SP Electricity North West

BiTraDER

Deliverable 6

Network Trials Report

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Contents

Glossary

ANM	Active Network Management - The use of distributed control systems to continually monitor network limits and provide signals to curtailable connections or flexible services to modify outputs in line with these limits.
API	Application Programming Interface
BAU	Business As Usual
BESS	Battery Energy Storage System
CBA	Cost Benefit Analysis
CHP	Combined Heat and Power gas generator
CMZ	Constraint Management Zone – An area of the network where ANM is used to manage local constraints
Connectee	Any individual or company connected to the electricity distribution network
Constraint	A demand greater than network ratings or voltage outside statutory limits. In this definition demand is used in the context of the load on the network (including generation).
Curtailable connection	Connection arrangements which allow Electricity North West to signal, in real time, a curtailment of demand or generation when there are network overloads or restrictions affecting the network local to the connectee whilst the network is operating in an intact, system normal state. Connectees will generally be given a curtailable connection where offering a non-curtailable connection would require network reinforcement which has cost and time implications on them being connected
Curtailment	The turning off, or down, of a connectee's import or export to alleviate a constraint based upon contracted and agreed principles of available capacity
Curtailment obligation	The requirement for a connectee to provide curtailment. The specific details of this requirement will be stated in their connection agreement
DNO	Distribution Network Operator – An organisation that owns, operates and manages the electricity infrastructure that distributes electricity from the transmission network operated by NESO, to end users (commercial and domestic properties)

Demand connection	An asset that is connected to the distribution network and requires import supply
Demand increase (flexible service)	A connectee providing a flexible service where the outcome is an increase in demand (this could be provided by either generator reducing export, or a demand connectee increasing import within their maximum import capacity limits)
Demand reduction (flexible service)	A connectee providing a flexible service where the outcome is a reduction in demand (this could be provided by either generator increasing export within their maximum export capacity limits, or a demand connectee reducing import)
ENA	Energy Networks Association
Flexibility	The modification of generation injection and/or consumption patterns, on an individual or aggregated level, often in reaction to an external signal, to provide a service within the energy system
FMAR	Flexibility Market Asset Register – A proposal by Ofgem to standardise flexibility market participant asset registration
FSP	Flexible Service Provider
Merit order list	A list of connectees in a specific order for the ANM system to action
NESO	National Energy System Operator – An organisation that monitors, controls and actively manages the power flows on the electricity transmission network to maintain a safe, secure and reliable electricity supply. NESO is a natural monopoly in the flexibility market, acting as a neutral facilitator
NIC	Network Innovation Competition
NMS	Network Management System
Non-curtailable	Under system normal conditions, a connection which is planned and operated such that it should not be curtailed; however, it may be curtailed in the event of the loss of any one or more elements (e.g. an overhead line route, a transformer, an underground cable)
PPA	Power Purchase Agreement – A contract in which a generator such as a solar or windfarm agrees to sell electricity to a buyer at an agreed price over a set period
SP ENW	Scottish Power Electricity North West
UI	User Interface

Executive Summary

This report is the sixth deliverable for the BiTraDER (Network Innovation Competition) NIC project which is being delivered by SP Electricity North West (SP ENW) and its partners. The aim of this report is to explain the project progress to date, focusing on the results and learnings from the live network trials.

It builds upon the previously delivered and published report for the BiTraDER project:

1	BiTraDER Customer Engagement and Trading Scenarios	30/11/22
2	BiTraDER Trials Plan, Trading Rules and Initial Specification Report	30/06/23
3	BiTraDER Trading Platform Design	03/09/24
4	BiTraDER Architecture Build Lessons Learned Report	10/03/25
5	BiTraDER Simulation Trials Report	28/05/25

The main objective of the BiTraDER project is to demonstrate how access to a neutral market allows connected resources to trade their obligations bilaterally, encouraging more of them to offer flexible services, increasing availability of flexibility and thereby reducing whole system costs.

The project currently remains on track to meet its aims, objectives, and all deliverables outlined within the full submission document.

This report provides an overview of the project including a summary of the simulation trials and the rationale for progressing beyond the stage gate. The main body then discusses the planning and execution of the live network trials along with the results, lessons learnt and next steps.

1 Introduction

As part of the UK's journey toward net zero, Distribution Network Operators (DNOs) are experiencing an increase in requests by customers to connect low carbon, renewable energy sources to the network. These connections can cause network constraints which are usually resolved through expensive, time-consuming and disruptive network reinforcement.

As a more cost-effective solution, DNOs have introduced curtailable connections and flexible services which, when used alongside advanced network automation algorithms such as Active Network Management (ANM), can control the customer's generation or demand output in real-time to resolve constraints.

Curtailable connections allow customers to connect to the network without the need for traditional reinforcement. Therefore, these connections are lower cost and can be delivered within shorter timescales than a 'non-curtailable' connection. When accepting a curtailable connection, a customer accepts the obligation to curtail their asset's export or import, in response to a request from the DNO, under certain network conditions. This is referred to as a 'curtailment obligation' and the specific details are stated in the customer's connection agreement.

Although these connections are lower cost and quicker, many customers are hesitant to accept them due to the inherent risk of being curtailed, and the associated commercial risk. Instead, some customers prefer to pay more and wait for a non-curtailable connection with negligible risk of being curtailed. In the case of low carbon generation such as solar, owing to the high capital investment required to establish the facility in the first instance, customers need certainty of a high in-service utilisation factor, meaning they are particularly sensitive to the risk of curtailment and much less likely to accept a curtailable connection.

