Virtual Energy System

Workstream 2 - Developing the underpinning frameworks

Show & Tell

February 2022

Note to reader:

These slides are a snapshot of the work to date on the Virtual Energy System underpinning framework. The intent is to share the evolving knowledge and learnings with industry. For more information on the latest developments please contact VirtualES@nationalgrideso.com

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Agenda – the next 60 minutes

- **Introductions**
  5mins: Dial-in buffer, introductions, context and objective of Show & Tells
- **The Virtual Energy System (VirtualES)**
  10mins: What it is, it's objectives, and the scope of this workstream
- **Benchmarking**
  5mins: Findings from cross sector benchmarking
- **Key socio-technical factors**
  10mins: Overview of factors
  30mins: Questions & interactive exercise

Introductions

Show & Tell objective

Share knowledge and learnings from the work to date with industry

Virtual Energy System

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ENABLING THE VIRTUAL ENERGY SYSTEM

Jonathan Barcroft

Workstream 2 Lead – Virtual Energy System, National Grid ESO

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THE CHANGING ENERGY SYSTEM

Our mission is to decarbonise the energy system and bridge the gap to net zero.

40GW

Offshore Wind by 2030

FES - 2021

18-30GW

Interconnection by 2041

NOA - 2022

120-230GW

Flexibility by 2050

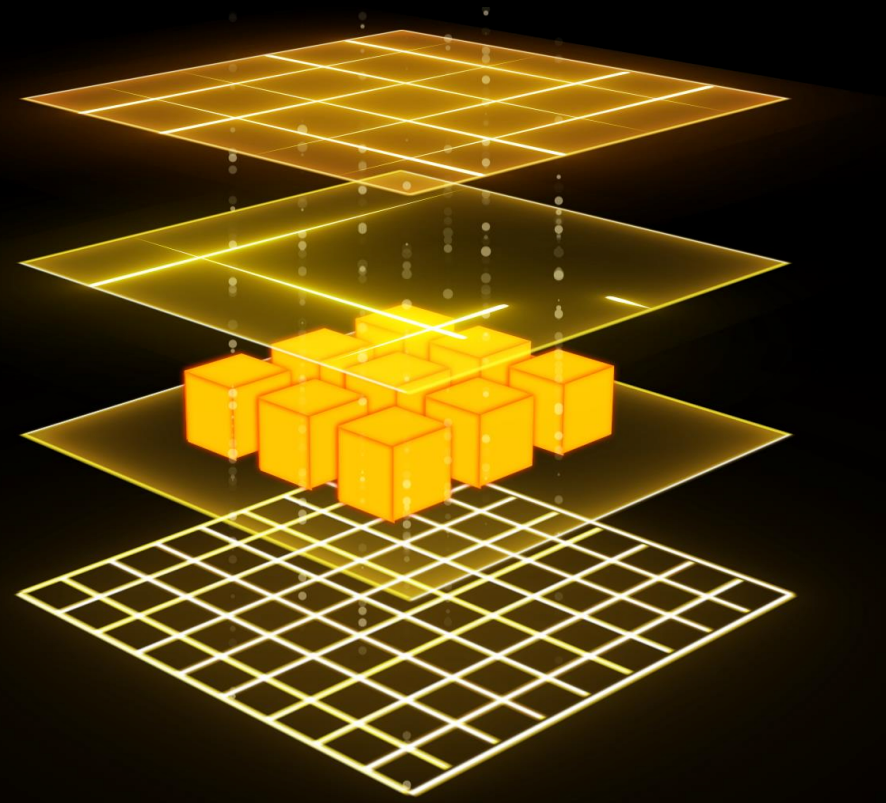
FES - 2021

Increased data availability and digitalisation of systems is fundamental to enable markets and technology to manage peaks and troughs.

