Digital Spine

Feasibility study

Developing an energy system data sharing infrastructure

September 2023

Executive brief

Developed for:

Department for Energy Security & Net Zero

Executive summary

Developing an energy system data sharing infrastructure

Following the Energy Digitalisation Taskforce in early 2022 and its recommendations to develop a 'digital spine' for the sector, this feasibility study was commissioned by government to scope what precisely a digital spine is, and how it might be developed to benefit the energy sector.

The work presents the cumulative thinking of the consortium of Arup, Energy Systems Catapult and the University of Bath, along with the 100+ individuals and organisations that were consulted in the co-creation of what has now become the concept of a **data sharing infrastructure**.

An outcome of engagement activities conducted as part of this feasibility study was to move away from "***Digital Spine***" and "***Data Sharing Fabric***" terminologies, as they caused significant confusion and were unhelpful in communicating and articulating the overall purpose of an energy system data sharing infrastructure.

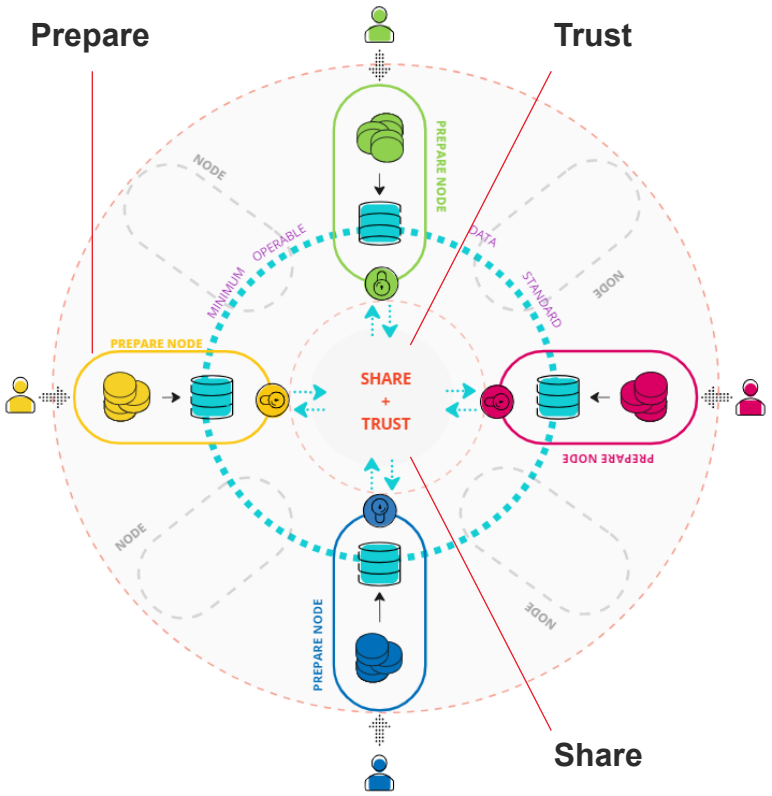
Instead, to promote broader audience understanding, it is described by the three functional components: **Prepare**, **Trust**, and **Share**, as shown in the adjacent diagram**.** Each component plays a vital role to ensure an ecosystem of data sharing is realised.

It is currently considered that government involvement will be crucial for implementing an MVP of the data sharing infrastructure due to the government's ability to prioritise public interest, provide security and trust, drive standardisation and interoperability, and ensure long-term stability.

A data sharing infrastructure is a modern public service for public good, and as such, a cost recovery route is proposed to pay for its implementation, and ongoing operation and maintenance.

This report is part of a suite of documents summarising the findings and conclusions of the feasibility study:

- **Full report** – 411 pages
- **Summary report** – 52 pages
- **Executive brief** – 16 pages



Proposed components of a data sharing infrastructure

Findings are the view of the consortium and are not official government policy

The contribution to UK Government's objectives

Summary of how a data sharing infrastructure would support the strategic needs of the energy sector

Overview

The energy industry must undergo significant change to ensure the delivery of an affordable, resilient, net zero energy system.

The future system requires the integration of large volumes of low-carbon and renewable infrastructure with a significant increase of assets and interactions needed. The industry currently suffers from a lack of data sharing which present challenges in the ability to manage the increasing complexities of the future system.

The ability to ingest, standardise, and share data between different actors and customers will be critical in managing this and enabling:

- Lower overall system costs due to efficiencies
- The UK government meeting its strategic and legal objectives around net zero
- A flexible and stable system that can manage the increasing complexities of a net zero system
- An increased pace of innovation to support achieving all the above
- A resilient system with reduced risk of market failure.