Additionally, customers can provide a 'flexible service' to the DNO by agreeing to increase generation output, or reduce demand, at times defined by the DNO in exchange for remuneration. Owing to the long-term commitment associated with a flexible service contract, some customers are similarly hesitant to offer this. The commitment can be perceived as a barrier if customers are unable to meet the contract requirements over a prolonged period (i.e., a year).

BiTraDER seeks to allow new and existing customers to mitigate the risks associated with curtailment obligations by enabling customers to trade their curtailment obligations bilaterally. BiTraDER will also provide an opportunity for customers to participate in flexibility on an 'ad hoc' basis, removing the risk associated with long term contracts and boosting liquidity in the market.

2 Overview of BiTraDER

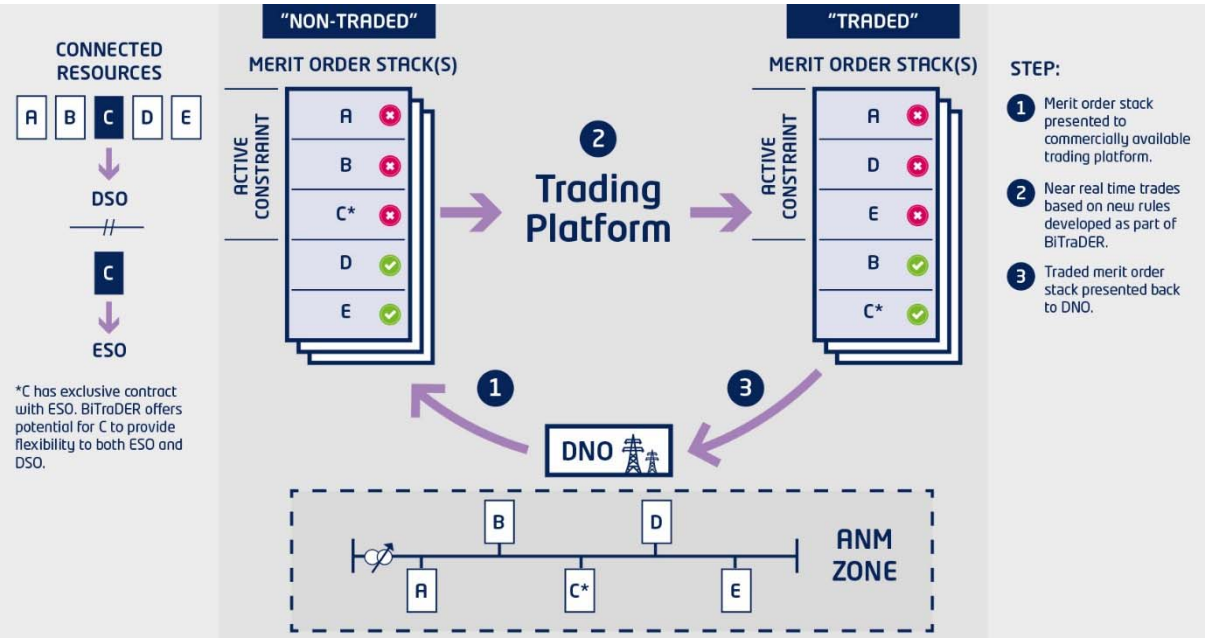
BiTraDER will investigate, design, build and trial – on our live network – a brand new and highly innovative market allowing resources connected to the distribution network to trade their curtailment obligation bilaterally.

The project will assess current and future customers' appetite for bilateral trading, determine the data requirements to support operation of the market, design the interfaces needed to present all necessary information to the trading platform, develop the bilateral market trading rules

determining what is and isn't a valid trade, explore the market's ability to operate in near real-time, and determine the functionality required to return the output of the market to the DNO and National Energy System Operator (NESO) systems for execution in real time.

BiTraDER is designed to facilitate independent trading, therefore SP ENW will provide the necessary information to the market and receive the output of the market after close of trading. The project will examine the role of the market administrator and propose who might be best placed to operate the market in Business As Usual (BAU). Figure 1 shows the high-level illustration of the trading process as per the BiTraDER full submission document.

Figure 1 BiTraDER illustrative method



BiTraDER will be completed in six phases, over a four-year period:

1. *Customer engagement* – engagement and recruitment of customers to inform the design of the trading rules and platform, during the design phase, and to participate in trading during the simulation and live trial phases.

2. *Design* – development of the core trading scenarios, market principles and trading rules, including validation and practical challenges associated with enabling trades. Design of the trading platform and end to end data architecture, considering cyber security and other associated risks. Capture of the technical requirements and the interface considerations for integrating the trading platform with the SP ENW systems.

3. *Build* – build and test of the trading platform and data architecture using the outputs of the design phase. The acceptance criteria for testing will be developed during the design phase.

4. *Simulation trials* – a series of tests will be run using simulated network models and customer assets, allowing customers to participate in simulated trading of their curtailment obligations.

Following the simulation trials there is a 'Stage Gate' which provides the opportunity to ensure that the plan for implementation of the live trial is both reasonable and deliverable within the constraints of the approved project. Should the project pass the stage gate we will move to the live trial phase, otherwise we will progress immediately to project closedown and BAU transition.

