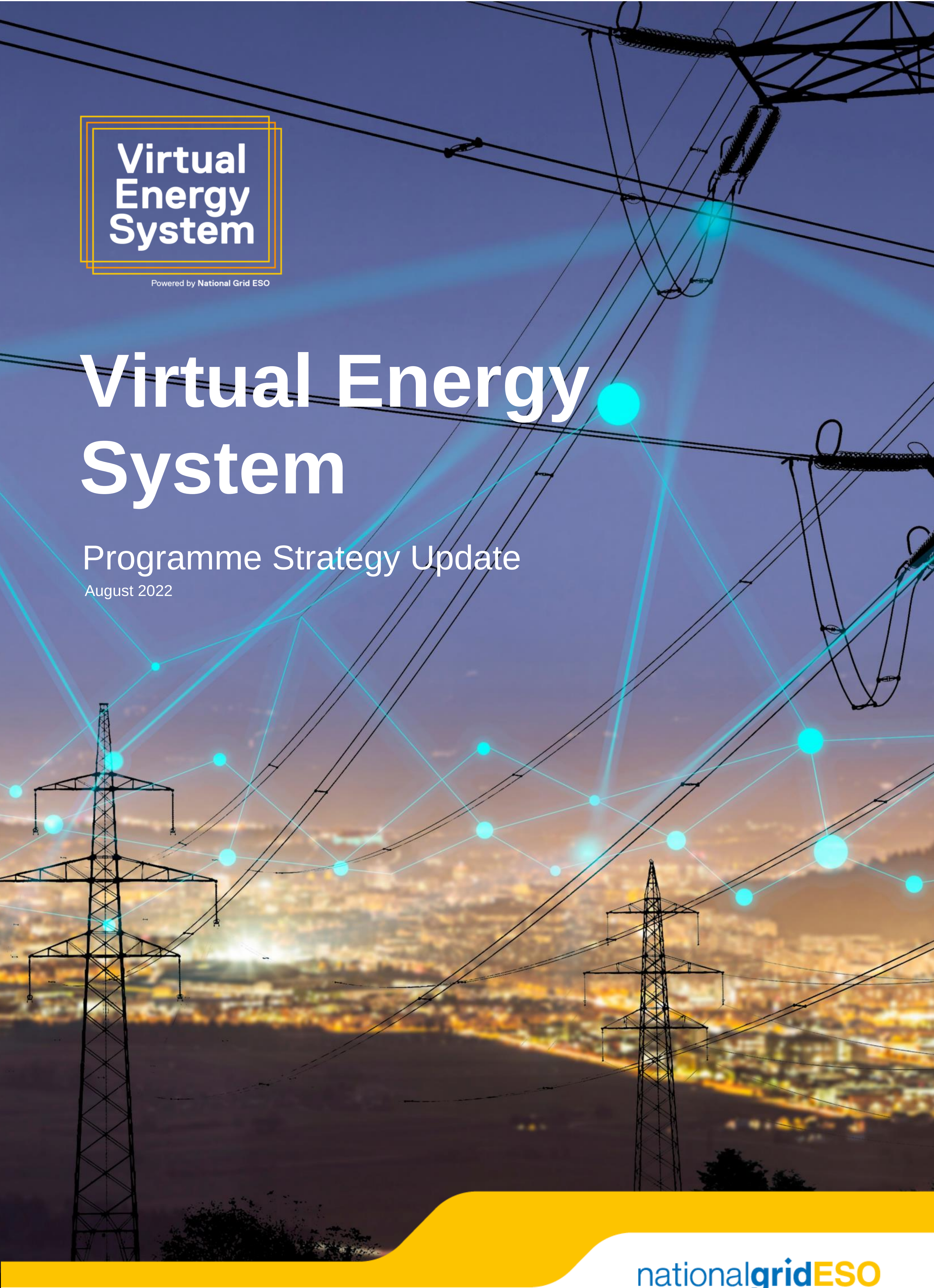

Virtual Energy System

Powered by National Grid ESO

Virtual Energy System

Programme Strategy Update

August 2022

nationalgridESO

1.What is the purpose of this paper?

This paper provides an overview of the Virtual Energy System proposition and programme. It has been formed from our previous programme communications and consolidated to provide a single source of information.

This paper contains the following sections:

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2. What is the problem we are trying to solve?

The UK Government's Ten Point Plan to deliver net zero by 2050 has highlighted the importance our electricity system will play in the decarbonisation of heat and transport, as well as its integration with the production of other clean fuels, such as hydrogen.

At National Grid ESO we are committed to driving and embracing the digitalisation of the GB energy system in response to the growing complexity of our energy landscape.

This decade will see fundamental changes to the GB energy system, including increasing:

- renewable capacity connecting to the grid, including 50GW of offshore wind
- flexibility from the demand side alongside existing services from generation side
- interactions with other sectors e.g. transport through cessation of the sale of combustion engine vehicles, with a dramatic shift to Electric Vehicles
- availability of green finance and innovation funds to help develop disruptive technologies

Our Bridging the Gap report considers the changes required to operate the future energy system. We require an energy system with far greater flexibility which in turn will require an increase in visibility and an ability to simulate a wide range of scenarios. This ensures we can make the best use of all available resources, while safeguarding security of supply and optimising costs for the end user.