VIRTUAL ENERGY SYSTEM

Objective:

- enable the development of an ecosystem of digital twins for the GB energy system

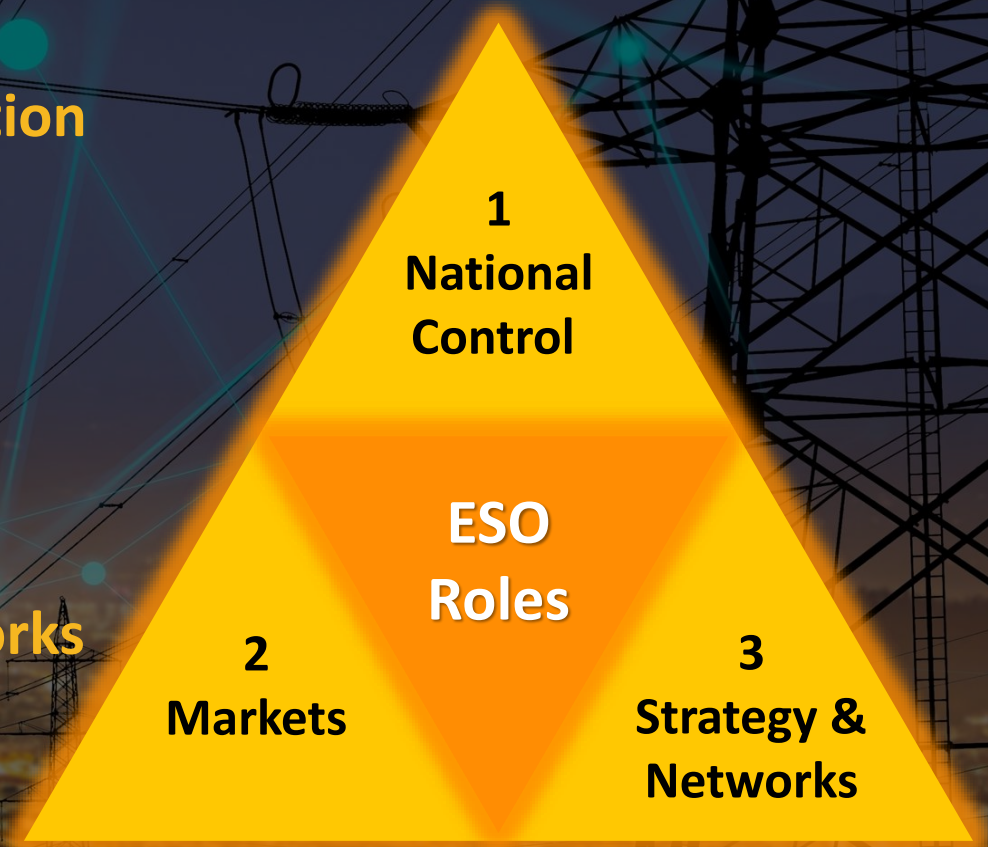


3 workstreams:

- Stakeholder engagement
- Common framework & principles
- Use cases

INITIAL USE CASES

1. **National Control**
   - enhancing **optimisation** and **data integration** capabilities to support **dispatch** decisions
2. **Markets**
   - understanding **consumer** and **technology** dynamics to simulate **flexible demand**
3. **Networks**
   - developing digital twins of **physical networks and assets** to support system **stability**



VIRTUAL ENERGY SYSTEM: COMMON FRAMEWORK

1. **Benchmarking:** Understanding the current cross-sector and global best practice for connecting assets, systems, and digital twins.

2. **Key elements:** Determining the key socio-technical factors that need to be considered for the Virtual Energy System to succeed.

3. **Developing standards:** Collaboratively developing, with industry, the agreed standards and approaches for the key elements.

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CATAPULT Energy Systems

IB1 Icebreaker One

Benchmarking

Simon Evans

Digital Energy Leader, Arup

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Benchmarking objective

"Understand the current cross-sector and global best practices for connecting assets, systems, and digital twins"