5. *Live network trials* – a live trial of trading covering a specific area of the SP ENW network, including the curtailment of assets connected to our network.

6. *Closedown and BAU transition* – analyse the costs and benefits of BiTraDER and produce a closedown report for dissemination. Develop the process for transition to BAU, provide training to internal planners and operational engineers on all new codes of practice, and publish a functional specification for BiTraDER.

3 Simulation trials

3.1 Overview

The simulation trials enabled the project team to test for the first time the user interface of the BiTraDER trading platform. Participants were instructed to register onto the platform and submit trades in response to simulated constraint notifications.

The simulated constraints were sent to the trading platform via an Application Programming Interface (API) from an SP ENW ANM test environment known as the ANM orchestrator. The ANM orchestrator had ten in-built look-ahead and merit order lists (MOLs), containing data on fabricated assets which were assigned to each trial participant.

The constraints in the look ahead lists were of varying magnitudes and included both import and export over configurable hourly time periods.

The MOLs contain ten assets per look ahead constraint, each having an associated 'Contract Operation Type', to determine whether an asset is a buyer or a seller and what service that asset can provide.

For BiTraDER buyers, there are two contract types:

- *Constrained Demand – a flexible ANM connection whose import can be curtailed.*
- *Constrained Generation – a flexible ANM connection whose export can be curtailed.*

For BiTraDER sellers, there is one contract type:

- *Flexible Output Change – a non-curtailable connection who can provide a service to mitigate the constraint such as demand turn down or generation turn up.*

Once the trading platform received a list from the ANM orchestrator, trial participants were then notified of opportunities to trade. After the trade, the new MOL was received by the ANM orchestrator for each applicable half hourly trade period.

Since this was a simulation environment, there weren't any live constraints taking place, so the volume delivered, performance delivery and service fulfilment were calculated manually using an excel based calculator tool.

Further details of the orchestrator, API and simulated look ahead/MOLs can be found in the BiTraDER Test Plan report.

3.2 Learnings

The feedback gained at this stage was that users found the platform intuitive and easy to use. However, there were several limitations of the simulation environment that affected the output of the trades:

- *The format was considered too simplistic, restricting the participants ability to apply real world operational and commercial logic when submitting bids and offers.*
- *Replicating realistic market conditions proved challenging, particularly because participants operated different asset types and each had their own BAU assumptions about how these assets operate.*
- *Guide prices were introduced to support trading decisions, but this reduced realism as most submitted prices hovered around the suggested values.*

Despite these limitations, the simulation trials successfully validated the robustness of the market rules and the ability of participants to trade.

Since, there were only seven businesses signed up, liquidity was a significant challenge, particularly as frequency of the trades were biweekly. It appeared quite early on that the commitment to biweekly trades was too frequent for some of the businesses.

Some of the trades therefore were supplemented by the teams at SP ENW and Electron. One of the benefits of this was that it gave the internal team greater autonomy over which trades matched which could lead to better example results. The disadvantage again is the fact that it takes away from realistic market conditions.

Overall, the simulation trials demonstrated that the trading platform and ANM systems (albeit a test version of the ANM system) functioned effectively and that stakeholders are supportive of peer-to-peer energy markets such as BiTraDER. Trial participants gained a thorough understanding of how the market works and are supportive of seeing the project progress to BAU.

Full details of the simulation trials can be found in the BiTraDER Simulation Trials report.

4 Stage Gate Review

A stage gate was included in the project plan to ensure that the live network trials could be delivered in a practical and achievable way within the approved project scope.

The simulation trials, originally planned to run from August 2024 to May 2025, concluded earlier than expected because the intended learning outcomes were achieved ahead of schedule. Although ten simulated constraints had been planned, it became clear early on that the limitations of simulated assets were affecting the realism of trading.

Participants found it difficult to interpret underlying market conditions, resulting in trades that did not reflect BAU behaviour. These findings demonstrated that achieving realistic outcomes would require trading with real network assets and introducing a monetary element to give participants a genuine stake in the process.

The outcomes of the simulation trials therefore highlighted the need to progress to live network trials, where realistic trading behaviours and meaningful price discovery could be tested.

In anticipation of this, the team began early engagement with potential participants. Discussions with regional universities and several Flexible Services Providers (FSPs) providers gave confidence that sufficient liquidity could be achieved, particularly given previous challenges with customer recruitment in earlier phases.

A review of the original business case confirmed that the benefits identified in 2021, such as reduced load-related expenditure, lower curtailment, and improved coordination with NESO, remain valid and important.

Considering 2024 forecast data, which reflects increased levels of flexible generation and curtailable connections on the SP ENW network, an updated qualitative assessment suggests that these benefits may be even greater than originally anticipated. This assessment, along with a full quantitative update of the benefits is due to be published after this report and the overall recommendations will be included in the final closedown deliverable report in July 2026.

Stakeholder interest remains strong, supporting the potential for these benefits to be realised. During the simulation trials, participants were engaged, offered valuable feedback, and indicated support for the solution progressing into BAU.

Following these insights, the BiTraDER team submitted a formal request to Ofgem in June 2025 to progress beyond the stage gate and commence delivery of the live network trials. Approval to proceed was subsequently granted.

5 Live trials in depth

The live network trials provided the opportunity to test the end-to-end process of the BiTraDER market under real network conditions with real money changing hands.

