosystem which want practical action to accelerate progress to ensure distributed energy resources (DER) and flexibility are available to:

- support affordable and reliable operation of the electricity market and power system
- enable accelerated electrification by households and businesses as part of the transition to a zero emissions economy.

The FlexForum produced the Flexibility Plan 1.0[1] to provide an initial list of the practical, scalable and least-regret steps needed to enable households, businesses and communities to make choices which maximise the value of DER and flexibility.

This is one of a series of insights papers which are a summary of questions and challenges raised with and by the FlexForum.[2] The purpose is to help to create the conversations which are needed to identify the critical paths forward and spur the action required to accelerate the transition to a digitalised electricity system which maximises the value of DER and flexibility.

A digitalised electricity system is needed for flexibility to fully play its part

While developing the Flexibility Plan 1.0, the FlexForum had many discussions about the need for the electricity sector to embrace digitalisation and enable households, businesses and resources to maximise the value of their flexible resources and to practically contribute to electrification and decarbonisation. A digitalised electricity sector will be more sustainable, secure, reliable, and affordable.

Digitalisation requires the electricity sector to create and store data in a digital and computer-readable format so it can be processed, intermingled, stored, shared and transmitted efficiently and securely. These data will be shared across the traditional industry participants as well as with consumers and other service providers.

Doing so makes data and information available to operate networks and markets and ensuring we keep the lights on as we transition the energy sector. Furthermore, it enables households, businesses and communities to make choices about electrification and their level of participation in the transition.

Digitalisation across the sector relies on seamless and automated exchange of data and information – this means interoperability and standardisation of communication and connectivity – so customers and those working on their behalf can easily access and accept different products and services if that is what they want. Developing a list of possible sources and uses of data for all future scenarios is impossible and technical standards are constantly being updated, so we must ensure that the framework and process we adopt can easily adapt to changes over time.

This is the connection to flexibility. Flexibility, or modifying generation or consumption patterns in reaction to an external signal, relies on seamless and automated exchange of data and information.

The challenge will be identifying principles that lead to an efficient level of interoperability and standardisation that enables flexibility services to flourish. We strive to find the sweet spot where: DER and flexibility can provide services that support system reliability and security; customers can easily choose and change suppliers across the range of electricity services; and there is continued evolution (and competition) in communication and connectivity options.

More information on the FlexForum and its members can be found on the FlexForum webpage

To have a conversation or to send your thoughts and views, please contact us at info@flexforum.nz

[1] You can find the Flexibility Plan 1.0 here. It contains definitions of some common terms and the steps referred to throughout this paper.

[2] You can find the genesis of this FlexForum insights in the notes from FlexForum session 9 on 26 May 2022.

Digitalisation allows flexibility to play its part

Households, communities and businesses are starting on an electrification journey resulting in the proliferation of electric vehicles (EV), EV charge points, local generation, battery storage, electric space and water heating, electric motors and other smart devices. These DER will need to be seamlessly integrated into the networks, electricity system and market in a way that gives opportunities to provide additional value to their owners, while preserving the security and reliability of the physical networks for all consumers.

Digitalisation must be at the heart of this integration to deliver the information needed to balance the electricity systems required to keep the lights on from second-to-second, across seasons and for planning years ahead. This information also enables households, businesses and communities to make choices about electrification and their level of participation in the electricity markets, including the choice to invest in and supply flexibility.

The United Kingdom's Digitalising our energy system for net zero: strategy and action plan 2021 published in July 2021 does a good job of describing the significant benefits of a digitalised electricity system.[3] A more detailed assessment of the benefits of digitalisation can be found in Delivering a Digitalised Energy System which sets out expected outcomes - with and without digitalisation - for electricity customers, security and reliability of supply and affordability.[4]

[3] Check it out here: Digitalising our energy system for net zero: strategy and action plan 2021

[4] Check it out here: Delivering a digitalised energy system, Energy digitalisation taskforce report, January 2022. The image shown here is from page 12 of the report.

Digitalisation enables communication and connectivity

The electricity sector is data and information rich, but digitalisation has not been universally embraced. Data continues to be stored in analogue formats, which means information is either underutilised, unused completely, or trapped in industry silos.

Take for example New Zealand's grid emergency in August 2021, which occurred when a shortfall in generation resulted in load-shedding affecting about 35,000 households and businesses. The requests made by the System Operator to electricity distributors to reduce load were communicated via emailed PDF files and phone calls.

