electricity north west

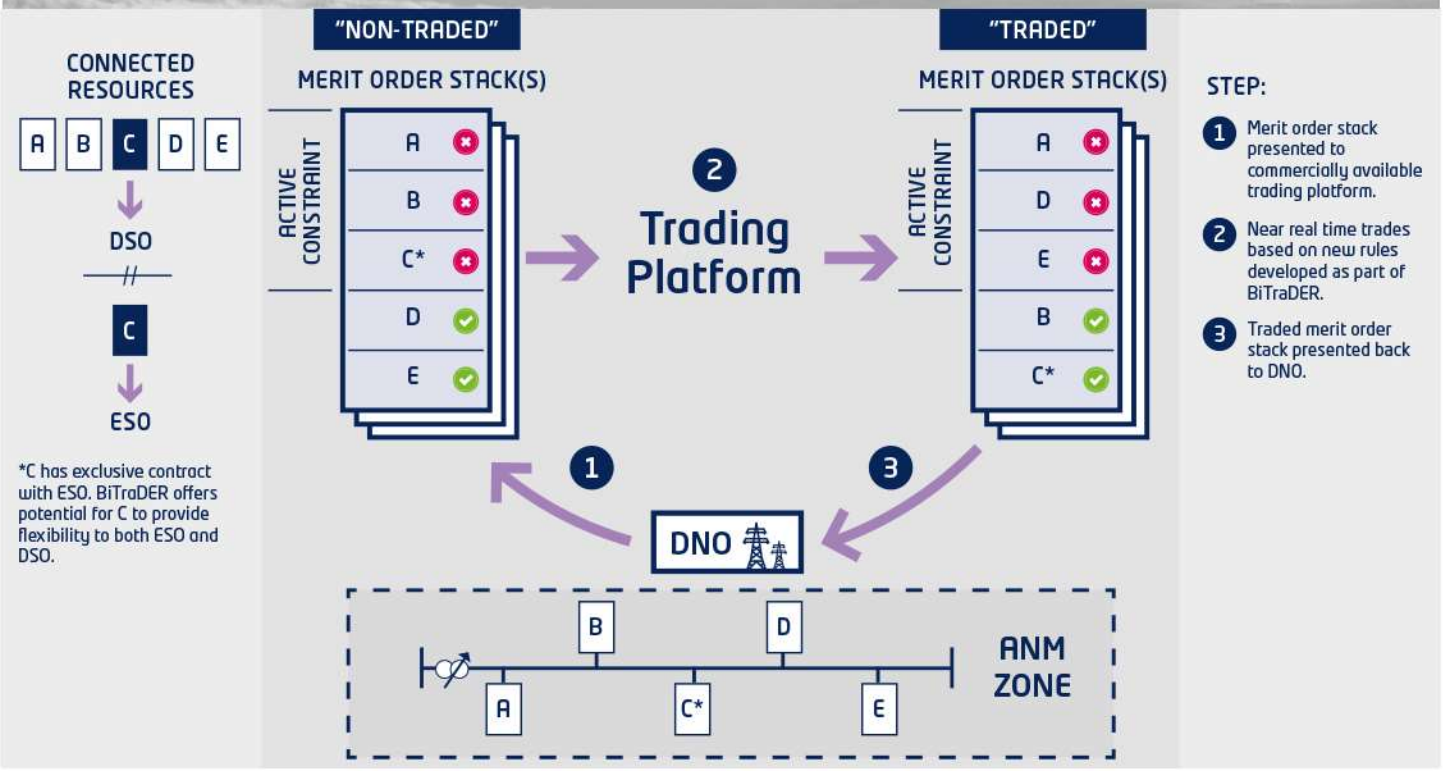
Bringing energy to your door

BiTraDER

Deliverable 4

Architecture Build Lessons Learned Report

February 2025



Project Partners

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ELECTRON

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Version

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Approval

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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 – A type of software interface between two systems
'All-in' Price	The maximum total price a buyer is willing to pay to avoid curtailment and the minimum total price a seller needs to be paid to take on a curtailment, summing availability and utilisation payment components
Availability Price	The price a buyer is willing to pay, or a seller is willing to offer to be available regardless of whether a constraint occurs or not
Baseline	The point from which any delivery of flexibility is measured
BaU	Business as Usual
'Buyer'	Party buying the ability to transfer their curtailment obligation to another connectee and accept a more favourable position in the merit order list
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).
DER	Distributed Energy Resource – Demand and generation assets that are embedded within the distribution network
ENA	Energy Networks Association
ENWL	Electricity North West Limited
Flexible services	Services purchased from a flexible service provider to provide demand turn down, and demand turn up to alleviate network constraints. These services are used to defer and avoid reinforcement, as well as to allow other customers to connect faster and cheaper to the network and can be provided from demand or generation

