



NGESO and NGED

Coordinated Operational Methodology for Managing and Accessing Network Distributed Energy Resources (COMMANDER)

Workstream 4 Report – Roadmap for the physical
deployment of the preferred ESO/DSO coordination
scheme



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Glossary

Term	Definition
ADE	Association for Decentralised Energy
ANM	Active Network Management
BEIS	Department for Business, Energy and Industrial Strategy
CER	Capacity Expansion Reserves
DER	Distributed Energy Resource
DFR	Distributed Flexibility Resource
DNO	Distribution Network Operator
DSO	Distribution System Operator
ENA	Energy Networks Association
ENTSO-E	European Network of Transmission System Operators for Electricity
ESO	Electricity System Operator
TFDF	The Future of Distributed Flexibility
FSO	Future System Operator (National Energy System Operator from Summer 2024)
ICCL	Imperial College Consultants London
IWES	Integrated Whole Energy System
Ofgem	Office of Gas and Electricity Markets
ON	Open Networks (ENA initiative)
NGED	National Grid Electricity Distribution
NGESO	National Grid Electricity System Operator
STOR	Short Term Operating Reserve

Executive summary

The Commander project has aimed to evaluate a selection of options for potential future coordination schemes. By tackling this complex subject in this manner, key system functions, coordination enablers and dependencies that may pose a risk to future coordination have been explored and made visible to help facilitate and focus stakeholder engagement. The project started in October 2022, and since then there have been significant policy and regulatory evolutions driven by the ESO and Ofgem that have impacted the ESO-DSO Coordination topic. WS4 builds upon the findings of the previous workstreams, namely on Workstream 3, whereas our recommendation for a staged approach fundamentally advocated for the deployment of Scheme 1 from present until 2035 (seen as a “mid point” in the overall roadmap for improved coordination) and the full deployment of Scheme 2 from 2035 onwards. During the execution of Workstream 4, it was identified that there is a critical need for improved coordination of flexibility services not only across electricity networks but also leveraging a whole system approach with other energy vectors, namely gas and hydrogen in the 2030s and 2040s. A whole system approach to the coordination of flexibility and network reinforcement is required to ensure whole system effectiveness and efficiency of network planning combined with real time operations, as well as reducing the dependency of flexibility markets on one energy vector only;

Scheme Implementation: Gap Analysis

The review of actors and activities, which provided an update of the ENA Future Worlds mapping for the two coordination schemes, shows that there are several areas of activities between the different system actors which will need to be addressed to accommodate improved coordination of flexibility services. These include establishing a common approach for planning and conducting communications, introducing incentives and removing barriers for new flexibility services and improving coordination of strategic planning. The Gap Analysis has been used to help facilitate focussed feedback from NGED and ESO, and to help facilitate scheme definition for discussion in the workshops.

Scheme Implementation: Cost Benefit Analysis

To further support the evaluation of the benefits which can be provided by improved coordination of flexibility services, a series of cost benefits analysis was developed in order to quantify the benefits of potential efficiency savings which can be delivered by the coordination schemes. The CBAs were based on the volumes of flexibility forecast by the IWES model, combined with historic GB flexibility unit cost information and indicative scheme stage 2 costs based on the previous ENA Future Worlds studies. A range of scenarios were modelled which included a spread of values for flexibility unit costs, achieved efficiency savings and accelerated or delayed flexibility volume uptake rates. The findings from the cost benefits analysis indicate that there is a strong incentive to invest in the near future in order to deliver long term whole system efficiencies from enhanced coordination of flexibility services.

Based on the flexibility volumes and efficiency analysis, most modelled cases showed the maximum whole system benefits, which are in effect consumer benefits, would be realised by delivering enhanced coordination as early as 2028. Only the lowest flexibility benefits scenarios (minimum flexibility unit costs and very low achieved efficiency savings) showed the preferred year to commence enhanced coordination to be after 2028 (2030/31). Early investment will also need to address the identified facilitating measures for improved coordination, and to ensure that appropriate corresponding working practices are planned in at an early stage. It is important that working practices which may lead to long term inefficiencies or inhibit enhanced coordination are not embedded in such a way that they are hard to adapt as the requirement for improved coordination becomes greater when flexibility volumes significantly increase.

Roadmap for Schemes Deployment Roadmap

To help map the transition from current flexibility requirements to those necessary when the GB/UK energy systems are fully decarbonised, additional IWES analysis was conducted for 2035. The interim year IWES analysis indicated that although the flexibility volumes were significantly increased from current levels, the projected annual system capex cost savings delivered by overall improved coordination were significantly smaller than for the fully decarbonised energy system represented in the WS3 2050 analysis. This is largely attributed to impact of the projected volumes of LCTs and RES in the energy system by this time and the inertia of legacy generation systems. The IWES 2050 analysis shows that the volume of flexibility services expected to be delivered annually for a fully decarbonised energy system are substantial (in the region of 140TWh/annum) and that flexibility will be instrumental in delivering net zero.

Roadmap Development

The development of the roadmap to deliver the proposed flexibility coordination schemes considered the most useful information to include at this stage, including actors, initiatives, milestones and risks. The roadmap is designed to provide thought leadership to illustrate potential ways forward for the enhancement of flexibility coordination and is not attempting to providing a detailed project plan of all necessary measures. When combined with the findings from the flexibility IWES and CBA analysis, the risks of lack of coordination and ultimately the impact on consumers becomes evident.

The recently defined roles and improved strategic planning introduced by Ofgem and DESNZ, including the Regional Energy Strategic Planners and Market Facilitator, will go some way to fulfilling the needs identified for whole system coordination. There are however a number of coordination aspects which have not yet been addressed. These additional coordination aspects may be introduced when the new roles, and associated consultation feedback, are further developed.

Key areas of focus could be:

- Coordination of the identification of flexibility service need with whole system network reinforcement planning.
- Ensuring that the distribution networks are adequately reinforced to enable access and utilisation of transmission connected variable renewables, by LV and HV consumers, in periods of high generation.

- Ensuring that distribution connected resources (DER and CER) can provide benefits to the whole system, not just their region of operation, via the provision of flexibility services.

Roadmap and Facilitating Measures

A number of flexibility coordination facilitating measures were identified and feedback sought from the wider project team, stakeholders and workshop attendees. Key focus areas being:

- Standardisation of Data Exchange.
- Visibility of network assets.
- Resolution of Primacy rules for system actors.
- Policy and Regulation

The material published by the ENA Primacy Working Group has been reviewed and a summary included for context. Recent primacy rules studies focussed on potential conflicts of STOR and ANM flexibility services conclude that the current likelihood of conflicts occurring do not warrant full implementation of the proposed primacy rules yet, but that the situation will change as the requirement for STOR and ANM flexibility services steadily increase (due to the transition to net zero).¹ However, stakeholder feedback indicated that this view is not universally shared, and highlighted the fact that establishing a full set of Primacy rules is an essential precursor for developing new systems designed to reflect these rules. Additionally, stakeholders have confirmed that establishing Primacy rules for STOR vs ANM is a priority focus area.

Building on the WS1 and the overall Commander study findings, a refreshed review of the EU-SysFlex programme was undertaken, which has run a number of trial projects which address different areas of flexibility and its coordination.

Policy and regulation will also need to consider ways to promote increased coordination between the ESO and DSOs, and address potential hurdles which may currently exist.

KPIs

KPIs should be developed to be able to monitor and evaluate progress towards improved, and subsequently enhanced, coordination of flexibility services. These should target key metrics related to the procurement and dispatch of flexibility services and also the progress of the necessary facilitating measures and the mitigation of associated risks. A regular evaluation for the optimum structure and role of ESO-DSO coordination will also be necessary, namely on the transition from Scheme 1 to Scheme 2, as flexibility volume drivers, technology development and market structures may influence the nature of the preferred long term solution and the timing of any significant transitions to new approaches to whole system coordination.

¹ <https://www.energynetworks.org/assets/images/Impact%20quantification%20of%20primacy%20rules%20pdf.pdf?1700544942>

Stakeholder Engagement

As a key stakeholder engagement exercise, the dissemination workshop that was originally planned for Workstream 5 was brought forward and organised in January 2024, where ESO and all DNOs were represented. The discussions held during the workshop and feedback from the attendees highlighted that there is a diverse range of views and issues which need to be addressed in this area. One of the key challenges is to develop a common vision for coordination and several attendees raised the need to get all parties together to accelerate progress and to form joint plans to resolve key blockers. The need for clear policy direction was also raised, in order to provide greater certainty for network operators, flexibility service investors and suppliers. Attendees also suggested that some aspects which are seen as key benefits of enhanced whole system coordination, for example appropriate distribution network investment to facilitate long-term whole system benefits, may also be able to be realised by the appropriate incentivisation from the regulator, which is currently not in place.

Next steps

Workstream 5 will provide a summary of the overall project, key findings and recommendations. We will populate the project closure document and provide a 1-pager for a summary of the key take aways of Project Commander and our recommendations on next steps for ESO and DSO for improving whole system coordination.

1 Workstream 4 approach

The overall coordination scheme selection was completed within WS3, which established that Scheme 1 (Enhanced ESO-DSO coordination) should be implemented immediately, with a transition to Scheme 2 (Distributed Flexibility Coordinator) being undertaken in the medium term.

This workstream reviews the key requirements for the selected schemes and provides an analysis of the changes from the current business as usual (BAU) approach to coordination and the progression to Scheme 1 and then subsequently Scheme 2 are reviewed in detail. The potential benefits of improved and subsequently enhanced coordination are assessed both from a whole system annualised cost perspective provided by the IWES modelling and by CBAs developed for this workstream. The CBAs utilise a combination of IWES flexibility analysis data, GB historic flexibility market data and previous ENA Future Worlds information to provide illustrations of the investment benefits for enhanced coordination which can deliver whole system efficiencies resulting in lower costs for flexibility.

A roadmap for implementation of the proposed coordination schemes has been developed, which considers the overall findings from this study and other related studies, in combination with feedback from a broad spectrum of stakeholders and the latest Ofgem decisions on new strategic and facilitating roles for network planning and flexibility market management.

Stakeholders have been engaged, from both the ESO and DSOs to ascertain industry opinions, areas for improvement and key hurdles which must be overcome.

2 Scheme Implementation: Gap Analysis

As already presented in WS3, the recommended pathway is going from Business-as-Usual (BaU) case to Scheme 1 by the year 2035 and then transitioning and fully implementing the Scheme 2 by 2050. In the following chapter, we will present the mentioned schemes in detail, including roles and responsibilities of the system actors, new activities and interactions and changes required in order to get across from one scheme to another.

2.1 Approach

Our approach was to first update the BaU case, since it aligned with the ENA Open Networks analysis done in 2019. The objective was to identify the changes already happening in the system, since the utilisation of flexibility services is growing rapidly. We've identified the interactions and activities in Scheme 1 and Scheme 2, which will go through change when transitioning from Business as Usual to Scheme 1 and then from Scheme 1 to Scheme 2. Focus area was the impact of change initiatives on different areas of operation within ESO and NGED which will be further discussed in this report.

A detailed review of the previous ENA Future Worlds scheme definitions and subsequent update for the proposed Commander coordination schemes has been undertaken. The system actors and activities have been mapped out, and critical interactions identified which need to be addressed to facilitate improved coordination between network system operators. Feedback has been sought from NGED and ESO to provide clarifications and review comments on these critical components. The feedback has been considered in the development of the roadmap and where appropriate captured in this section.

2.2 Gap Analysis

In this chapter we will give a short overview of the schemes with the focus on the key areas of difference between Business as Usual - Scheme 1 and Scheme 1 – Scheme 2. Areas of impact on ESO and NGED operations will be identified. We will set out the facilitating measures to be implemented in order to go through the necessary changes during transition period.

2.2.1 BAU 2019

According to ENA Open Network project, at the time being it was agreed that Business as Usual case would correspond to the Future World D – ESO Coordinates. Looking at the diagram we can see that DSO/DNOs have no direct contact to Flexibility service providers at distribution network level, which is far from the current situation. In this report we've updated the Business as Usual case to better reflect the current situation between the system actors in the field of procurement and activation of flexibility services.

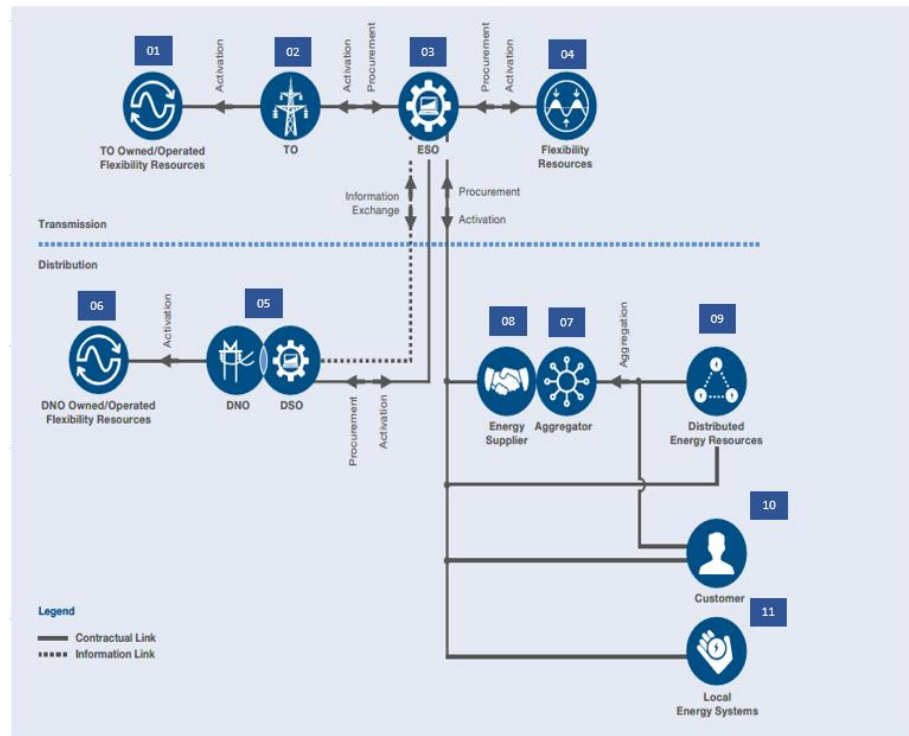


Figure 2-1 - Business as usual 2019 Scheme based on ENA Open Networks' Future World D

2.2.2 BAU 2023

Updated version of BAU case represents realistic state of system actors' relationship and interactions. We can see that both ESO and DSO/DNOs now have direct approach to the flexibility service providers at distribution network level. ESO can directly access large flexibility resources at transmission network, and large scale and aggregated flexibility resources at distribution network. There is a possibility that the ESO may also procure flexibility services directly or via coordination with the DSO/DNO. Information exchange should cover the activation of flexibility resources that can majorly influence Distribution Networks in certain DSO/DNO License Area.

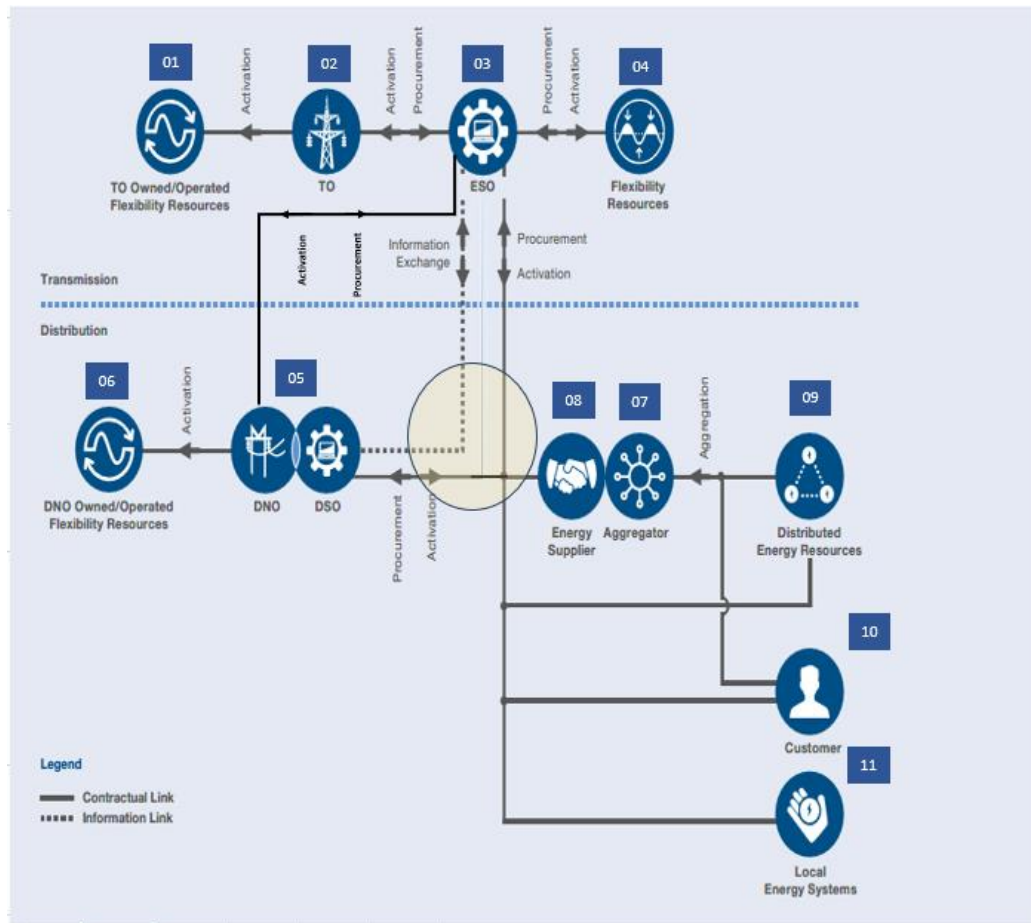


Figure 2-2 – Business as usual Scheme 2023 update

2.2.3 BAU to Scheme 1 (Enhanced Coordination)

While developing the transition path from BAU case to Scheme 1, we've realised that some steps in coordination enhancement between ESO and DNO/DSOs have already been set up. For the sake of clarity, we will group flexibility resources at DN as "External Flexibility Service Providers". Flexibility resources owned/operated by DNO will be referred to as "Internal Flexibility Providers – DSO". Similar to that, flexibility resources owned/operated by TO will be referred to as "Internal Flexibility Providers – ESO" and flexibility resources at TN as "External Flexibility Providers – ESO".

According to the previous work in project Commander, DFR will be optimised using two key stages.

In the first stage of optimisation, DSO/DNOs use DFR to manage distribution network operation, defer distribution network reinforcements, aggregate the available DFR resources that ESO can use considering local distribution network constraints and pass that information to the ESO.

The ESO will then optimise and allocate the DFR services in all DSO License Areas in coordination with large-scale flexibility resources connected to the Transmission network in the second stage to support the national transmission system at minimum cost. The management of potential conflicts will be a critical component of the optimisation and allocation process.

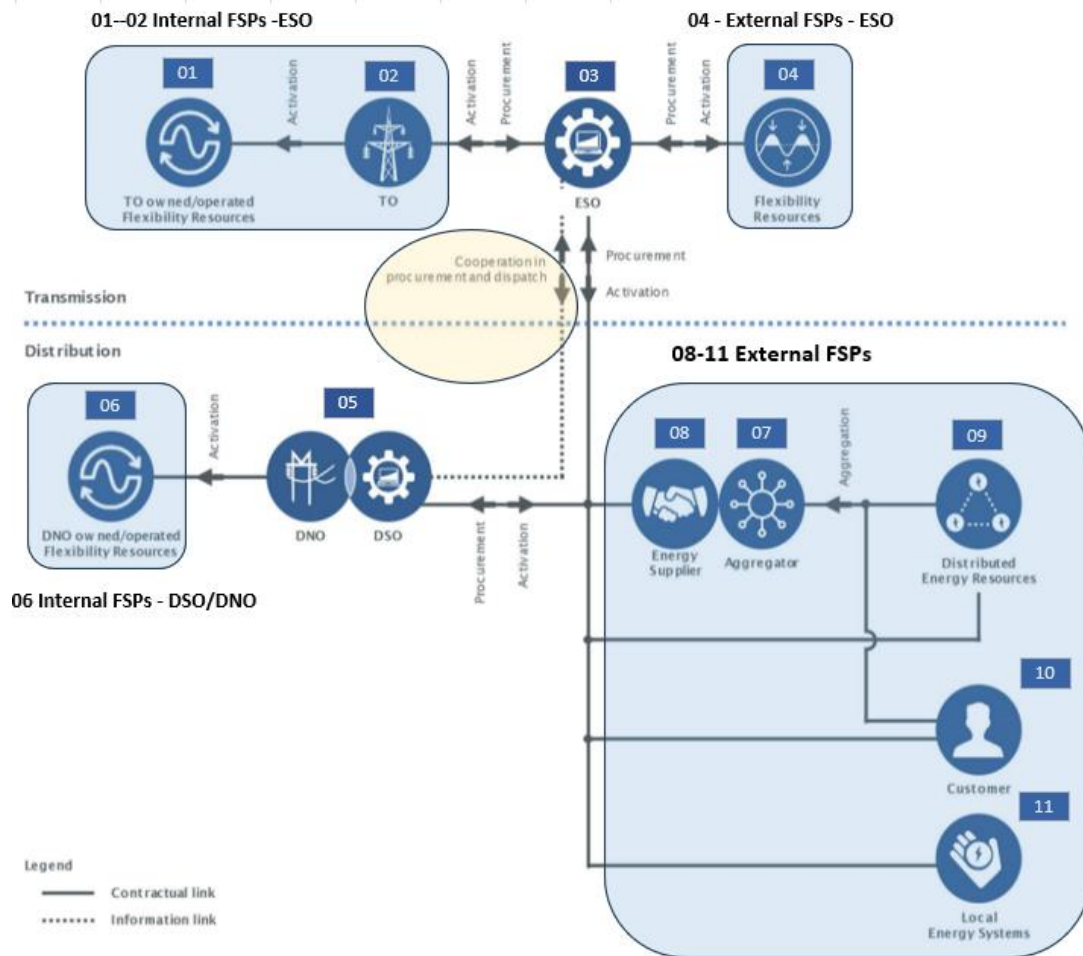


Figure 2-3 – Scheme 1 based on ENA Open Networks' Future World B

Key change between BAU and Scheme 1 will be the process of coordination in procurement and dispatch of flexibility services. In Scheme 1, both ESO and DSO/DNOs have direct access to flexibility resources, but the process of coordination is what should be further developed.