The key objective of the live network trials was to gain insights into trading dynamics within a realistic environment, specifically:

- *Participant considerations when pricing bids and offers.*
- *Scenarios impacting trading capacity.*
- *Potential barriers encountered by participants.*

To enable this, further upgrades to both the trading platform and the live ANM system were required, along with further customer recruitment targeted within the SP ENW network.

5.1 Platform enhancements

The BiTraDER platform is built on existing elements from the ElectronConnect flexibility market platform and provides the core functionality required to operate the market including asset onboarding, market visibility, trade submissions and data capture.

While these components enable the market to function at a basic level, to enable the live trials key operational processes were enhanced prior to the market operating in a live environment.

Additional functionality from the ElectronConnect platform has been utilised for the dispatch and performance verification elements of the BiTraDER platform.

5.1.1 Dispatch

The BiTraDER platform used the traded MOL generated by the matching algorithm to define assets that are available for dispatch. The market operator can define the Instruction volume, update this volume by sending a further instruction, and send a stop instruction when the constraint is resolved. They can view all ongoing dispatch events for multiple assets in the current instructions table.

To receive and acknowledge dispatch instructions, the BiTraDER participants configured a webhook URL.

5.1.2 Performance Verification

The Performance Verification mechanism used in the ElectronConnect platform follows the process defined in the Open Networks ENA (Energy Networks Association) Standardised DNO Settlement Methodology. This uses instructed volume, meter reading, and baseline values to calculate the minute-by-minute delivery % for every dispatch event the asset took part in. These calculations are done per dispatch event and can be exported by the market operator as a csv file. Previous dispatch events are displayed to participants via the Performance Verification User Interface (UI).

5.1.3 Partial Trade Functionality

Through discussions with potential BiTraDER live trial participants during recruitment, the team identified that some generator assets lack the capability for partial dispatch; they can either export at full capacity or be switched off.

The existing BiTraDER algorithm calculates matches bids and offers on 'all-in' price. The matched volume is based on the minimum bid/offer volume. This design allows for participants to be matched at a lower volume than submitted, rendering the current algorithm unsuitable for assets that cannot dispatch partial volumes.

Consequently, the BiTraDER platform was enhanced to allow participants to specify their asset's partial dispatch capability and dispatch increments.

5.1.4 Transition from simulation to live trials environment

The BiTraDER platform underwent the necessary updates to accommodate live customer data and will adhere to the same stringent data protection and retention standards as all ElectronConnect production environments.

5.1.5 Off-platform processes

The off-platform processes relate to activities that are not yet embedded in the BiTraDER platform.

Most notably, settlement was conducted externally, even though the BiTraDER platform aligns with the ENA standardised methodology. Keeping settlement off platform provided flexibility to test different methodologies quickly during the trials without being constrained by fixed system logic. While the necessary performance data (such as baselines, dispatch volumes, and meter readings) were generated within the BiTraDER platform, the calculation itself was performed externally.

Participants in the live trials received comprehensive training on the BiTraDER platform. The existing user guide, developed for the simulation trials, was updated to include instructions for baseline and meter reading uploads, as well as asset dispatch based on platform instructions.

After the trial phase, and in preparation for BAU, a refined end-to-end process will be developed. This will be based on updated functional requirements and fully integrated into the platform for future BAU operation.

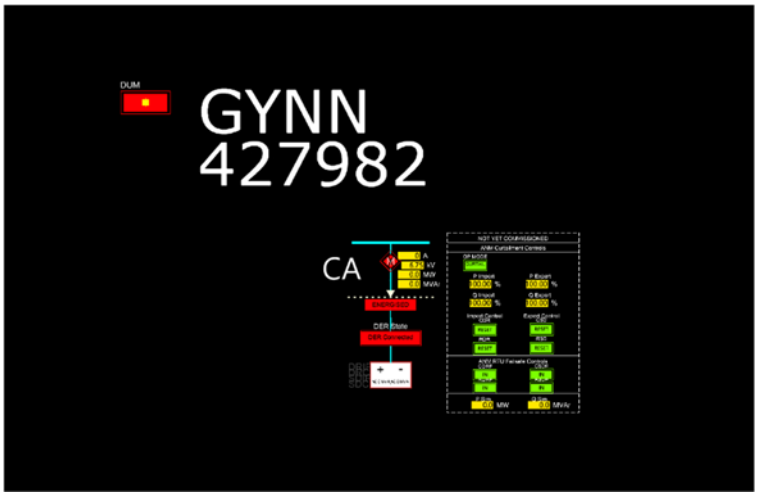
Further details on the platform upgrades to enable live trading can be found in the BiTraDER platform live trials specification report.

5.2 ANM enhancements

The upgrades applied to the ANM orchestrator have been transferred to the live ANM system and integrated with the trading platform through an API. The registration details of the assets involved in the trials were then added onto the system to enable them to appear in the look ahead and MOL.

As detailed in section 5.3, the trial assets were located within different locations on the network, so they had to be constructed within a virtual Constraint Management Zone (CMZ) on the Network Management System (NMS). An example of an ANM enabled virtual asset can be seen in figure 2.