Flexible service provider	A demand or generation connectee providing flexible services to either the wholesale market or to the DNO and NESO
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
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
Non-curtailable connection	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)
ON	Open Networks
Peer to peer trading	Trading between connectees, independent of the DNO or NESO
'Seller'	Party selling the ability to accept a curtailment obligation from another connectee, within the limits of their connection agreement
Service Fulfilment (%)	Compares the seller's delivered volume against the instructed volume to calculate the settlement and payment

Executive summary

This report is the fourth deliverable for the BiTraDER (Network Innovation Competition) NIC project which is being delivered by Electricity North West Limited (ENWL) and its partners. The aim of this report is to explain the project progress to date with a specific focus on the methods to implement, build and test the designed solution into a functional prototype.

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

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.

This report, and the detailed associated reports, explain the project progress to date including the system build phase covering the trading platform and internal architecture along with the lessons learned throughout the process.

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 of time (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

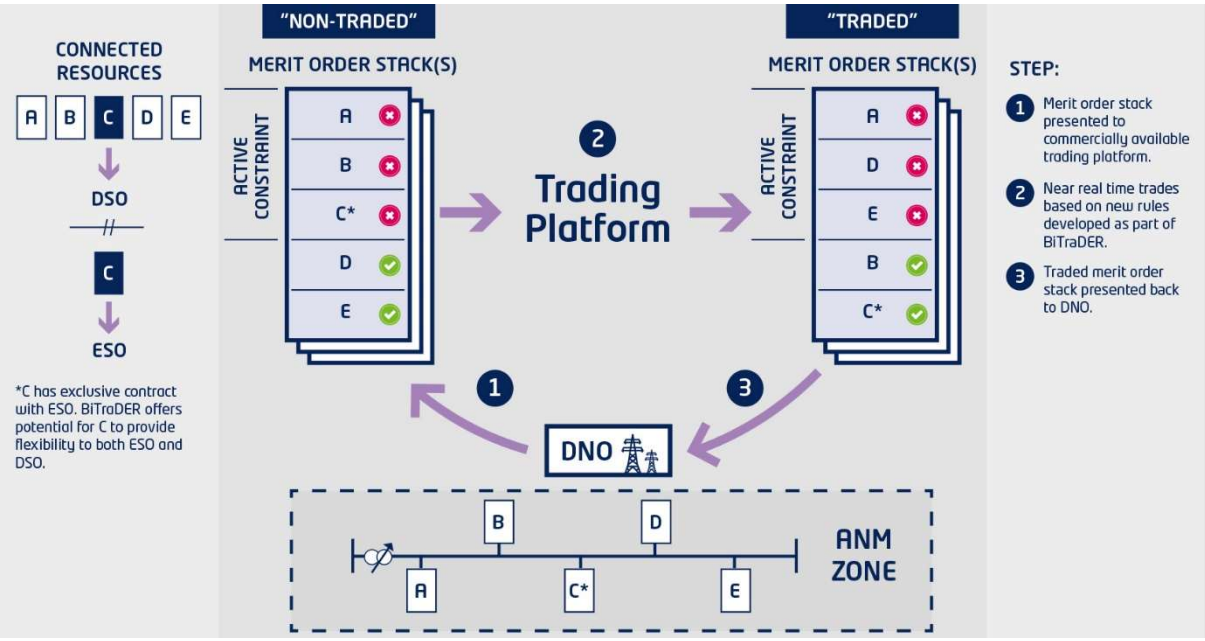
BiTraDER will investigate, design, build and trial – on our live network – a brand new and highly innovative market allowing resources connected to the distribution network to trade their curtailment obligation bilaterally.

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 Operation (NESO) systems for execution in real time.