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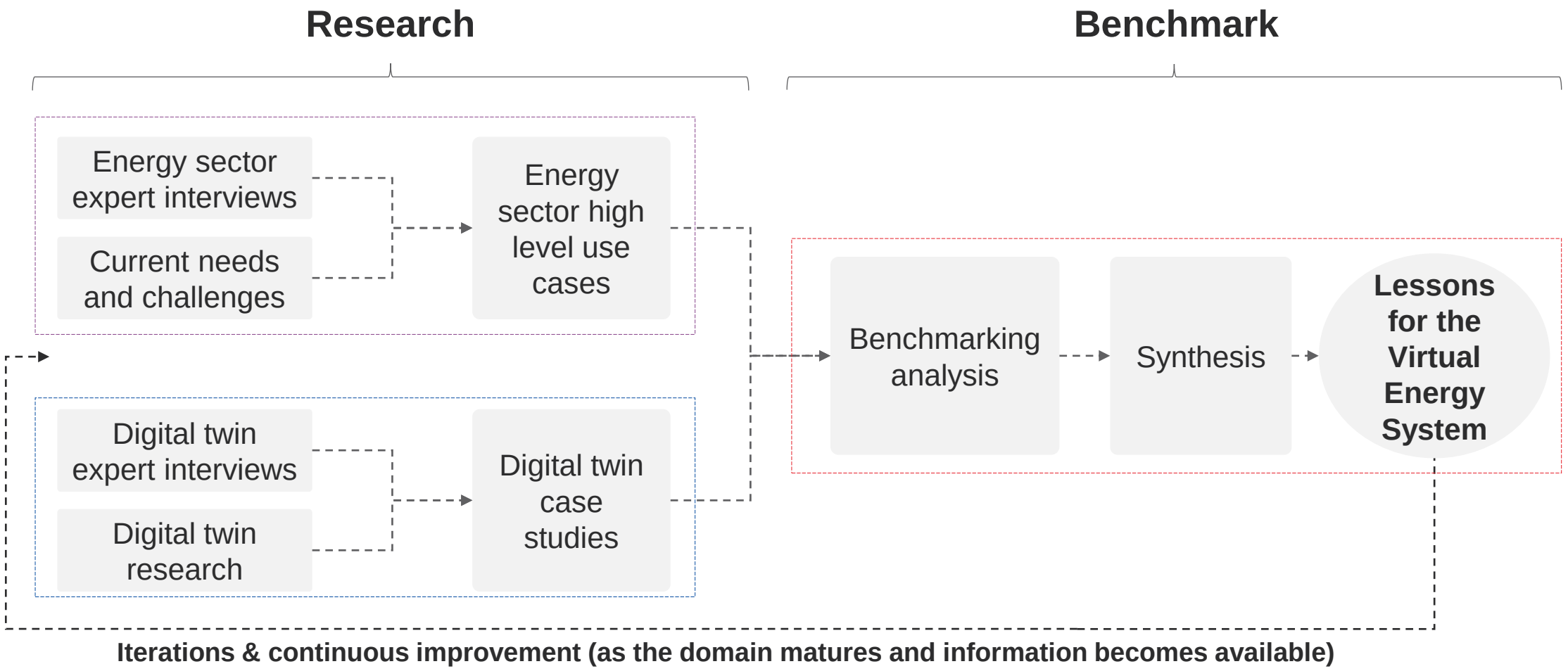
Benchmarking approach



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Benchmarking use cases

Segments

Generation | **Transmission** | **Distribution** | **Retail** | **Consumption**

Use cases

1. Transition to net zero
2. Asset monitoring & predictive maintenance
3. Optimisation of energy production
4. Linking electricity & gas networks
5. Real time and predictive balancing
6. Flexibility modelling for increase renewable
7. Model energy storage needs
8. Demand response
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

Sectors

Aviation | **Banking** | **Energy** | **Rail** | **Maritime & Shipping** | **Telecoms** | **Water**

Australia
Estonia
Singapore

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Benchmarking outcomes

Analysis

People

- Skills
- Capability
- Key roles

Process

- Government
- Regulatory involvement
- Political support
- Transparent Engagement
- Contractual relationships

Technology

- Cyber security
- Computing power
- Connectivity
- Security and privacy
- Trust in distribution
- Open software
- Ease of reliable interoperability
- Modelling
- Cost of technology

Data

- Data best practices
- Data completeness
- Harmonise existing data standards
- Interoperability
- Common taxonomies and ontologies
- Data visibility