Digitalisation could have provided machine-to-machine connectivity allowing seamless (and potentially automated) communication between the System Operator, distributors and flexibility suppliers about the grid emergency circumstances, detailed information about local conditions, and an inventory of the resources available for the event.

This connectivity - being able to see what is happening at any time and place, and respond – and the associated communication will be essential to operate distribution networks and the wider power system as we electrify and there are millions of connected DER. This type of connectivity does not happen by accident, but rather comes as a result of conscious planning and design. Some examples of efforts towards digitalisation already exist in our electricity system but there is room for improvement and more action:

- the EECA & EEA Demand Response Protocols evaluation project that is currently underway (FlexTalk)
- the process of retailer switching and the ICP registry that facilitates this exchange between retailers
- the EIEP13A & B standards for exchange of data between retailers and consumers or their authorised agents
- the electricity spot market and generator dispatch process managed by the system operator
- the publicly available specifications for EV Chargers (SNZ PAS 6010:2021 & 6011:2021).

Digitalisation depends on interoperability and standardisation

Interoperability for DER means being able to exchange information and interact with other components and interfaces in the energy system. This includes the key parties buying and selling flexibility services including system operators, distribution networks, electricity retailers, aggregators and VPPs. These parties will receive and react to external signals ranging from real-time pricing information, to dynamic operating envelopes[5] to specific dispatch instructions.

> *The fundamental benefit of interoperability flows to customers where it enables them to easily access and take up different products and services where they wish to do so. Interoperability supports the customer journey for consumer energy resources, by making it easier to choose different energy services (including switching), expanding opportunities to be rewarded for participating in different markets, and reducing the complexity and time associated with managing and maintaining equipment.*
>
> Energy Security Board: Interoperability policy for consultation – Directions paper, page 6.

The Institute for Energy Economics and Financial Analysis noted the need for interoperability in their submission to the Australian Energy Ministers on the topic of the AS4755 standard: "This lack of interoperability should be viewed as a significant barrier to the efficient orchestration of multiple behind-the-meter appliances. Defining a common protocol

[5] For more on dynamic operating envelopes see the FlexForum Insights: Making better use of available distribution network capacity will enable more affordable and reliable electrification, January 2023.

can avoid this issue. This is particularly important given that energy efficiency and DR have evolved to become communications and data-based. Rather than working on one-way communications based on assumptions about appliance performance, modern energy efficiency and DR uses two-way communication and collects data to ensure the actual DR impact is as predicted. Such sophistication avoids inaccurate assumptions and helps mitigate the risk of gaming of DR markets."[6]

The European Union has also seen the benefits of interoperability and funded the establishment of an Interoperability Community. Int:net is establishing a community of practice to support interoperability for the energy transition. In their own words this was established "because existing experiences with interoperability in the energy and other sectors have shown that reaching and maintaining interoperability is not a one-off task but requires continuous effort. One needs to keep track of changing policies and regulations, emerging new use cases and requirements, and evolving standards, among others. One also needs to make sure that tools and processes are kept up-to-date and fit-for-purpose."

Ensuring interoperability across the electricity system will enable access to the true value of the millions of DER expected from the energy transition by making sure information for making efficient decisions is available to:

- network and market operators
- the people (or those acting on their behalf) planning, financing, installing, and owning DER
- those supplying flexibility services with those DER.

> "*To deliver the potential consumer benefits from DER, and to mitigate the associated challenges, it is important that the National Electricity Market (NEM) successfully and efficiently integrates DER such that consumers can operate (or set-and-forget) their devices more effectively … This integration is likely to be more effective if at least some of the DER assets are interoperable – defined for the purposes of this report as the ability of DER to work with other components and interfaces in the NEM for the benefit of consumers, including with other DER assets and interfaces with key parties (including AEMO, DNSPs, retailers, and, in the future, aggregators and VPPs).*"
> FTI: DER interoperability assessment framework, page 20

Significant work has been done in the US, UK, Europe, and Australia on interoperability in the energy system, allowing New Zealand to leverage their learnings and build a robust and adaptable system for Aotearoa.