BiTraDER is designed to facilitate independent trading, therefore ENWL 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.

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, taking into account cyber security and other associated risks. Capture of the technical requirements and the interface considerations for integrating the trading platform with the ENWL 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 ENWL 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 BiTraDER trials

There are three stages of trials for BiTraDER, all of which are in the project plan including the mini trials which were an additional testing stage added to the original submission.

i. *Mini trials:* A one-day workshop on January 31 2024.

ii. *Simulation trials:* Scheduled to run from October 2024 to May 2025.

iii. *Live network trials:* Scheduled to run from May 2025 to January 2026 (subject to passing the stage gate).

3.1 Mini trials

As described in the BiTraDER Trading Platform Design report, the mini trials were added as an additional stage after completion of the trading rules design. The purpose was to de-risk the rules by carrying out some manual trading scenarios with a set of experienced participants which included asset owners, operators and aggregators.

In total seven participants attended the event and provided useful feedback for the project team to consider before commencing the BiTraDER system build:

- *Payment structure:* An availability payment was unanimously favoured to accompany the utilisation payment when submitting trades. The availability and utilisation price are then added together to form an 'all-in' price.

- *Baselining:* Along with a self-declared option, additional methods to determine day ahead baselines were requested. In response, the project team have opted to allow participants during future trials to use the (Energy Networks Association) ENA Open Networks (ON) flexibility baselining tool.

- *Concerns around liquidity:* The main concern that was highlighted to the project team was a concern on the number of assets that would be available to trade in the market.

3.2 Simulation trials

The simulation trials will see an initial prototype of the trading platform built to enable a series of trading scenarios, using simulated constraints sent via an Application Programming Interface (API) from an ENWL ANM test environment known as the ANM orchestrator.

The ANM orchestrator, discussed further in section 4.4.1 has ten in-built look-ahead and merit order lists (MOLs), using fabricated assets. Each list has a configurable timestamp ready to send out to a group of trial participants.

LCP Delta, the customer engagement partner on the project, has so far successfully managed to recruit seven business to participate in the simulation trials. The recruitment for additional businesses to attend will be an ongoing task throughout the trial period.

The constraints in the look ahead lists are of varying magnitudes and include both import and export over hourly time periods.

The half hourly 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.

Using an API, the trading platform will receive the lists from the ANM orchestrator and notify the trial participants of opportunities to trade. Once trading has taken place, the ANM orchestrator will receive the new traded MOL for each applicable half hourly trade period.

In a live network environment, should the constraint occur, the live ANM system would curtail assets based on the new MOL. Since this is a simulation environment, there won't be any live constraints taking place, the volume delivered, performance delivery and service fulfilment will be calculated manually using an excel based calculator tool.

The simulation trials will run up to May 2025. A look ahead list and MOL will be sent to the trading platform twice a month.

To ensure that the simulation trials reflect how the market will operate in BAU, the lists are sent to the platform for constraints occurring the next day, in line with the day ahead market mechanism. Trial participants will have a two-hour window to trade before a conceptual gate closure limits further trades.

The project team and trial participants will have a meeting the next day to discuss the outcomes of the trade, which will include a visual presentation of the old and new MOLs, to gain an understanding of the implications and benefits of participating in BiTraDER.

3.3 Live trials

The live network trials will provide the opportunity to test the BiTraDER market under real network conditions with real money changing hands.

To enable this, further upgrades to both the trading platform and the live ANM system will be required.

The trading platform will need to perform additional steps in the end-to-end process such as trade verification, dispatch and settlement. This is discussed further in section 4.3.

The upgrades applied to the ANM orchestrator will be transferred to the live ANM system and integrated with the trading platform. The integration process will need to take account of cyber security, and a robust testing regime will be required to ensure the new interface functions correctly and safely.

Due to the uncertain nature of demand and generation, it is impossible to guarantee constraints will manifest on the network and they may need to be simulated. It is important to note that even if the constraint is not real, the actions and consequences will be, allowing customers to understand how trading impacts them and whether this affects their appetite to trade.

There is an ongoing risk regarding customer recruitment which has been recorded on the risk register.

To enable the live trials, there needs to be a high level of both existing demand and generation customers on the same part of the network and meeting this requirement has thus far proved challenging. The project team are currently looking at the constraint specific management zones on the live ANM system to attempt to locate and engage potential participants who could get involved in the live trials.