Change initiatives and proposed facilitating measures impacting coordination between ESO and DSOs can be presented on a high-level basis in the following groups:

Table 2-1 – BAU to Scheme 1 Transition - Area of Change and Facilitating Measures

Area of change	Facilitating measures for deployment of Scheme 1
Coordination and data management	<p>Internal and external protocols for communication and coordination should be set up to define the frequency of communication, joint planning and conflict resolution, system planning information exchange, coordination of congestion management. Collective engagement to define new standards. Further development of primacy rules is required to the extent needed to develop new system specifications.</p> <p>Establishing list of data to be exchanged between ESO and DSOs in the process of procurement and activation of flexibility services – network development plans, generation and demand forecast, etc. (data privacy, data protection to be taken into consideration).</p> <p>Possibly setting up a joint communication platform.</p>
Market facilitation	<p>Providing incentives for flexibility service providers to participate in multiple markets.</p> <p>Minimising exclusivity in market contracts to allow assets to participate in multiple markets.</p> <p>Coordination at procurement stage to account for potential conflicts, with consideration of relevant primacy rules which account for regional and local variations and needs.</p>
Improving visibility of FSPs to ESO and DSOs	<p>Working with regulatory bodies to create a supportive environment for flexibility services. Enabling FSPs to access multiple revenue streams and stack value across different markets. Potential issues with confidentiality and data privacy will need to be considered.</p> <p>Providing transparent information of the network needs - the data should be visible, easily accessible.</p>

The impact on ESO and NGED will be represented through three areas of operation: Commercial, Operations and Planning.

In the following table we present the potential changes in the process of coordination during procurement and dispatch and their influence on interactions between ESO-DSO.

Table 2-2 – BAU to Scheme 1 Transition – Gap analysis

	ESO – DSO Coordination ESO Impact	ESO – DSO Coordination DSO/DNO Impact
Planning	<ul style="list-style-type: none"> – ESO will optimise and allocate remaining FLR at DN, using information received from DSO/DNO; – ESO optimises on utilisation of larger-scale flex resources at TN and DFR; – ESO will procure services according to own network needs but in active coordination with DSO; – ESO will have visibility and access to FLR directly or through aggregators and will operate them within the boundaries provided by the DSO; 	<ul style="list-style-type: none"> – Forecasting undertaken to account for local network constraints; – After the first stage of procuring flex resources, DSO/DNO will aggregate remaining FLRs, consider local network constraints and pass on that information to the ESO; – This process is sequential and implies that ESO and DSOs will actively coordinate and procure FS by forecasting their long-term and short-term needs; – DSO will provide dynamic regional operational boundaries of FLR which depend on availability of resources, load levels and network conditions. – Both ESO and DSO/DNO have visibility and access to FLR; – DSO can also procure flex services at TN in coordination with ESO.
Commercial	<ul style="list-style-type: none"> – ESO and DSO will have coordinated qualification process; – Settlement and charging will need to be standardised and have the same approach for ESO and DSOs; – ESO to facilitate Central Flexibility service market. 	<ul style="list-style-type: none"> – ESO and DSO will have coordinated qualification process; – Settlement and charging will need to be standardised and have the same approach for ESO and DSOs. Appropriate industry consultation will be needed to develop a pathway and facilitate; – DSO/DNO to facilitate Regional Flexibility service market; – ESO and DSO/DNO will exchange information regarding the volumes of services being procured and activated and will include those in their investment and operational planning. Appropriate communication systems and associated security required;

Operations	<ul style="list-style-type: none"> – Procurement/Activation of Flex Services will be coordinated between ESO and DSO/DNO through data exchange; – Cooperation between control centres to minimise potential FS conflicts and to maximise synergies between service requirements; 	<ul style="list-style-type: none"> – Procurement/Activation of Flex Services will be coordinated between ESO and DSO/DNO through data exchange facilitated by agreed Primacy rules; – Cooperation between control centres to minimise potential FS conflicts and to maximise synergies between service requirements;
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Consequently, changes in the coordination between ESO and DSOs will influence the activities and interactions with DFR.

2.2.4 Scheme 1 (Enhanced Coordination) to Scheme 2 (Distributed Flexibility Coordinator)

Under this scheme, both the ESO and DSO have full access to DFR flexibility services, with decisions about access to services determined on an operational basis by a Distributed Flexibility Coordinator (DFC). The role of Distributed Flexibility Coordinator is to act as a neutral market facilitator for all distributed flexibility sources, ESO and DSOs. DFC will collect requirements from ESO and DSOs and volumes and costs associated with distributed flexibility services, optimising those across all timescales and identifying procurement solutions for ESO and DSOs.

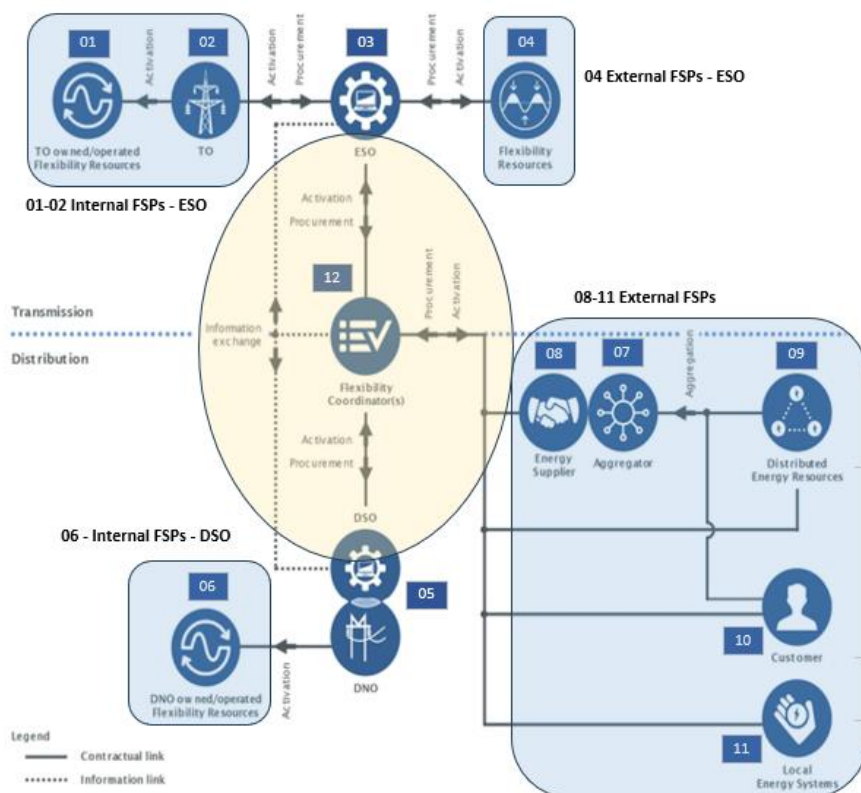


Figure 2-4 – Scheme 2 based on ENA Open Networks' Future World E

Transitioning from Scheme 1 to Scheme 2 will require considerable alterations in operational mode in both ESO and DSOs.

Table 2-3 – Scheme 1 to Scheme 2 Transition - Area of Change and Facilitating Measures

Area of change	Facilitating measures for deployment of Scheme 2
Introduction of Independent Flexibility Coordinator	<p>Completing regulatory and policy changes.</p> <p>Setting up Flexibility Coordinator as the new system actor or assigning this role to already existing entity.</p> <p>Defining new roles and responsibilities.</p>

Coordination and data management	<p>Defining communication channels and establishing data exchange between Flexibility Coordinator and other system actors (ESO, DSO/DNOs, Flexibility Service Providers).</p> <p>Deciding on a communication platform (joint platform or creating APIs for separate platforms interaction).</p> <p>Adjusting roles and responsibilities of ESO and DSO/DNOs to Scheme 2.</p>
Market Facilitation	<p>According to the results of Ofgem consultation, Market facilitator will be established with three functions assigned: strategic leadership, market coordination and implementation monitoring.</p> <p>The recently announced roles of NESO (previously named FSO) include operational responsibilities, indicating that the NESO may contribute towards real-time coordination.²</p>

One of the first steps in this transition is to establish the entity called Distributed Flexibility Coordinator. One possible option is to set up a completely new institution. However, the role of DFC could also be taken by already existing body at the time.

Flexibility coordinator will take over the lead role in coordinating the DFRs (qualification, contracts, procurement, activation) and providing support in DFR utilisation to ESO and DSOs.

² "This new National Energy System Operator will drive forward net zero across both the electricity and gas systems, operating a 'whole system' approach. It will hold responsibilities in operations, strategic network planning, long-term forecasting and market strategy, and will deliver these roles while maintaining energy security and minimising costs for consumers.", Available at <https://www.nationalgrideso.com/what-we-do/becoming-national-energy-system-operator-neso> (April 2024)

Table 2-4 – Scheme Transition – Gap Analysis

	ESO – DFC Procurement and activation ESO Impact	DSO - DFC Procurement and activation DSO/DNO Impact
Planning	<ul style="list-style-type: none"> – Procurement of flexibility services products based on the system needs and timescale (constraint management, peak demand management, specific network conditions - faults or maintenance work, power restoration) - ESO will support DFC with these data. – Flexibility coordinator will suggest appropriate asset for flexibility service according to the service selection principles or rules. 	<ul style="list-style-type: none"> – Procurement of flexibility services products via DFC based on the system needs and timescale (constraint management, peak demand management, specific network conditions - faults or maintenance work, power restoration) – Flexibility coordinator will suggest appropriate asset for flexibility service according to the service selection principles or rules.
Commercial	<ul style="list-style-type: none"> – Flexibility coordinator will act as a neutral market facilitator for all distributed flex resources; – ESO will decide on the required flex service type; – ESO will communicate with DFC regarding procurement, tenders, contracting activities, FLR performance monitoring, invoicing. 	<ul style="list-style-type: none"> – Supporting regional markets for flex resources; – Communicating with Flexibility coordinator in terms of present/future investments; – DSO will communicate with DFC regarding procurement, tenders, contracting activities, FLR performance monitoring, invoicing.
Operations	<ul style="list-style-type: none"> – In close to real-time period, ESO will support DFC with system operation state/requirements; – Communication with DFC for short-term timescale flex services procurement; – Monitoring transmission system state and data exchange with FC and accordingly activating/curtailing FLR; – Activation orders (dispatching activities) remain in the hands of ESO; service activation information will also be provided to the DFC 	<ul style="list-style-type: none"> – Deciding on short term (close to real-time) procurement process; – Monitoring the performance of flexibility services in real-time; – Supporting DFC with information on system operation state and requirements. – FS are activated based upon selected FS product; – Based on the system state in close to real-time operation decisions on activation/curtailment will be made; – Activation orders (dispatching activities) remain in the hands of DSOs; service activation information will also be provided to the DFC

Both ESO and DSOs will coordinate with DFC regarding procurement of flexibility services, tenders, contracting activities, FLR performance monitoring and invoicing. Coordination will need to be fulfilled on regular time intervals which are commensurate to the activities being coordinated and the market services available.

The DFC will need to be informed on operational data, containing information of the electricity system state and requirements in real-time and to be provided with information relating to present/future investments, operation planning.

System operators will provide requirements relating to flexibility services products based on the system needs and timescale (constraint management, peak demand management, specific network conditions - faults or maintenance work, power restoration).

The Distributed Flexibility Coordinator will suggest appropriate assets for flexibility service according to the service selection principles or rules for long-term and short-term timescale, but the final decision will be left to the system operator.

3 Scheme Deployment: Cost Benefit Analysis

3.1 Approach

Imperial College Consultants London conducted additional analysis with the IWES whole system model to assess the impacts on whole system costs, and the projected uptake of flexibility services for 2035, which was considered a useful reference point for interim analysis. The results have been compared with the full net zero 2050 analysis results provided by the IWES modelling in previous workstreams. The flexibility volume analysis has also been utilised to support the development of cost benefits analysis.

To enable an outline assessment of the potential benefits provided by improved operational efficiencies of the coordination schemes, the impact of efficiency savings that could be delivered by improved coordination can be considered.

One way to assess the benefits of these efficiency savings is by estimating the overall cost of procuring flexibility services each year, which can be achieved by assigning indicative unit costs for flexibility and combining with annual volume projections.

Typical unit costs for flexibility will vary considerably depending on the type of assets used to deliver the flexibility services, therefore recent historic UK flexibility data has been used to provide a range of indicative costs which are then applied to different cost benefits scenarios.

The annual uptake volumes of flexibility have been developed from the IWES modelling for 2050 and 2035, in combination with the GB FES scenarios published by National Grid with a selection of LCTs, energy storage and renewable energy forecasts being combined to provide a profile shape for the potential uptake of flexibility service volumes on an annual basis.

The combination of a range of unit costs for flexibility and the developed flexibility uptake profiles have been used to assess the impact of modest efficiency savings, ranging from 3% to 7% which are considered to be conservative estimations for the benefits which can be delivered from enhanced whole system coordination of flexibility services. The results have been used in conjunction with the historic ENA Future Worlds cost estimations for stage 2 deployment of flexibility coordination schemes, within a typical network investment CBA, to illustrate the corresponding preferred years for investing in enhanced coordination under the modelled assumptions.

3.2 Flexibility Uptake Scenarios

The rate of uptake of flexibility is the central driver for when improved coordination needs to be operational. If flexibility volumes were stay very low, then the benefits of improved efficiencies, which are realised through improved coordination of flexibility across the networks, will remain reactively small. As the volumes of flexibility continue to grow, then any efficiency gains will become more significant when considered against the overall whole system costs.

To be able to determine indicative growth profiles for flexibility volumes, the flexibility volume analysis, prepared by ICL's IWES modelling for the original 2050 Net Zero scenario, in combination with the interim 2035 scenario has been utilised.

A set of indicative uptake profiles were generated, which combined National Grids Future Energy (FES) annual uptake profiles across asset groups which will influence the need for and ability to provide flexibility services. This includes renewable energy generation, electrification and storage of heat, EVs, smart appliances and energy storage. Different weightings of these asset groups were used to generate several uptake profiles, and to see how strongly the consolidated profile would be impacted by the different asset groups.

The different trajectories of the consolidated profiles showed relatively close alignment (refer to **Figure 3-1**), with the greatest variations occurring between 2035 and 2043. As there are still many unknowns regarding how flexibility services volumes will be driven and supplied, and that this may warrant a detailed assessment in itself, it was agreed that taking an average of the generated profiles would be a reasonable approach from which to generate illustrative volumes for the uptake of flexibility services.

The small reduction in the projection of volumes of flexibility services, shown after 2045 reflects the FES forecasts for EV volumes, with an anticipated reduction due to changes in consumer behaviour and the availability of different forms of public transport.

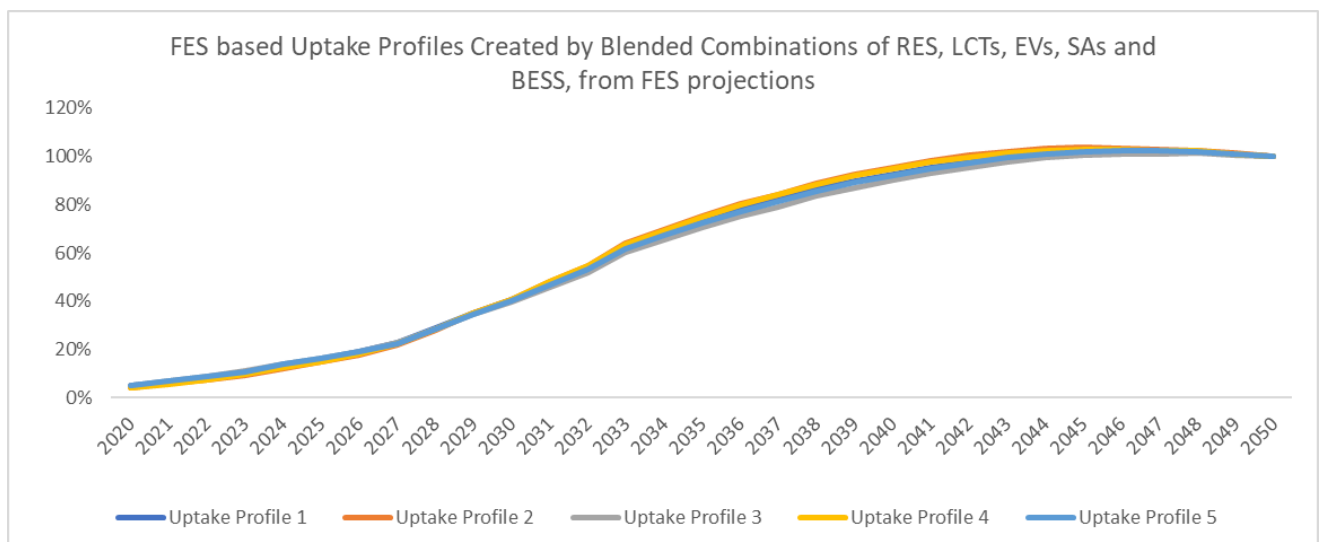


Figure 3-1 – FES Based Uptake Profiles for Flexibility associated Variable Energy Generation and Flexible Assets

The IWES whole system modelling undertaken by ICL in WS3 produced flexibility volumes, across the UK regions, for 2050 which represents a fully decarbonised energy system. Additional IWES analysis was undertaken as part of this workstream (WS4) which provided interim flexibility volume analysis for 2035.

The generated FES based Flexibility uptake profile (**Figure 3-1**) was used to translate the flexibility volumes for the IWES 2050 scenario (refer to **Figure 3-2**) into a Flexibility volumes uptake profile to 2050.

The IWES 2035 flexibility volumes, were used to be able to correlate the IWES whole system forecasts with the FES based flexibility uptake profile. Adjustments were made to the ‘S-curve’ of the uptake profile, in order to align the two data sets. This flexibility profile was then used as the central case for the subsequent cost benefits analysis. Alternative adjustments were made to the S-Curve uptake profiles to illustrate the impact of a fast uptake and slower uptake profile on the business case for transitioning to improved whole system coordination. The fast uptake scenario represents the

Flexibility uptake S-Curve delivering the equivalent volume from the IWES 2035 interim stage modelling, two years earlier in 2033. Whereas the slower uptake scenario represents the Flexibility uptake S-Curve delivering the equivalent volume from the IWES 2035 interim stage modelling, two years later in 2037.

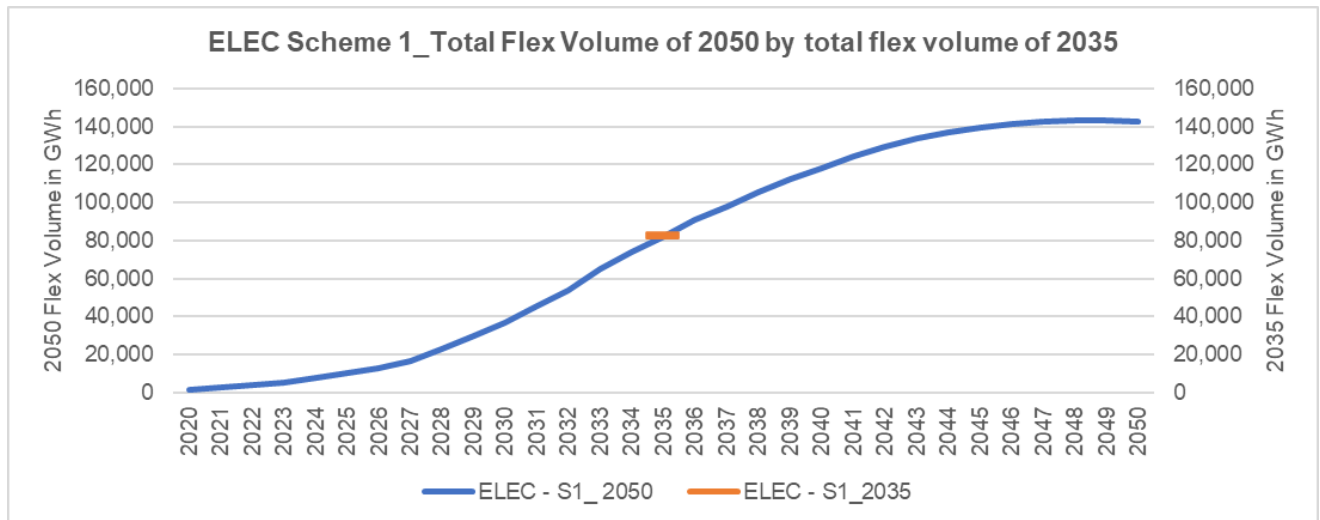


Figure 3-2 – FES Based Uptake Profiles for Flexibility associated Variable Energy Generation and Flexible Assets

The uptake profiles are used to provide illustrations of the benefits of improved whole system efficiencies delivered by improved coordination approaches, the actual flexibility volumes will depend on many market factors and may vary accordingly.