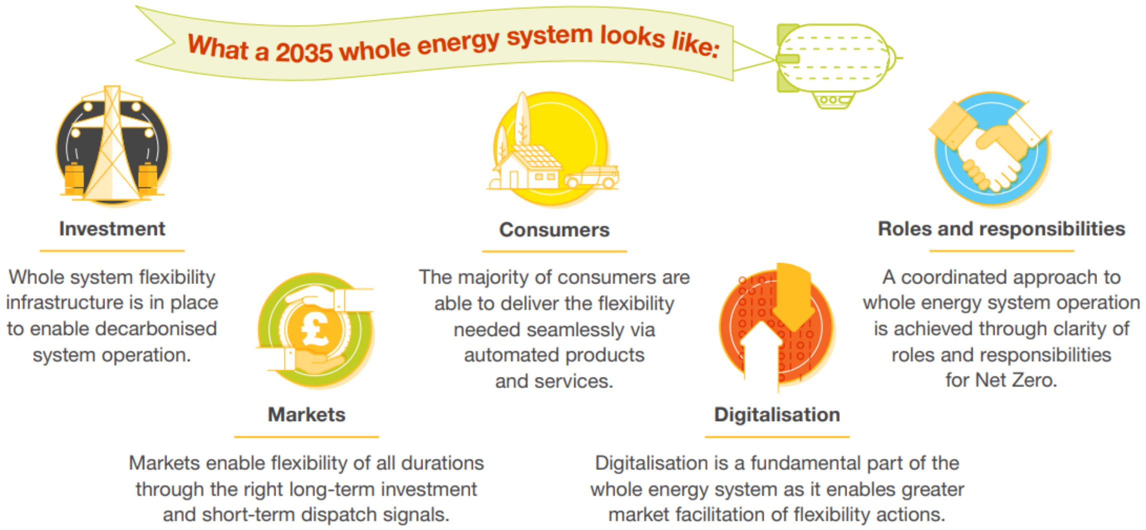

Figure 1: Summary of 2035 energy system - Bridging the Gap 2022

As the energy system becomes more complex, interconnected, and dynamic our existing industry data processes become outdated and impractical. Our decisions will require multiple sources of data, span more organisations and become more complex. This is a problem that a 'Virtual Energy System' of connected digital twins can help to solve.

Digital twins represent complex industrial assets, processes and systems as data and models with supporting information management. When built with common interfaces and interoperable designs these can then be linked up between organisations to solve sector level problems more effectively collectively.

3. What is the Virtual Energy System?

The ambition of the Virtual Energy System programme is to enable the creation of an ecosystem of connected digital twins of the entire energy system of Great Britain. It will operate in synchronisation to the physical system. It will include representations of electricity and gas assets and link up to other sectors.

This ecosystem of connected digital twins will enable the secure and resilient sharing of energy data across organisational and sector boundaries. This sharing of data will facilitate more complex scenario modelling to deliver optimal whole-system decision making. Whole-system decisions will result in better outcomes for society, the economy, and environment by balancing the needs of users, electricity and gas systems and other sectors.

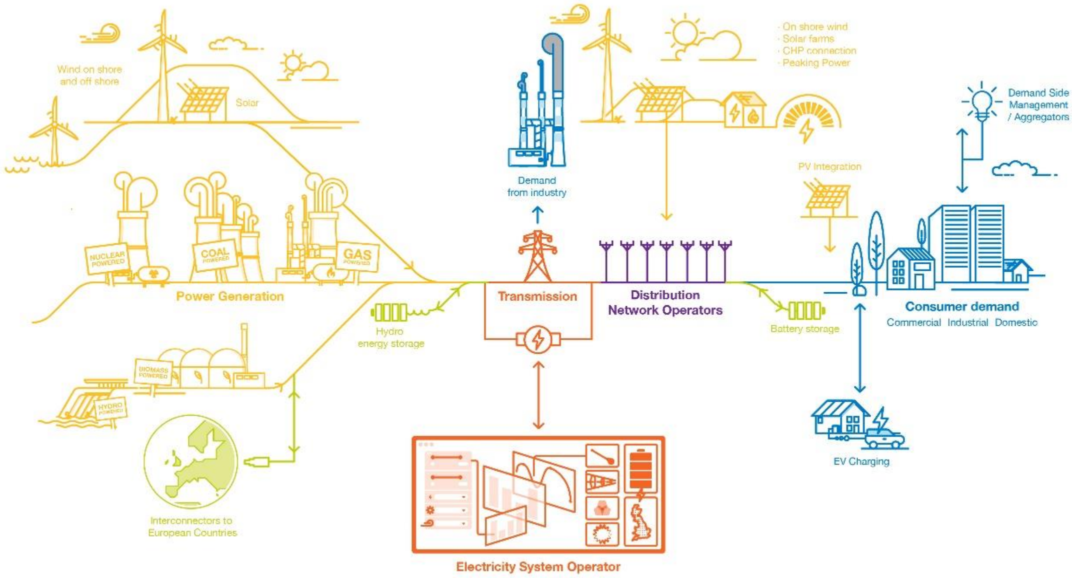

Figure 2: A visualisation of elements of the electricity system

The Virtual Energy System is not an alternative to organisations developing individual digital twins, it is an integration that maximises their value. The interoperability of Virtual Energy System supports the development of digital twins providing an opportunity for experience, capabilities and for reusable components to be shared between organisations. This view of interoperability is supported by the UK Government's Cyber-Physical Infrastructure consultation.

Digital twins can bring significant benefits to organisations when used to solve internal problems. These internal twins typically drive internally focussed benefits while the data and insights could be used to deliver wider external and whole-system benefits. Sharing benefits and driving a step change in the energy sector's digitalisation requires interoperability - which is what the Virtual Energy System aims to provide. The wider benefits of connected digital twins have been described in the Gemini Papers – "Why Connected Digital Twins?" paper from Centre for Digital Built Britain (CDBB).

4. What are the costs and benefits?

The energy system today is mostly operated based on bilateral exchanges following industry codes that share limited data and which have not kept pace with the level of automation and transformation of the system. In some cases, existing processes result in the same data being provided in different formats and conventions to a range of parties - each requiring dedicated processes to reconstruct and integrate models from the data that was shared.

As the energy system becomes more distributed, interconnected, and dynamic our existing industry data processes become outdated and impractical. Decisions will require multiple sources of data, span more organisations, and become more complex. Solving this problem is the value that the Virtual Energy System delivers.