4 BiTraDER system build

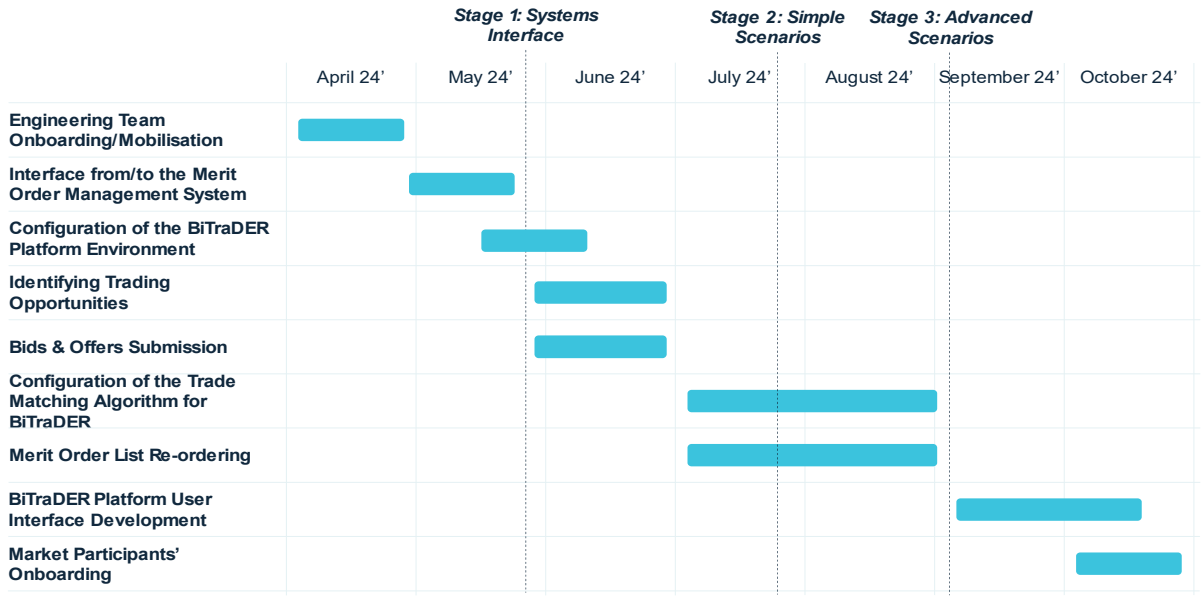
BiTraDER project partner, Electron, worked with the ENWL IT team to build the system architecture developed during the design phase into an initial working prototype, to be tested in the simulation trials. This section provides a summary of the process with more details provided in the BiTraDER Platform Development report.

4.1 Trading platform build

The BiTraDER trading platform has been built on the existing ElectronConnect product: a flexibility market platform which enables and coordinates localised energy markets and distributed energy resources to increase the utilisation of renewable power and network capacity, guaranteeing the best available price for all parties and every transaction.

The detailed design of the BiTraDER trading platform is provided in the Trading Platform Design and Data Model report.

Figure 2 BiTraDER build phase timeline. Source: Electron



The project team adopted a staged delivery approach. The tasks for the trading platform and adapter are shown in figure 2, with the tasks for the ANM orchestrator and integration completed separately in alignment for each stage. At the conclusion of each stage, newly implemented functionality was demonstrated to the project team.

4.1.1 Stage 1: ElectronConnect and ENWL ANM interface

The first round of integration testing focused on establishing the interface between the BiTraDER trading platform and ENWL's ANM replica system, the orchestrator tool.

This test involved the ElectronConnect platform receiving constraint look-ahead and MOL information from the orchestrator tool and returning the MOL unchanged.

4.1.2 Stage 2: Simple simulation trial scenarios

The second round of testing aimed to prove the BiTraDER platform's ability to support trading for simple trial scenarios.

This included functionality to identify trading opportunities by filtering constraint look-aheads and MOLs, ElectronConnect platform's functionality to submit bids and offers into the market, ElectronConnect platform's trade matching algorithm, and MOL re-ordering logic and mechanism.

4.1.3 Stage 3: Advanced simulation trial scenarios

The final stage of testing covered all the simulation trial scenarios, including those with flexible services contracts, multiple buyer contracts, and curtailment index updates.