3.3 Flexibility Value Scenarios

To provide reasonable baseline costs for estimating indicative benefits which could be achieved from improving the efficiency of the overall operations of the flexibility markets, a review was undertaken of the currently operational flexibility market platforms, and a selection of available datasets provided on their websites.

3.3.1 UK Flexibility Markets and Market Platforms

3.3.1.1 Overview

There are three main flexibility trading platforms in use by the UK ESO & DNOs. The System Operators that use each platform are outlined in the table below:

Table 3-1 – Flexibility Trading Platforms and SO Users

Flexibility Trading Platform	System Operators using the Platform (as of Jan 2024)
Piclo Flex	ENWL, NGED, NPG, SPEN, SSEN, UKPN, NGESO

Piclo Max	ENWL
Flexible Power	NGED, NPG, SPEN, SPEN
EPEX SPOT	UKPN
Electron Connect	Piclo Max
Demand Flexibility Service	NGESO (Currently conducting trials)
Single Market Platform	NGESO (In Development)
Enduring Auction Capability	NGESO (In Development)

Piclo Flex is an independent flexibility trading platform that has operated in 6 countries and is currently operating in 4. As of January 2024, all 6 UK DNOs and the ESO are all active on Piclo Flex. Piclo has over 90,000 assets on its system totalling more than 20GW of flexibility and have advertised over 1,200 competitions. In 2023 there was 2.642GW of accepted flexibility provision.

Flexible Power was a joint initiative between the four DNOs operating on the platform to create one location for the publication of their flexibility service requirements. The information provided on this site tends to be more limited in comparison. Instead, it directs you to individual DNO sites and published materials on their sites. Basic information as to the volume of flexibility is available, but clearly defining what was tendered via flexible power, and what was via Piclo, is unclear.

The Demand Flexibility Service (DFS) was introduced by the ESO in late 2022/early 2023. Over 1.6m household and business participants have provided approximately 350MW of flexibility to NGESO since then. The following table describes the volumes and costs of flexibility³ across a month from 16th November 2023 to 17th December 2023:

Table 3-2 – Summary of Flexibility Service Types, DFS Required, Procured and Settled Volumes and Costs

Service Type	DFS Required (MW)	DFS Procured (MW)	Settled Volume of DFS (MW)	Settled Cost (£)
Live	3,300	2,792	1,987	4,753,627
Test	6,650	5,194	3,025	4,539,264
Total	9,950	7,986	5,012	9,292,891

³ Demand Flexibility Service 2023/24 | ESO (nationalgrideso.com)

3.3.1.2 Balancing Reserve

In addition to the flexibility market platforms described above, the Balancing Reserve service (a Balancing Mechanism) is procured via a daily auction managed by the ESO. This provides the ESO with a firm volume of available Regulating Reserve⁴ (product designed to provide real time system balancing) in advance, which reduces volatility and market prices. The recently launched Balancing Reserve has secured in the region of 400MW of capacity (both positive and negative balancing reserve) from conventional generators, peaking plant and BESS.

3.3.1.3 ESO Platform Developments

The ESO is developing several new platforms which are aiming to consolidate the procurement and dispatch of flexibility related services including for balancing and ancillary services.

Open Balancing Platform

The ESO has been developing a range of new balancing mechanism products including the Open Balancing Platform (OBP)⁵. The Platform seeks to harmonise and rationalise future management of balancing services for the ESO⁶, and includes the following key themes:

- Manage increased volumes of market participants.
- Be adaptable to new requirements, innovation and services.
- Enable a level playing field for new flexibility services.
- Optimise balancing cost.

The OBP will initially target the support the bulk dispatch of battery storage and small Balancing Mechanism Units. (BMUs). By 2027 the Open Balancing Platform aims to replicate and replace the existing Electricity Balancing System, Balancing Mechanism and the Ancillary Services Dispatch Platform.

Single Markets Platform

The ESO has been developing a Single Markets Platform (SMP) since 2022. The SMP seeks to provide a common interface for all ESO ancillary services, with a primary aim of improving the onboarding of and interactions with ESO ancillary service suppliers. Initially the SMP is targeting day ahead frequency response markets, but aims to incorporate additional ancillary and balancing services in the future. The SMP has a development schedule mapped out until Mar 2025⁷, with one of the final listed tasks being 'DSO Data integration Phase 2'. No details are currently provided for this task regarding the nature of the data to be integrated from the DSOs, or for previous (Phase 1) works already conducted for DSO data integration into the SMP.

⁴ <https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/balancing-reserve>

⁵ <https://www.nationalgrideso.com/what-we-do/electricity-national-control-centre/balancing-programme>

⁶ <https://www.nationalgrideso.com/document/315731/download>

⁷ <https://www.nationalgrideso.com/document/318371/download>

Enduring Auction Capability

The ESO's Enduring Auction Capability (EAC)⁸ is being designed to deliver co-optimised procurement for ESO day-ahead Frequency Response and Reserve products. The new process is aiming to improve procurement efficiency whilst enabling providers to participate in multiple markets. Trials of the new platform are in progress which use a newly developed optimisation algorithm.

None of the above ESO platform developments have listed objectives to support the improved coordination of flexibility services across the ESO and DSOs. The SMP includes a future task (2025) for the integration of DSO data, specific task details are not yet available. Some of the platforms will be running in parallel with flexibility market platform development for DSO services.

3.3.1.4 Flexibility Data

One approach to providing illustrations of the potential future costs and the associated benefits of improved coordination of Flexibility Services, is to consider the projected volumes of flexibility services (which have been assessed by the IWES modelling) in combination with typical average unit price ranges for utilisation of flexibility services. Future unit price ranges will be impacted by many factors including the availability, and suitability of large volumes of low-cost suppliers, which will include CERs and DERs, and the level of overall variability between future energy supply and demand over a range of time periods. Existing published flexibility datasets were reviewed to determine reasonable unit cost ranges, the Local Constraints Market (LCM) was selected for analysis as it provided a usable dataset with a broad spread of asset types delivering flexibility services and the associated contracted unit rates for utilisation.

Other datasets were available from Piclo, however these did not provide a breakdown by asset type and also showed considerable variation in contracted unit rates. The costs for different flexibility product lines are formed from service, availability and utilisation fees. The data was retrieved from the Piclo Data Hub (January 2024) for the Piclo Flex UK Confirmed Bids⁹. When considering the accepted bid utilisation prices for the Dynamic product category, these ranged from £35/MWh to £6,741/MWh, with an average unit rate of £495/MWh (Average exc. high outliers above £1200/MWh). The majority of the accepted bids were between £200-£500/MWh. The average accepted utilisation rate for the Secure product category was £178/MWh. Details of the utilisation rates, across the different flexibility product categories are shown in

⁸ <https://www.nationalgrideso.com/industry-information/balancing-services/enduring-auction-capability-eac>

⁹ <https://data.piclo.energy/>

Figure 3-3. Most of the cost of the Sustain product category is formed from the service cost, the utilisation cost is absent for the majority of the service entries for Sustain.

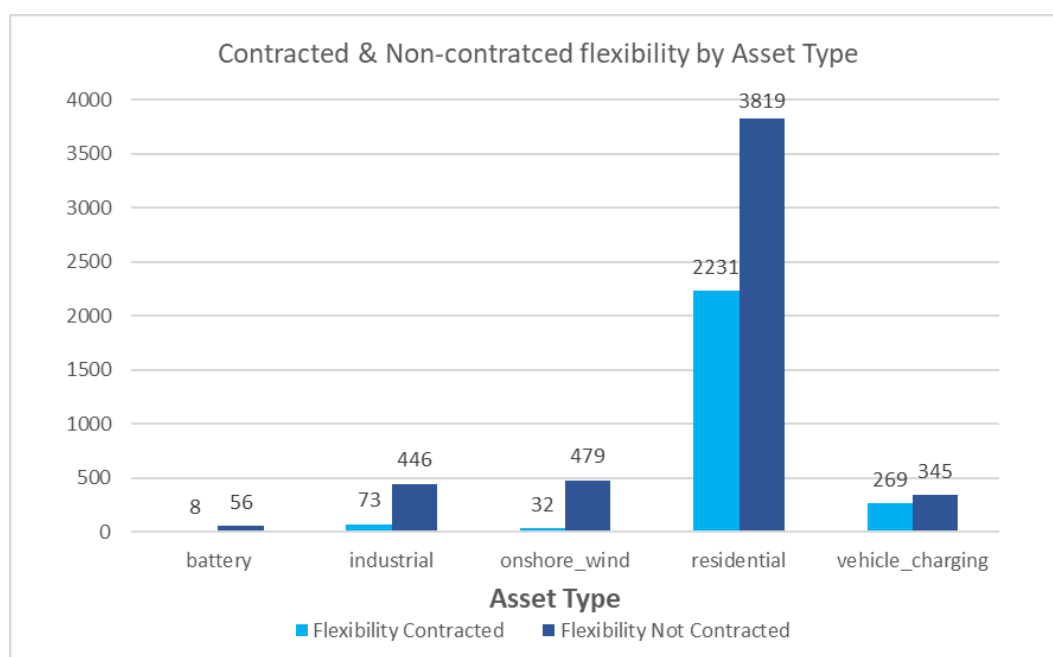
Figure 3-3 - Piclo - Flexibility Prices - Utilisation £/MWh

Utilisation Price (£/MWh), Jan 2024, accepted bids

	Dynamic	Restore	Secure	Sustain
MIN	£35	£180	£2	£35
AVG	£495	£462	£178	£35
MAX	£6,741	£995	£550	£47
COUNT	1422	9	576	2979

The Local Constraint Market (LCM) was set up to access flexibility for the constrained area along the B6 boundary, the boundary that separates NG Transmission from SP Transmission¹⁰. The information provided on Piclo allows for the analysis of flexibility procurement for the LCM by volume, asset type and costs.

The flexibility procured in the LCM was split into 7 asset types, 2 of which were not contracted for the provision of flexibility (i.e. their bids failed) due to being considered uneconomic. The remaining 5 asset types were split across 6 flexibility providers. The frequency of flexibility bids contracted and not contracted are shown below.

**Figure 3-4 – Flexibility Contracted and Non-Contracted Volumes by Asset Type 2023 (Source Piclo Flex)**

¹⁰ This dataset was selected for the analysis as there was good availability of complete data across the different metrics, the data available from the DNOs or Piclo websites for DNO flexibility procurement is not currently standardised or complete.

As illustrated in **Figure 3-4**, the asset type with by far the largest number of contracted bids is residential. However, it is worth putting it in context in that there were far more residential assets tendered to provide flexibility than any other asset type, likely due to the flexibility provider acting as an aggregator (Octopus Energy). Vehicle charging is the asset type most successful in being contracted, with 44% of tenders being contracted. Residential comes in 2nd with 37% of tenders being contracted, whereas battery, industrial and onshore wind assets perform at a much lower award rate.

The average tendered utilisation price and range of tendered utilisation prices varied greatly between asset types as can be seen below in **Figure 3-5**.

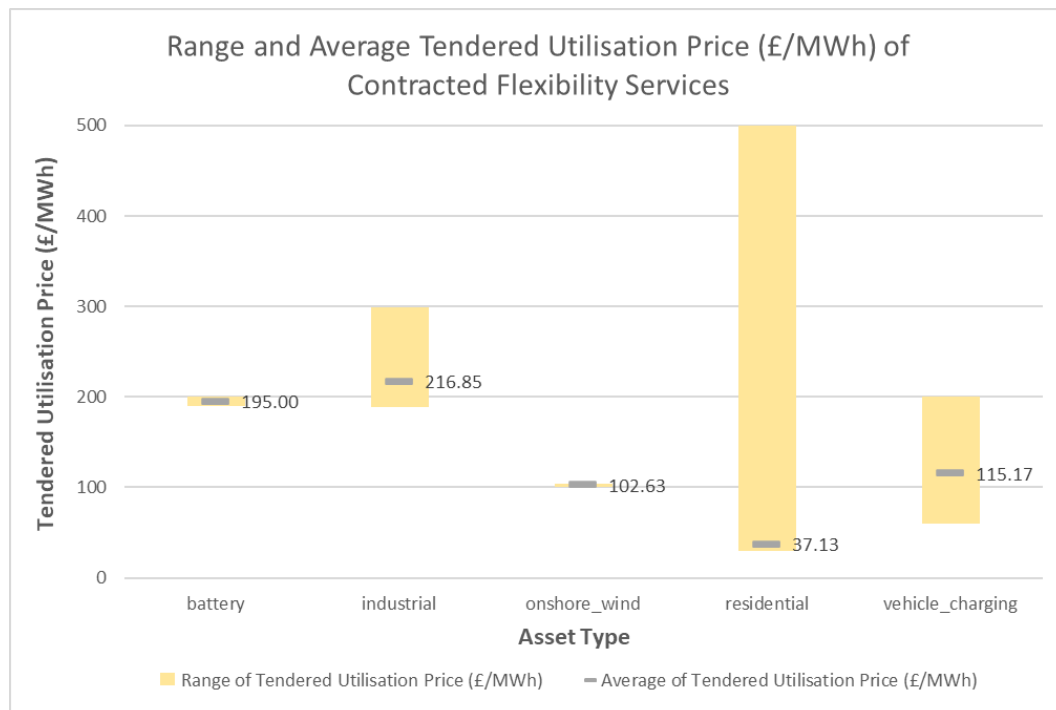


Figure 3-5 – Flexibility Tendered Utilisation Price by Asset Type 2023 (Source Piclo)

As illustrated in **Figure 3-5** the tendered utilisation price of contracted batteries and onshore wind varied very little (both with a range no more than £10/MWh), although it is recognised that this will be partly due to the relatively low numbers of bids that were successfully contracted. Industrial and vehicle charging prices varied significantly more with ranges between £100 - £150. Residential utilisation prices showed significant variation, with bids being contracted between £30 - £500.

Residential assets were contracted for flexibility at an average price of c. £37/MWh, representing an average price of below 40% of the next lowest average price of c. £103/MWh which is for onshore wind assets. The average tendered utilisation price of contracted onshore wind & vehicle charging assets both sit near to £100/MWh, whereas industrial and battery assets had an average contracted price nearer to £200/MWh.

The most frequently contracted tendered utilisation price was £30/MWh that was offered for residential flexibility. However, when the cost of each contracted utilisation price is considered in the context of MWh procured, the picture is notably different as can be seen in **Figure 3-6** below.

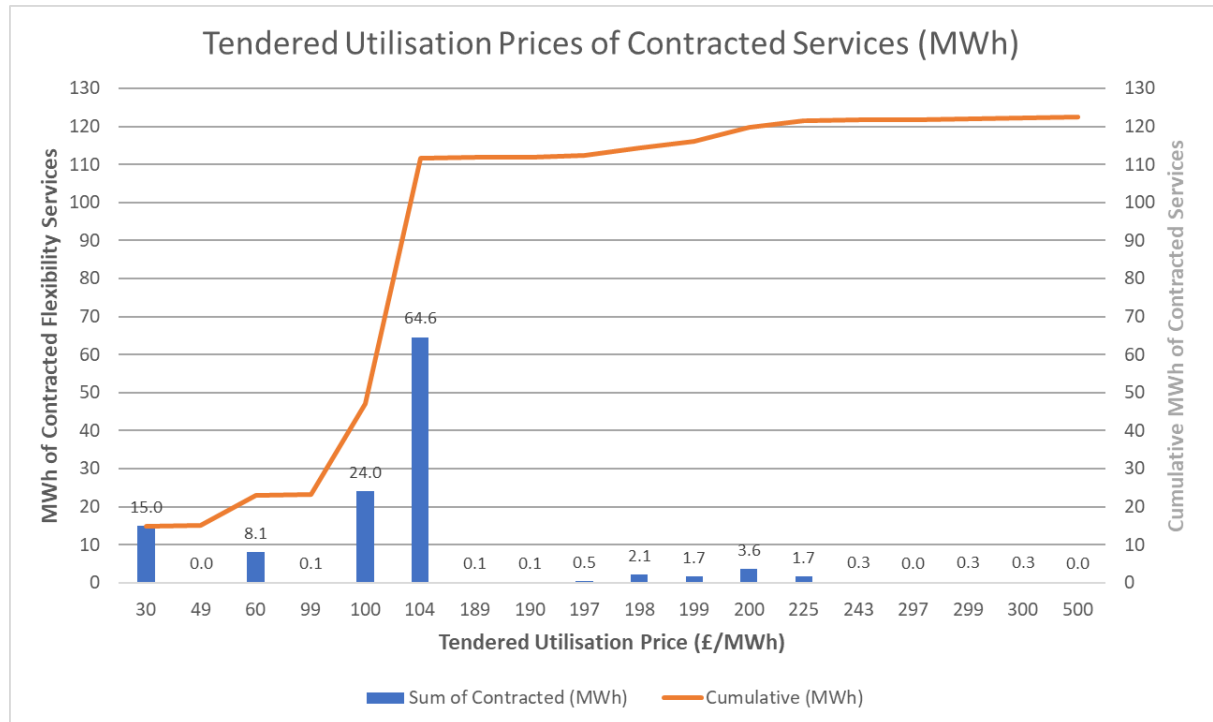


Figure 3-6 – Flexibility Contracted and Non-Contracted Volumes by Asset Type 2023 (Source Piclo)

Despite the high numbers of contracted bids from the residential asset group, which typically have a tendered utilisation price of around £30/MWh, only 15MWh of the 122.4MWh of contracted flexibility was procured at this price, or around 12%. As previously illustrated in **Figure 3-4** only residential assets offered flexibility at this price point. Notably, the highest volume (in MWh) of flexibility procurement came at a price point of £104/MWh, all of which was for onshore wind. The 64.6MWh of procured flexibility at this price makes up more than 50% of the total procured flexibility. The 24MWh of flexibility procured at £100/MWh makes up almost 20% of the total procurement. These two highest quantities (MWh) of contracted flexibility make up the 32 cases of onshore wind being contracted. Therefore, almost three quarters of the total flexibility procurement came from onshore wind. Vehicle charging is responsible for the 8.1MWh contracted at £60/MWh.

It is observed that the majority of procurement was lower end of utilisation price range, with over 90% of flexibility procured at £104/MWh or less.

3.3.1.5 Flexibility cost Range Summary for Coordination Scheme Cost Benefits Analysis

Based on the available information sourced from Piclo covering flexibility tendered and contracted prices and volumes by asset group in 2023 (April-December), a range of £30/MWh to £100/MWh will be used for subsequent cost benefits analysis.

3.4 Whole System Efficiency Scenarios for Scheme 2 Flexibility Coordination

3.4.1 Approach

It is expected that improved coordination of flexibility services, especially when considering a whole system approach, will lead to overall system efficiencies which in turn will result in average costs per unit of flexibility being reduced. Efficiency based savings would be expected as a result in improvements in the following areas of flexibility market operations:

- Improved identification of flexibility requirements.
- Improved visibility resulting in improved Supplier targeting of needs.
- Improved resolution of potential conflicts.
- Overall improved coordination and management and dispatch handling.

To determine the potential whole system savings which can be achieved by improved coordination of flexibility services, a range of percentage efficiency gains were combined with the flexibility uptake profiles detailed in section 3.2 and typical flexibility prices as detailed in section 3.3.

The results were compiled for a range of scenarios, including:

- Low to medium efficiency savings - ranging from 3% to 7%
- Low to medium average contracted flexibility prices – ranging from £30/MWh to £100/MWh
- Slow, Central and Fast Flexibility Uptake Profiles – based on IWES 2050 and 2035 projections, with a 2 year advanced and delayed volume for the 2025 projection.

The above data was used initially to look at the cumulative benefits which could be delivered by improved efficiency of coordination, and then subsequently within a tailored version of the standard Ofgem network investment appraisal CBA.

3.4.2 Example Costs for Transitioning from Scheme 1 to Scheme 2 to realise Whole System Efficiency Gains for Flexibility

The actual costs associated with transitioning from a ESO-DSO coordinated approach to a whole system coordinated approach which includes new coordination roles are unclear. In particular as to when costs incurred with setting up the new coordination roles and improved data management and market integration systems result in offsetting costs which would otherwise be incurred by the ESO or DSO to improve their coordination. When considering the previous ENA Future Worlds study, the Scheme 1 (Similar to World B) total costs were actually higher than for Scheme 2 (Similar to World E). However, if we wish to compare potential costs for transitioning to improved coordination, we can consider the stage 2 costs associated with the two ENA future Worlds, including those associated with a new Flexibility Coordinator (FC) role as set out for Scheme 2 (Similar to World E). These are shown in Table 3-3.