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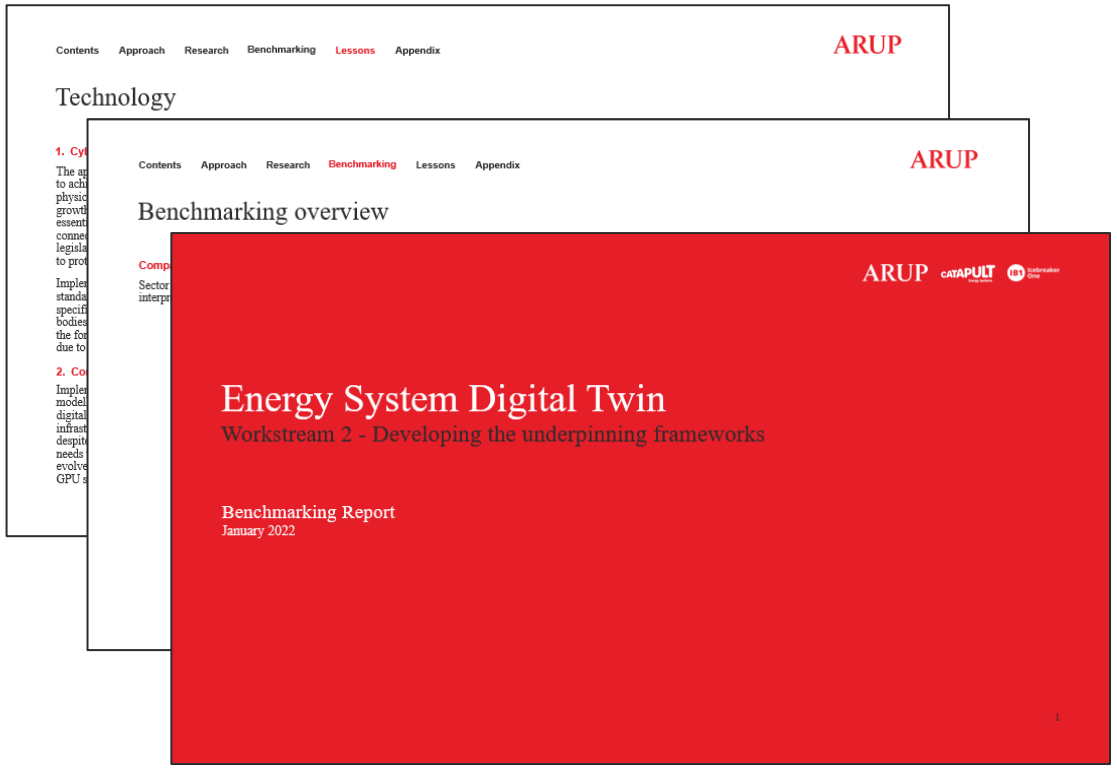
Learn more



Public release of the full benchmarking report coming soon

For more information, contact:

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Key socio-technical factors

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Key socio-technical factors

"Determine the key socio-technical factors that need to be considered for the Virtual Energy System to succeed"

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Summary of key socio-technical factors

People	Defining roles & responsibilities	Raising awareness & fostering culture	Building capabilities & skills	
Process	Aligning around industry codes & standards	Engaging Stakeholders	Creating a governance framework	Determining the operating environment
Data	Aligning models & taxonomies	Establishing management & governance	Increasing visibility & enabling sharing	Managing security
Technology	Connecting physical infrastructure	Analysis of Software	Creating open interfaces	

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People factors

PRIORITY

Defining roles & responsibilities

Formalise Roles and Responsibilities for VES with the intentions of consumer benefits

Define key stakeholders' position across the VES ecosystem with indication of tasks and duties for which they are responsible. Focus to be given to:

- Data management roles and responsibilities (e.g., data owner, steward and user) in the context of VES
- Leadership roles and responsibilities at operational and executive management level.

Raising awareness & fostering culture

Share vision, belief and behaviours and enabling practices to support VES objectives

Define the cornerstone beliefs and behaviours that will be needed to support the delivery of VES objectives. This will identify key values and practices that will support VES visions.

Key values would include things such as openness, security, customer centricity, agility and ethics which encourage shared prosperity. Whereas practices would include an developing the approach for change management and building trust.

Building capabilities & skills

Understand skills & competency needs with respect to current skill levels and develop capacity building strategies

Define the capabilities needed to support the VES ecosystem and identify the best strategies and practices to develop and establish these.