Additionally, this stage validated the BiTraDER platform's capability for partial capacity trading, allowing larger contracts to be split into multiple smaller ones.

4.1.4 Development process

The phased integration testing approach allowed the project team to systematically verify the BiTraDER platform's functionality, from basic communication to complex trading scenarios, ensuring a robust and reliable system ready for deployment.

The Electron product team broke these stages down further into epics, large work packages used to manage deadlines and plan the expected workload on the engineering team.

These epics were prioritised in weekly planning sessions by the product and engineering leads. Once epics were prioritised, the product and engineering teams used epic refinement sessions to break down epics into smaller, more manageable user stories.

Once the entire team had agreed to the content and scope of the user stories, the engineering team underwent task breakdown sessions, where they split each user story into a set of manageable tasks containing detailed steps for implementation and testing.

4.2 Trading platform components

This section describes the components required to enable the trading platform's functionality and operation during the simulation trials.

4.2.1 Constraint look-ahead filtering and merit order list re-ordering

- Identifies all predicted constraints, their sizes, duration, start and end times.
- Identifies all resources (buyers and sellers) in the constraint look-ahead and checks whether they are registered on the BiTraDER platform.
- Identifies resources from the constraint look-ahead in the MOL and filters out (excludes) resources that are not allowed to trade in the market.
- Calculates the maximum capacity that buyers and sellers can trade in the BiTraDER market.
- Produces constraint-specific MOLs, which are used to notify participants about trading opportunities.

4.2.2 User registration

- Allows market participants to register on the BiTraDER deployment.

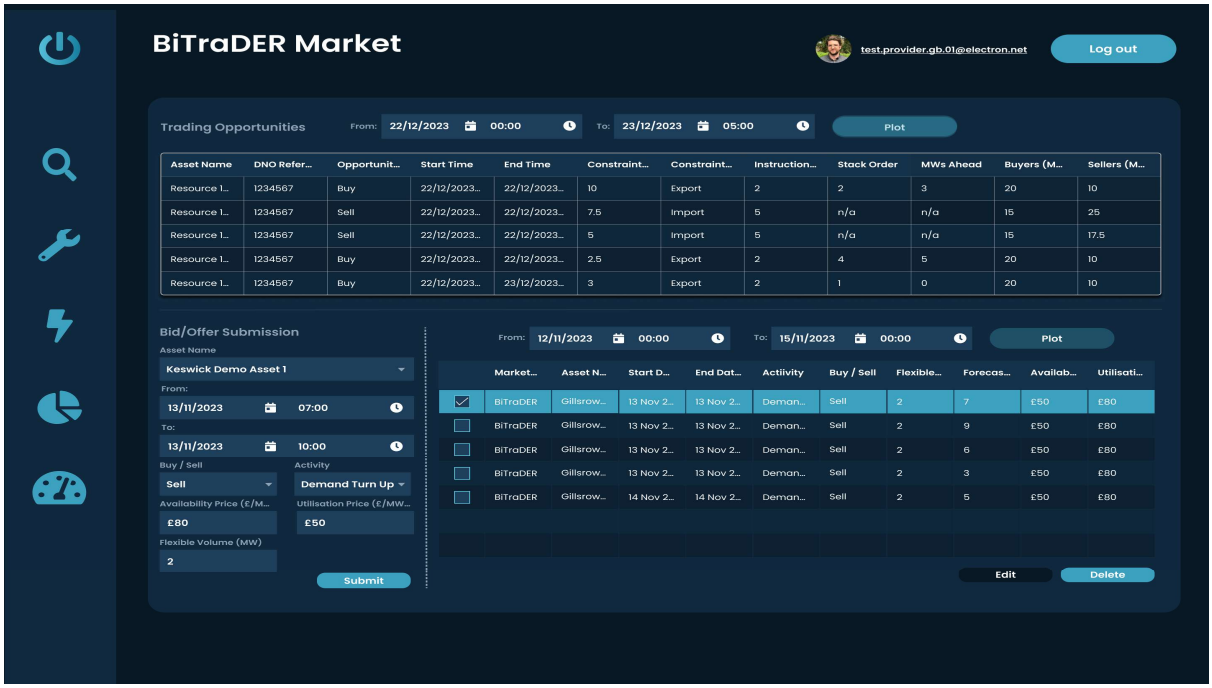
4.2.3 Asset registration

- Offers asset registration workflows using the ENA ON flexibility service pre-qualification standard template.