Greater value offerings for the customers

As the energy system moves towards net zero the way in which customers interact with the system is set to dramatically change. With current ways of operating this will incur significant costs to customers. Customers need an affordable, trusted, seamless energy experience with the necessary controls and protections that maintain customer experience. A data sharing infrastructure is critical to the robust delivery of these solutions, ensuring delivery of affordable energy to all.

Meet policy objectives

The UK government have set out a net zero strategy and commitment to achieving net zero by 2050. To achieve this the UK must decarbonise its current energy system by 2035, integrating large volumes of low-carbon and renewable infrastructure without compromising energy security or resilience.

The complexity of the future system means that success can only be achieved through greater use of data and technology. Without this, the UK risks failing to meet its commitments.

Flexible and stable system

To achieve an affordable, resilient net zero energy system, a whole systems view must be considered, with numerous actors working in tandem to deliver a flexible and secure network of assets.

To support the delivery of new markets assets owners and operators must be able to easily move their assets between different markets and service providers. All of this can only happen through greater use of data and technology. Without this there is a significant risk of market failure and likely inability to achieve resilience objectives.

Increased pace of innovation

To achieve an affordable, resilient, net zero energy system significant innovation is needed. Innovative solutions that create new commercial structures or introduce more efficient ways to operate the network typically require data from multiple sources.

The current siloing of data and lack of sharing infrastructure means that barriers to entry for innovators are high and innovation cannot happen at the rate it is needed. A data sharing infrastructure would support access to the data needed to drive this

Findings are the view of the consortium and are not official government policy

Mitigating market failure

Considerations of market failure for developing a data sharing infrastructure

Overview

The Energy Digitalisation Taskforce recommended the need for a data sharing infrastructure. It considered that their absence would result in a loss of 'optionality' in how the future energy system is developed.

In the context of a data sharing infrastructure, the following types of market failures are considered:

- **Provision of information**
- **Absence of an interoperable way to share**
- **Lack of structural trust**
- **Data monopolies**
- **Increasing complexity of the energy markets**

Detailed descriptions of each market failure mechanism are given in **Appendix M** of the full report.

Governance considerations

The energy market already is already familiar with the sharing of operational data related to system operation or financial flows within the energy retail market.

For example, organisations such as RECCo or ElectraLink facilitate data transfer with market participants to discharge their licence obligations. The codes are then governed by a strong framework that has iterated over time to deliver for the market needs.

The agreement of these types of frameworks is a core function of a governance mechanism that overcomes a common market failure, which is a lack of information.

The five prioritised use cases suggest that information provisions for each is lacking and may represent an information provision market failure. Therefore, the level of governance required for such a solution should reflect the technical maintenance and core functions of a data sharing infrastructure.

A decentralised and distributed approach to governance, reflecting the proposed distributed technological implementation will mitigate the described market failure risks (e.g., digital monopolies developing).

Avoiding duplication across industry programmes

Another consideration for government is the efficient use of resources allocated to define, develop, and operate a data sharing infrastructure.

Coordinating multiple programmes, such as the National Digital Twin Programme (NDTP), Virtual Energy System, or Open Energy that receive funding from government should be priority of government to ensure effective uptake of policy outcomes, avoiding conflicting objectives, and ensure interoperability between programmes.

To mitigate risks from duplication of activities across programmes government should ensure coordination, collaboration, and careful resource allocation to optimise and maximise the impact of the publicly funded initiatives.

Findings are the view of the consortium and are not official government policy

Summary of findings from over 100+ engagement sessions

Main observations emerging from sector wide engagement

Meeting common objectives

A consistent theme observed through the stakeholder engagement activities was consensus around the ability of a data sharing infrastructure to effectively enable key policy objectives, such as:

- **Energy equity and affordability:** enabling energy that is affordable to consumers, keeping bills affordable, assisting vulnerable customers and reducing fuel poverty.
- **Energy security**: ensuring the UK is on a path to greater energy independence, ensure reliability of energy resources.
- **Support net zero**: supporting the economy through the net zero transition.
- **Economic security**: supporting growth, innovation and competition.

Emerging themes

Through the exploration of the use cases and stakeholder engagement activities, several observations and themes have emerged:

- A data sharing infrastructure should be equally a technological and a governance initiative, so that it can respond to the complex challenges around sharing of data.
- A data sharing infrastructure that was confined to the energy sector only would significantly risk the creation of further siloes across sectors and future abortive work.
- A data sharing infrastructure as an ecosystem for data sharing across the energy sector should be as simple as possible. It should avoid creating a barrier to entry for data providers, particularly in the requirement alignment to standards, and for actors with lower digital capability and reporting.

The value of a data sharing infrastructure

Through stakeholder interviews it was observed that the stakeholders found it difficult to clearly articulate the value of a minimal level data sharing infrastructure in relation to the problems they are trying to solve.

It was observed that stakeholders focused on the end functionality needed to solve a specific problem.