The ecosystem of interoperable digital twins will enable the secure and resilient sharing of energy data across organisational and sector boundaries. Without interoperability, data cannot be shared between digital twins, leading to sub-optimal decisions made in silos. Seamlessly sharing data enables more comprehensive modelling to deliver efficient, whole-system, data-driven decision making, which results in better overall outcomes for society, the economy, and the environment. These are the benefits unlocked by the Virtual Energy System of interoperable digital twins.

In our research of previous projects, including the Energy Data Task Force (EDTF) and the Energy Digitalisation Task Force (EDiT), we have noted that the specific financial benefits associated with an interoperable system had not been quantified by any programme or project. This highlights that quantifying interoperability and its value is challenging. However, interoperability and digitalisation are woven into all recent analysis as a *key enabler* of operating the integrated and digitalised future energy system. We consider that interoperability of systems for data exchange has been determined to be an essential component of the future energy system.

We have also observed that there is very strong stakeholder support for greater openness and transparency of data across the energy sector.

The benefits case of Virtual Energy System follows a series of dependencies:

1. To achieve net zero requires an **integrated energy system**
2. Operation of an **integrated energy system** requires **modelling of a wide range of scenarios**
3. **Modelling a wider range of scenarios** requires **visibility of system behaviour and capability**
4. **Visibility of behaviour and capability** of the system, which is made up of assets owned and operated by different organisations, is dependent on **data sharing**
5. This **data sharing** requires the interoperability and capabilities that the **Virtual Energy System** of connected digital twins can bring

During development, each use case within the Virtual Energy System programme will be considered as a project. Each bringing its own assessment of the costs and benefits of implementation. These will consider development and operational costs alongside the benefits of the resulting service or analysis. Use cases will be prioritised where they bring together data and digital twins from more than one organisation or build a previously unavailable modelling capability. Examples of high-level use cases identified in the Virtual Energy System Benchmarking Report are given in Figure 3 below. For any central services or proposed standards, a cost benefit analysis will also be considered as their requirements become clearer.

1. Transition to net zero
2. Asset monitoring & predictive maintenance
3. Optimisation of energy production
4. Linking electricity & gas networks
5. Real time balancing and forecasting
6. Flexibility modelling for increase renewables
7. Model energy storage needs
8. Dynamic power modelling
9. Planning the future transmission network
10. Optimise connectivity capacity
11. Model stability of network
12. Visibility of transmission & distribution interface
13. Hazard event & threat impact simulation
14. Multi-pathway resilience modelling
15. Asset monitoring for improved modelling
16. Predict localised energy production
17. Real time distribution network optimisations
18. Optimise energy storage usage
19. Planning future distribution network
20. Improve demand forecasting
21. Better services to customers
22. Smart demand response
23. Prosumers
24. Planning of local LCT implementation

Figure 3: Example high level use cases – Virtual Energy System Benchmarking Report

Where a use case requires access to similar data from different organisations, or where multiple use cases require access to the same data, then the cost of developing interfaces would be reduced by having the Virtual Energy System. This will be realised through reducing bespoke interface development by facilitating interoperable digital twins through the common framework principles and guidance.

As the programme matures into the start of 2023/24, we will develop methods of capturing, recording, and reporting on the costs and benefits delivered or proposed by the Virtual Energy System.

5. Who are the Virtual Energy System users?

The potential users of the Virtual Energy System are all the actors within the real-world energy system, with the ultimate beneficiaries being the end-consumer due to more efficient whole-system operation/planning. The range of users represented and active within the Virtual Energy System will grow as more use cases are developed and added.

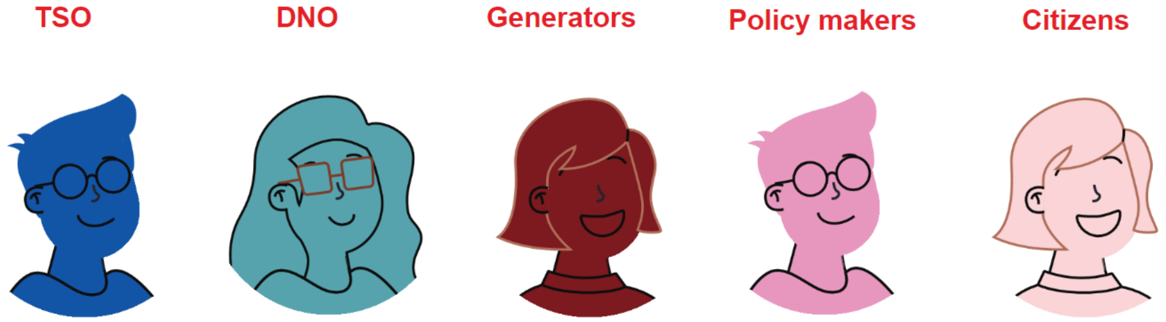

Figure 4: non-exhaustive examples of user personas of the Virtual Energy System

Our work on developing the common framework has identified 24 high-level use cases (see Figure 3) covering a variety of users of a connected energy system that could be addressed by the Virtual Energy System. These align with the Digital Twin Toolkit's use case framework, published by CDBB, and are published in our Benchmarking Report.

Users of the Virtual Energy System will either:

- Have data, models, and digital twins that they could contribute to the Virtual Energy System
- Have a problem that could be solved by access to data and models that are part of the Virtual Energy System

Their user journey will depend on the position in the Virtual Energy System. The needs of users will be considered during the development of use cases and the common framework. They will also be represented in the Advisory Groups that the programme will form.

6. How does this link to UK government strategy?

The Energy Digitalisation Task Force (EDiT), and the recent joint response by BEIS, Ofgem and Innovate UK, both highlighted the need for an integrated and digitalised energy system, and the urgent need for action now.

As identified by the EDiT taskforce, delivering a data sharing fabric and a digital spine for the energy system are essential components to underpin the digital interoperability of the sector. We believe that Virtual Energy System could become the “orchestrator” (as termed in the EDiT) for:

- **delivery of the digital spine**: a technology stack that creates a network of connected nodes which ingest, standardise, and bring together a minimal layer of operational critical data
- **adoption of a data sharing fabric**: a sharing and cataloguing and data management technology stack to facilitate and manage the search, sharing and accessing of data across organisations. This should look at leveraging existing work done by Open Energy.