4.2.4 Trading opportunities and bids and offers submission

- Presents trading opportunities like those shown in figure 3 to BiTraDER market participants and allows them to submit bids and offers into the market.

Figure 3 BiTraDER platform trading opportunities. Source: Electron



4.2.5 Trade matching algorithm

- Utilises the trade matching algorithm to facilitate the BiTraDER trading rules.
- Each bid or offer consists of an availability price and a utilisation price, which are added together to calculate the all-in bid or offer price.
- Bids and offers are matched based on the all-in price (availability plus utilisation) and the availability payment.
- More information about the BiTraDER trading rules are available in the BiTraDER Trading Rules report.

4.2.6 Performance verification

- Offers performance verification workflows to market participants.
- Accepts baselines and meter readings from sellers to calculate the capacity delivered during dispatch events.

4.3 Upgrades for live trials

This section provides an early assessment of the changes required to transition the BiTraDER platform from the simulation trials to the live network trials subject to passing the stage gate.

4.3.1 Trade verification

- Ensures that all agreed trades remain valid on the day of dispatch.

- Checks that sellers can still provide a useful service to buyers and confirms that trading counterparties are still connected to the same part of the network.

4.3.2 Dispatch

- Dispatch instructions to be sent to assets via API.
- API to be configured between the live ANM, trading platform and customers assets.

4.4 Internal architecture build

It was decided to focus the system build for the simulation trials on the following aspects of the trading platform:

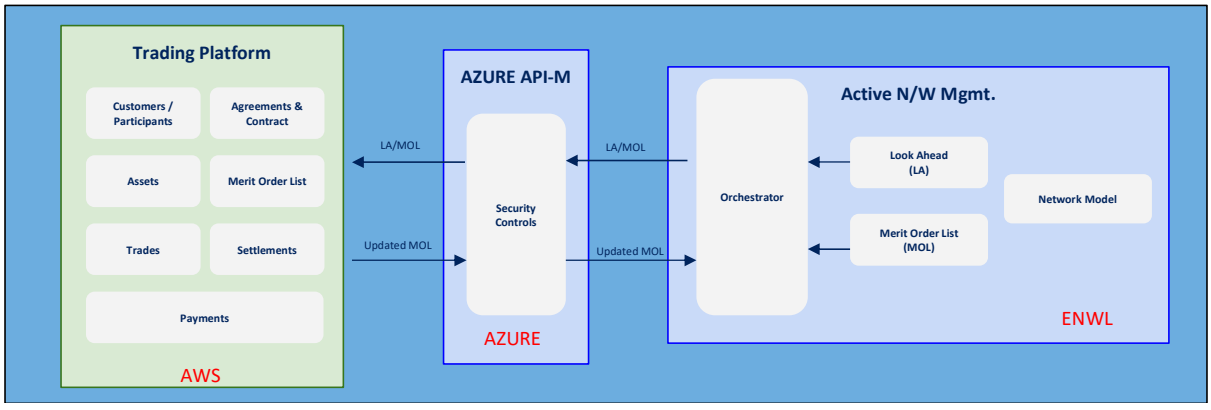
- End user customer experience.
- Price discovery.
- Managing the trading timelines.

This led to the conclusion that for the simulation trials, it is not required to integrate the trading platform with the live ANM system. Instead, the curtailment that leads to the trading activities will be simulated, along with the DER assets that are traded.

4.4.1 ANM orchestrator

The decision was made to create a simulation trial ANM orchestrator component that managed the flow of information between ANM and the trading platform. This solution is shown in figure 4.

Figure 4 Information flows



For each of the simulation trial scenarios, the ANM orchestrator submits the relevant look ahead and MOLs to ENWL's API management server in AZURE called API-M.

An example of the look ahead and original MOL is shown in figures 5 and 6.

The role of API-M is to provide a set of security controls to the solution. This includes authentication and access control and message payload validation.