Finding the right amount of standardisation

Some level of standardisation will be necessary to achieve interoperability, but this does not mean complete standardisation is required. In addition, developing a comprehensive list of possible data and data sources that covers all future scenarios is impossible. Given that technical standards are constantly being updated, we must ensure that the framework and process we adopt can easily adapt to changes over time without choosing standards that limit our ability to change.

> *"Deciding on which technical standards or features to implement … is a complex matter for three reasons: first, the technical standards … could be applied to a very wide range of issues; second, there are typically both pros and cons associated with any potential standard, and these will depend to some extent on how the broader system evolves; and third, the technical standards are likely to remain in place for an extended period of time, so their implementation needs to weigh up the needs of current and future consumers, and also consider the potential risk of inefficient technology lock-in. … DER interoperability and DER standardisation need to be seen as related concepts: to support a desired degree of DER interoperability, it may be necessary to impose a degree of standardisation on certain elements of the supply chain, such that DER supports system reliability and security, or such that consumers who own DER can switch their energy retailers. However, there may be other technical characteristics where a degree of flexibility and non-standardisation of how devices and interfaces inter-operate may be more appropriate, in order to encourage competition and innovation for the benefit of consumers"*[7]

[6] Institute for Energy Economics and Financial Analysis, August 2021, at https://ieefa.org/wp-content/uploads/2021/08/Mandating-AS4755-Ignores-Households-and-Widely-Supported-International-Solutions_August-2021.pdf.

[7] FTI: DER interoperability assessment framework, pages 24-25.

We seek to avoid the widespread use of bespoke or proprietary solutions for the communication and connectivity needed to deliver the benefits of demand flexibility. Importantly, this standardization is related to how information is exchanged between those parties with an interest in flexibility services, meaning businesses can still use bespoke and proprietary solutions to operate within their own businesses as needed.

We need to develop principles that guide us to the right amount of standardisation

We need a set of principles to help make the decisions that will inevitably require trade-offs. Building upon the work of others, we believe the following principles are a good starting point to improve connectivity and communication to support flexibility services.

1. **Communicate required standards and processes clearly** so that anyone considering, or who already owns or manages, resources capable of delivering flexibility services to electricity networks and/or markets, understands the processes and specifications to: acquire information about opportunities; register devices; exchange information; and react to signals to deliver flexibility services from those resources.
2. **Adopt international standards** so that New Zealand can leverage the work that has gone into developing existing overseas products and services, and easily adopt/import those solutions from overseas
3. **Use open and non-proprietary standards** because open standards enable different devices to communicate with each other regardless of their manufacturer and because the interfaces are publicly accessible it reduces barriers, prevents lock-in, and grants all consumers and those acting on their behalf to access and benefit from the underlying data and services
4. **Enable information to get around easily and usefully** because more efficient and reliable methods for exchanging data between the parties with interest in demand flexibility will mean data is available when and where it is needed most so that consumers will see benefits such as better system security and reliability
5. **Ensure data security and privacy** as demand flexibility requires the sharing of data between devices, per principle #4, it is important to ensure that the data is secure and private. Data should be easy to share but only shared with approved parties and using adequate encryption to protect sensitive information. Protecting consumer privacy is paramount but cannot be used as an excuse to inhibit data exchange or the development of automated processes allowing authorised parties to exchange data
6. **Adopt trusted certification or testing processes for devices** because this ensures that interoperability expectations are met for all parties relying on the equipment delivering flexibility services
7. **Involve stakeholders** by using a process and a responsible party for maintaining, updating and freely publishing the preferred standards which involves cross-sector industry participation
8. **Embrace automation** because automation can help deliver many of the previous principles by reducing the need for manual intervention. This can help to improve performance, efficiency and reduce costs

By keeping these principles in mind as we develop requirements for flexibility services we expect the following outcomes across the sector from making information more accessible and available:

- ensuring we remain within the physical limits of the infrastructure because forecasts and responses needed to manage real-time conditions are clearly communicated and acted upon
- communications from buyers of flexibility services (e.g. distributors, Transpower, System Operator, retailers, and others) are clear and utilise open standards that enable interoperability so that suppliers can engage with multiple parties

- it is easy and affordable for owners of DER to register for, enrol in, and perform flexibility services themselves or switch to have their devices enrolled with any flexibility supplier
- committed or intended actions related to demand flexibility are transparent, to ensure that resource owners are able to direct their services to maximise value while continuing to ensure security and reliability across the system.