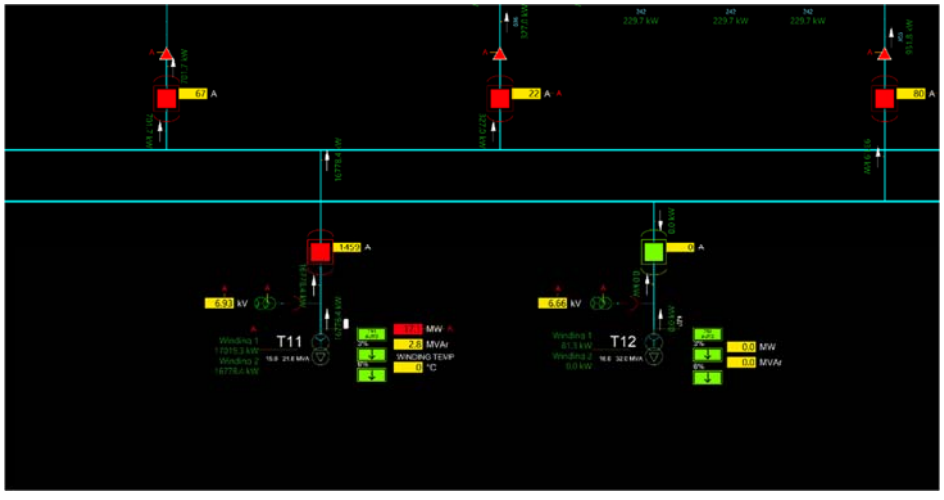
Figure 2 ANM enabled virtual asset



Simulated Supervisory Control and Data Acquisition (SCADA) signals within the CMZ could be adjusted to create a constraint and test that the network and asset data flows would create a look ahead list and MOL that theoretically could be sent to the trading platform.

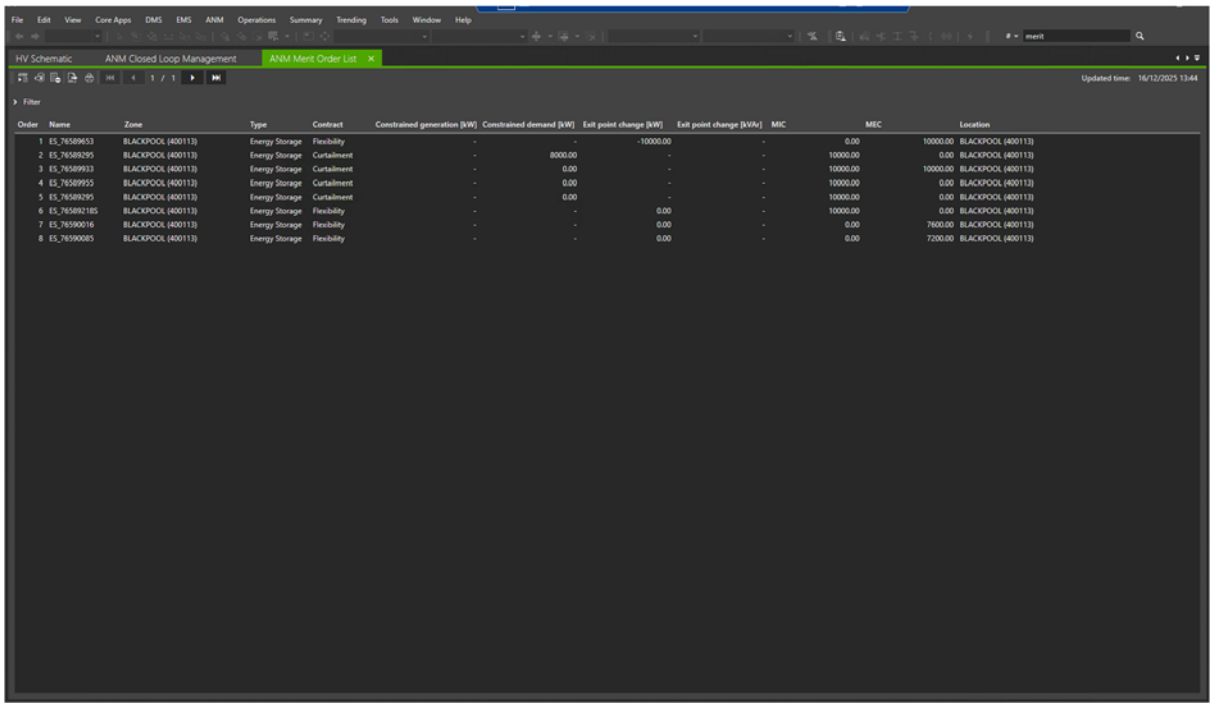
Figure 3 shows an example of a two-transformer primary were switching out a transformer results in an overload constraint on the remaining transformer. The asset within figure 2 could be adjusted manually to resolve the constraint and replicate the effect of the trial outputs.

Figure 3 Virtual CMZ constraint



The actual look ahead lists and MOLs used during the live trials were pre-prepared and embedded with the correct timestamp in the ANM system ready to be sent to the trading platform for live trading. An example of a MOL can be seen below in figure 4.

Figure 4 Merit order list



The change in output from the assets following a trade were reflected in the meter readings which were compared with the traded volume in the performance verification module of the trading platform. These results could be replicated manually afterwards on the NMS virtual CMZ to determine the actions that would have been taken.

When the ANM system triggered a constraint, a dispatch instruction was sent to the platform and onto the asset. The purpose of this was to demonstrate a full end-to-end test of the data flows between the ANM system, the trading platform and the participant assets.