For this reason, it is considered challenging to achieve and understand the proof of the benefit of a data sharing infrastructure if it is measured at a single use case level, or on a use case by use case basis.

The value of a data sharing infrastructure is realised by solving common challenges faced across several use cases.

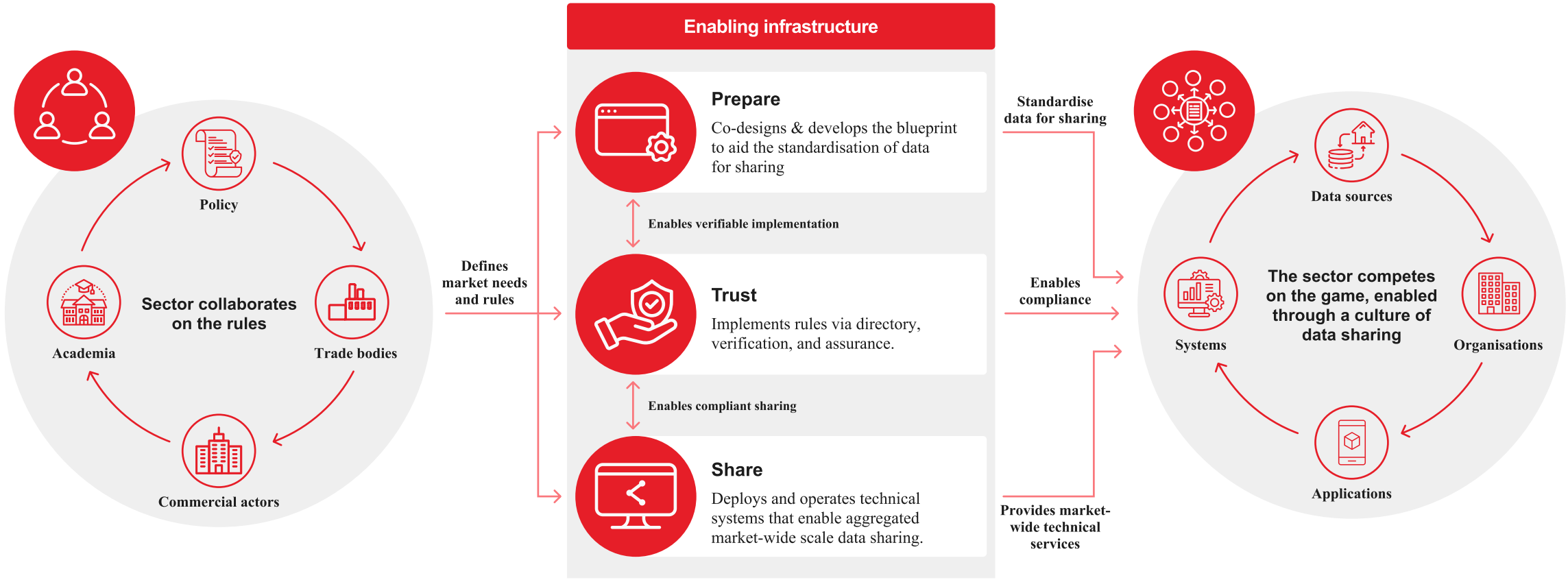
It is therefore recommended that a holistic approach for benefits is used, which considered whether it is better to solve each possible use case across the energy sector requiring data sharing in isolation or whether it is more effective to enable the missing foundational capability across the sector as a whole.

Findings are the view of the consortium and are not official government policy

Ecosystem of a data sharing infrastructure

A sector-led initiative with government support to develop and operate a data sharing infrastructure