More work is needed

The topic of connectivity and communication in the context of demand flexibility is a complex and challenging one. It involves bringing together a wide range of stakeholders, including consumers, utilities, regulators, and technology providers, and requires the integration of various systems and protocols.

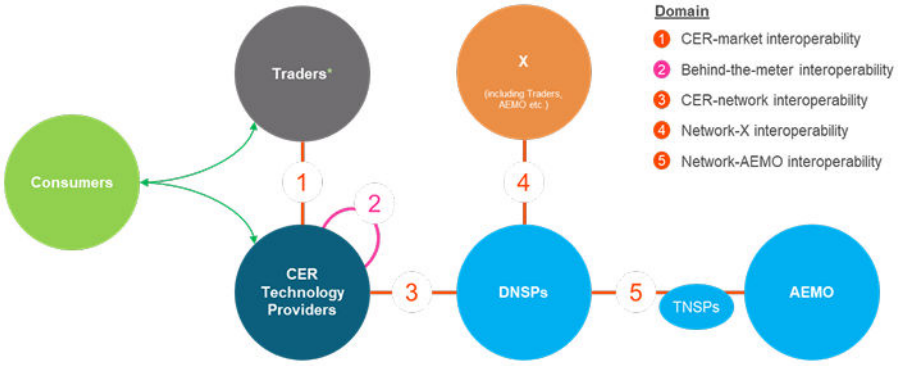
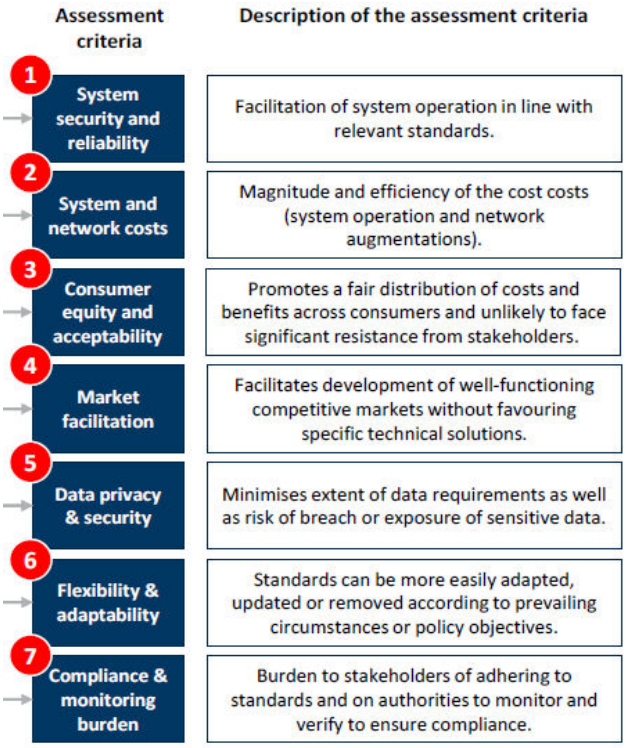
FlexForum plans to set up a workstream that will explore these challenges and we invite interested readers to participate. We need a diverse set of insights and experiences to deliver a more efficient, resilient, and sustainable power system.

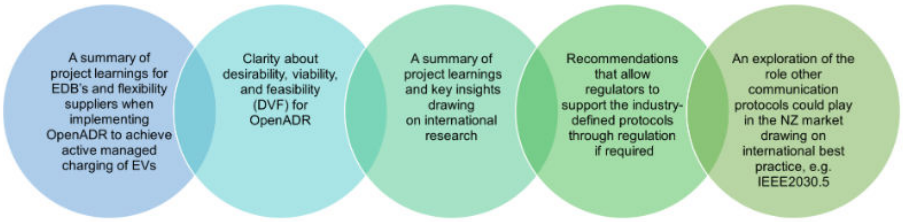
For further thinking, the following are a selection of use cases that led to deeper discussions as we developed the Flexibility Plan.