Whilst this method did involve an element of simulation, the behaviour of the participants during trading did not change. Participants received the pre-prepared look ahead and MOL and acted in the same manner as if it was sent from a live CMZ.

The integration process has taken account of cyber security, and a robust testing regime has been used to ensure the new interface functions correctly and safely.

5.3 Customer recruitment

The difference between the live network trials and simulation trials is that the assets participating needed to be in the SP ENW licence area and covered under a CMZ in the ANM system.

As anticipated, the number of assets on existing flexible connections was insufficient to create an 'ideal' live trading scenario. The main reason for this is that SP ENW have an extremely low level of curtailment annually.

It was therefore necessary to strike a balance between running the 'ideal' scenario with live flexible connections and one which could still test and weigh up the benefits of live asset trading.

By utilising existing assets that could be temporarily operated as flexible connections, the requirements to determine whether trading in BiTraDER is suitable could be tested.

Two approaches were taken to identify existing assets willing to participate in the trials.:

5.3.1 Engagement with universities

SP ENW utilised its existing contacts across the region's universities, reaching out to four institutions.

Following discussions with estate teams and a review of their assets and power infrastructure, it became clear that there was a lack of volume that could be traded to support meaningful trades. Typical assets included chillers and heating systems, capable of only small trades up to a few of hundred Kilowatts (kW). In addition, there was a reluctance to change the output of these assets during term time which restricted trial windows.

As a result, this approach was not taken forward. However, Lancaster University with its larger rural campus and more substation infrastructure, offered more suitable assets that could be utilised including a large wind and solar farm.

5.3.2 Use of Electron's FSP register

The second approach involved contacting existing assets listed on Electron's FSP register.

Unlike the universities, these providers were more commercially focused and already had experience in operating assets in existing flexibility markets. This was more successful with five businesses expressing interest in exploring BiTraDER as a means of generating additional income and reducing curtailment risk. Their portfolios included assets in the range of Megawatts (MW), providing sufficient volumes to enable suitable trades.

5.3.3 Asset selection

It was important to understand in detail the capabilities of the assets in each of the FSP's portfolios to gauge whether they would be suitable for the trials.

The project team set up a 1-2-1 meeting with each FSP, along with Lancaster University to explore specific use cases for different asset types and how they could benefit from participation in BiTraDER.

Once the benefits of participating were clear, Electron's asset registration form was distributed. Participants then selected sites they believed were suitable and available for the trials. The form captured key asset details including information on how each asset could operate flexibly for example the level of capacity it could provide for turn down or turn up services.

Some of the FSPs operated as asset owners and some managed the assets on behalf of the owners. In the latter case additional time was required to secure permission from the owners before those assets could be included in the trials.

The project team discussed compensation with each participant, outlining both a general incentive for taking part in the trials and additional incentives linked to individual trial events. These included covering any costs incurred when assets were dispatched, ensuring participants were fairly rewarded for their involvement.

5.3.4 Scenario development

With all registration forms submitted, suitable trading scenarios could begin to take shape. However, the selection of assets available were not located within the same area of SP ENW's network. As noted earlier, the 'ideal' live trading scenario would involve assets under a single CMZ.

To address this, an additional allowance was introduced that incorporated a degree of simulation whereby the assets selected would need to be connected virtually onto a test network to create an artificial CMZ. This approach was considered acceptable because although the assets were not physically situated on the same part of the network, the trading behaviours of the participants would remain consistent. Crucially, the main outcome of assessing whether the BiTraDER market could operate in BAU could still be achieved under these conditions.

With the assets chosen, two scenarios were devised which incorporated both an import and export constraint. These both had a good mix of technology types including batteries, solar, wind and gas peaking plants with constraint volumes of over 20MW anticipated.

The assets mainly operated within the wholesale and NESO markets but some also had contractual Power Purchase Agreements (PPAs). The scenarios centred on the use case of keeping renewable buyers connected whilst curtailing non-renewable sellers.

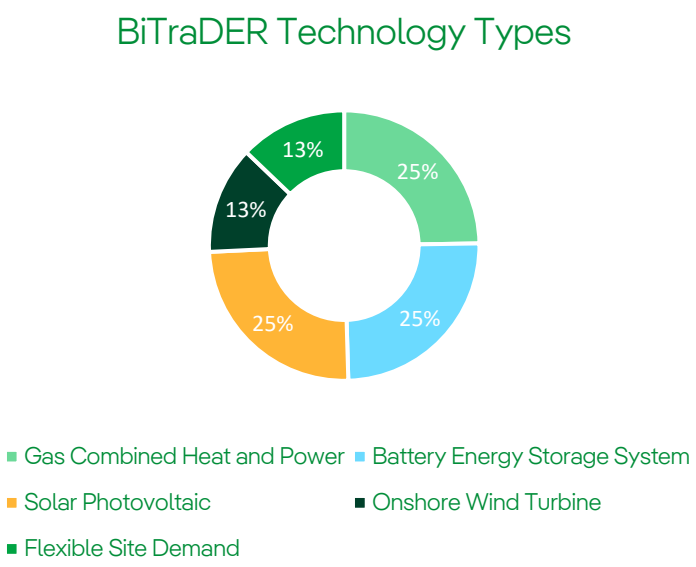
Since the buyers were on theoretical flexible connections, the decision was made to not physically dispatch the asset, rather send an email confirmation letting them know that they would be curtailed or they have avoided curtailment should they have been on a true flexible connection.