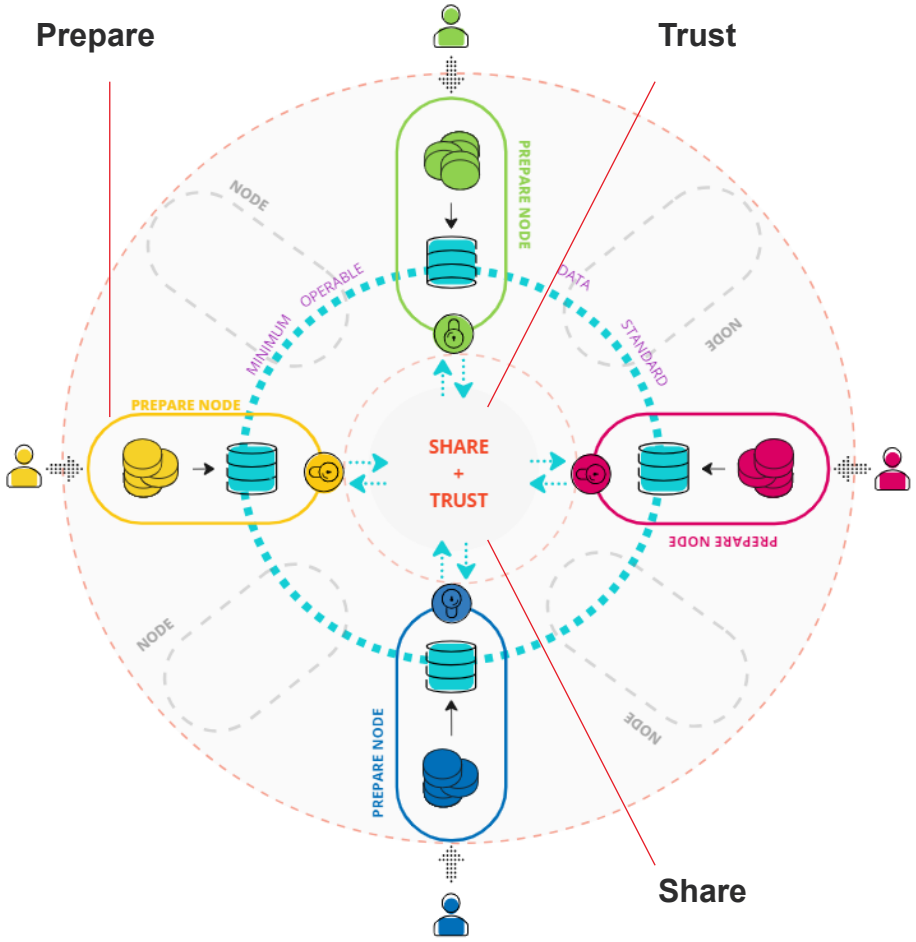
The diagram shows a data sharing infrastructure in the context of sector actors collaborating on defining data sharing rules; thereby, enabling a market that can compete on providing services to end customers, enabling faster innovation, and supporting the sector meet its net zero targets.



Findings are the view of the consortium and are not official government policy

Proposed components of a data sharing infrastructure

Overview of the three key components that enable an ecosystem of data sharing



Prepare: a cross-sector data preparation node

A node on the organisation's own infrastructure that prepares data into a minimum operable data standard (specific to each data type and use case), and presents it through standard APIs, access and security controls.

There should be one consistent cross-sector version.

Trust: a sector-wide trust framework

Provides the definition, implementation, and governance of the legal and identity frameworks. This establishes the user's confidence, right, and legality, where required, to share data between parties.

There can be more than one of these in the sector.

Share: a sector-wide data sharing mechanism

The connectivity layer and technology implementation for the governance of access controls to data.

There can be more than one of these in the sector.

Findings are the view of the consortium and are not official government policy

Prioritised use cases

Stakeholder-led approach to defining use cases, technical and delivery requirements

In total, 15 potential use cases were identified through stakeholder engagement, and market research. They aimed at finding potential use cases that helped with the definition of a data sharing infrastructure and met the overarching policy objectives.

Five use cases were selected and prioritised for further research. These were divided into two categories:

- **Day 1 use cases** – those use cases for which a data sharing infrastructure could bring immediate value.
- **Strategic use cases** – those use cases that provide the future strategic potential of a data sharing infrastructure.

The day 1 use cases were detailed further to understand the clear definition of how they would use a data sharing infrastructure to achieve a particular goal.

In addition to identifying potential use cases, the stakeholder engagement also highlighted the functional requirements for a data sharing infrastructure.

See **Appendix C** of the full report for further details on the use cases, and **Appendix L** for details worked examples of two use cases interacting with a data sharing infrastructure.

Type	Use case name	Use case goal
Day 1	Vulnerable consumer identification	To provide a holistic and up-to-date view of vulnerability by facilitating the exchange and connectivity of data related to vulnerable consumers. To ensure this view is accessible for use at the right level of details needed to different parties to take appropriate actions.
Day 1	LAEP & coordination of local decarbonisation planning	To use common input data and more granular level data to create better and more aligned decarbonisation plans. To enable easier coordination of local decarbonisation planning and actions.
Day 1	Electricity flexibility	To improve the timely exchange of information to better understand, use and incentivise the reliance on and provision of flexible assets
Strategic	Electricity market reforms - nodal pricing	To enable the exchange of data needed to test the potential working of a future nodal market structure.
Strategic	Sector coupling	To enable to better forecast the demand for flexibility over time so that it will be possible to define how to integrate different energy system and the role they can play in a whole system operation of the power network

Findings are the view of the consortium and are not official government policy

Implementation phase governance (time horizon: 2024-2026)