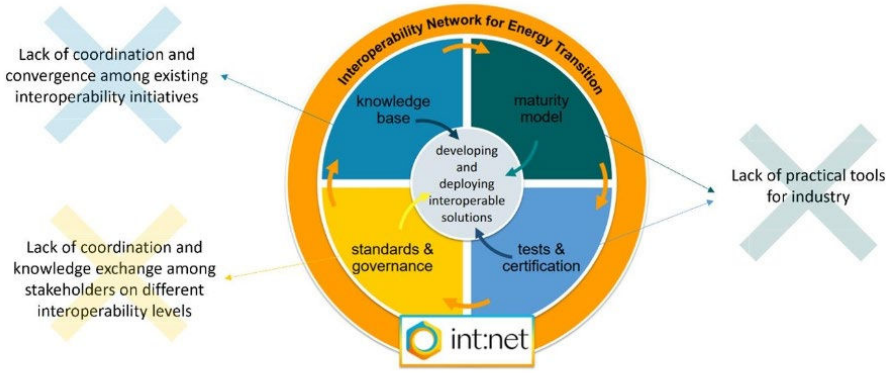
Use case	**Data Provider(s)**	**Data User (and how they might use it)**	**Examples of Relevant Standards or Communications Protocols**
EV / EVSE management to minimise physical system constraints and manage electricity costs	EV / EVSE Manufacturer Distributor(s) System Operator	Flexibility Supplier (measure, monitor and control devices)	OCPP OSCP OCPI EEBUS
Access to relevant signals for managing flexibility resources (e.g. current generation emissions, prices, constraints)	System Operator Distributor(s)	Flexibility Supplier (know when an action needs to be carried out)	ICCP IEEE 2030.5 OpenADR
Managing highly flexible resources such as consumer batteries	Flexibility Buyer(s) Flexibility Supplier(s)	Flexibility Supplier (control a battery (BESS) or other resource)	DNP3 APIs using JSON formats
Edge control / default settings as redundant configuration if communications are lost	Flexibility Supplier	Flexibility Supplier (to ensure local systems act predictably and appropriately)	MODBUS
Coordinating the use of flexibility services to create opportunities for value stacking and efficient deployment	Flexibility Buyer(s) Flexibility Supplier(s) *Two-way communications needed	Flexibility Buyer (indicates a need, time, place, price) Flexibility Supplier (ensures managed resources are optimally committed)	OpenADR APIs

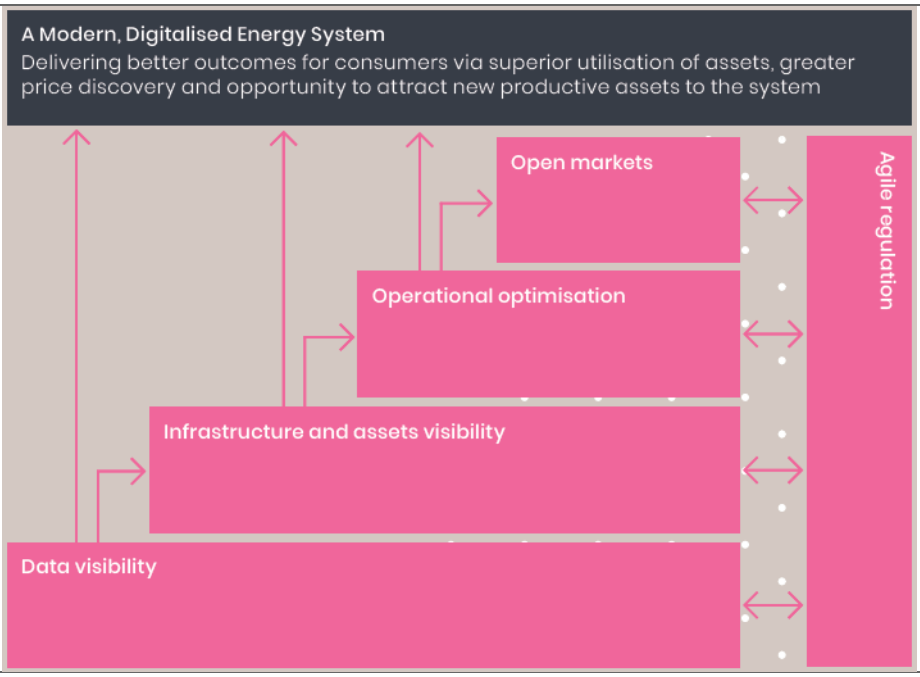
Further reading…

The following is a list of resources that contain much deeper technical and policy related thinking on the topic of digitalisation. These documents served as the foundation for developing the principles on page 6 and will continue to guide our thinking going forward. Please share any of your preferred resources with a brief description or important takeaway via email at info@flexforum.nz.