Sellers on the other hand were required to dispatch if capable to do so. Most of the sellers did opt for dispatch but wanted advanced notice of the curtailment instruction. In many cases an hour notice was suitable, but it was noted that this is longer than the real time dispatch that was designed for the BiTraDER market.

5.4 Trial results

The live trials were conducted with the involvement of five participants, who collectively operated eight grid-scale assets. The specific technology classifications for these assets are illustrated in figure 5.

Figure 5 BiTraDER technology types



Throughout the two-week trial period, 12 constraints were identified by the BiTraDER platform and presented to participants for bidding. From these identified constraints, successful matched trades were achieved in three instances as shown in table 1.

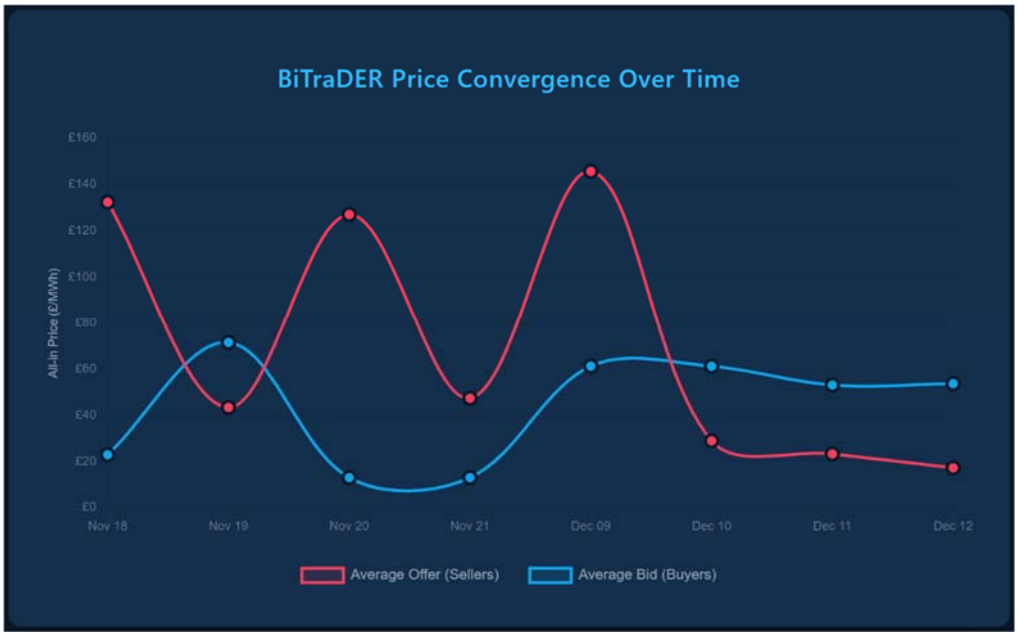
Table 1 trial results

Predicted Constraint Size (MW)	Predicted Constraint Length (hrs)	Actual Constraint Size (MW)	Actual Constraint Length (hrs)	Seller Asset Utilisation (MW)	Delivery as % of Constraint Size
16.5 Import	1	8.25 Import	1	10	121%
20.3 Import	3	20.3 Import	3	12.6	62%
20.3 Import	3	20.3 Import	4	3.9	19%

A convergence of bid and offer prices was observed over the course of the trials, as shown in figure 6.

This trend is attributed to participants refining their pricing strategies in response to market activity and other participant's submissions. Consequently, a higher volume of matching was recorded in Week 2 relative to Week 1. This increase was further facilitated by strategic adjustments made to the market bidding window timings.

Figure 6 Trade convergence



Many BiTraDER sellers decided to opt out of partial volume trading, as shown in Figure 7.

Although this feature was originally implemented to accommodate assets with binary operational profiles, such as Gas Combined Heat and Power (CHP), it was adopted across other asset classes. Participants indicated that the novelty of the market created challenges in calculating opportunity costs; requiring the full offer volume to be confirmed served as a risk management tool to mitigate this uncertainty. As a result, this feature was utilised by Battery Energy Storage System (BESS) assets for 62% of offers.

Figure 7 Offer tradability by asset type

Significant variation was noted in the cleared All-In price as seen in figure 8. This was primarily influenced by the buyer's specific commercial model and the timing of the constraint. In alignment with the intended market design, cleared availability prices remained significantly lower than cleared utilisation prices. This confirms that sellers were successfully incentivised to minimise availability pricing to increase the probability of a successful match.

Figure 8 Trade price variation

Further information on the live trial outcomes can be found in the BiTraDER live trial outcomes and proposed platform enhancements report.