Creating the Virtual Energy System is a socio-technical challenge that requires a collaborative and principled approach, that is aligned with the recommendations of the National Digital Twin programme.

The Virtual Energy System is also aligned to Ofgem’s Data Best Practice Guidance. Supporting implementation of common terminology, metadata, discoverability, quality, security, and interoperability. The Virtual Energy System also supports Presumed Open.

7. How does this align to other energy sector programmes?

There are several existing initiatives across the energy sector to bring focus groups together to drive progress in data and digital innovation. These include, for example, the following organisations and initiatives:

- Energy Digitalisation Taskforce (EDiT)
- ENA (Energy Networks Association) - Data and Digitalisation Steering Group
- Energy Systems Catapult (ESC) - Modernising Energy Data
- Geospatial Commission – National Map of Storage
- Global Power System Transformation Consortium (G-PST)
- Ice Breaker One - Open Energy
- National Digital Twin programme / Connected Places Catapult – Digital Twin Hub
- Open Data Institute (ODI)
- Ofgem Data and Digital Service Providers forum

Our users and stakeholders will be from across the energy sector and will include related sectors. It is critical that the programme avoids duplication by learning from and supporting other programmes. We will endeavour to ensure these programmes are also represented in our future engagement either through advisory groups or direct engagement. Where our interests are aligned, we will explicitly collaborate with them to deliver the requirements of the Virtual Energy System and to support their work.

Further information on our stakeholder engagement strategy is given in Question 10.1.

8. Why is ESO best placed to drive the programme?

Our role as a trusted central coordinator across actors in the energy system, coupled with our net zero leadership and our transition to a Future System Operator (FSO), offers a unique position to take a sector-wide, whole-systems and independent view. We are therefore well placed to orchestrate and coordinate the creation and delivery of the Virtual Energy System with the support of innovation partners from across the energy and technology sectors.

Implementation will require extensive cross-sector engagement and collaboration, and our role will be to facilitate and drive its development until it becomes industry-led.

The EDiT report observed that sector-wide and coordinated stakeholder engagement and collaboration is key in the development of public interest digital assets:

> *"At present, there is a patchwork approach where different organisations are independently leading on distinct assets with lock-in. This means they are not as well coordinated or integrated as they could be, and the rate of progress will vary wildly. In addition, sector stakeholders are not well informed about the development of the assets or do not understand how they will work together."*

Quote 1: Energy Digitalisation Task Force 2022

There is also no other organisation in the energy sector facilitating the creation of an ecosystem of connected digital twins. Across the energy sector, organisations are investing in their own internal digital twins, with limited cross-sector integration or collaboration. The Virtual Energy System, that we are leading, fills the gap identified by EDiT and the National Digital Twin programme.

The programme would benefit from the support of Ofgem as the regulator and BEIS, who in their response to EDiT have committed to provide the leadership and direction, supporting industry on the transition to a digitalised energy system and ensuring that it contributes to broader strategic objective.

The data and models within the Virtual Energy System will be owned and maintained by entities across the sector. The long-term goal is that a mature Virtual Energy System will be led, grown and governed by the industry through collaboration and agreed governance processes. Achieving this maturity will take time however the system is changing now, and we require the capabilities to operate a net zero electricity system by 2035. With this timeframe in mind, we are kickstarting this effort by giving a strong push towards the establishment of the governance and technology needed to facilitate this collaboration now.

9. How does this link into other ESO programmes?

Our Digitalisation Strategy and Action Plan outlines our current development priorities supported by stakeholder engagement. The Virtual Energy System is included in the 2022 strategy as a key element of our future modelling capability.

We operate the system as a whole but do not own any physical assets, we are therefore dependent on data exchanges with external parties. These data exchanges are typically bilateral and require individual processes and interfaces. There are several programmes under way to change our data landscape.

The Virtual Energy System programme is externally focussed on the development of an ecosystem of connected digital twins. It is distinct from current programmes for the development of our internal systems and data. These future systems will, in time, become part of the Virtual Energy System by sharing outward from our systems and pulling in external data and models from the Virtual Energy System.

The Virtual Energy System will interact with several of these developing programmes, primarily:

- **Data Analytics Platform (DAP)** – will be the technology underpinning all our internal and external data management, pulling together data from a variety of sources and ensuring there is only one source of the truth. We anticipate that the Data Analytics Platform will become the destination of the data being used within ESO. However, the DAP will be developed focussed on our purposes, whereas our Virtual Energy System approach is to pull together data from all the energy sector, as such DAP is a stakeholder to the Virtual Energy System.
- **Digital Engagement Platform (DEP)** – will enable a single point of access for all ESO data and services. We will interact with the DEP in a way that allows us to understand what kind of data is currently requested by third parties and for what purposes.
- **Network Control Management System (NCMS)** – will introduce a new real time situational awareness capability. Virtual Energy System will develop use cases and models to support our work in this area.
- **Balancing Transformation** – will transform our balancing, forecasting and dispatch capabilities. This is the one area where we predict the Virtual Energy System will bring the highest economical value to the system by leveraging data and simulation capabilities to optimise dispatch and balancing operations.

As the use cases and common framework are developed, they will contribute to and be supported by these programmes. We have also presented the programme to the our Technology Advisory Council for feedback and will continue to engage with them for expert contributions.

10. How is the programme structured?

We have formed three workstreams to deliver this programme. These workstreams are:

- Workstream 1 - Stakeholder Engagement
- Workstream 2 - Common Framework
- Workstream 3 - Use Cases

Each workstream will support the long-term goals of the programme while delivering short term value by sharing learning, establishing processes, proving technologies, and making new data available.