Table 3-3 - Summary of ENA Future Worlds Estimated DSO, ESO and FC Cost Breakdowns by Stage

Actor and Stage	Stage Totals £m				
	Scheme 1 (Based on World B)	Scheme 2 (Based on World E)	Maximum Considered for FC and ESO-DSO transition Costs	Minimum Considered for FC and ESO-DSO transition Costs	Average Considered for FC and ESO_DSO transition Costs
DSO Stage 1	£352	£248			£0
DSO Stage 2	£500	£222	£222		£222
ESO Stage 1	£177	£188			£0
ESO Stage 2	£260	£146	£146		£146
FC Stage 1	£0	£132	£132	£132	£132
FC Stage 2	£0	£215	£215	£215	£215
Totals	£1,289	£1,151	£715	£347	£531

The costs associated with a transition to an enhanced level of coordination can potentially be considered as the Stage 2 costs for either Scheme, which equates to c. £760m for Scheme 1 and £715m for Scheme 2 (which also includes the FC costs, and is shown as maximum FC and ESO-DSO transition costs in Table 3-3). However, the additional projected costs associated with establishing and operating the new Flexibility Coordinator role, which is an integral role for Scheme 2, are only £347m (shown as minimum FC and ESO-DSO transition costs). As some of the Stage 2 costs for either Scheme will be commonly incurred by either approach, an average of the maximum and minimum cost illustrations (£531m) has been adopted to provide an indication of when the benefits of efficiency savings become significant compared to costs which may be associated with achieving the improved coordination necessary to deliver the efficiency gains.

3.5 Annual and Cumulative Benefits Analysis

The annualised savings, based on the relationship between flexibility volumes, contracted prices and example efficiency savings are illustrated in **Figure 3-7**. The indicative costs which may be associated with transitioning to whole system coordination of flexibility services, as described in section 3.4.2, have been added as a point of reference.

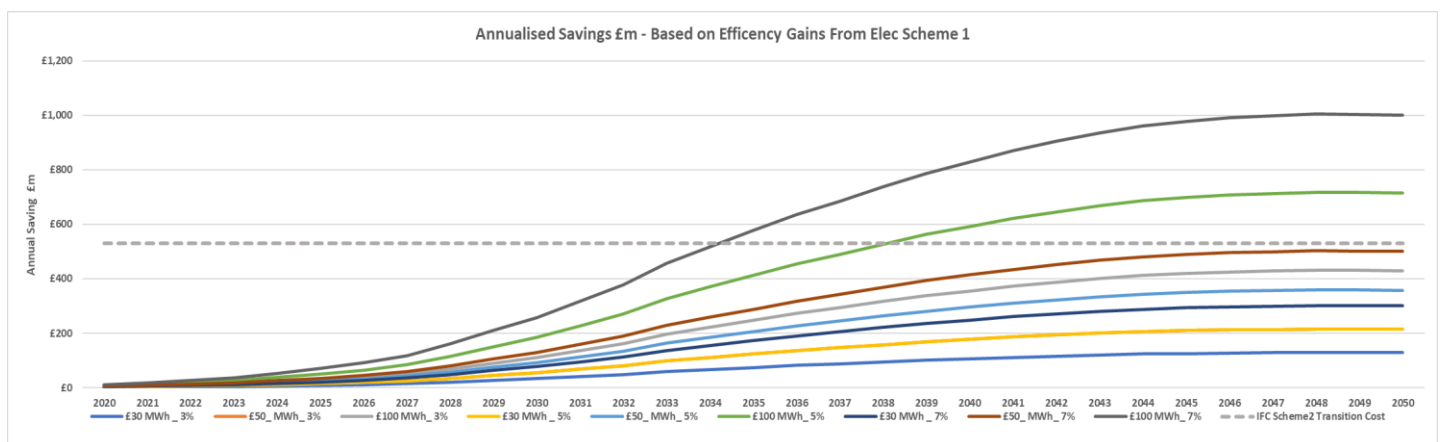


Figure 3-7 – Potential Annualised Savings Based on Projected Volumes, Example Efficiency Gains, and Typical costs for Contracted Flexibility Services

The most extreme scenario modelled, which includes flexibility procured at an average of £100/MWh and a 7% efficiency gain delivered by improved coordination, results in an annual whole system cost saving which is equivalent to the illustrative whole system coordination transition costs in 2034.

The potential cumulative annual savings which would be delivered by improved efficiency gains are illustrated in

Figure 3-8. Under the modelled scenarios, the cumulative savings (if accrued from 2024 onwards) resulting from the illustrated efficiency gains range from around £2Bn to £16.5Bn by 2050. It is worth noting that although efficiency gains may not be achievable from 2024, the volumes in the early years are very small compared with the later years, so the actual start year (when pre-2028) has minor impact on the illustrated results.

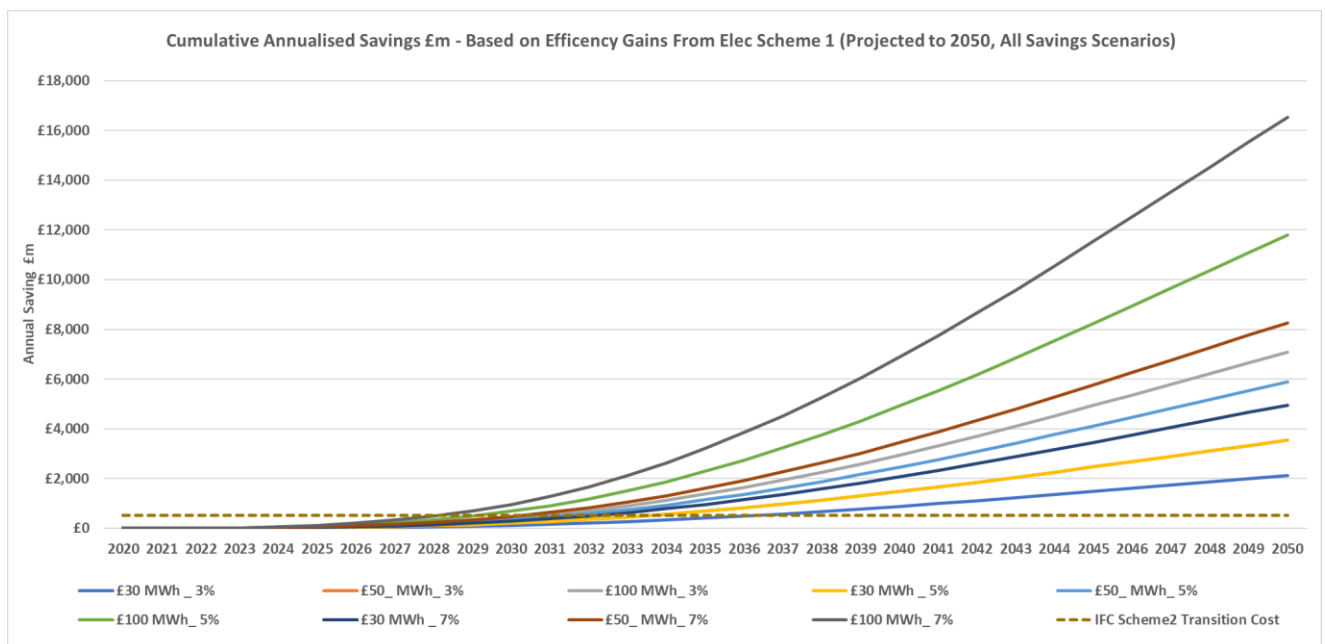


Figure 3-8 – Potential Cumulative Savings Based on Projected Volumes, Example Efficiency Gains, and Typical costs for Contracted Flexibility Services – Showing Lower Savings Scenarios, Projected to 2050

To improve clarity for the key points of interest across the different scenarios, the lower savings scenarios to 2050 (**Figure 3-9**) and all savings scenarios to 2037 (**Figure 3-10**) are included. These illustrate indicative simple breakeven points against the example whole system coordination transition costs.

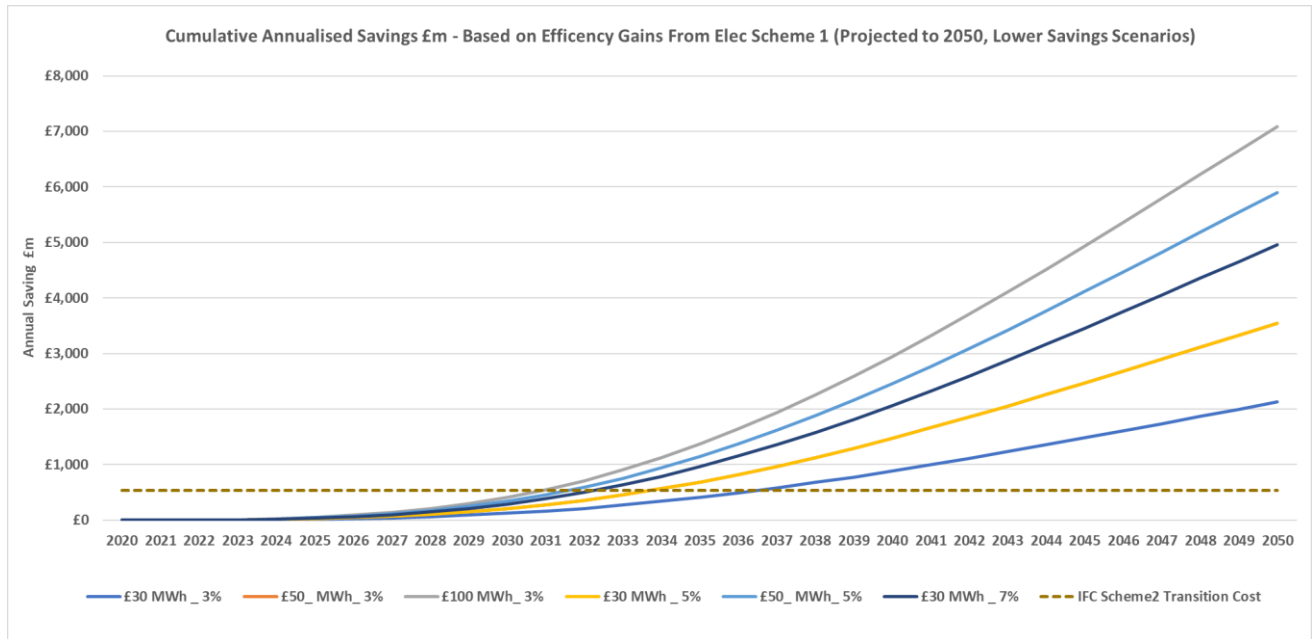


Figure 3-9 – Potential Cumulative Savings Based on Projected Volumes, Example Efficiency Gains, and Typical costs for Contracted Flexibility Services – Showing Lower Savings Scenarios, Projected to 2050

The illustrated scenario (refer to **Figure 3-10**) which generates the highest savings (£100/MWh flex, 7% saving) produce cumulative savings, equivalent to the indicative whole system enhanced coordination transition costs by around 2028. The lowest modelled savings scenario (£30/MWh flex, 3% saving) show an equivalent cumulative savings by late 2036.

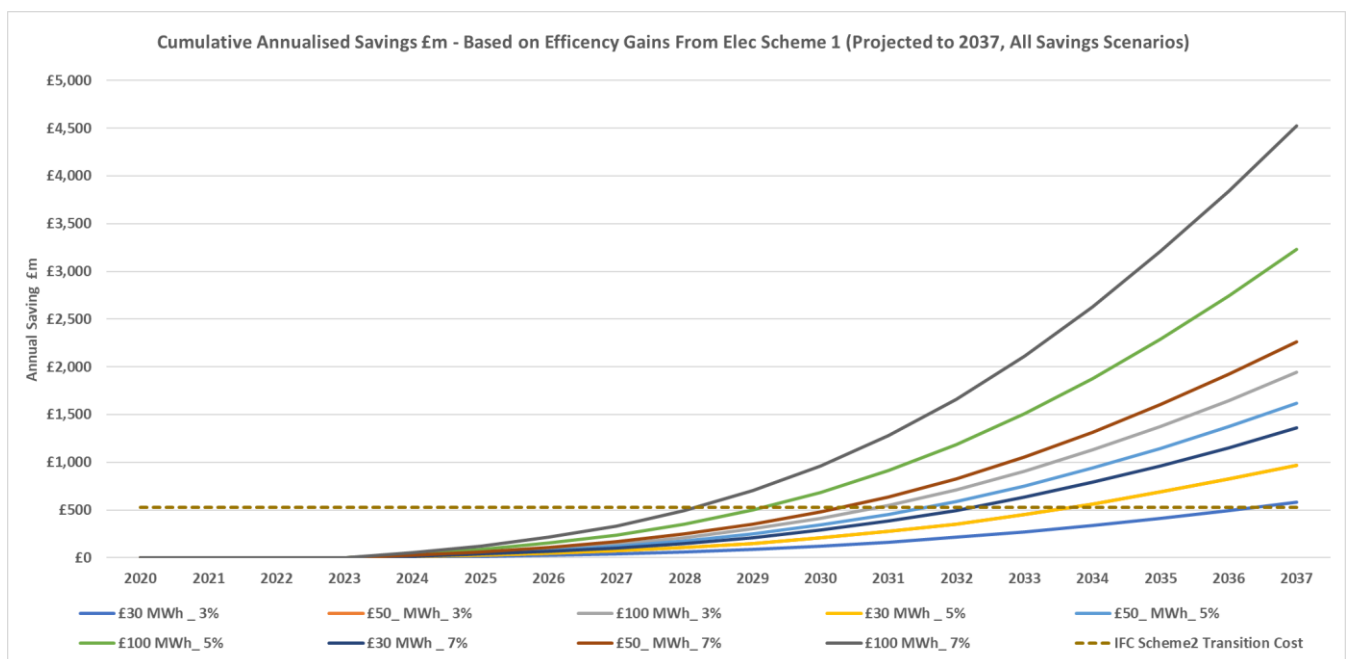


Figure 3-10 – Potential Cumulative Savings Based on Projected Volumes, Example Efficiency Gains, and Typical costs for Contracted Flexibility Services – Showing All Savings Scenarios, Projected to 2037

3.6 Ofgem standardised Network Investment Cost Benefits Analysis (CBA)

3.6.1 Approach

A Cost Benefits Analysis has been developed, based on the standard Ofgem network investment CBA, to illustrate the benefits of potential efficiency savings which can be delivered by enhanced coordination of flexibility services. Information provided by the IWES analysis has been combined with national FES uptake profiles for a selection of LCTs, RES and energy storage technologies to generate indicative uptake profiles for flexibility volumes. These have been combined with historic GB flexibility market data and scheme costing data from the ENA Future Worlds study to determine preferred investment and operational years for a range of illustrative efficiency scenarios.

The annual savings developed from the flexibility data and uptake profiles, as described in section 3.5 have been used in combination with the illustrative whole system improved coordination costs within a tailored version of the standard Ofgem Network Investment CBA workbook.

The CBA includes the standard economic factors for evaluating long term network investments such as Capitalisation rates, Depreciation and Discount factors. All economic settings have been kept as the defaults for all modelled CBA scenarios.

The CBA has been used to compare the NPV over a range of different periods from 5 years to 45 years, which result from operating with improved whole system coordination efficiencies from 2028 onwards. The CBAs have been used to assess the change in NPVs, dependent on the year of which the improved efficiencies start. The capital investment costs has been set out across the two previous years. For example, if the efficiency gains have been realised from 2028, then the capital expenditure will have been distributed across 2026 and 2027. Additionally, the previous ENA Future Worlds cost build up included an element of operational expenditure (Opex). In practice there will be ongoing operational costs, and the capital expenditure may be incurred across additional years, however these factors can be considered to be applicable to all scenarios so will largely be levelled out.

Any additional Opex, not captured in the ENA Future Worlds assessment, would also be expected to be largely transferred from different actors and roles, with any additional annual Opex requirements which are dedicated specifically to new whole system coordination functions being relatively small when considered against the whole system value of flexibility per annum. A selection of the previously described scenarios have been tested for comparison, these include:

- £30/MWh Flex, 3% efficiency gains
- £30/MWh Flex, 5% efficiency gains
- £30/MWh Flex, 7% efficiency gains
- £50/MWh Flex, 3% efficiency gains
- £50/MWh Flex, 5% efficiency gains
- £50/MWh Flex, 7% efficiency gains
- £100/MWh Flex, 3% efficiency gains

- £100/MWh Flex, 5% efficiency gains
- £100/MWh Flex, 7% efficiency gains

Modest efficiency gains have been modelled, in conjunction with the 2023 (April-Dec) flexibility contracted rates per MWh which make up over 90% of the flexibility delivered via the Pico Flex flexibility market platform over this time period (refer to section 3.3 for further details).

3.6.2 Key results

Example CBA NPV for low and high scenarios

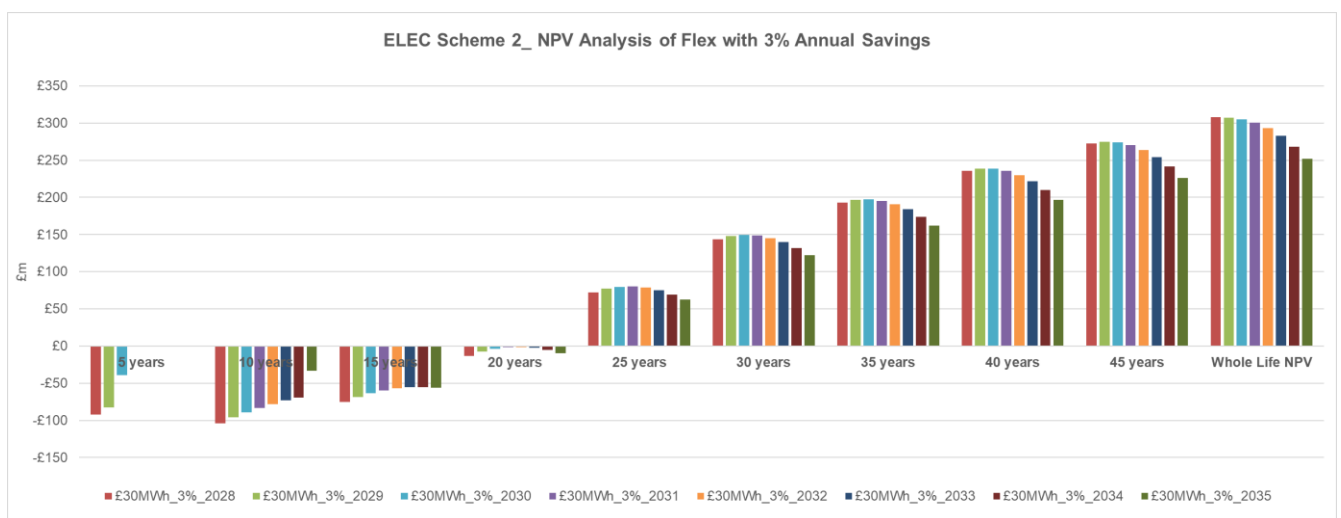


Figure 3-11 – CBA NPV Analysis for Lowest Flexibility Savings Scenario - £30/MWh flex, 3% efficiency gains from enhanced coordination, £531m Capital Outlay

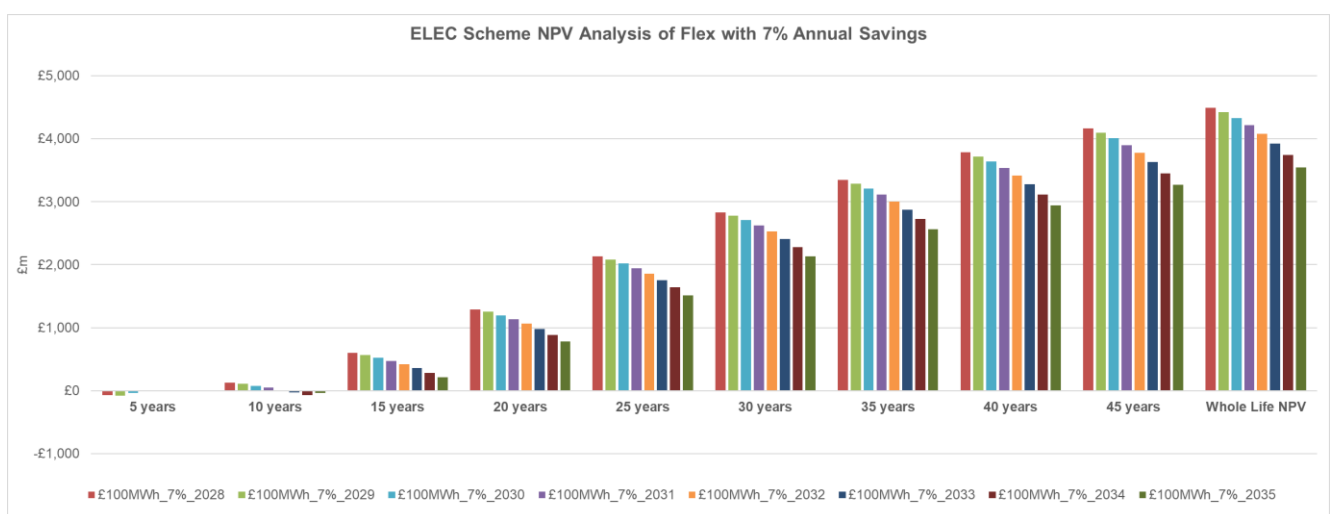


Figure 3-12 – CBA NPV Analysis for Highest Flexibility Savings Scenario - £100/MWh flex, 7% efficiency gains from enhanced coordination, £531m Capital Outlay