5.5 Participant feedback

5.5.1 Market design

- *Transparency is essential: Participants want visibility of all bids (including unsuccessful ones), market participants, and opportunity costs to better understand potential revenues in a developing market.*
- *Greater bid flexibility needed: Suggestions included allowing split-volume bids at different price levels to enable more tailored bidding strategies.*
- *Concerns over uncertainty: Unpredictability around real-time constraints and short activation notice periods were seen as drawbacks. Participants generally wanted at least an hour's notice.*

- *Preference for revenue certainty: Participants favour mechanisms that allow them to secure value early, like availability payments or other scheduled flexibility products.*

- *Scheduled dispatch: Most participants favoured an email in advance of the constraint to confirm that an asset will be dispatched. The BAU process in contrast requires assets to respond in real time via an API. Thus, most of the assets involved in the trials would not be ready to participate in BiTraDER in BAU at this time.*

5.5.2 Price formation

- *Uncertainty in price formation: Lack of clarity on what constitutes a successful trade made pricing difficult, particularly due to the peer-to-peer nature of the BiTraDER market compared to traditional operator-led markets. A DNO flexibility benchmark was suggested to improve price certainty.*

- *Diverse participant approaches: Differences in technologies, industries, and priorities led to varied pricing strategies, which limited trade matching during the trial.*

- *Expectation of improvement in BAU: Greater market liquidity and a broader mix of participants in a BAU setting are expected to increase the likelihood of successful trades.*

5.5.3 Alignment with other markets

- *Trading window improved: Adjustments to the trading window better aligned BiTraDER with wholesale day-ahead markets, making it easier for participants to trade during the working day.*

- *Preference for quick responses: Participants favoured shorter response windows after auction close to improve operational efficiency.*

- *Competing markets take priority: Wholesale markets, the Balancing Mechanism, and reserve services were identified as key competitors that currently take precedence over BiTraDER.*

5.5.4 BAU

- *Low additional effort to participate: Participants felt BiTraDER could be integrated into daily operations without significant extra work, provided transparency improves and the market matures.*

- *Concerns over revenue potential: Limited liquidity and misaligned opportunity costs led to doubts about the level of achievable revenues during the trials.*

- *Limited impact on non-firm connections: BiTraDER was seen as offering only marginal benefits for supporting non-firm connections, due to low curtailment likelihood and challenging trade matching. Though this could improve over time with increased market activity.*

6 Cyber security

The architectural approach to cyber security has full traceability in a bi-directional way between what has been implemented, and the origins of certain decisions being made.

Within the design process we adhere to cyber security standards and frameworks which contain obligatory security controls across physical, network, operating system, application, and data stacks. These controls must be met to reach compliance with the particular standard and thus become measurable.

In implementing these controls, we create architectural principles, which any given control may apply to one or more principles. The principles apply the security controls to business risk, technical, and user requirements, which in turn inform the design.

In terms of BiTraDER, the approach in table 2 applies:

BiTraDER deliverable	Cyber security deliverable	Rationale
D1 – Customer engagement and scenarios	None	Initial engagement with customers to determine the appetite for the peer-to-peer trading model
D2 – Trading rules and technical requirements (including business process maps and information models	Business impact assessment	Business processes are mapped such that key business impacts can be analysed
	Threat analysis	There are existing threat models that can be applied to the documented BiTraDER business processes
	Security principles	These are generic and are applied across all projects
	Security requirements	These are based on ISO 27001 standards
D3 – Trading platform design	Risk assessment	Risk assessment needs IT assets to be determined as part of the design phase
D4 – Architecture build	Penetration testing	The built architecture is tested from a security perspective to ensure that the security requirements have been met
D5 – Simulation trials	None	The simulation trial system has already incorporated the necessary requirements to account for cyber security risks

BiTraDER deliverable	Cyber security deliverable	Rationale
D6 – Live Network trials	None	The live trial system has already incorporated the necessary requirements to account for cyber security risks

6.1 BiTraDER cyber security report

The information within the full BiTraDER cyber security report contains sensitive information that could be used by an adversary. The full report can be provided to parties who require it to conduct their duties in delivering the project.

7 Lessons learnt

The results from the trials identified a strong interest in the market from participants. The changes made to the trading rules (e.g. pricing options, timings of bid/offer submissions etc.) and platform functionality led to an improved experience for participants, and further learning is expected as the market moves to BAU.

The main concerns for the participants remain the transparency of prices in the market and the likely level of liquidity. During the trials this led to gaps between the prices submitted by buyers and sellers to take part in in the market. This concern was increased due to the different strategies and priorities of the participant types active in this trial based on the different demand / generation technologies (e.g. between renewable generators and carbon intensive assets).

Unfortunately, the trials were unable to provide a view of whether these concerns would be addressed overtime due to low customer numbers and large simulation component that was be used. However, as mentioned previously, we would expect increased liquidity leading to greater diversity of technology types and participants should make trades more likely.

The approach to baselining will remain under review. Preferences were made during the trials, and it was agreed that this aspect would continue to be examined in the post-trial / pre-BAU period. As part of this we would consider work undertaken in other innovation projects alongside the best practice identified during the development of the ENA Open Network Flexibility Baselining Tool.

Finally, while the trials do not identify an increased willingness to take up a non-firm connection from participants, it did show that those participants operating in the flexibility market would be keen to take part in BiTraDER. And those with flexibility contracts would be willing to interact with the BiTraDER market on an ad-hoc basis.

8 Conclusions and next steps

This report addresses the requirements for the BiTraDER D6 deliverable. The next step is to produce a final functional specification for BiTraDER including the trading rules, interface requirements, data requirements and platform design.

The functional specification document and subsequent final steps of the project will together discuss and recommend the implementation for BiTraDER in BAU. To help prepare for this, a finalised Cost Benefit Analysis (CBA) is being prepared to prove the justification of continuing the solution post innovation.

The results of the CBA and final recommendations will be included within the BiTraDER final report due 31/07/2026.