Report	Snippet	Link
Energy Security Board: Interoperability policy for consultation – Directions paper Australia	**Figure 5: consumer energy resource interoperability domains (incorporating the dynamic export limits use-case)** 	https://www.datocms-assets.com/32572/1665556228-interoperability-policy-directions-paper-final.pdf
FTI: DER interoperability assessment framework Australia		https://www.datocms-assets.com/32572/1639638302-final-fti-assessment-framework-for-der-interoperability-policy-december-2021.pdf

Report	Snippet	Link
EECA / EEA Demand Response Protocols Project (Flextalk) New Zealand	**DELIVERABLES** A functional specification document that provides direction for the electricity industry on the application of the OpenADR 2.0 communication protocol in New Zealand for actively managing EV charging. A supporting guidance document that provides: 	https://www.eea.co.nz/Site/asset-management/adr-project/about-adr-project.aspx
European Commission - Study on ensuring interoperability for enabling Demand Side Flexibility EU	*Table 2-4: Mapping of selected use cases on the actors' functionalities* **Actor A** / **Main functionality** / **Use Case** **Supplier** / Provide price signals / 6 - Demand-supply adjustment by cooperation between supplier and customer; 10 - Smart Meter GW notifies actual tariff to CEM **Aggregator** / (De)Commissioning / 1 - Device Registration & configuration Maintenance / No use case mapped Monitoring / 7 – Exchanging information within the home; 8 - External Actor Retrieves status Scheduled activation / 2 - Flexible start of Smart Device; 9 - CEM requests time from Smart Meter GW Instantaneous activation / 5 - Load Control of Smart Device by CEM. In-home optimization / 4 - Control of Smart Device by CEM **DSO / TSO** / Instantaneous activation / 3 - Response of Smart Home to Emergency	https://data.europa.eu/doi/10.2759/26799

Report	Snippet	Link
Analysis of Flexible Demand Standards for Pool Controls: 2022 Flexible Demand Appliance Standards USA - California	**Table 2-3: National and Industry Cybersecurity Standards** **Cybersecurity Standard** / **Organization** / **Description** NERC Critical Infrastructure Standards / North American Electric Reliability Corporation / Minimum cybersecurity standards for critical grid infrastructure NIST 8259A / National Institute of Standards and Technology / Cybersecurity for IoT Device Manufacturers PAS 1878:2021 and 1879:2021 / British Standards Institute / British standards for smart appliances SB 327, Jackson, 2018 / California State Government / CA statute on connected devices and information privacy UL 2900-1 Standards / Underwriters Laboratories / Minimum standards for network-connectable products ETSI TS 103 645 / Cyber Security for Consumer Internet of Things / Good practices for IoT devices Source: California Energy Commission	https://www.energy.ca.gov/publications/2022/analysis-flexible-demand-standards-pool-controls-2022-flexible-demand-appliance
EU int:net Community: Technical Roadmap List of global Interoperability Initiatives EU	 **Cornerstone 1: A common knowledge base to facilitate convergence among initiatives**	Roadmap: https://intnet-project.eu/images/230316_Reif_InteroperabilityRoadmap.pdf Global List of Interoperability Initiatives: https://intnet-project.eu/resources/technical-resources
Institute for Energy Economics and Financial Analysis - Mandating AS4755 Ignores Households and Widely Supported International Solutions Australia	Five Key Issues with AS4755 ..... 6 1. Interactions with Other Policies and Approaches to Peak Demand and Minimum System Load Are Unclear ..... 6 2. AS4755 Is Crude and Outdated ..... 8 3. The AS4755 Series Does Not Support Interoperability ..... 11 4. Open Interoperable International Solutions Are Available ..... 13 5. The Original D-RIS, Including the Cost-Benefit Analysis, Was Flawed 15	https://ieefa.org/wp-content/uploads/2021/08/Mandating-AS4755-Ignores-Households-and-Widely-Supported-International-Solutions_August-2021.pdf

Report	Snippet	Link
UK Energy Data Taskforce Digitalising our Energy System for Net Zero (2021) Delivering a digitalised energy system (2022) UK		https://es.catapult.org.uk/case-study/energy-data-taskforce/ Digitalising our energy system for net zero: strategy and action plan 2021 Delivering a digitalised energy system, Energy digitalisation taskforce report, January 2022