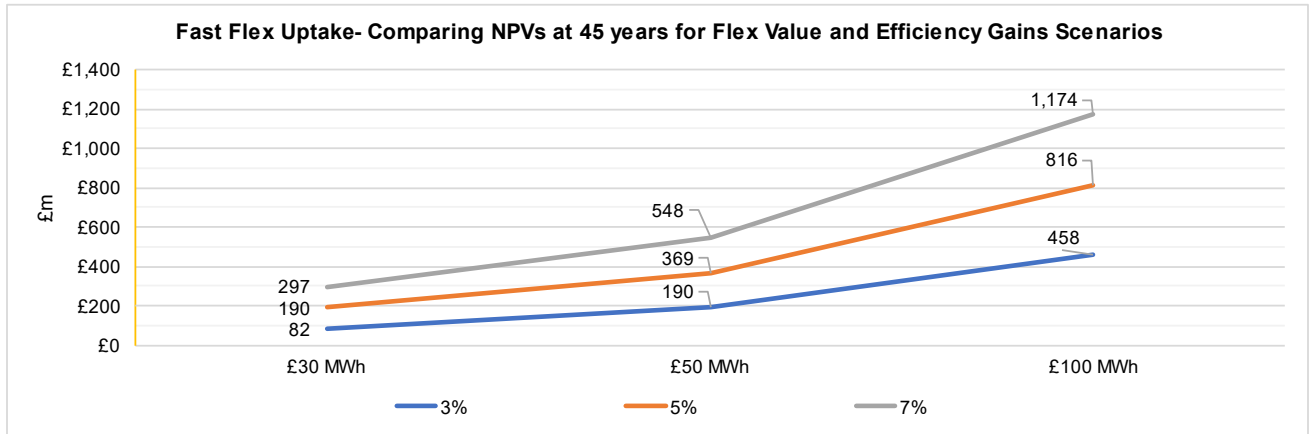


Figure 3-13 – CBA NPV Analysis showing 45 year NPV for range of Flexibility unit rate values, and efficiency gains delivered by enhanced coordination, for the Fast Flex uptake scenario

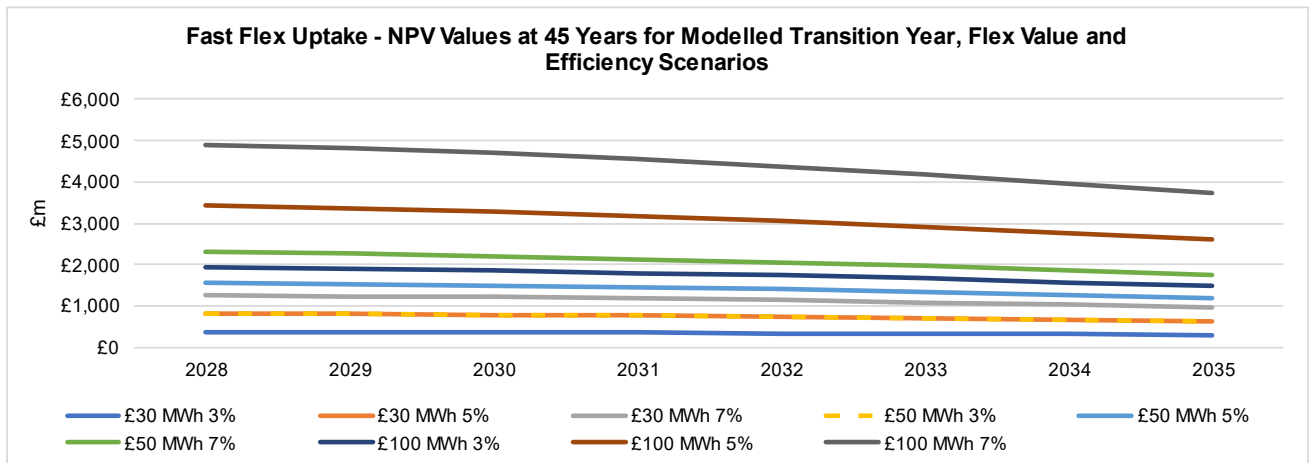


Figure 3-14 – CBA NPV Analysis showing 45 year NPV for range of Flexibility unit rate values, and efficiency gains delivered by enhanced coordination, for the Fast Flex uptake scenario

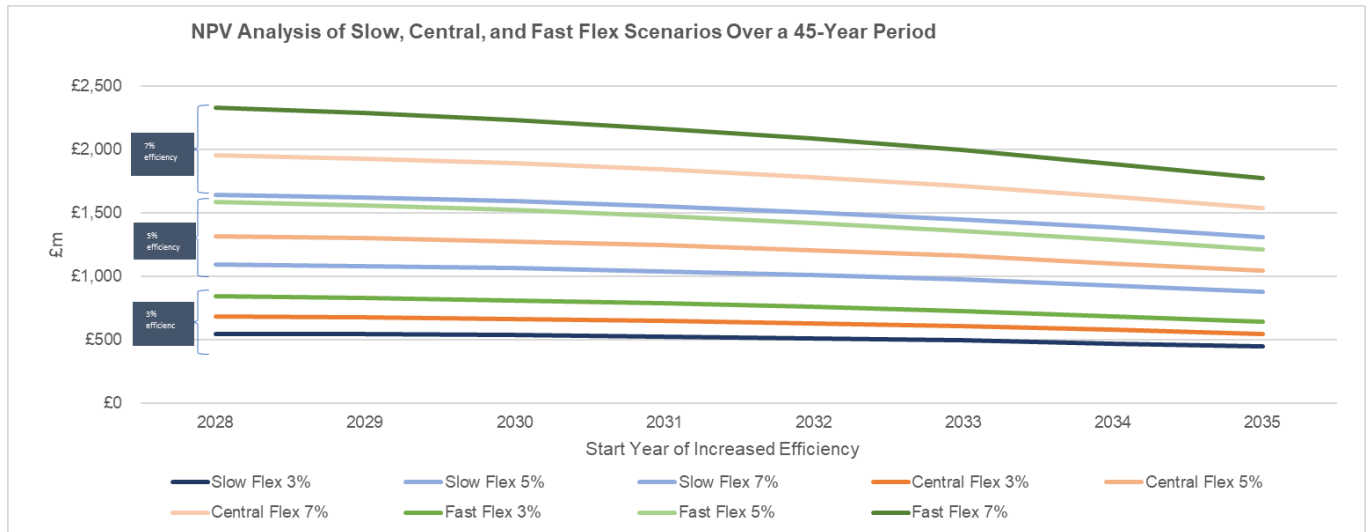


Figure 3-15 – CBA NPV Analysis showing 45 year NPV for different flex scenarios and start year of increased system efficiency from enhanced coordination

3.6.3 CBA Summary

The CBA study, using the standard Ofgem CBA template for assessing network investments, has indicated that for the capital costs applied, the preferred business case for investing in improved coordination in order to realise fairly modest gains on whole system efficiencies for flexibility should be undertaken in the near future. Efficiency gains from 2028, with the investment being undertaken in the two previous years, provide the best 45-year NPV for the large majority of modelled scenarios. The exceptions being scenarios where the flexibility average unit rates are low (£30/MWh) and the efficiency gains are very low (3%), for which the optimum operational year (based on 45-year NPV) for improved efficiency delivered by enhanced coordination is 2029 or 2030. Even under this minimal cost and improvement scenario, leaving the enhanced coordination efficiency gains until 2031 produces a lower 45-year NPV than for a 2028 operational start year.

3.7 Summary and conclusions

The simple annual and cumulative efficiency-based savings economic analysis illustrates that above certain volumes of flex there is a strong case for focussing on measures which can provide efficiency savings in the cost of flexibility. Scheme 2, which focusses on whole system optimisation is considered to be one of the key mechanisms which can facilitate such efficiency savings, with expected benefits being derived from improved overall coordination including for:

- Improved identification of flexibility requirements.
- Improved visibility resulting in improved Supplier targeting of needs.
- Improved resolution of potential conflicts.
- Overall improved coordination and management and dispatch handling.

Illustrations of Flexibility volume increases, based on FES projections for a range of influencing technologies and asset groups, in combination with the IWES whole-system modelling have been utilised to set out volume uptake paths. The volume uptake profiles have been combined with low to medium flexibility average unit prices to determine the corresponding economic benefits which can be delivered by modest efficiency gains which could be delivered by improved whole system coordination.

When considering the scenarios modelled, which are viewed to be on the conservative side for flexibility unit prices and potential efficiency gains, the cumulative savings from improved coordination-based efficiency gains surpass the project implementation costs for the improved coordination from between 2028 (£100/MWh flex, 7% efficiency gains) and 2037 (£30/MWh flex, 3% efficiency gains).

The application of the standard Ofgem network investment assessment CBA has been used to assess the investment case. Scenarios have been modelled across a range of flexibility unit price points (£30/MWh - £100/MWh), and for different efficiency gains (3%-7%). The initial year of operation of the improved coordination has been tested from 2028 to 2037, to determine which investment year will provide the best NPV, which for the modelled scenarios will reflect the best value for consumers. The illustrative capital expenditure being undertaken in the previous two years. For the large majority of tested scenarios, the optimal year of improved coordination was shown to be 2028, and only for the lowest flexibility unit rates (£30/MWh) and efficiency gains (3%), a later year was preferred (2030/31).

3.7.1 Coordination Scheme Implementation Considerations

The economic analysis is not considered to be exhaustive and does not consider the practicalities of actual delivery. It does however illustrate that there is a strong economic case for the early transition to improved whole system coordination of flexibility services when this can deliver improved efficiencies. It also highlights that the benefits of improved coordination will be dependent on flexibility uptake rates, cost of flexibility and the ability to deliver efficiency gains in the flexibility market. Further analysis of the projected flexibility volumes and unit rates, combined with regular reviews of actual and short-term flexibility growth and average unit rate projections will be needed over the next few years.

As the illustrative costs for improved coordination are drawn from the previous ENA Future Worlds programme from 2019, it will be necessary to undertake a full review of the costs, and how any new role for improved whole system coordination may partly offset costs which would otherwise be incurred by the network operators. This was beyond the scope of this study.

4 Roadmap for Schemes Deployment

4.1 Approach

A roadmap for the deployment of the proposed coordination schemes has been developed. This represents the identified key actors, tasks, facilitating measures, milestones and risks and is set out from 2023 to 2040. The roadmap seeks to highlight some of the interdependencies between the different elements of the roadmap and to set out potential pathways. The latest roles and strategic planning activities published by Ofgem have been included for referencing, with known dates aligned within the roadmap timeline.

4.2 Policy and regulatory context

4.2.1 Approach

A review of existing GB policy and regulations and proposed changes to strategic and market facilitation roles has been undertaken. This has been used to provide current context for the proposed coordination schemes and to ensure that current Ofgem and DESNZ plans are adequately considered in the coordination scheme implementation road mapping.

4.2.2 Ofgem Consultation and the development of New Market Operators

Details of the Ofgem consultations on the proposed new market operators are covered in WS3, a brief overview and update are included in this subsection.

4.2.3 Regional Energy Strategic Planners

In November 2023, Ofgem gave the go-ahead for the creation of new regional energy planning roles across Great Britain to improve local energy planning and speed up the transition to net zero¹¹.

The Regional Energy Strategic Planners (RESPs) will work with organisations at a local level including local government and gas and electricity networks, to improve understanding of the infrastructure needed in different parts of the country and attract investment for projects.

The new approach to energy planning will see RESPs create clear plans for how local energy systems need to be developed to reach net zero, considering both the national targets set by government, and the local needs and most appropriate approach in each area.

Ofgem Consultation Determination¹²

Our decision is to proceed with reforming local governance arrangements as set out in our March 2023 Consultation:

¹¹ Ofgem green lights regional energy planning roles to speed up net zero transition | Ofgem

¹² Decision on future of local energy institutions and governance | Ofgem

- Energy system planning: introduce Regional Energy Strategic Planners (RESPs) to ensure there is appropriate accountability and effective coordination for strategic planning at a sub-national level.
- Market facilitation of flexible resources: assign a market facilitation function to a single entity with sufficient expertise and capability to deliver more accessible, transparent, and coordinated flexibility markets.
- Real time operations: keep real time operations within the DNOs, ensuring clear accountability for network reliability and safety.

4.2.4 New Market Facilitator (MF)

Ofgem initially determined that the FSO is the lead option for both the RESPs and for the new Market Facilitator (MF) role. However, stakeholder feedback from the associated consultation also proposed that Elexon could be a viable candidate for the new MF role. Ofgem will go out to further consultation regarding the preferred delivery body for MF.

'In the Consultation we proposed the FSO as the lead option for the delivery of both new roles - the RESPs and market facilitator. Our (Ofgem's) decision is for the FSO to be the delivery body for RESPs. We intend to consult shortly on the merits of Elexon or the FSO being the delivery body for the market facilitator role. This follows stakeholders identifying Elexon as a viable option in response to our Consultation.'

Following their initial rounds of industry consultation, Ofgem have defined the key functions of the Market Facilitator as being:

- Strategic Leadership
- Market Coordination
- Implementation Monitoring

Ofgem have set out potential activities against each key function as shown in

Table 4-1 – Market Facilitator Delivery, Key Functions and Potential Activities (Ofgem, ([Market facilitator delivery body \(ofgem.gov.uk\)](https://www.ofgem.gov.uk/market-facilitator-delivery-body)))

Function	Potential activities
Strategic leadership	<ul style="list-style-type: none"> • Translate Ofgem and the Department for Energy Security and Net Zero's (DESNZ's) vision for local flexibility markets into a market coordination delivery plan. • Monitor developments across policy, regulation, innovation, and energy markets and proactively identify upcoming challenges, opportunities and risks that may require intervention. • Identify if changes are required to the market facilitator's functions, engaging with Ofgem where necessary to update roles and responsibilities. • Provide advice to government and Ofgem where regulatory or policy gaps are identified or where there is a need for joining-up and coordination.
Market coordination	<ul style="list-style-type: none"> • Propose and manage changes to the processes, rules, and standards in a transparent and collaborative way. • Facilitate open, participative discussions with wide stakeholder representation as part of the change management process. • Decision-making on processes, rules, and standards. • Develop and publish a delivery plan and implementation timetable, identifying the deliverables required for standardised, transparent, and coordinated local flexibility markets and for alignment with transmission flexibility market arrangements. • Commission or undertake market and technical research, analysis or modelling.
Implementation monitoring	<ul style="list-style-type: none"> • Monitor whether and how the agreed processes, rules, and standards are adopted to ensure they are implemented on time and as intended. • Report implementation issues to Ofgem which will assess whether compliance and enforcement action are required. • Assess how the new processes, rules, and standards work in practice, creating a feedback loop to the market coordination function where issues or potential improvements are identified.

4.2.5 MF Commander Scheme Impact

For the proposed Flexibility Coordination Scheme 2, the IWES modelling has reflected a whole system approach to flexibility services coordination, which combines the coordination of identifying the need for flexibility, its procurement and dispatch in conjunction with the selected reinforcement of the whole energy system to provide a fully optimised approach.

To be able to achieve a fully coordinated whole system approach, two key activities will be required:

- The individual RESPs will also need to be considered and coordinated on a national level for the whole of the UK, which currently is indicated to be a future function of the FSO and may be delivered partly by the proposed Strategic Spatial Energy Plan and the Centralised Strategic Network Plan.
- The identification of flexibility requirements at a regional level will need to fully consider the existing and future electricity network capacities, alongside other energy vector capacities including hydrogen.

4.2.6 ENA Primacy Rules Evaluation

The ENA has several working groups which have been focussed on the identification and potential mitigations of various areas of potential conflict which have impacted, or may in the future impact on the coordination of flexibility services across ESO and DSO operations.

The Primacy Working Group (PWG) have published several reports detailing the findings of the working group, one of which focusses on the potential conflicts of Transmission Constraint Management (TCM) events and DNO network capacity management.

This Use Case involves a possible scenario in which the ESO is trying to reduce the export of a single/multiple generator(s) to manage a Transmission Export Constraint when, at the same time, the DNO is trying to procure a Generation Turn Up (GTU) / Demand Turn Down (DTD) service from different assets in the local area.

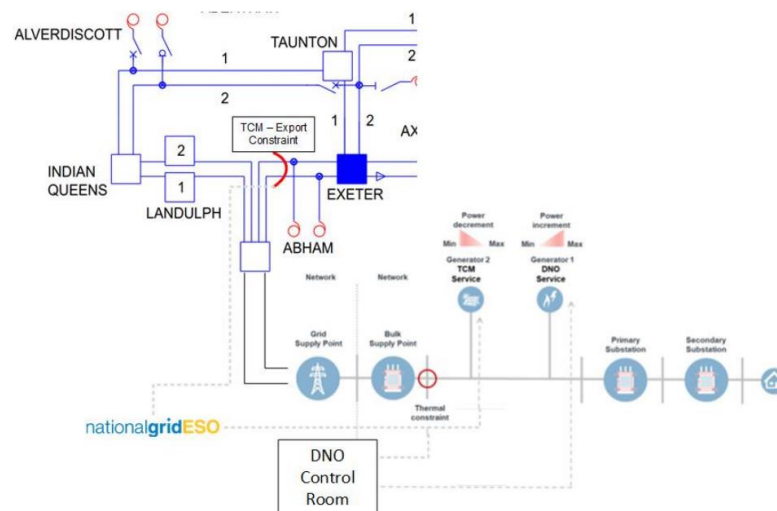


Figure 4-1 - TCM - DNO Service Use case Overview, Source: ENA¹³

¹³ [https://www.energynetworks.org/publications/on22-ws1a-p5-primacy-draft-rules-increment-1-\(28-apr-2022\)](https://www.energynetworks.org/publications/on22-ws1a-p5-primacy-draft-rules-increment-1-(28-apr-2022))

The ENA PWG has aimed to identify a wide range of events which could result in potential conflicts between different system actors dispatching flexibility services. As part of this process, they have considered the likelihood of conflict events occurring and the level of risk to the network resulting from a potential conflict. The existing DNO Flexibility Products, together with their operational characteristics and risk to network are shown in **Figure 4-2**.

Service Parameter	DNO Flexibility Products				
	Sustain	Secure (Scheduled)	Secure (Dispatched)	Dynamic	Restore
When required?	Scheduled forecast overload	Pre- fault / peak shaving		Network abnormality / planned outage	Network Abnormality
Risk to Network	Low	Medium		High	High
Utilisation Certainty	High	High		Low	Low
Frequency of Use*	High	Medium		Low	Low
Minimum Flexible Capacity	0-50kW				
Minimum Utilisation Duration Capability	30 mins				
Minimum Utilisation	15 - 30 mins				
Maximum Ramping Period	N/A	N/A	<15 mins	<15 mins	<15 mins
Availability Agreement Period	N/A	Contract stage	Week ahead	Contract stage if appliccable	Contract stage if appliccable
Utilisation Instruction Notification Period	Scheduled in advance**	Contract stage	Real Time	Real Time	Real Time

* Frequency is location specific defined at the point of procurement

** Utilisation requirements may differ to schedule and be instructed in real time

Figure 4-2 – DNO Active Power Products

The ENA PWG discuss the benefits of improved near time forecasting of DNO Flexibility dispatch requirements, and how the sharing of additional data with the ESO can provide whole system benefits and reduce potential conflicts:

‘Forecasting DNO dispatch requirements closer to real time will improve the overall efficiency of DNO services as it can consider a more realistic perspective on non-contracted generation. Feeding in additional data from the ESO, and wider markets on the positions of generators will further enhance dispatches, and whole system outcomes.’

The ENA PWG also highlight that although the periods of conflict should be reduced, the increased level of dependencies will require enhanced coordination, otherwise the impact of conflicts may be higher:

‘The additional targeting of services should reduce the periods of conflict. However, this does create more dependencies between parties and more coordinated primacy scenarios. With less leeway (i.e., margin for error between forecasts) in the scenario, the impact of conflict could be higher.’

Recent ENA primacy rules studies focussed on potential conflicts of STOR and ANM flexibility services conclude that the current likelihood of conflicts occurring do not warrant full implementation of the proposed primacy rules yet, but that the situation will change as the requirement for STOR and ANM flexibility services steadily increase.¹⁴

4.2.7 Coordination Scheme Implementation Considerations

These considerations highlight the criticality of enhanced coordination, and how this will need to consider the interdependencies between different system actors including the needs of real time dispatch requirements, as well as short to long term whole system network capacity planning.

4.3 Whole System Analysis (IWES) – Interim Year

4.3.1 Introduction

Improving coordination between electricity system operators (ESOs) and distribution system operators (DSOs) can lead to significant benefits in the long term, especially with the increasing availability of distributed flexibility resources such as electric vehicles, smart appliances, and smart heating systems. However, the benefits of such coordination in the near term (e.g. by 2035) are uncertain due to the lower penetration of these resources. Moreover, as the system flexibility is driven by the increased penetration of variable RES and electrification of other energy vectors (e.g. transport, heat, industrial processes), the demand for system flexibility services in 2035 is likely to be less than in 2050, given the lower penetration scale of those factors. To better understand the benefits of improving ESO-DSO coordination by 2030, two schemes - Enhanced ESO-DSO coordination (EC) and Distributed Flexibility Coordinator (DFC)- have been analysed and quantified alongside the previous analyses conducted for 2050.

4.3.2 Approach

The power sector is expected to significantly reduce its carbon emissions by 2035, with any remaining emissions being offset by negative emission technologies. By 2035, we assume that 50% of the transport fleets will have transitioned to low-carbon alternatives, and 10% of heat demand will be electrified. The assumptions could be conservative aiming to identify the lower bound of the system benefits of improving coordination in the short and medium term. Using the Future Energy Scenario “Leading the Way”, we compare the techno-economic performance of three systems: (i) Business-as-Usual (BaU), (ii) Scheme 1 (S1 EC), and Scheme 2 (S2 DFC). For comparison, the system capacity and operation have been optimised for each case using the Integrated Whole Energy System (IWES) and the results of S1 EC and S2 DFC have been compared with those of BaU.