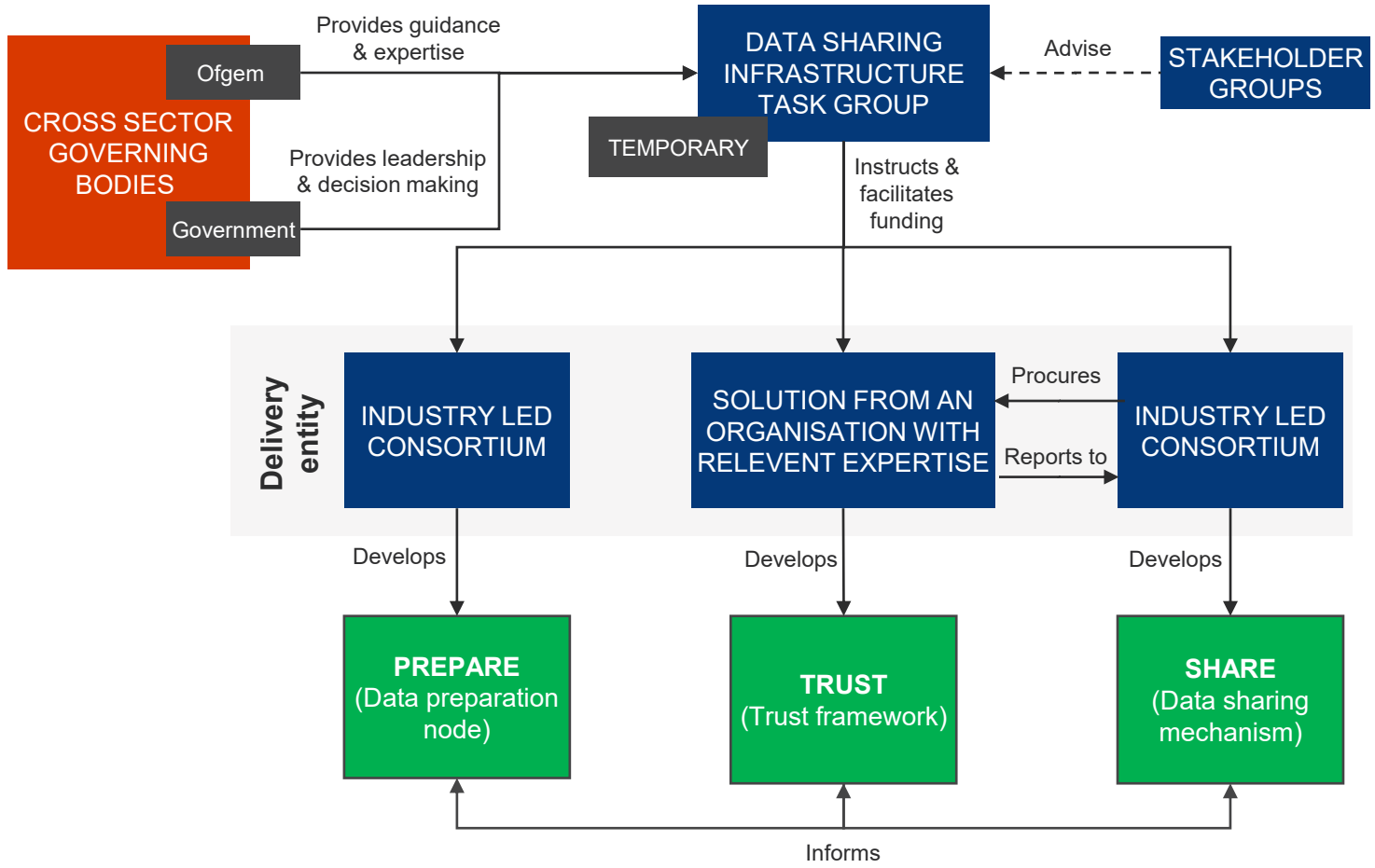
Governance of a data sharing infrastructure during implementation

Governance models were developed for implementation and steady-state operation phases of a data sharing infrastructure over three distinct time horizons, representing the necessary time required to establish capabilities and potentially enact primary legislation to create new sector wide entities:

- **Implementation (2024-2026)**
- **Interim-state (2026-2030)**
- **Steady-state (2030+)**

This diagram outlines the proposed governance during the implementation phase. The proposed approach is for a co-development of both the data preparation nodes and data sharing mechanism, and the direct procurement of a trust framework solution from an organisation with relevant experience. This approach enables government and industry to select and deliver a high priority use case, either taken from those detailed in the use cases, or elsewhere. The governance shows two possible consortiums, one focussing on the development of a data preparation node, and the other on the development of the data sharing mechanism.

During implementation it is recommended that a ***Data Sharing Infrastructure Task Group*** be established with the specific remit to fund and accelerate development, which is aligned with the objectives of the NDTP.



Findings are the view of the consortium and are not official government policy

Cost considerations

Summary of the estimated investment required to develop a data sharing infrastructure

The cost ranges for the various functional components of a data sharing infrastructure are considered a class 5 estimate, with uncertainty range of +100% or -50%.