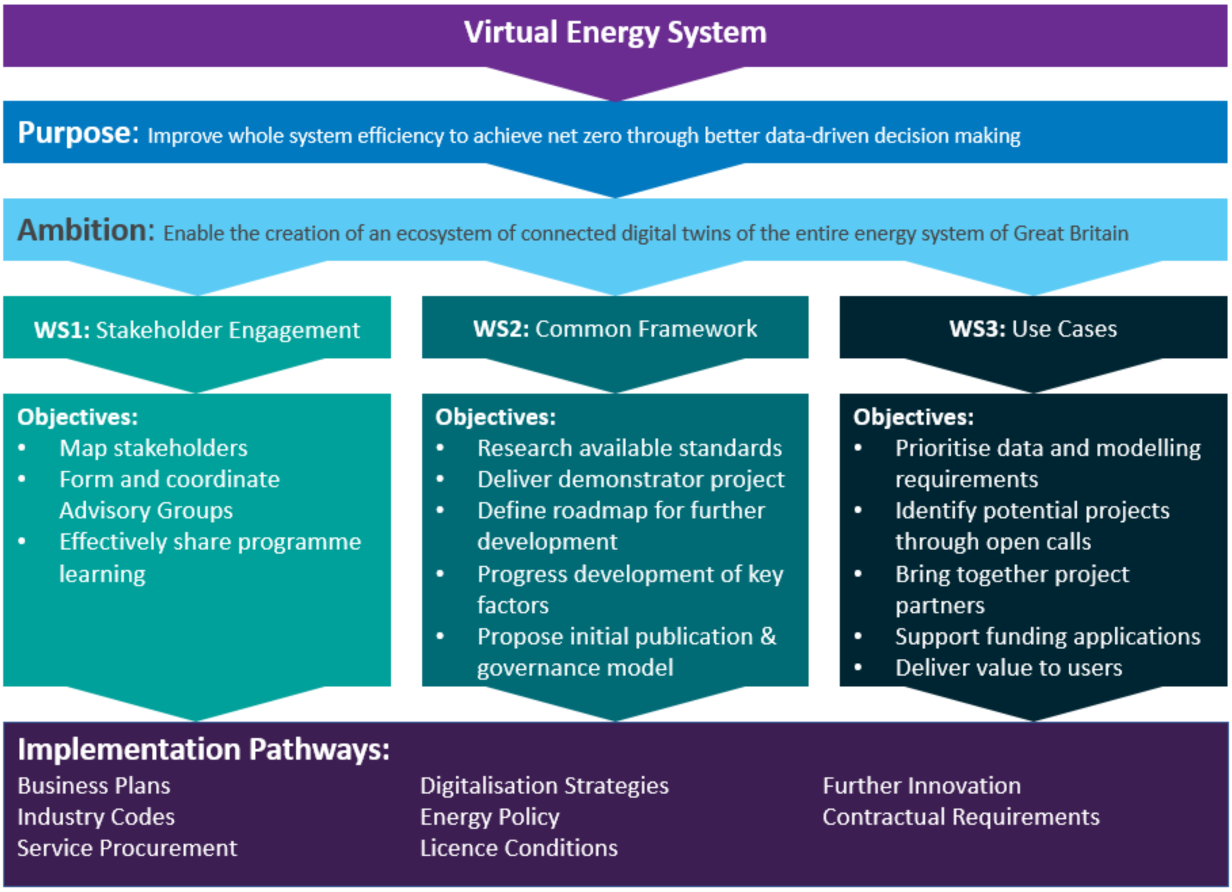

Figure 5: Overview of programme workstreams

Both the common framework and use cases workstreams will comprise of a portfolio of related Network Innovation Allowance (NIA) and Strategic Innovation Fund (SIF) projects. These projects will tackle specific technical challenges aligned to achieving net zero and delivering value for consumers. Each project within the Virtual Energy System will develop and demonstrate a new capability in modelling or process and identify new open or shared data sources.

The stakeholder engagement workstream will ensure that engagement, including Advisory Groups, supports the programme's development and prioritisation. It will also support sharing of knowledge and experience through our project website, communications, and events.

Stakeholder engagement and collaboration will be critical for the success of the Virtual Energy System and therefore must have dedicated resource. The Virtual Energy System must be developed with the sector, for the sector. A "top down" approach will result in a rejection of adoption as has been seen in other programmes.

10.1. What is our engagement strategy (Workstream 1)?

Engaging stakeholders and creating a governance framework are the processes by which the Virtual Energy System foundations will be established. The whole sector, and consumers, will be impacted by the Virtual Energy System and so must have the appropriate level of input into its development, with supporting governance to navigate the broad range of opinions.

The stakeholder engagement strategy for Virtual Energy System has four priorities:

1. Communication of project to share learning, drive interest and encourage participation
2. Interviews and workshops with related external organisations and initiatives to collaborate
3. Developing Advisory Groups and associated workshops to ensure representation of stakeholders in decision making
4. Internal coordination to prioritise requirements and support digitalisation

The ambition of the Virtual Energy System stretches beyond the creation of a single data sharing framework; it encompasses cyber security concerns, data infrastructure planning, and it necessarily involves envisioning the proper regulatory framework to govern the virtual grid, as well as identifying the proper business cases that will drive the value for each component.

The programme team will consider using existing channels in the energy industry, but for this to be a true ecosystem of connected digital twins of the energy system it must integrate with but go beyond ENA and existing sector forums and be truly democratic and open in its membership. Our proposal is to setup Advisory Groups populated by the appropriate experts to address each separate class of questions as they emerge.

In all our stakeholder engagement we will collaborate with other ESO and energy-sector programmes and business planning processes to avoid duplication. Where there is any overlap with related programmes either internal or external the discussions and outcomes will be shared.