4.3.3 2035 - 2050 Comparison

Expected benefits from improving ESO-DSO coordination are smaller by 2035 (i.e. around £0.1bn/year) compared to long-term benefits projected by 2050, which are between 0.3 and 0.4

¹⁴ <https://www.energynetworks.org/assets/images/Impact%20quantification%20of%20primacy%20rules%20pdf.pdf?1700544942>

£bn/year in the Hydrogen heating pathway (H2) and between 1.45 and 2.29 £bn/year in the full heat Electrification (ELEC) pathway. The long-term benefits are 14 – 23 times higher than the medium-term benefits. The comparison of the benefits of improving ESO-DSO is shown in Figure 4-3.

The results are expected due to the much smaller capacity of distributed flexibility resources and lower demand for flexibility in 2035 than in 2050. System benefits of improving the coordination will be more visible when more electrification and variable RES become more prevalent by 2050.

The results show that the savings in 2035 come from savings in distribution network reinforcement costs in both S1 and S2. In S1, some savings are also observed in hydrogen systems and export; however, the savings are offset by the increased electricity Opex from large-scale generators, the cost of negative emission technologies like DACCS and the cost of demand response. The cost savings of distribution network reinforcement in S1 are slightly more significant than those in S2, indicating the expected outcome of S1. However, as S1 partially restricts distributed flexibility services for transmission, the scheme will trigger more usage of generation flexibility, increasing the electricity Opex as gas plants are used to provide generation flexibility.

As discussed in the previous report, S1 will also require more distributed flexibility, such as demand response, electricity storage and heat storage, than S2. S1 must also be supported by highly efficient electricity heating appliances such as heat pumps to minimise the distribution network capacity reinforcements.

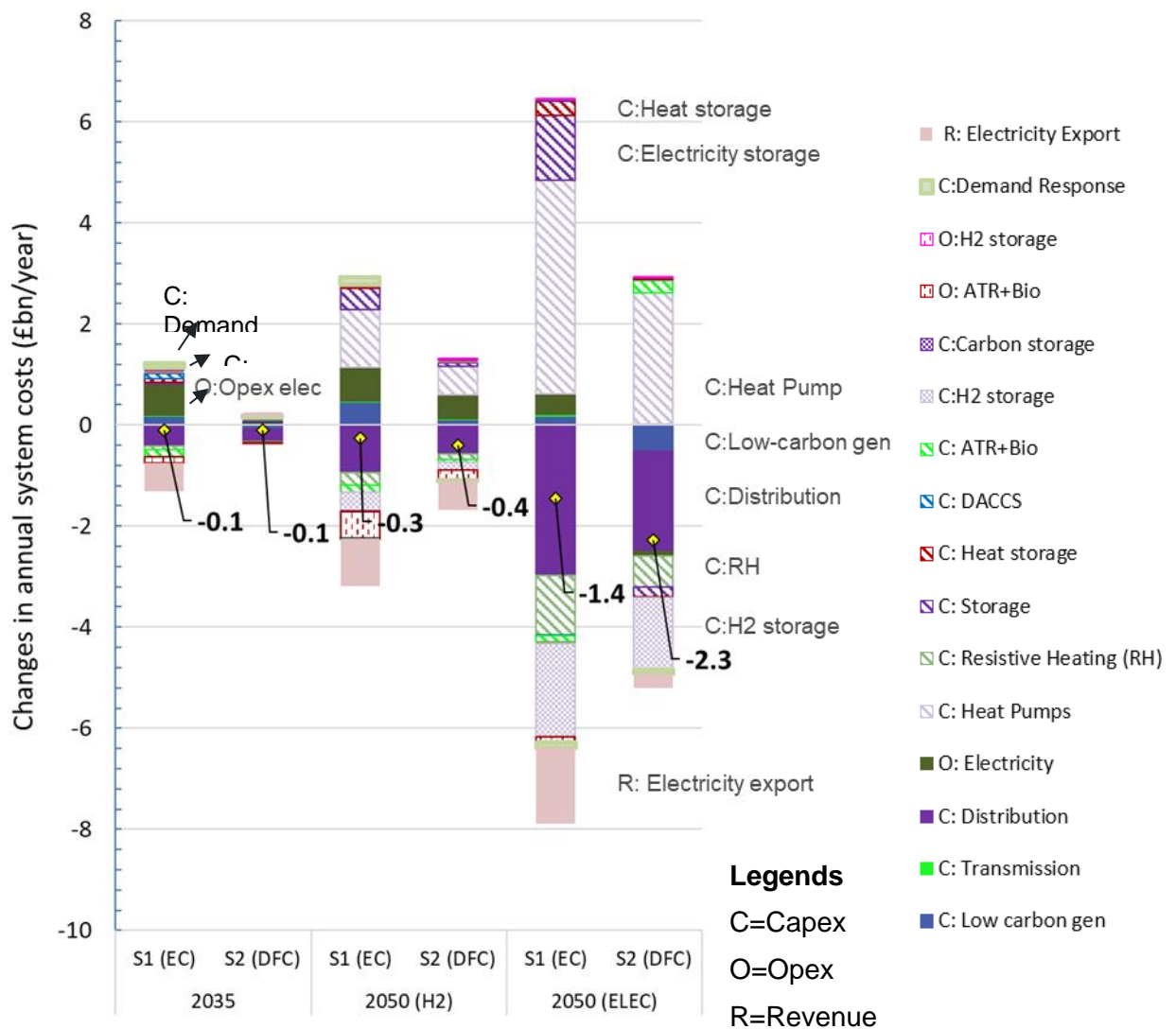


Figure 4-3 Benefits of improved coordination in 2035 and 2050

The impact of improving ESO-DSO coordination on the electricity distribution capacity requirements is shown in Figure 4-4. In this context, the findings of the analyses of the 2035 scenario are the same as those of the 2050 scenarios. Using distributed flexibility in 2035 can reduce the demand for increasing distribution capacity by 14–21 GW (17%-25%). Improving ESO DSO coordination by 2035 will reduce demand for reinforcing distribution capacity by 5–7 GW. Scheme 1 will result in the lowest distribution capacity requirement, while Scheme 2 will require an additional few GWs to enable more distributed flexibility resources to be used. The same patterns have been observed when we analysed the results of the 2050 scenarios.

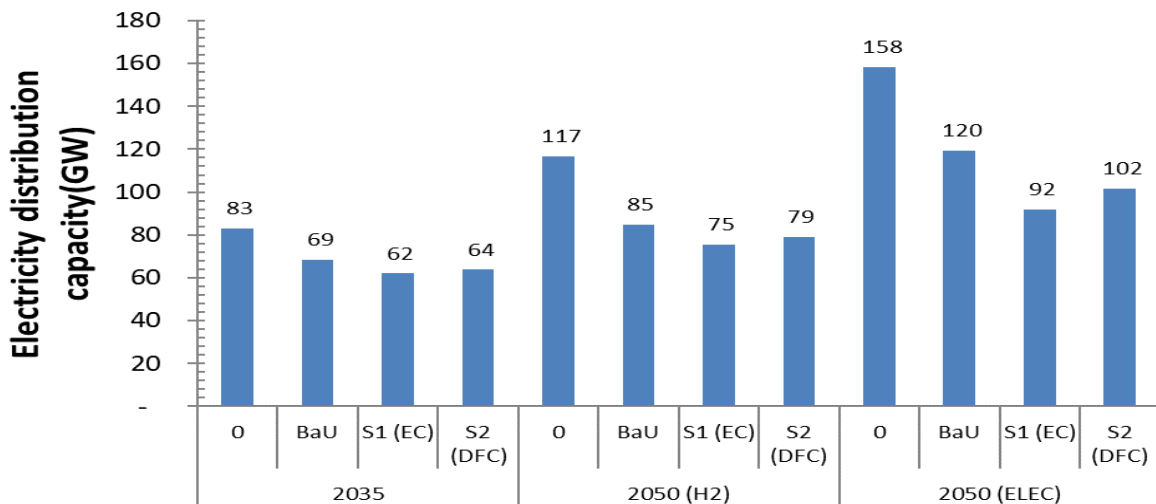


Figure 4-4 The impact of improved coordination in 2035 and 2050 on electricity distribution capacity requirements.

4.3.4 Considerations for Coordination Scheme Transition

The results of the 2035 and 2050 studies demonstrate that a sufficiently strong distribution network to enable distributed flexibility can be utilised optimally from the whole-system perspective.

4.4 Approach for the Roadmap Development

The roadmap is intended to provide a summary view of the key actors and activities, which are necessary to deliver the proposed coordination schemes, and is set against an indicative timeline. It is not intended to include detail programme of works or a detailed project plan of particular aspects of the transition. The supporting narrative provides further details of the key features included in the roadmap. As previously described in section NN, there have been several developments undertaken by Ofgem and DESNZ during the Commander project delivery, where possible the findings from the relevant Ofgem industry consultations and the newly proposed market roles have been incorporated into the ESO-DSO coordination scheme roadmap.

A review of the key information to be included within the roadmap was undertaken within the Commander team. This can be considered for the following categories:

- Triggers and External Milestones
- Key Milestones
- Internal Operators (ESO and DSOs)
- Facilitators and Planners
- Suppliers and External Consumers
- Technical Requirements
- Key Risks

Details for each of the categories represented in the roadmap follow:

4.4.1 Triggers and External Milestones

Triggers were considered for when there is a necessity for improved coordination which supports the need to transition from a Scheme 1 approach to coordination, to the whole system coordination approach offered by Scheme 2.

The key driver for this trigger point was considered to be the volume of flexibility services which are reached as the net zero agenda is delivered, and the associated whole system cost for these flexibility services. When the volume of flexibility services reaches a certain level, then relatively minor savings in efficiency produce significant economic benefits and would result in notable benefits to the costs incurred by system users and electricity consumers.

4.4.2 Key Milestones

As discussed in previous workstream reports, since the Commander project was initiated there have been a series of progressive market governance structural changes proposed by Ofgem which will impact of improved coordination of flexibility services between the ESO, DSOs and other market actors. Where information is available these have been included as key milestones in the roadmap, further details of the new market structures are provided in section 4.2.

4.4.3 FSO – Becomes Operational

The Future System Operator will take on several new roles as well as fulfilling the existing ESO roles. The new roles are expected to include increasing the overall coordination of energy infrastructure development required to deliver net zero in an efficient and effective manner via the creation of the new Regional Energy System Planners (RESPs).

4.4.4 Standardised Data Exchange Formats, APIs, across Market Actors

A key area of response from many industry and stakeholder responders from the Ofgem consultation is the urgent need for the common adoption of standardised data exchanges across all market actors. Establishing an agreed standard for data exchange for all flexibility services market actors is seen as a key milestone. If this is not achieved then there will be ongoing limitations on the level of coordination which can be adopted across the industry and market actors. Note that this milestone represents the standardisation of common protocols to be used in the flexibility services data exchanges, rather than the full and complete adoption for all market actors and systems.

4.4.5 ESO-DSO Data Visibility and Coordinated Procurement and Dispatch of Flexibility Services

To be able to continue improve the coordination of flexibility services across the relevant market actors, visibility of network asset loadings and availability is critical. The ability to control network asset settings in conjunction with accurate measurement of power flows and operational conditions which impact on asset capacities are also critical. This will become increasingly important when assets become increasingly loaded as a result of decarbonising heat and transport. The result of reduced diversity of energy sources in the future, as liquid fuels for transport and gas-based fuels for heating are steadily replaced with electricity, will result in LV networks becoming increasingly critical in providing a wider range of services for consumers.

If visibility of the LV networks is not enhanced in line with their increasing criticality for consumers, then the risk of overloading, and potential for subsequent loss of supply, will increase. This is especially the case if a variable tariff is considered, which promotes the consumption of variable generation from renewables during periods of peak generation. For example, when an abundance of wind power generated electricity results in a tariff-based stimulus via automated consumer owned assets. A sudden increase in demand may occur which may, if unchecked, overload essential assets in weaker LV circuits. Lack of visibility of these network assets may result in the need for DSOs to take an overly cautious approach to prevent this from happening, and where possible, impose stringent limits on all of the connected consumer loads. This in turn could prevent the useful consumption of surplus wind or solar energy, which would ultimately result in lower whole system efficiencies and increased costs for the consumer. Whereas visibility of these assets for the system coordinators and relevant actors would enable appropriate management of connected flexible consumer assets to ensure network stability is maintained, whilst also maximising the opportunity for consumer assets to utilise electricity during periods of high levels of generation from renewables.

4.4.6 Independent Flexibility Coordinator Established

For the whole system enhanced coordination of flexibility and network reinforcement as represented by Scheme 2, a new organisational role which can operate in an independent manner is required.

This project is not advocating how this role should be implemented from an organisational perspective, but rather that a means to ensure independence is delivered. The new roles proposed by Ofgem following their consultation on the future of distributed flexibility, of Market Facilitator and RESPs, will fulfil significant components of the whole system coordination. Ofgem have noted that they have not decided on the full remit for the newly advised roles.

The overall coordination of the RESPs and the proposed new Market Facilitator hasn't yet been defined by Ofgem. The joining up of these two roles, through a combined whole system approach, is considered key to realising the whole system benefits identified for Scheme 2, and as modelled in the ICL IWES analysis. In particular, there is the key identified need to consider the future network requirement to enable a whole system approach to procuring and delivering flexibility to enable the maximum consumption of variable renewable energy generation across the different network voltages and operational regions. As Ofgem are seeking further consultation on the scope and responsibilities for the newly proposed roles, the options for overall system coordination may become clearer following the conclusions from these future consultations.

4.4.7 Independent Flexibility Coordinator Fully Operational

It is anticipated that if a whole system approach is taken for overall coordination of flexibility services, that there would be a period of several years before different system actors were fully integrated in terms of the overall coordination, and also a similar timescale for the necessary technology to be fully trialled, embedded and upscaled. This milestone represents the point at which the large majority of network reinforcement and the full life cycle of flexibility services, from needs identification to settlement, are coordinated and integrated to deliver whole system benefits.

4.4.8 Internal Operators

From the perspective of coordinating network reinforcement and flexibility services, the ESO and DSOs have been considered to be internal system operators or actors. This is aligned with the definitions agreed for the previous ENA Future Worlds study.

The ESO and DSOs have a range of programmes in place and planned to improve the coordination of flexibility services. Improving the sharing of data regarding existing flexibility services and network needs being a key component.

4.4.9 Facilitators and Planners

4.4.9.1 Policy and Regulation

The ongoing developments in regard to Article 18 of the Electricity Balancing Guideline (EBGL) for the and its necessitation of certain terms and conditions relating to electricity balancing, are being implemented alongside other relevant regulations in the expectation of the mitigation of possible hurdles to progression.

4.4.9.2 Regional Energy Strategic Planners (RESPs)

The new roles of Regional Energy Strategic Planners (RESPs) has been confirmed by Ofgem. The RESPs will be part of the new responsibilities for the FSO and will undertake the planning of significant energy infrastructure within specified regional areas, and will consider gas networks (including hydrogen), heat networks as well as the electricity networks. The full remit of the new RESPs is currently being developed by Ofgem.

4.4.9.3 Market Facilitator

Ofgem is also introducing a new Market Facilitator role with the aim of delivering improved cohesion of flexibility markets. Initial responsibilities have been identified as:

- market coordination
- implementation
- monitoring
- strategic leadership

Further details regarding the Market Facilitator role are discussed in section 4.2.4.

The new Market Facilitator role is expected to fulfil some of the remit of the commander flexibility coordination schemes, especially regarding market coordination and strategic leadership. It is currently unclear whether the new role will also be considering the optimisation of flexibility in combination with future network planning, as assessed by the IWES modelling of the two coordination schemes.

Scheme 2 would require the joining up of the Market Facilitator role with the RESPs and the new proposed Centralised Strategic Network Plan. Whole system optimisation would also need to be implemented, which is currently not defined within any of the proposed new roles.

4.4.9.4 Centralised Strategic Network Plan

To help to facilitate the long-term planning of major energy infrastructure required to deliver net zero, DESNZ and Ofgem have also established the need for longer term network planning and have recently defined the new role of Centralised Strategic Network Plan (CSNP)¹⁵. This will be a new responsibility for the FSO and will be considered alongside the ongoing development of Future Energy Scenarios (FES) and the new Strategic Spatial Energy Plan (SSEP). The CSNP will consider the system needs over a 25 year timeframe, with an update being published every three years. The CSNP will also undertake an annual assessment for near term needs, which will consider strategic energy requirements up to 12 years. The relationship between CNSP products and stages is shown in **Figure 4-5**.

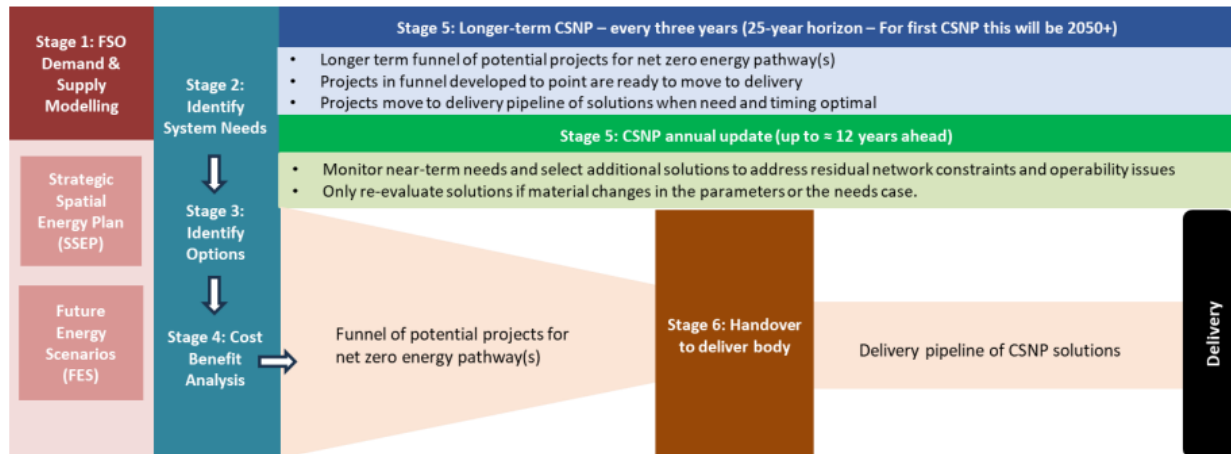


Figure 4-5 – Interaction between CSNP products and CSNP Stages

The relationship between the CSNP and the RESPs and MF has not yet been defined.

¹⁵ [Decision on the framework for the Future System Operator's Centralised Strategic Network Plan \(ofgem.gov.uk\)](https://www.ofgem.gov.uk/decision-on-the-framework-for-the-future-system-operator-s-centralised-strategic-network-plan)

4.4.9.5 Strategic Spatial Energy Plan

National Grid have set out five priority areas where action is needed to transform the electricity networks (Dec 2023)¹⁶. One of the priority areas being to *‘Reform the planning system, centered around a strategic clean energy vision’*. Within this priority area National Grid have announced that a Strategic Spatial Energy Plan will be established by 2025, which will consider the energy projects required to meet the UK’s 2035 energy and carbon targets:

‘Establish a ‘Strategic Spatial Energy Plan’ by 2025 that sets out what needs to be built, where, and when. This should provide an authoritative evidence base for the key clean energy projects that are needed to deliver our 2035 targets and beyond, and be endorsed in national and local planning policy.’

As the development of the Strategic Spatial Energy Plan (SSEP) has only recently been agreed, there are few details published about the scope of the plan. There is currently no indication that the plan will be considering how flexibility services, in particular those associated with consumer demands, will be considered within the evolving low carbon energy systems. However, these may be included as the SSEP is developed in the future.

4.4.9.6 ENA Primacy Working Group

The ENA Primacy Working Group has assessed a range of actual and potential areas of conflict between the ESO and DSO procurement and activation of flexibility services. They have focussed on developing a set of primacy rules to cover a range of flexibility scenarios which may potentially result in conflicts between the ESO and DSOs. Further details are provided in section 0.

4.4.10 Suppliers and External Consumers

4.4.10.1 Flexibility Services Providers

Flexibility Service Providers (FSPs) can be considered as electricity network users who can temporarily change their level of demand or generation in a flexible manner following a request to do so.

Providers of flexibility Services include:

- Consumers – turning their demand up or down.
- Generators – Increasing or decreasing their generation output.
- Storage operators – including electrical and thermal storage systems.
- Direct Generator-Consumer trading which collectively manage the net supply-demand.

¹⁶ <https://www.nationalgrid.com/document/149501/download>

The FSPs may contract directly with a flexibility consumer such as the ESO or a DSO, or via an aggregator which would manage, and typically bundle up, multiple FSPs and then provide the aggregated service to the ESO, DSO or potentially a 3rd party.

4.4.10.2 Flexibility Market Platforms (FMPs)

There are currently three main flexibility market platforms (FMP) servicing the needs for flexibility for the DNOs and ESO. These are:

- Piclo Flex
- Flexible Power
- Demand Flexibility Service

The FMPs are discussed in detail in section 3.3.1. The development of the existing market platforms have been supported or instigated by the network operators.

4.4.11 Technical Requirements

4.4.11.1 Standardisation of Data Exchanges

The standardisation of data exchanges is recognised as a key requirement by a broad range of industry stakeholders, and was a topic area which was regularly commented on within the responses to the Ofgem consultation on the Future of Distributed Flexibility. Improved data standardisation has been targeted by Ofgem for GB DNOs in ED2 and is a key focus of the EU-SysFlex programme. Data standardisation can be considered as a functional requirement, in terms of how data is organised and managed, and also with respect to the technical definition of how data is transmitted between different actors in the energy system. Further details regarding data standardisation are provided in section 4.5.