The cost ranges summarised are derived from and correlate with open data available from previous government-funded projects, and the consortium's experience from previous completed similar digital projects.

Therefore, the costs range contains uncertainty, and are a value judgement that is subject to change as new information becomes available. Further details assessments are needed to reach a class 1 or 2 estimate.

Such historical prices provide an initial estimate, but further detailed cost estimate are dependent on the following requirements:

- Delivery pathways
- Detailed outline of the MVP technology
- Scale of implementation
- Use cases

Data preparation node

The **MVP implementation** of the data preparation node, encompassing the, sharing, or transformation of data, is expected to be **£1m-£3m**, depending on the complexity of design, procurement pathway, and future improvements.

The potential **steady state** costs can cost **£2m-£4m per year**.

Trust framework

The **MVP implementation** of the trust framework, to ensure security, and compliance, is anticipated to cost **£2m-£6m.** This reflects the complexity of enabling scalable, and codifying the various legal terms and conditions, identity management, and security controls.

The **steady-state costs** would be **minimum £2m per year.**

Data sharing mechanism

The **MVP implementation** of data sharing mechanism, the engine that facilitates seamless data sharing, is estimated to be **£10m-£20m**.

The **steady-state** costs would be **minimum £18m per year.**

Overall investment

The overall investment for the **MVP implementation** of an energy sector data sharing infrastructure is projected to be **£13m-£29m.**

The **steady-state costs** would be **minimum £22m per year.**

These costs do not account the income generated from licensing, exporting technology, and other enabling innovation.

Findings are the view of the consortium and are not official government policy

Opportunity for government intervention

Overview of the opportunity for government intervention and considerations required to assess its viability

Overview

The delivery of the resulting solution will require a combination of governmental, industrial, trade bodies, and academic collaborations.

While a collaborative approach emphasises participatory decision-making, co-creation, and collective ownership of the infrastructure, enabling diverse perspectives, innovation, and agility in implementation, it often involves establishing multi-stakeholder committees, or working groups to ensure effective coordination and representation of all stakeholders, which can be challenging for any one stakeholder to undertake.

Therefore, an initial push or encouragement from Government is required to align the dispersed actors.

It is currently considered that government involvement will be crucial, due to government's ability to prioritise public interest, to provide security and trust, to drive standardisation and interoperability, and to ensure long-term stability.

By taking a proactive role, government can support and fast track the creation of a robust data sharing infrastructure.

Intervention considerations

Intervention should be appropriate and flexible, growing or reducing as required to meet the needs of the challenge.

In principle, government intervention should only be considered if the industry requests assistance, and there is a clear need for sector alignment and coordination.

The users of a data sharing infrastructure could be from any sector and organization; therefore, an initial request from the industry to the government could be to bring together actors and provide an environment for open decision-making, fostering a culture for data sharing.

Additionally, long-term governance is expected to require regulatory intervention to maintain a minimum level of engagement, as operations become steady state.

Observed experiences of other energy projects which have attempted transitioning from an innovation project to a business-as-usual service, suggests that a level of policy or regulatory intervention is needed to ensure organisations that are part of or creating digital infrastructure for the energy sector are engaged appropriately.

Cost recovery

Data sharing infrastructure is a modern governmental service for public good, and as such, a cost recovery route will be required to pay for the implementation, ongoing operation and maintenance of a data sharing infrastructure.

The cost recovery route could involve, for example, a licensee or a consulting service charge that the energy infrastructure operator charges for the use of the data sharing infrastructure, or its blueprint. This will ensure recovery of public funds, remove any dependency on public funding and ensure sustainability of service in the long term.

The need for a data sharing infrastructure has been evidenced by all major stakeholders in the energy sector; therefore, users to pay and adopt this service will not be a risk for this implementation.

Further assessment is required to outline a detailed operating model.

Findings are the view of the consortium and are not official government policy

Emerging recommendation themes

Themes of recommendations identified through the feasibility study

Through the delivery of this feasibility study and the stakeholder engagement activities, several recommendation themes have emerged. These can be summarised in three categories, and directly translate to the recommendations detailed on the next page.

- Government to provide clarity to the sector
- Develop the technical capability
- Facilitate appropriate governance

Government to providing clarity to the sector

To make use of the momentum gathered through this feasibility study, there are opportunities and no regrets actions that can be taken by government that will provide clarity to the sector on the direction of travel for the development of a data sharing infrastructure.

With existing initiatives already establishing and developing technical capabilities in this space, it is important for government to provide clarity on what it hopes to achieve. Providing a statement of what government's plans are, noting sequencing, rough timetable and expectations for engagement, would give the wider energy sector an opportunity to engage with the development. It would also establish where effort is, and is not, worth making for a wide range of market participants.