10.2. How will the common framework be developed (Workstream 2)?

When implemented the common framework will be a suite of artifacts, assets, and solutions that are deployable and re-usable by actors across the sector. It is currently considered that these artifacts, assets, and solutions will include:

- Principles that set out the goals for successful implementation
- Guidance that describes applications of standards and provide links for more detail
- Technical specifications or requirements for interfaces where required
- Software and technology components that can be re-used and may be either open source developed for Virtual Energy System or other recommended packages that are compatible
- Services for performing functions such as Identity Access Management or search
- Case studies and examples of existing implementations, for example by linking to the Digital Twin Hub

These requirements are evolving and will become clearer as the programme progresses. A priority of the common framework is to be open and to facilitate competition. The use of open standards and open source will be considered. Each element of the common framework will be considered in a cost benefit analysis.

In time the common framework will become a central source of compliance requirements, guidance, and governance processes like an industry code. It will be designed in a modular way and supported by associated governance processes and role definitions.

Following the example set by the National Digital Twin programme and their Climate Resilience Demonstrator project (CReDo) a highly effective method of developing a common framework is to demonstrate its application through a tangible use case.

We have proposed a demonstrator project focussed on visibility of supply side system flexibility. This demonstrator is designed to allow for the key socio-technical factors to be progressed through its development. The use of a separate demonstrator ensures that it is not dependent on other projects and can be defined in a smaller scale focused on a use case that covers a range of key socio-technical factors.

Our SIF Alpha application for the Virtual Energy System was specifically for the development of the common framework. The project was declined for funding on the basis that the deliverables did not have a clearly articulated route to production and would benefit from smaller trials. We intend to act on this feedback and have developed a refined demonstrator project that continues at pace and has clear deliverables. This is currently being considered for NIA funding. During the delivery of this project we will ensure that value is clear and that next steps are identified for implementation.

10.3. How will the use cases be developed (Workstream 3)?

The Virtual Energy System will be a replica of the entire GB energy system. As such, the ESO will not develop or own the components. We will agree with stakeholders which use cases to build and how to prioritise them to deliver whole system value. While the programme develops in maturity, the ESO is leading by example with three initial use case projects. These projects build out high-value areas of the Virtual Energy System and generate learnings for future use case projects.

A use case applies a digital twin methodology, (which is compliant with the Virtual Energy System common framework) to solve a particular complex problem. We define a digital twin methodology as taking in real-world data and then modelling or processing it to produce useful outputs for decision making. We are particularly interested in use case projects that bring together data from multiple organisations to solve a problem. This is because the Virtual Energy System primarily delivers value by facilitating the interoperable data exchanges which drive joined-up decision making across sector.

Our first example use case is the Advanced Dispatch Optimiser. This project with Alphabet X is aligned to our National Control role. It considers the feasibility of developing an advanced optimisation tool for control room dispatch operations. The project will define the requirements, including adaptive models and data exchanges, and propose a roadmap for how this tool could be developed.

Our second example, aligned to our Markets role, is the Crowdflex project. We are working with Octopus Energy, Ohme, Element Energy, Centre for Net Zero, Western Power Distribution (WPD) and Scottish and Southern Electricity Networks (SSEN) Distribution. The Crowdflex project aims to establish domestic flexibility as a reliable energy and grid management resource. A large-scale trial will be used to gather operational evidence and approaches to modelling domestic flexibility will be developed using statistical techniques, including consideration of data exchanges required between flexibility providers and system operators .

Our third ESO role is Networks, in this area we have been working with Scottish Power Energy Networks, University of Strathclyde and Digital Catapult. The EN-Twin-E project is aiming to deliver visualisation and simulation of the electricity transmission and distribution networks as a complete system in real-time, including necessary data exchanges at transmissions-distribution system boundaries.

Also aligned to Networks we are supporting related gas projects including Gas Networks Interoperable Digital Twin with National Grid Gas Transmission. We are also working with SGN on their Hydrogen Electrolyser and Gas Distribution Network digital twin project. These projects all seek to develop digital twins of different components of the current/future gas system. They will consider the data exchanges needed between these twins to optimally operate the network and connected assets.

Our ambition is that future use case projects will be brought forward by other users of the Virtual Energy System and be supported by ESO rather than ESO led. We will form a Use Cases Advisory Group to ensure that these are prioritised effectively and their costs and benefits assessed robustly. We will also support the formation of use case projects by bringing together groups of users through innovation challenges like the ESO's Open Innovation Event.

Each use case will deliver further digital twins into the Virtual Energy System increasing the representation of the real world over time.

11. How will innovation feed into implementation?

The Virtual Energy System must adopt an agile methodology. The problem is highly complex, fast paced and includes multiple stakeholders. It is therefore difficult to set out exactly what the Virtual Energy System will look like before we have gone through a design process.

For that reason, we are following the SIF and Government Digital Services (GDS) aligned approach of agile development, following the discovery, alpha, beta, live stages. Each stage providing clear deliverables and de-risking the overall programme development.

For this next phase we have proposed using a portfolio of NIA and SIF projects which are led by ESO or led by another network and supported by ESO. These projects allow aspects of innovation risk to be mitigated in a time bound and measurable way. Each project must individually show a net benefit through learning or new data, methodologies, and processes. Each project will also feed learning into the common framework and wider Virtual Energy System developments.

To scale the Virtual Energy System, it must move from innovation into a 'business as usual' (BAU) state. Depending on the element being developed this will follow different routes. Figure 6 below shows the options available depending on maturity and capability at the end of the project.