4.4.12 Key risks

Key risks have been identified and a summary have been included as an individual category on the roadmap. The identified key risks fall into the following areas:

Long term planning for the whole system coordination of existing and proposed roles

- Lack of long term planned coordination between RESPs, MF, SOs, Flex Suppliers and the low carbon agenda. Also lack of long-term whole system consideration.
- Lack of achieved coordination between RESPs, MF, SOs and Flex Suppliers resulting from absence of long-term planning and resolution/adoption of necessary standards.

Data Standardisation

- Failure to establish and adopt new Standardised Data Exchanges.
- Limited Targets on Data Standardisation Set for ED2, limited progress achieved by SOs.

Network Visibility

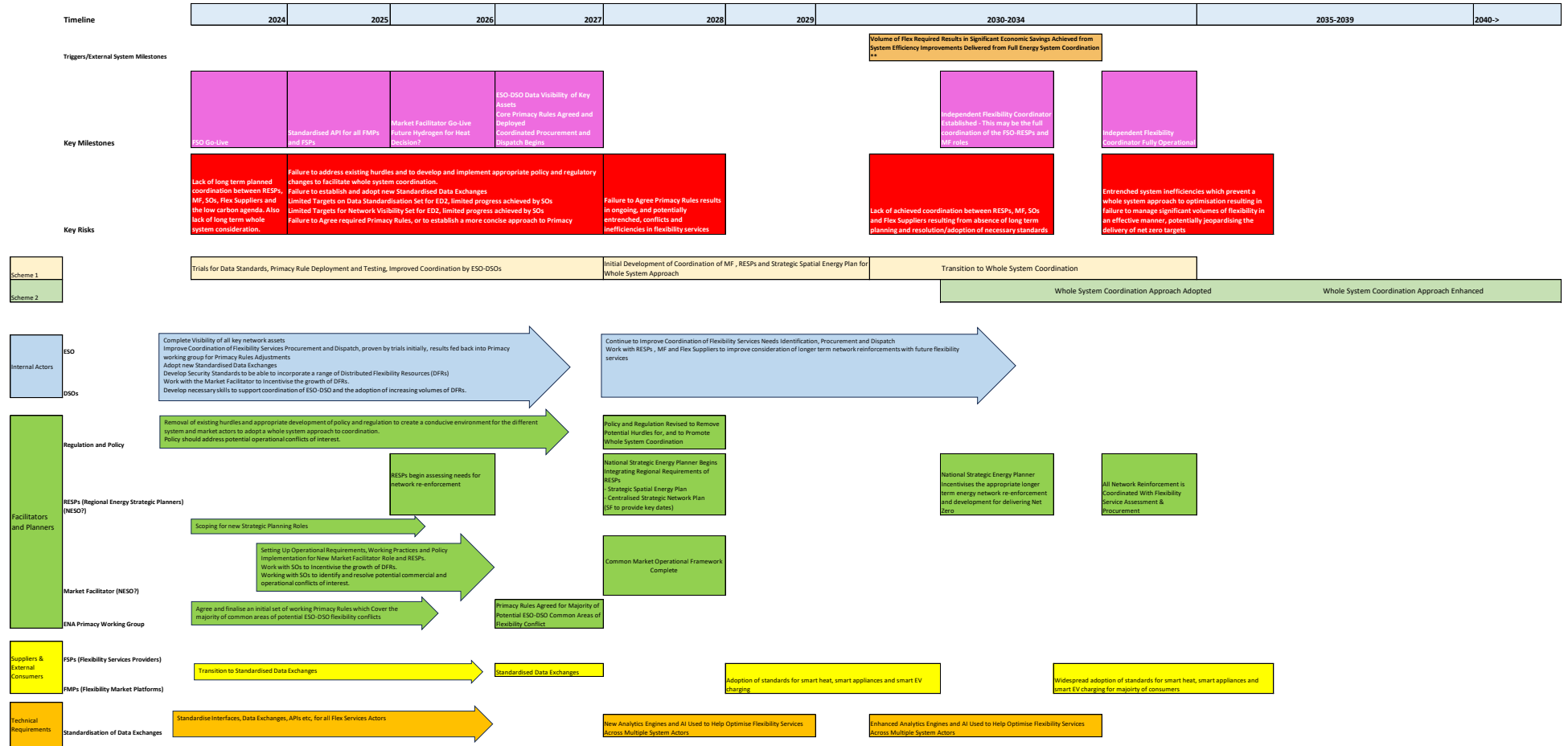
- Limited Targets for Network Visibility Set for ED2, limited progress achieved by SOs during ED2.
- Wide variation in network visibility achieved by different DSOs, resulting in a diverse range of opportunity for the deployment of improved coordination between the ESO and different DSOs, resulting in issues with standardisation of approaches for different system actors and resulting inefficiencies.

Primacy Rules

- Failure to Agree required Primacy Rules, or to establish a more concise approach to Primacy.
- Failure to Agree Primacy Rules results in ongoing, and potentially entrenched, conflicts and inefficiencies in flexibility services.

Whole System Approach

- Entrenched system inefficiencies which prevent a whole system approach to optimisation resulting in failure to manage significant volumes of flexibility in an effective manner, potentially jeopardising the delivery of net zero targets.



4.5 Scheme Development – Facilitating Measures

4.5.1 GB Data Exchange Development for Network Operators

4.5.1.1 Grid & Distribution codes

The most recent issues of The Grid Code (Issue 6, Revision 20) and The Distribution Code (Issue 55), both published on 15th December 2023, provide the foundations of data sharing between GB TSOs and DSOs/DNOs. For example, in the grid code, PC.A.2.5.4.2 says “*Network Operators shall provide the following data items (to the TSO) in respect of each Interface Point within their User System:*

- a) *Maximum Export Capacity;*
- b) *Maximum Import Capacity; and,*
- c) *Interface Point Target Voltage/Power Factor”*

Whereas, an example of data sharing clarifications from the distribution code is as follows: “*The DNO will co-ordinate all Demand forecast information for each Grid Supply Point to meet the requirements of the Grid Code. The DNO will aggregate forecast information provided by Users, where appropriate, and provide forecast information to NGESO where the Demand, or change in Demand, is equal to or greater than the Demand Control Notification Level at any DNO Connection Point.*”

4.5.2 Open Networks Project

The Open Networks programme was run by the ENA between 2017-2021 to aid in the “*transition to a smart, flexible system*”, a notable part of which has been the improvements in data sharing and publishing. In February 2022, the ENA published their “Proposal for Operational Data to be shared by DNOs” document.

This document summarises current data sharing practices, such as Long Term Development Statements, Network Capacity Maps etc, and identifies potential improvements and recommendations. However, this triggered a response letter from Ofgem dated 2nd March 2022 ([Open letter - Operational data sharing commitments from network and system operators \(ofgem.gov.uk\)](https://www.ofgem.gov.uk/open-letters/operational-data-sharing-commitments-from-network-and-system-operators)), in which it recommended further data sharing such as DFES and DNOA documentation. However these documents focus primarily on data sharing with customers and data users as opposed to with each other.

In October 2018, the ENA published a report titled “Data Exchange in Planning Timescales; Data Scope - Final Report” ([ENA Open Networks Template \(nationalgrideso.com\)](https://www.nationalgrideso.com/en/open-networks-template)), in which proposals relating to data sharing between Transmission and Distribution System/Network Operators, both in terms of timeframes and data content, were presented. Proposed increased data shares included time of peak and minimum demand and further details on sub-1MW embedded generation.

4.5.3 Data Standardisation

The Energy Data Taskforce (EDTF) was commissioned by the UK Government, Ofgem and Innovate UK to develop an integrated data and digital strategy that helps unlock the opportunities of a modern, decarbonised and decentralised Energy System for the benefit of consumers. It was run by Energy Systems Catapult.

In 2019, Energy Strategy Catapult published an independent report titled “A strategy for a Modern Digitalised Energy System”. Within this document¹⁷ (), the taskforce set out a number of recommendations, including:

- The Government & Ofgem should direct the sector to become digitalised.
- Network & System Operators should adopt the approach that energy system data is “presumed open”.
- A data catalogue should be established to provide visibility through standardised metadata.
- An asset registration strategy should be established coordinate registration of energy assets.
- A unified digital system map of the UK’s energy system should be established.

Building upon these recommendations, Ofgem went on to publish their Digitalisation Strategy and Action Plan (DSAP) and Data Best Practice (DBP)¹⁸ Guidance documents in November 2021. The DSAP guidance ([Digitalisation Strategy Action Plan Guidance v1.pdf \(ofgem.gov.uk\)](#)) was summarised into 7 key points:

- Prioritise providing benefits to the stakeholders who pay for the Products and Services as well as benefits that are in the Public Interest.
- Ensure Products and Services work towards a defined vision.
- Take full advantage of opportunities to deliver benefits early and to iterate improvements to Products and Services.
- Enable stakeholders to understand the Products and Services, the status of their delivery and how to access them.
- Ensure visibility about the nature and status of actions in the Digitalisation Action Plan.
- Ensure there is a shared understanding of how success and performance is measured.
- Coordinate with the wider ecosystem of Products and Services.

Meanwhile, the DBP document outlined 11 Data Best Practice principles as follows:

- Identify the roles of stakeholders of Data Assets.
- Use common terms within Data Assets, Metadata and supporting information.
- Describe data accurately using industry standard Metadata.
- Enable potential Data Users to understand Data Assets by providing supporting information.
- Make Data Assets discoverable for potential Data Users.
- Learn and deliver to the needs of current and prospective Data Users.
- Ensure data quality maintenance and improvement is prioritised by Data User needs.
- Ensure Data Assets are interoperable with Data Assets from other data and digital services.
- Protect Data Assets and systems in accordance with Security, Privacy and Resilience (SPaR) best practice.
- Store, archive and provide access to Data Assets in ways that ensure sustained benefits.
- Treat all Data Assets, their associated Metadata and Software Scripts used to process Data Assets as Presumed Open.

¹⁷ Catapult-Energy-Data-Taskforce-Report-A4-v4AW-Digital.pdf (esc-production-2021.s3.eu-west-2.amazonaws.com)

¹⁸ Data_Best_Practice_Guidance_v1.pdf (ofgem.gov.uk)

These 2 guidance documents attempt to standardise digitalisation and data practices across the DNOs to maximise the effectiveness of the collected data for consumers, stakeholders and public interests alike.

4.5.4 Examples from EU Innovation Programmes

4.5.4.1 German Demonstrator – EU-SysFlex

The German demonstrator on the EU-SysFlex programme¹⁹ focusses on a local first principle, where the TSO procures all flexibility services via the DSO.

The relationship between the system actors in the EU-SysFlex German demonstrator are shown in **Figure 4-6**. The demonstrator uses a customised version of the Common Information Model (CIM) for the majority of communications between the TSO, DSO, forecasting, optimisation and analytics (labelled as Software Platform). Custom data transfer protocols (based on IEC standards) are used between the DSO and the aggregator and field assets. The TSO accesses all distribution resources via the DSO, and does not have direct visibility or control of flexibility resources connected to the distribution network.

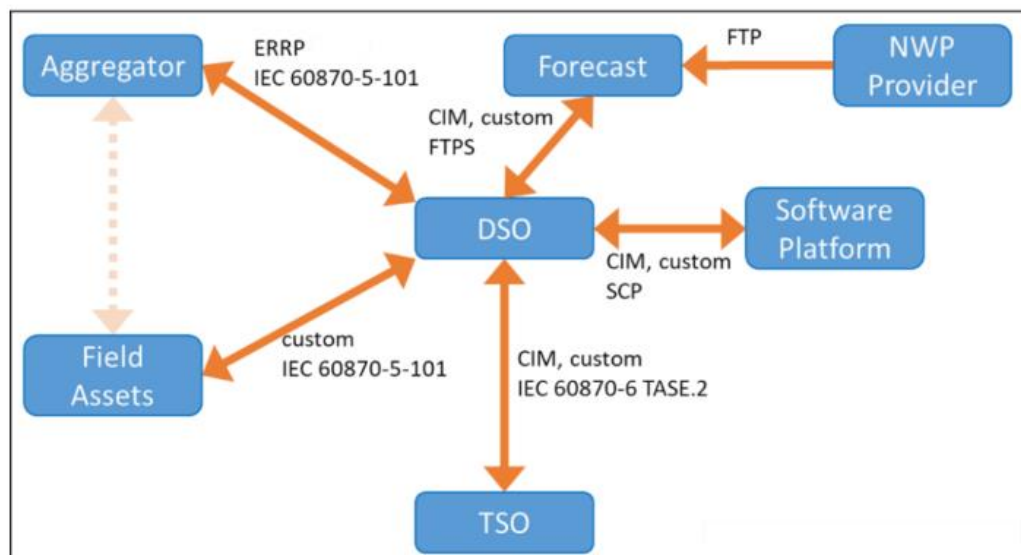


Figure 4-6 – EU-SysFlex TSO-DSO Coordination German Demonstrator – Simplified Representation of System Actors and Data Exchanges

EU-SysFlex programme emphasises the importance of data exchange and interoperability for delivering the coordination of flexibility services.

‘According to IEC TS 61850-2 interoperability can be defined as the ability of two or more devices to exchange information and use it for correct cooperation to perform the required functions. In other

¹⁹ [WP6-Demo-Fact-Sheet_German_Final.pdf \(eu-sysflex.com\)](#)

words, two or more systems (devices or components) are interoperable if they can perform a specific function cooperatively by using information that is exchanged.

Interoperability is in the explicit focus of EU-SysFlex as it enables exchange of any data type between multiple stakeholders and multiple systems. However, EU-SysFlex prioritises mutual understanding in terms of:

- *business processes,*
- *data exchange functionalities and*
- *data models*

rather than harmonising data formats and communication protocols.'

Findings from the demonstrator and wider EU-SysFlex programme also emphasise the large volume of data exchange required for near to real time system optimisation, and how this becomes a major consideration when operating a highly coordinated and optimised network which utilises a high degree of flexibility.

The key findings from the German Demonstrator are shown below, additionally the importance of simultaneously dealing the active and reactive power are emphasised.

'The most efficient use of flexibilities can only be achieved by considering active and reactive power management at the same time.'

4.5.4.2 Recommendations and Lessons

An efficient and effective TSO-DSO coordination process should be based on the following principles:

- Every system operator is responsible for its own grid.
- Every system operator predicts the available flexibility potential in its own grid.
- System operators from connected grids are informed about available flexibility potential.
- Flexibility selection and activation is carried out by the system operator where the flexibility is connected.
- Both TSO and DSO needs, and constraints are taken into account. Data management principle, "data thrift", followed by the German demonstrator proved its feasibility, and is based on the following aspects:
 - Grid data always stays in the sphere of the respective system operator.
 - Grid impact analysis remains the responsibility of the respective system operator.
 - Data exchange is aggregated as much as possible to reduce complexity. The decentralized optimization approach followed by the German demonstrator has proven to be highly resilient, efficient and secure as it follows the optimization principle "local before regional"

4.5.5 Coordination Scheme Implementation Considerations

The EU-SysFlex German Demonstrator offers an alternative approach to the existing GB ESO-DSO approach to the coordination of flexibility services, where all transactions pertaining to services connected at the distribution networks are delivered to the ESO via the DSOs. This approach holds the central principle of 'local first' and also emphasises interoperability across the system actors, the standardisation of data exchange (using modified CIM and IEC standards) and the aggregation of data wherever possible. This approach may also assist with the resolution of primacy rules.

4.5.6 Network and Asset Visibility

A critical enabler for improved coordination of flexibility services across network operators is reliable and widespread visibility of network assets. Asset visibility entails both the cataloguing of connected third-party assets and also the real time visibility of network operator assets and third-party assets. Real time visibility is increasingly required when larger volumes of flexible assets may be responding to variable pricing signals and acting en masse. Without good network asset visibility, and the ability to either dynamically alter network or asset configurations, network assets may become overloaded for such events.

4.5.6.1 ESO Network and Asset Visibility

The ESO has very good visibility of the assets connected on the transmission networks but has limited visibility of the status of the distribution networks and connected assets, and wishes to increase visibility to help deliver certain services.

National Grid ESO published their ESO Digitalisation Strategy and Action Plan (DSAP)²⁰ in June 2023. In it they outline their ambitious plan for their development in the digital, data and technology spaces. Other documentation contains pockets of information relating to digital network visibility and data standardisation, however the full details of any plans relating to data standardisation and network visibility may have been unsuitable for publication.

The August 2022 "ESO RIIO-2 Business Plan 2 Digital, Data, and Technology Annex"²¹ document outlines National Grid's view on the importance and value of data standardisation, as to deliver a "single integrated platform for ESO" would "require standardisation of the CM (capacity market) and CfD (contracts for difference) data structures with other market services and products". However, it is worth noting that NGESO does not "foresee those changes taking place during BP2".

The planned developments set out in the DSAP are spread across three key roles:

- Role 1: Control Centre Operations
- Role 2: Market Development & Transactions
- Role 3: System Insight, Planning and Network Development

²⁰ [download \(nationalgrideso.com\)](https://nationalgrideso.com/download)

²¹ [download \(nationalgrideso.com\)](https://nationalgrideso.com/download)

Though numerically quantified targets are not apparent, there are clear key areas of development and progress laid out reflecting progression in these spaces, such as Digital Platform Integration, development of additional datasets, the development of the Open Data Portal and the ongoing work on sharing information, data and systems solutions design across ESO & DSO/Flexibility markets.

4.5.7 DNO/DSO Network and Asset Visibility

The six GB DNOs have committed to improving network visibility as part of their RIIO-ED2 Business Plans and general business improvements, though the information that has been published by the DNOs regarding their current levels of network visibility, targets for increased visibility and the path to deliver these targets, differs between DNOs.

4.5.7.1 ENWL

ENWL have highlighted their strategy to “deliver 100% network visibility coverage at all voltage levels in RIIO-ED2” within their Network Visibility Strategy document from December 2021. According to ENWL, the “data needed to provide a granular view of the operation of all the network voltage levels will come from a combination of smart meters, third-party sources, the installation of new permanent LV and HV monitoring equipment, and the use of derived data from techniques such as state estimation.”

The document highlights how by the end of RIIO-ED1, ENWL expected to have installed monitoring on 45% of all connected customers, to rise to 95% by the end of RIIO-ED2, with the remaining 5% coming from “customers from smart meters”, or where not available, by modelling “these networks using actual data from similar networks”.

4.5.7.2 NGED

Prior to National Grid’s takeover of Western Power Distribution, WPD also published their own Network Visibility Strategy in December 2021. It is highlighted within that visibility of “historically passive distribution networks will require significant preparatory work” suggesting a prior lack of visibility of the low voltage network. The document outlines intentions to install monitors at “15,500 of the highest priority substations... at a cost of £31 million”. By the end of the RIIO-ED2 period, it is intended that NGED will have “100% visibility of the power flows on its network at all of its primary substations... (around 1,800 in total)”.

4.5.7.3 NPG

Northern Powergrid do not appear to have committed to any fixed numerical target, but have however detailed their intention to improve network visibility in their Digitalisation strategy and action plan document from June 2022. In it they detail how their “LV monitoring investment, smart meter data and use of data analytics to fill in the gaps will enable enhanced visibility of LV networks”. Enabling real-time visibility “including energy flows and environmental conditions, down to the LV network level” is a key objective of their data and digitalisation strategy.

4.5.7.4 SPEN

In their Digitalisation Strategy published in March 2023, SPEN acknowledged that they currently “do not have visibility of all assets that sit on our network” going on to say “As a DNO/DSO, we need to have a clear understanding of what assets are connected to, and how power flows through our

network. Traditionally, we have had very low visibility of this, particularly for the low voltage network, and this has limited the ability to understand where constraints are likely to appear". As part of the strategy there are plans to "Develop an ENZ Platform, built directly on the NAVI and Smart Meter Data Integration Fabric (SDIF) solutions to provide an integrated system with enhanced real-time data-driven visibility and control of the LV network."

4.5.7.5 SSEN

Like NPG and SPEN, it is not clear from the published data whether they have set a numerical target for the visibility of their network assets, however SSEN plan to "use smart meter data for visibility", though they note the low levels of uptake of the technology in their customer base. They highlight this again in their 2023 Digital Action Plan, describing their intention to use "smart metering data and analytics to improve our visibility of the network and deliver insight to our customers".

4.5.7.6 UKPN

As part of their RIIO-ED2 Business Plan submissions, UKPN provided the document titled "Appendix 18a: Network visibility strategy paper". In it they observe that they "have good visibility of power flows, power quality and voltage stability" at EHV & HV levels. At an LV level they say estimate by the end of RIIO-ED1 their "network visibility coverage on the LV network from physical monitoring to be across 13% of our Distribution Transformers", going on to say "Our physical LV monitoring activities are focused on both Distribution Transformer asset classes, Ground Mounted Transformer (GMT) and Pole Mounted Transformers (PMT), and our expectation by the end of RIIO-ED1 is to have LV monitoring across 22% GMTs and 0.5% PMTs."

They also highlight DER visibility, which they note is lower at a HV level, saying: "In terms of real time operational metering visibility across generation sites, UK Power Networks has close to 100% visibility for EHV (132kV and 33kV) connected DERs. This accounts for 86% in EPN and 83% in SPN of our total installed generation capacity of c.10GW. For HV connected generators that are embedded in interconnected networks, monitoring levels have historically been lower at around c.30% of sites."