Developing the technical solution

In order to test the concept of the data sharing infrastructure government should take forward a minimum viable product (MVP) to test the technical implementation.

This should consist of taking forward the technical architecture, which has identified strong alignment with the National Digital Twin Programme (NDTP).

This, alongside existing industry initiatives, provides a large opportunity to coordinate existing work and further government areas of focus set out in the Digitalisation Strategy 2021.

Facilitating appropriate governance

The implementation of a data sharing infrastructure requires appropriate governance. In order to set that up the boundaries of what is expected of that governance regime should be tested and developed.

The creation of a task group, seeking to develop an appropriate governance mechanism for a data sharing infrastructure within the energy sector should be a priority of government when developing the MVP.

Areas of further work

The work highlighted 11 areas for further work that have been identified through this feasibility study. These areas can be grouped into three categories:

- **Developing the technical solution**
  - Development of technical components
  - Security framework
- **Facilitating appropriate governance and skills**
  - Integration of existing initiatives
  - Data Sharing Infrastructure Task Group
  - Detailed analysis of delivery and governance
  - Foster a culture of data sharing
  - Trust framework
  - Knowledge dissemination activities
- **Developing standards and blueprints**
  - Data sharing infrastructure detailed blueprints
  - Management of standards
  - Detail review of licenses, codes, and legislation

Findings are the view of the consortium and are not official government policy

Accelerating the development of a data sharing infrastructure

Recommendations to collaboratively enable the data sharing infrastructure

1) Develop an MVP

Develop the technical solution by DSIT/DfBT/DESNZ support a development project where the MVP of a data sharing infrastructure is developed, built, and tested.

Work with the existing initiatives that are functionally like the component parts of a data sharing infrastructure to accelerate the development of the MVP. These are the Integration Architecture (National Digital Twin Programme), Open Energy, and Virtual Energy System.

No-regret actions (0-6 months)

- Host technical alignment meetings with existing initiatives (NDTP, VirtualES)
- Select a use case to develop the MVP

Other actions (6-12 months)

- Select and implement a funding route for the development of the MVP
- Allocate staff to the coordination of the MVP

2) Establish a Task Group

Facilitating appropriate governance by DESNZ & Ofgem to convene and provide a clear mandate and funding to a **Data Sharing Infrastructure Task Group**

The Task Group's objective is to support and accelerate the development of data sharing infrastructure.

No-regret actions (3-12 months)

- Set up a "tiger team" of dedicated resources to determine the priorities of the task group
- Select and implement a funding route and priorities determined by the tiger team

Other actions (6-18 months)

- Conduct the 11 areas of further work that support acceleration, articulated in **Appendix O** of the full report.
- Prepare a pathway to standing up a Task Group

3) Publish a decision

Government to providing clarity to the sector by DESNZ and Ofgem publishing a statement of how a data sharing infrastructure will be developed and adopted by the sector.

Decision outlines the scope of the government, industry, and potential national programmes.

No-regret actions (0-12 months)

- Create a plan that government can test with industry stakeholders.
- Publish a call for input on creating a data sharing infrastructure and associated governance.

Other actions (18-24 months)

Update the digitalisation licence condition (9.5) to compel licensees to engage with the data sharing infrastructure.

Findings are the view of the consortium and are not official government policy

Consortium recommendations

Recommendations to collaboratively enable the data sharing infrastructure

Developing the MVP

It is the position of the consortium that the most sensible path to developing the data sharing infrastructure is to combine the initiatives noted within the feasibility study:

- NDTP/Telicent's CORE solution is a match to the needs identified for the **Prepare** component.
- Virtual Energy System demonstrator has a significant alignment with the **Share** component.
- Open Energy has relevant expertise to implement the **Trust** component.

There is currently a critical window of opportunity to coalesce these programmes to enable a rapid MVP. While other initiatives may exist, they are less well developed and aligned, and their selection for an MVP would delay acceleration of delivery. Joining these programmes will not be without challenges. It is suggested that government funds a technical alignment study to avoid losing momentum gained to date. This study will evidence technical alignment between the programmes, and continue sector engagement, while a delivery pathway to an MVP is selected by government.

Once aligned, Ofgem/DESNZ mandates ESO to deliver a data sharing infrastructure by collaborating with NDTP. The MVP development can be funded through the RIIO ED2 reopener mechanism – which provides opportunities for appropriate government oversight.

Governance

DESNZ/Ofgem can ensure appropriate oversight for the technical alignment study by contracting SMEs to represent public needs. For MVP development, an advisory team is assigned to collaborate with NDTP.

In addition to the development of the MVP, a concurrent workstream resolving issues of governance should be undertaken. Doing so supports the energy sector in building a sector-specific implementation of a data sharing infrastructure and resolve issues of who manages and operates any instances of it for public good. This workstream also helps map out the governance of the 'blueprints' of a data sharing infrastructure within the energy sector. We are of the opinion that this should take the form of a 'tiger team', who detail what the task group should undertake as its priorities and scopes.