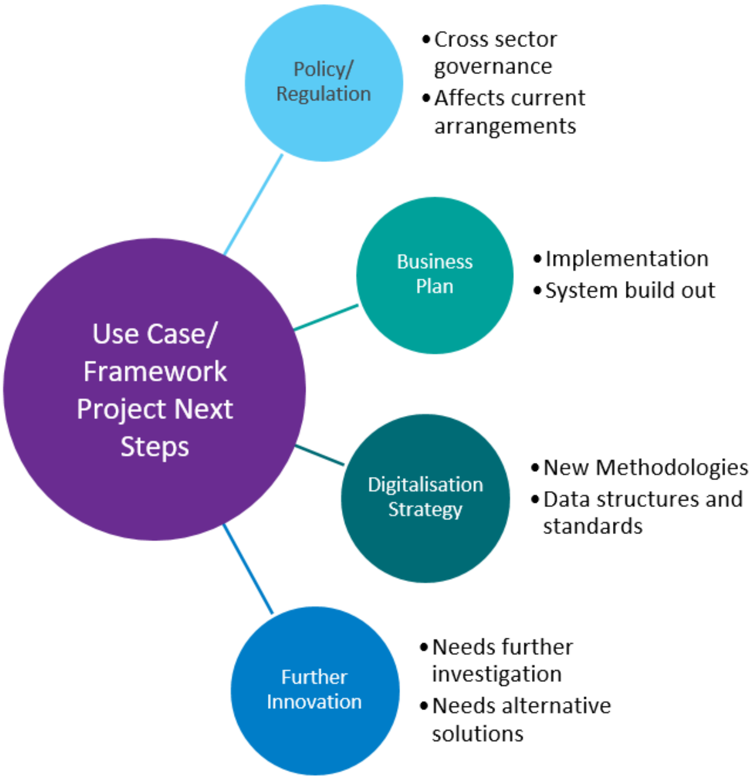

Figure 6: Next Steps of Projects on path to BAU

12. How will the Virtual Energy System work in practice?

The common framework will create the common language, recommended infrastructure, and processes to connect and federate individual digital twins from across the energy sector together.

The Virtual Energy System will not create a singular digital twin of the energy system or single central platform for GB. Instead, it will create a decentralised network where each actor, for example a Generator, Transmission or Distribution Network, could develop their own digital twins and then connect and share their data through the Virtual Energy System. In short it will attempt to write a *Constitution of the Energy Digital Twin*, or a *Digital Twin Grid Code* laying out the requirements, rules, and principles to which all constituent digital twins will have to be conformed so that they may connect and share data.

The framework will consider both social and technical factors including, but not limited to: governance, policy, legal, data rights and consent management, ontologies, metadata standards, interoperability approaches, skills, data standards, security protocols, dispute resolution, performance, and codes of practice.

It is fully aligned with the recommendations of the National Digital Twin programme and with the EDiT recommendations for a digital spine and data sharing fabric. The Energy Systems Catapult, the authors of the EDiT, were part of the team advising ESO on the development of the common framework.

Organisations within the energy sector will build their own digital twins. Many electricity and gas networks have already proposed this in their digitalisation strategies. We will support this development by sharing the common framework and by working with these other organisations to understand their requirements and experience. Without collaboration and the common framework, these proposed digital twins will be incompatible leading to technical debt and lost opportunity.

To accelerate the development of these digital twins, in partnership with other organisations, we will develop targeted innovation projects centred around high-value use cases. These will focus on proving and developing modelling methodologies and opening up new data sources. Our priority will be where two or more organisations can join the data of their digital twins together solve a problem.

As the programme develops, we expect other organisations will want to get involved to benefit from the opportunities of the Virtual Energy System. We will support these organisations to develop projects and to implement the common framework.

The Virtual Energy System will represent a wide range of organisations and their diverse use cases. Through our advisory groups, from our stakeholder engagement workstream, we will develop an understanding of the data that is most needed for these use cases. These critical components will be prioritised through the advisory groups.

The simple diagrammatic representation of how the Virtual Energy System will operate is outlined at a high level in Figure 7. The exact design of the Virtual Energy System will evolve as the programme matures and following the proposed demonstrator phase.

Each digital twin within the Virtual Energy System will be owned and maintained by independent organisations. The data and metadata from them will be shared in machine-readable interfaces through APIs, data portals, etc, that are operated by the digital twin owners, aligned with the interfaces, security controls and formats defined in the common framework. To become a part of the Virtual Energy System organisations will need to follow the requirements of the common framework.