Focus to be given to:

- Understanding Open Data
- Interoperability
- Technology architecture/resilience
- Analysis

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Process factors

PRIORITY

PRIORITY

Aligning around industry codes & standards

Look at whether standardised practices in the industry require amendment to support the VES

Review and identify whether existing Energy Sector standards and codes require amendment to enable the VES and/or support VES adoption. Focus to be given it:

- Technical standards for modelling and operation of energy systems
- Grid Code
- Distribution Code
- System Operator / Transmission Owner Codes

Engaging Stakeholders

Nurture industrial, governmental and political support

Identify the best approach to nurture strong support and active engagement from key VES actors. Focus to be given to:

- Nurturing transparent and open engagement and creating trust and shared ownership across a wide range of stakeholders (e.g., industry, academia, public and private sectors).
- Lock in support and direction from governmental and regulatory actors able to influence the energy sector through policy and targets.

Creating a governance framework

Set strategy and operational governance of the VES

Identify the high-level governance framework to support the VES ambitions.

Clarification of best suited governance models will help VES contributors by bringing clarity around how they will interact. It will look at effective routes for management of issues and change requests.

Determining the operating environment

Create an enabling context for VES to operate through business models, cross

Define at a high level the environment needed for VES to create value and sustains itself in the process.

Focus to be given to :

- Potential business model
- The legal framework needed to unlock the key challenge in relation to the sharing of data
- Policies context

Data factors

PRIORITY

Aligning models & taxonomies

Define an approach to harmonise existing data standards, taxonomies and ontologies.

Harmonise the data architecture that will support the VES to facilitate effective interoperability and data exchange. Focus on setting an approach to harmonisation by:

- Building sector wide cooperation.
- Identifying how to connect/use the various existing data standards, taxonomies and ontologies.

Establishing management & governance

Outline data management and governance needed to support VES

Identify how to best enable the data requirements across VES by defining:

- rights and accountabilities needed to ensure the appropriate behaviour in the valuation, creation, consumption and control
- practices, techniques, and tools for achieving consistent and efficient access to and delivery of data across VES
- ways to promote and assure the quality of VES data so that it is it fit for purpose/use and trusted

PRIORITY

Increasing visibility & enabling sharing

Identify ways to nurture effective data sharing to support VES interoperability.

Enable actors across the VES to create, exchange and consume data in a way that ensures clear, shared expectations for the contents, context, usage and meaning of that data. Focusing on :

- promoting direct access to data that is open
- easing the consent & approval processes for data requested
- simplify and guide data licencing
- Understanding how to best to describe and catalogue data to support search
- Allow feedback on the quality of data

Managing security

Set the core rules needed to address security, privacy and risk implications surrounding VES data

Define guiding rules to protect VES sensitive information assets (e.g., critical infrastructure and consumer data) and component system, either in transit or at rest. Focusing on understanding how to drive adherence to the latest practises, legislation and regulation

- evaluate security & privacy needs and risk of VES Data
- make security and privacy a fundamental VES design principle (e.g., access control and authorisation protocols for data usage, provide data integrity and immutability)

Technology factors

PRIORITY

Connecting physical infrastructure

Identify what physical IT infrastructure and devices and their connectivity are required to operate the VES

What additions to the system of distributed servers is required for VES, of cloud based infrastructure and its connectivity for analysis, sharing and modelling of the energy system and beyond.

Set a framework to evaluate the anticipated requirements, security and any other challenges to be addressed. Focus specifically where high volumes of physical devices, EVs and storage connect simultaneously to support real-time monitoring of large processes and assets.

Analysis of Software

Identify the likely modelling / simulation and analysis software which will be used to enable current and future modelling of the VES.

Determine an approach to share methodologies and results of modelling and simulation within a federated VES ecosystem, and co-simulation between the physical reality and energy market scenarios.

Explore what common principles and guidelines could support users when adopting analysis and data visualisation tools to provide a consistent understanding of results. What open source software initiatives are being developed or in use which could reduce costs and enable innovation.

Creating open interfaces

Software and hardware will differ by usage, but the exchange of data is critical for the import or export of data.

Identify existing data exchange formats widely used by software for access, import or export, which should be championed or enhanced in support of the VES
Identify where common metadata standards are supported by platforms so data provided is understood and used appropriately (potentially externally) with appropriate access rights. Identify common sensor interoperability of standards so that the sector can interchange use of sensors, request protocols etc.