The 'tiger team' can be wholly comprised of civil servants and is broadly defined as a short-term team that defines the scope of the task group. This can be funded as normal activity for DESNZ and/or Ofgem, or as an extension to this feasibility study. The funding model for the activities of the task group is less certain and is dependent on the work completed by the tiger team. It is likely also subject to a call for input or consultation on the expectations of the task group. A logic flow of this approach is set out on the next page.

Resources consideration

The development of the data sharing infrastructure will require many resources with a board set of skill. Therefore, further work is required to determine the resources required to undertake the programme.

It is assumed that the government's input in the discovery phase will be to support the creation of a plan for alpha phase. This plan will outline, using agile principles and stage gate reviews, class 2 cost estimates, resource requirements, and terms of reference for the 'tiger team' to fulfil their remit. Additionally, it will provide an outline of the long-term governance and operating models.

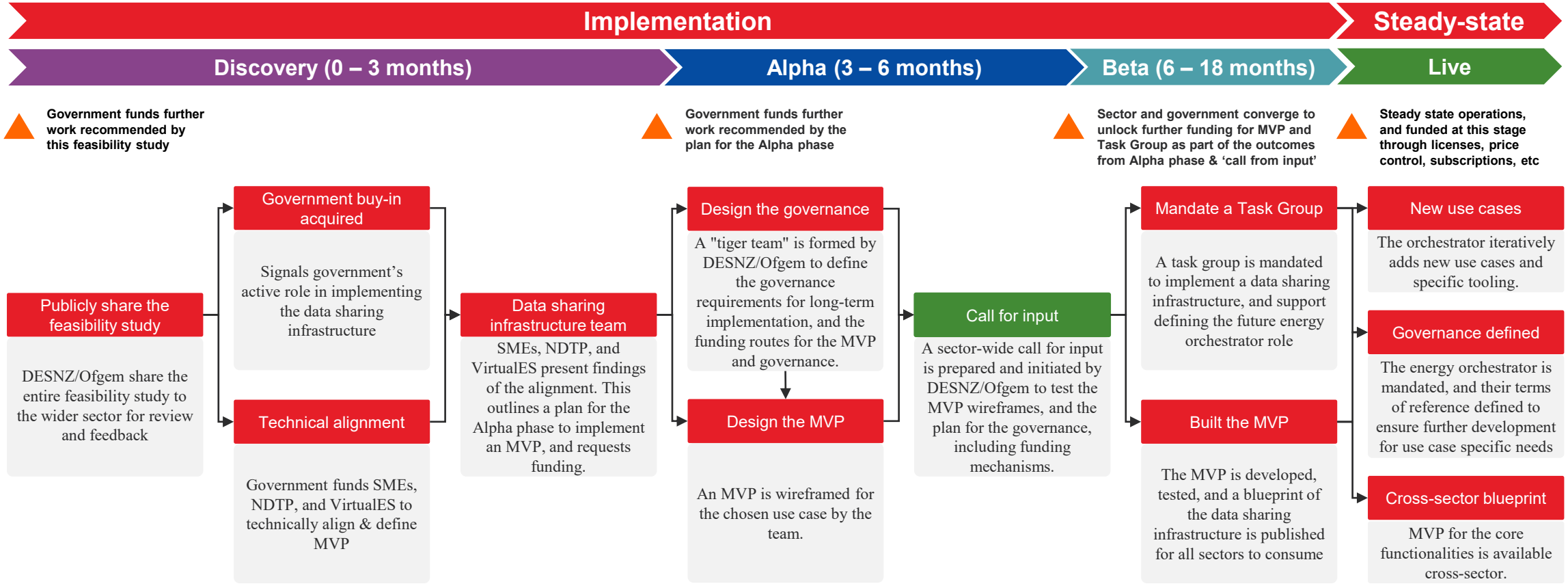
The 'tiger team' will also serve as the PMO to support the integration of various programs. They will be responsible for submitting a terms of reference for the 'task group' to the government to unlock further funding for the development of the MVP and establishing the task group. Therefore, they will have the remit and the ability to request additional funds at various stage gate reviews, as defined in the alpha plan.

Findings are the view of the consortium and are not official government policy

Timelines of the consortium recommendations

Recommendations to collaboratively enable the data sharing infrastructure

It is proposed that the government funds the Discovery/Alpha phases through an appropriate mechanism. The exact funding routes for Beta/Live will be determined in Alpha.



Findings are the view of the consortium and are not official government policy

ARUP

CATAPULT Energy Systems

UNIVERSITY OF BATH

Findings are the view of the consortium and are not official government policy