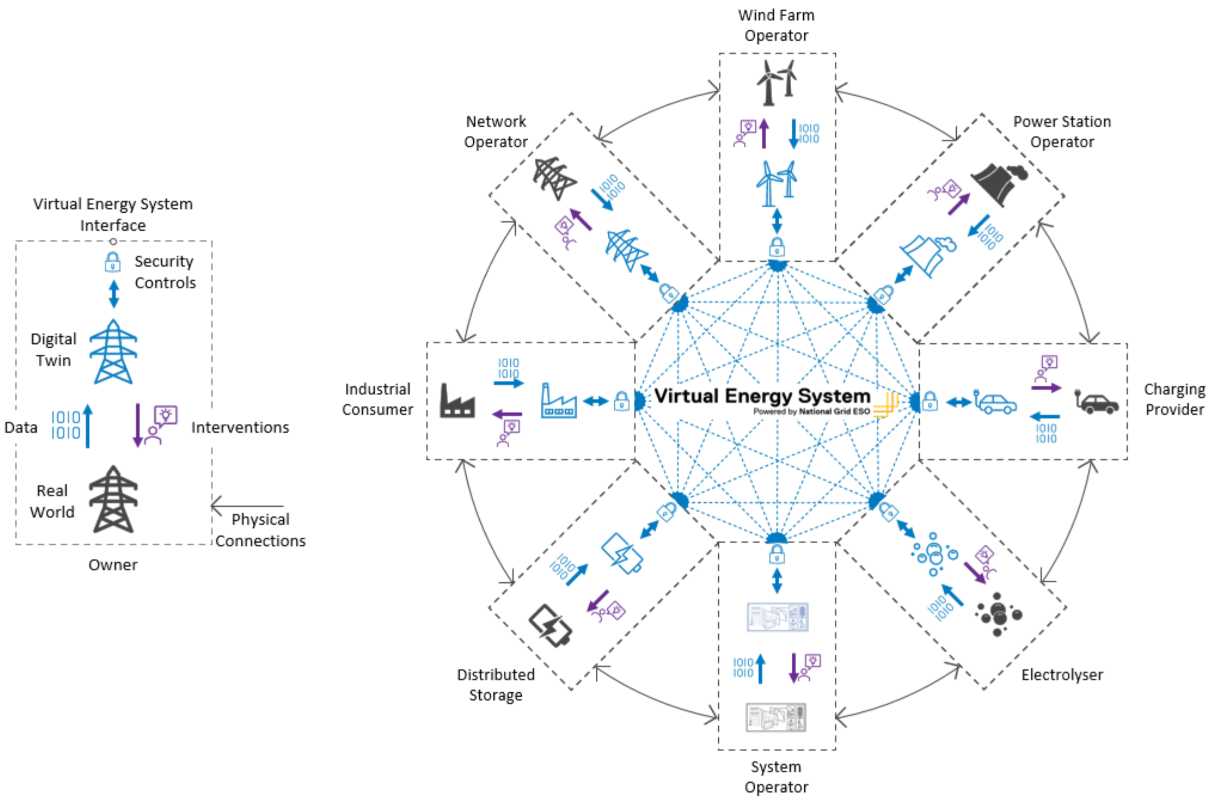

Figure 7: A simplified representation of potential components in the Virtual Energy System

Figure 7 above is simplified to only show a sample of participants in the energy system. In practice there would be many more digital twins representing generators, interconnectors and assets in the gas system.

In time additional services could be developed to accelerate development of use cases. Examples could include:

- a model integration service that combines distribution and transmission network data to develop a GB power system model for AC load flow
- competitive forecast services that can be integrated with other models
- validation or testing services that can confirm compatibility and recommend changes
- authentication and data marketplaces for shared data (not required for open data)
- third party digital twin development services compatible to common framework

A priority in Virtual Energy System is opening up access to data between organisations. This includes promotion of both open and shared data processes. This will require consideration of data licensing to ensure that the elements of the Virtual Energy System can be integrated and reused. This is also dependent on promoting visibility and accessibility of data sets. An example of a service to promote this could be a data catalogue and search service like Open Energy.

13. What is the timeline?

Short term

The programme was conceived in April 2021 and officially launched in November 2021. In the first months of the programme, we formed the tri-workstream model, proposed initial activities required to launch and prepared SIF Round 1 Discovery applications.

We held an online conference on 1st December 2021 to set out the ambition of the programme. Over 500 individuals registered and over 250 were present on the day. Recordings were shared online after the event for those that could not attend live. Our full day agenda included panel sessions with industry leaders in digitalisation, regulation, and innovation. We also shared the Virtual Energy System vision and opened initial discussions with the wider audience, who were also invited to complete a survey to guide our programme.

In 2022/23 we will launch Advisory Groups which will bring together experts from across the energy sector and beyond to define the priorities, requirements, and specifications. These Advisory Groups will meet regularly supported by targeted workshops. They will deliver solutions to the challenges of digitalisation and data exchange, drawing on existing industry knowledge and learning from projects currently underway. We will manage these groups bringing forward topics for discussion, proposal papers for review and organisational coordination.

In 2022/23 we will deliver the Alpha phase of the Crowdflex SIF project, modelling the domestic flexibility utility curve. Also, in SIF Alpha we have partnered with Southern Gas Networks (SGN) on a project investigating digital twins for Gas Distribution and Hydrogen. We are also developing projects to follow the next steps from the Advanced Dispatch Optimiser project which made recommendations on modelling methodologies.

The common framework workstream will launch a demonstrator NIA project in 2022/23 to deliver small scale proof of concept of the proposed architecture aligned to a simple visibility of supply side system flexibility scenario.

	Jul-Dec '21	Jan-Summer '22	Summer '22-Summer '23	Summer '23-Onwards
Prog. Phase:	**Discover**	**Design**	**Assemble**	**Implement**
WS1: Stakeholder Engagement				
	• Launch event • Online conference • Launch initial consultation • Identify partners	• Promote programme • Identify partnerships • ESO Open Innovation Event	• Define Advisory Group Structures • Launch first Advisory Groups • Conference	• Identify collaboration opportunities in other sectors • Advisory groups • Conference
WS2: Common Framework				
	• Tender for consultancy support • Initial benchmarking of global examples	• Set an initial scope for the framework • SIF Discovery Phase	• Define demonstrator structure • Launch project • Propose first principles for priority factors	• Initial standards and documentation launched • Governance process established
WS3: Use Cases				
	• Launch Advanced Dispatch Optimiser Project	• Launch Crowdflex SIF Project • Support partner projects	• Open calls for ideas • Launch further use case projects	• Develop next round of project ideas
Programme Deliverables	• First conference event • Programme strategy • Partner agreements	• Publish Benchmarking and Key Factors Reports • SIF Discovery phase results • ADO project report	• Demonstration of first components • Roadmap launched • Project tracker launched	• First member Digital Twins delivering value • Framework outline defined and published

Figure 8: Short Term Project Timeline

10 Year Vision

The vision in 10 years' time is well communicated by the National Digital Twin programme's Gemini Papers:

"An ecosystem of connected digital twins breaks down the complexities of understanding the system as a whole. This system-based outlook will help us all understand the knock-on effects and the trade-offs that a decision could cause. By connecting physical assets, processes, and systems with shared digital connections, we will gain insights that will enable improvements, optimisations, and better interventions across scales.

An ecosystem of connected digital twins pushes the information value chain further by driving innovation, increasing infrastructure resilience, and optimising the use of resources. This leads to better outcomes for all.

By sharing data across organisational or sector boundaries we can identify interdependencies. This leads to improved decision making that just would not happen immediately if each silo of data were considered independently. Better decisions, based on better analysis of better data, drive better outcomes for people."

Quote 2: Gemini Papers: Why Connected Digital Twins – Centre for Digital Built Britain 2022

Over the current financial year 2022/23 we will build out a longer-term roadmap of use cases, Advisory Group key questions/topics, and a plan for implementation of any core services as well as supporting users to bring forward use cases through the Advisory Groups.