4.6 Implementation Roadmap - KPIs

The effectiveness of the implementation of coordination schemes can be monitored by specific Key Performance Indicators (KPIs), which will measure the ESO-DSO coordination across all its stages: Planning, Procurement, Operation and Settlement. In this section, we will propose a list of specific KPIs, based on the inputs from the ESO and NGED and the industry experience in the rollout of policy implementation programmes. The KPIs should be focused on outcomes, namely for the monitoring of the effectiveness of coordination in the procurement of flexibility services, and for the monitoring of cost savings for the industry. Hereby we describe the KPIs that we recommend, namely:

Procurement effectiveness: it will be essential to measure the effectiveness of the procurement of DERs. This can be measured by tracking flexibility procurement specific costs (per MW) by ESO and DSOs. Also, we would recommend measuring the total number of procurement actions coordinated end-to-end between ESO and DSO(s). Building on an enhanced ESO-DSO coordination and, later on, the role of the DFC, we would expect a trend of reduction in the cost of flexibility procurement per MW procured, influenced by strategies of joint procurement, coordination between ESO and DSO in the pre-procurement stage and thus an increased buying power of ESO and DSO near DERs.

Curtailment volumes: an efficient ESO-DSO coordination should result in a lower quantity and volume of curtailment actions, e.g. Active Network Management (ANM). Curtailment volumes should be measured in a coordinated way between ESO and DSOs via a national and whole networks industry KPI.

Effective activations: the number of conflicts resulting from ESO and DSO access to the same DER services vs. total number of services provided by DERs.

Liquidity of each flexibility market: the total volume of flexibility volumes available for each of the flexibility market types will be a valuable metric to measure the success of enhanced planning, dispatch and operation of DERs between ESO and DSO.

4.7 Key Findings

Coordination Scheme Gap Analysis

The Gap Analysis of the coordination schemes actors and activities identified the need for improved operational and planning coordination between the ESO and DSOs and that series of new operational processes are required. For scheme 2, the ESO and DSO would need to further adapt their current working practices to provide their planning flexibility requirements to the DFC. It is expected that the dispatch signals would still be instructed by the ESO or DSO (ensuring that they retain overall operational control of dispatch), although these may either be transferred via the DFC or otherwise the DFC would be notified of the dispatch in real time.

Modelling and Analysis

The IWES and CBA scenario modelling highlighted the significance of the costs of managing and delivering flexibility services in our future low carbon and net zero energy systems. The relatively small efficiency savings which were modelled in the CBA scenarios also showed that a reasonable expenditure on enhanced coordination can not only be justified, but also should be considered in the next few years.

Roadmap and Facilitating Measures

The development of the roadmap for the coordination schemes helped to establish the dependencies of the different system actors, facilitating measures, milestones and risks. The need for improved data standardisation, network asset visibility and the resolution of Primacy rules is evident. A review of the current published commitments of the GB network system operators regarding improved network visibility and the standardisation of data exchange indicates that the dates for enhanced coordination set out in the roadmap will not be achievable unless there is an accelerated progress by the GB system operators in these key enablers.

Similarly, the resolution of Primacy rules, which is also identified as a key enabler, needs to be accelerated. This is an active focus area, with a number of ESO-DSO trial projects planned or already underway, however Primacy rules development has proved to be complex, and progress has thus far been behind industry expectations.

New System Roles to Support Enhanced Whole System Coordination

The recently defined roles and improved strategic planning introduced by Ofgem and DESNZ will go some way to fulfilling the needs identified for whole system coordination, there are however a number of coordination aspects which have not yet been addressed. These additional coordination aspects may be introduced when the new roles, and associated consultation feedback, are further developed.

Key areas of focus could be:

- Coordination of the identification of flexibility service need with whole system network reinforcement planning.
- Ensuring that the distribution networks are adequately reinforced to enable the consumption of transmission connected variable renewables in periods of high generation.
- Ensuring that distribution connected resources (DER and CER) can provide benefits to the whole system, not just their region of operation, via the provision of flexibility services.

Alternative Demonstrations of ESO-DSO Coordination

The outline review of the EU-SysFlex programme, and the German Demonstrator project which shared some parallels with the proposed coordination schemes, provides an alternative approach to managing the coordination process. This demonstrator project utilises a 'local first' model which relies on all management of distribution connected flexibility resources being conducted by the DSOs. The ESO procures flexibility services via the DSOs and does not directly access distribution connected assets. The demonstrator project team ascertain that this provides the optimum approach to coordination and also provides the highest levels of system resilience. The 'local first' approach may also help to simplify Primacy rules. The project findings also note the benefits of the aggregation of data between system actors, the principle of data thrift and the need to manage very large volumes of data if near to real time service optimisation is to be employed.

Workshop - Key Feedback

The WS4 workshop provided an engaged round of discussions, with many of the attendees proactively providing input and suggestions, and discussing existing issues related to the coordination of flexibility services. Key points raised included:

- ESO direct procurement of flexibility services connected on the distribution networks, which subsequently prevents the associated flexibility service providers from also offering flexibility services to the DNOs.
- The urgent need for bringing together the different parties to 'sit down' and accelerate the resolution of known hurdles and blockers including finding new methods of coordination and the resolution of Primacy rules.
- Developing regulatory incentives to support the long-term whole system benefits associated with net zero, including for example adequate reinforcement of distribution networks to accommodate the consumption of high volumes of transmission connected renewable energy.

KPIs

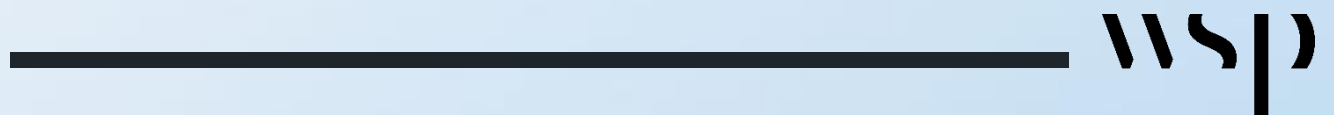
KPIs should be developed to be able to monitor and evaluate progress towards improved, and subsequently enhanced, coordination of flexibility services. These should target key metrics related to the procurement and dispatch of flexibility services and also the progress of the necessary facilitating measures and associated risks.

5 Next steps

Workstream 5 will be considering the findings from the overall Commander study and set out recommendations and potential next steps. Recommendations will incorporate the areas identified in the roadmap, which are not yet being addressed in published policy and guidance, and wider focus areas which have been identified as important measures required to accelerate the coordination of flexibility services across the different industry stakeholders. A review of the pros and cons of the different identified approaches to coordination will be included and key enablers, dependencies and challenges will be clearly set out.

Appendix A

Stakeholder Engagement



Appendix A: Stakeholder Engagement

ESO and DSO Feedback

Feedback was sought from the ESO and NGED project teams regarding findings from the Commander study and in particular where they have recognised the need for short term focus required to help facilitate improved ESO-DSO coordination.

‘Coordinating with DSOs means knowing what data is most valuable to collect, then having the processes to efficiently collect the data. Beyond collection, knowing what data is valuable to share with DSOs and then being able to efficiently share that data with them.

Finally, setting a standard process or set of rules that use the data to transparently make decisions to manage conflicts and opportunities for efficiencies (This is where Primacy rules come in).

Data is a huge challenge, but another key challenge is developing and gaining consensus for a vision of what good coordination looks like..

Another challenge is aligning processes across industry, which is where standardisation also comes in. Open Networks is the centre of driving process alignment and standardisation. Finally, understanding the impact of the Market Facilitator.

‘The ESO has a number of projects covering these areas. MW Dispatch is implementing a data sharing process that allows both the ESO and DSOs to take decisions to manage primacy. This is being trialled with 2 DSOs this summer, it is unclear at the moment whether this will be extended to all DSOs. Other project related to standardisation and coordination fall into Open Networks, which the Market Development workstream is focusing on settlement process, standard agreement, revenue stacking and baselining. The ESO’s current ongoing projects are focussed on shorter term objectives, longer term objectives are expected to be developed based on the outcome of the existing projects and on the direction provided by the new Market Facilitator which is scheduled to commence by mid-2025. The ESO are not currently aware of a deadline for the completion of all primacy rules.’

WS4 Workshop Feedback

A workshop was held during WS4 in January 2024, which presented the key findings from the commander project. WSP led the workshop in conjunction with the commander project team (ESO, ICL, NGED). Attendees included representatives from the ESO, the DSOs, Ofgem, the ENA, Industry trade associations and academic specialists.

Feedback was gathered during the workshop, and a broad range of subjects related to the coordination of flexibility services were discussed.

This section compiles inputs from the workshop, where stakeholders offered diverse opinions and suggestions regarding current operations and the two coordination schemes.

Increased ESO-DSO coordination - identified hurdles

Increased Collaboration Between ESOs and DSOs

- Effective ESO-DSO coordination requires clear roles, followed by rigorous technical-economic assessments. Understanding responsibilities and assessing feasibility ensures optimal outcomes regarding infrastructure compatibility and cost-effectiveness. This will help to foster closer partnerships and improve system efficiency and reliability.
- Coordination schemes should prioritize optimal outcomes on operational time scales, considering factors like response time and system reliability. An engineering-based roadmap is crucial, detailing steps, milestones, and resources for successful implementation.
- Furthermore, it's vital to recognize the dynamic nature of energy systems. Coordination schemes should be adaptable and flexible to accommodate changing conditions and requirements over time. Flexibility ensures continued optimisation and resilience in the face of evolving challenges.
- Await decisions from Ofgem to adapt strategies accordingly and ensure regulatory compliance in spring.

Progress and Future Plans for Distributed Flex

- Explore tailored solutions for regional and local needs to optimize flexibility deployment.
- Need to develop RESPs to address resilience challenges and support DERs integration.
- Focuses more on enhancing communication and collaboration between ESOs and DSOs to streamline the deployment of flex technologies.
- Considering market dynamics, centralizing market data is main activity. This could entail assigning responsibility to either Elexon or a dedicated entity like Open Energi.

Role of Market Facilitator and Regulatory Framework

- Considering the market dynamics, it's pertinent to explore the creation of a Central Market data entity, potentially led by Elexon or any dedicated entity. Leveraging Commander's initiatives, efforts should focus on aligning ESO and DSO functions for enhanced coordination and efficiency.
- Evaluate the functions and responsibilities of the Market Facilitator within the existing regulatory framework.
- Consider stakeholder feedback on the role of the Market Facilitator and its implications for market efficiency and transparency.

Regulatory Hurdles and Incentives

- Address concerns regarding regulatory frameworks incentivizing flexibility over infrastructure reinforcement.
 - Focus on or need to amend some changes in the regulations to incentivize coordination and collaboration among existing market players rather than the creation of new planning and facilitating roles.
-

Achieving Benefits Through Regulatory Changes and collaboration

- Identify opportunities for regulatory adjustments to streamline coordination schemes.
- Ensure regulatory changes support existing market actors and encourage their participation in flexibility initiatives.
- Evaluate the potential impact of regulatory reforms on market dynamics and stakeholder engagement.
- Internally and with DNOs, WSP is exploring repurposing data sets from collaborations with UK Power Networks and NGED. This data, focused on MW dispatch, promises rich insights into the operations for the coming year.
- The DSOs will share their insights, but it's not the complete solution. Stuart and the ESO see potential in evolving the dataset through collaborative learning with DSOs. This approach could significantly advance service coordination.

Clarification on responsibilities and accountability for real time operations

Transmission Bottlenecks and Coordination Challenges

- Address concerns regarding transmission bottlenecks and their impact on distribution network reinforcement.
- Evaluate the short to medium-term impediments posed by transmission capacity limitations on strategic reinforcement efforts.
- Seek clarification on how proposed planning and coordination will mitigate existing transmission bottlenecks and enhance system flexibility coordination.
- Explore mechanisms to enhance transparency and engagement in decision-making processes related to grid infrastructure development.
- It's important to recall that the DFC concept originated from a report in 2018. The concern was raised regarding how Ofgem allocates resources. However, this doesn't necessarily invalidate Optum's consultation efforts. Rather, it offers additional insights into what the DFC implementation might entail for success.

Need for Effective Coordination

- Importance of coordinating flexibility services and network reinforcement across the entire system for Scheme 2 benefits and achieving the similar benefits at regional levels.
- Emphasis on strategic, long-term system-wide planning for delivering Net Zero with minimal impact on consumer.
- Interest expressed in understanding and monitoring existing conflicts in flexibility coordination.
- Scheme 1 aims to minimize reinforcement costs by enhancing flexibility and coordination between ESO and DSO.

Role of Regulatory Changes vs. Establishing New Entities

- Suggestions that regulatory changes may support long-term requirements more smoothly than creating a dedicated entity.
-

- Counterpoint highlighting industry sluggishness in implementing coordination via existing mechanisms, suggesting a new entity for effective change acceleration.

Integration of Market Changes

- Addresses market changes like market-wide half-hour settlement and their integration into the distributed flexibility coordinator's processes.
- Challenges highlighted regarding adapting to changing demand scenarios, especially with potential fluctuations every half-hour due to market-wide influences.

Importance of Real-Time Operations and Conflict Resolution

- ESO requested clarification regarding the entity responsible for the distributed flexibility coordinator role. Additionally, they queried operational timescales, particularly whether real-time operations fall within the coordinator's scope.
- Need for addressing conflicts in flexibility coordination to ensure efficient system operation and service delivery.

Network Reinforcement for Distributed Assets

- Critical questions raised regarding the need to reinforce the distribution network to accommodate more distributed assets.
- Queries on funding dynamics associated with network reinforcement, including who would fund it and who would bear the costs.
- Challenge highlighted in reconciling strict cost-benefit analyses with the need for network reinforcement for whole system benefits.

Issues with Exclusivity Contracts and DFS

- Concerns raised by DNOs/DSOs about FSPs being tied to ESO DFS product through exclusivity contracts, limiting their ability to provide services to local DSOs.
- Clarification on the purpose of DFS as a mechanism outside the market, invoked when market solutions are lacking.
- Emphasis on DFS not competing on price but addressing market gaps, especially for meeting overall margin requirements.
- Emphasizing timely power adjustments and proposed exploring solutions, such as code-finding products.
- Regarding DFS exclusivity raises a crucial point that needs resolution within the common market operational framework. This framework, under the market facilitator's purview, addresses issues like active power curtailment within specified timeframes for FSP and DNA benefits. It should also accommodate mechanisms for finding products, as suggested by Stuart, and broader market design features such as bid forwarding procedures. This comprehensive approach ensures that the market operates efficiently and effectively.

Update of Investment Practices

- Recognition of the need to update established investment practices in the industry to address the funding of network reinforcements.
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- Emphasis on the importance of reconciling cost-benefit analyses with the broader systemic benefits of network reinforcement.

Ofgem's Involvement and Suggestions

- Ofgem's involvement in addressing DFS exclusivity issues through the Common Market Operational Framework managed by the market facilitator.
- Emphasis on addressing active power adjustments within specific timeframes for FSP and DNO authorized benefits.

Timeframe and Operational Considerations

- Emphasis on the importance of addressing active power adjustments within specific timeframes for FSP and DNO authorized benefits.
- Concerns raised about the operational implications of exclusivity contracts and their impact on flexibility procurement and delivery.
- Need for ensuring timely responses and actions within the operational framework to maintain system stability and efficiency.
- When considering overall costs, energy prices play a significant role, offering potential savings. However, challenges arise in reinforcing systems, involving complex processes and potentially requiring new permissions and consents. Efforts aim to leverage existing infrastructure and permissions wherever possible to streamline these processes.

Market Facilitator's Role

- Highlighting the role of the market facilitator in managing exclusivity issues and other operational challenges.
- Emphasis on the need for collaborative solutions between industry stakeholders and regulatory bodies to address market constraints and enhance flexibility procurement.

System Resilience and Adaptability

- Overall focus on enhancing system resilience and adaptability to accommodate future flexibility needs and changing energy supply-demand dynamics.
- Recognition of the importance of regulatory interventions and industry collaboration in ensuring a robust and flexible energy system for the future

Gap analysis and transition planning

Gap Analysis and Transition Planning

- Emphasis on identifying key changes necessary for a smooth transition process.
- Recognition that data exchange requires further stakeholder engagement for comprehensive understanding.

Data Exchange Challenges

- DSO's inquiry about the specific data to be exchanged raises concern regarding data exchange challenges.
-

- ESO highlights the importance of maintaining data confidentiality during exchanges.
- Data exchange complexities require more stakeholder involvement for resolution.

Accountability in Scheme 2 Dispatching Process

- DSO raises concern about the accountability of dispatching processes in Scheme 2.
- Discussion ensues on whether dispatching responsibility should be exclusive or shared with other entities.
- Addresses potential issues if DSOs or ESOs do not receive required services through the Flexibility Coordinator

Roles and Responsibilities of Distributed Flexibility Coordinator

- Highlighted the importance of a neutral market organization by the Distributed Flexibility Coordinator.
- Discussion covers various operational aspects like qualification contracts, activation, dispatch, and settlement.
- Emphasis on utilizing whole system modeling for optimal decision-making.
- Express the need for transparency between ESO, DSOs, and other system actors to ensure smooth operation

Unbundling Operational Functions in Scheme 2

- Exploration of unbundling certain functions like activation and settlement is suggested that they could remain with DSO and ESO contracts rather than having an integrated approach in Scheme 2
- Discussion on whether these functions should remain integrated or be separated within Scheme 2.
- Feedback from ESO and DSO will inform Scheme requirements regarding operational function unbundling.

Merits of Scheme 1 and Scheme 2 Assessment

- DSO acknowledges the benefits of Scheme 1 and emphasizes its implementation and raised the question of when it's appropriate to reassess Scheme 2's trajectory.
- Highlighting the importance of balancing immediate benefits of Scheme 1 with long-term considerations of Scheme 2.
- Need for informed decision-making regarding the progression of both schemes is emphasized.

Balance Between Immediate and Long-Term Considerations

- Emphasized the importance of maintaining balance between the short-term benefits with the long-term consequences.
 - Consideration of the immediate benefits of Scheme 1 is highlighted.
 - DSO's query about when to reassess Scheme 2's trajectory prompts consideration of timing.
-

- While generators bear costs for network reinforcement based on the voltage level they connect to, this burden isn't always evenly distributed between demand and generation. Despite this, the extent to which it serves as a barrier may be overstated in analyses. Proactive network reinforcement, inherent in both Scheme 1 and Scheme 2, offers a primary benefit, potentially mitigating this challenge.

Implementation of ANM and DER in the system

Relationship Between Flexibility, Efficiency, and Investment

- Illustration of how efficiency gains in flexibility coordination lead to substantial operational savings as flexibility volumes increase.
- Discussion on how small efficiency gains of flexibility services result in significant savings in long-term.
- Understanding the relationship between flexibility volumes and the investment needed for improved coordination.
- Highlighting the importance of operational savings in balancing a decarbonised energy system through increased flexibility.

Planning for Flexibility Uptake and Implementation

- Discussion revolved around incorporating the rate of flexibility uptake when planning new roles and implementation timescales.
- Exploring how flexibility data can help in investment planning ahead of any disturbance in the line and related schedules.
- Considering how a fully coordinated scheme can remain agile to changing market conditions, system requirements, and technologies.
- Importance of strategic planning to anticipate and adapt to changes in flexibility uptake and market dynamics.

Costs and Justifications for System Reinforcements

- Emphasis on carefully considering investments in distribution and transmission to achieve decarbonization goals.
- Highlighting the potential long-term benefits of investments, including enabling customer participation and achieving decarbonization targets.
- Addressing challenges such as permissions associated with reinforcing systems to accommodate flexibility.

Focus on ANM and DER

- Emphasis on enabling greater ANM and leveraging DER like electric vehicles as they become more prevalent.
 - Exploring the potential benefits of ANM and DER is important in this field to enhance flexibility and supporting decarbonization efforts.
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- Discussion on challenges related to integrating DER into the energy system and optimizing their contribution to flexibility.
- Importance of innovation and adaptation to maximise the benefits of ANM and DER in achieving flexibility and decarbonization goals.

Coordination of Regional Planning and Investment

Practicalities of Procurement and Dispatch Coordination

- Discussion on the necessity of fully considering operational requirements and timeframes for procurement and dispatch coordination.
- The practicalities of DSO directly controlled assets being dispatched by another party, e.g. embedded in ANM systems and connected via fibre optics to DSO control.
- Debate on the responsible party for network resilience if the flexibility coordinator fails to provide sufficient resources for DSO real-time dispatch requirements.
- The need for standardising data exchanges while acknowledging the varying timelines required to achieve this among different DNOs and DSOs

Coordination of Regional Planning and Investment

- Discussion on whether a centralised mechanism or umbrella role is needed to coordinate diverse inputs from regional planning.
- Considerations regarding investment decisions, asset placement, storage, and service procurement in the context of coordination.
- Addressing how RESPs will be coordinated to facilitate whole system planning.
- Exploring methods for future investment planning to address whole system benefits rather than just local customer needs.

Agility and Implementation Speed of Scheme 2

- Queries raised about Scheme 2's agility and potential speed of implementation in dynamically changing environments.
 - Discussion on whether Scheme 2's deployment can swiftly adapt to shifts or is contingent on the readiness of data platforms and information feeds.
 - Concerns for Scheme 2's flexibility and responsiveness in dynamically changing environments.
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