Figure 5 Constraint Look Ahead

constraint_id	constraint_size	constraint_size_units	resource_id	resource_name
18/10/2024 08:00				
C1	2000	kW	G1_A1	Asset_1
C1	2000	kW	G1_A2	Asset_2
C1	2000	kW	G1_A3	Asset_3
C1	2000	kW	G1_A4	Asset_4
C1	2000	kW	G1_A5	Asset_5
C1	2000	kW	G1_Agg1	Aggregate_1
C1	2000	kW	G1_Agg2	Aggregate_2
C1	2000	kW	G1_Agg3	Aggregate_3
C1	2000	kW	G1_Agg4	Aggregate_4
C1	2000	kW	G1_Agg5	Aggregate_5

Figure 6 Original MOL

Order	Contract Id	Resource Id	Resource Name	Operation Type	Value	Value Units	MIC kW	MEC_kW	Activity	Traded	Registered	Curtailment Index
17/10/2024 14:00:00												
1	A1_Buyer	G1_A1	Asset_1	ConstrainedDemand	0	kW	700	1200	Buyer	False	True	
2	A2_Buyer	G1_A2	Asset_2	ConstrainedDemand	0	kW	500	500	Buyer	False	True	
3	A3_Buyer	G1_A3	Asset_3	ConstrainedDemand	0	kW	200	1200	Buyer	False	True	
4	A4_Buyer	G1_A4	Asset_4	ConstrainedDemand	0	kW	400	400	Buyer	False	True	
5	A5_Buyer	G1_A5	Asset_5	ConstrainedDemand	0	kW	200	200	Buyer	False	True	
6	Agg_Seller_1	G1_Agg1	Aggregate_1	FlexibleOutputChange	0	kW	600	0	Seller	False	True	
7	Agg_Seller_2	G1_Agg2	Aggregate_2	FlexibleOutputChange	0	kW	500	0	Seller	False	True	
8	Agg_seller_3	G1_Agg3	Aggregate_3	FlexibleOutputChange	0	kW	0	200	Seller	False	True	
9	Agg_Seller_4	G1_Agg4	Aggregate_4	FlexibleOutputChange	0	kW	0	500	Seller	False	True	
10	Agg_Seller_5	G1_Agg5	Aggregate_5	FlexibleOutputChange	0	kW	200	0	Seller	False	True	

Once the look ahead and MOLs are received by the trading platform, the information is used to set up the trading opportunity for customers to trade.

Customers will undertake trading, specific to the scenario at that moment and the new resultant MOL shown in figure 7 is sent back to the orchestrator via API-M.

Figure 7 New MOL

Recvd Time	Recvd Timestamp	Scenario	Order	Contract Id	Resource Id	Resource Name	Operation Type	Value	Value Units	MIC kW	MEC_kW	Activity	Traded	Registered
2024-10-18T08:00:00+01:00														
2024-10-17 21:08:45	1729195725	1	1	Agg_Seller_1	G1_Agg1	Aggregate_1	FlexibleOutputChange	-600	kW	600	0	Seller	true	true
2024-10-17 21:08:45	1729195725	1	2	Agg_Seller_2	G1_Agg2	Aggregate_2	FlexibleOutputChange	-500	kW	500	0	Seller	true	true
2024-10-17 21:08:45	1729195725	1	3	A1_Buyer	G1_A1	Asset_1	ConstrainedDemand	600	kW	700	1200	Buyer	true	true
2024-10-17 21:08:45	1729195725	1	4	A2_Buyer	G1_A2	Asset_2	ConstrainedDemand	500	kW	500	500	Buyer	true	true
2024-10-17 21:08:45	1729195725	1	5	A3_Buyer	G1_A3	Asset_3	ConstrainedDemand	0	kW	200	1200	Buyer	false	true
2024-10-17 21:08:45	1729195725	1	6	A4_Buyer	G1_A4	Asset_4	ConstrainedDemand	0	kW	400	400	Buyer	false	true
2024-10-17 21:08:45	1729195725	1	7	A5_Buyer	G1_A5	Asset_5	ConstrainedDemand	0	kW	200	200	Buyer	false	true
2024-10-17 21:08:45	1729195725	1	8	A1_Buyer-2-2024-10-18	G1_A1	Asset_1	ConstrainedDemand	0	kW	700	1200	Buyer	true	true
2024-10-17 21:08:45	1729195725	1	9	A2_Buyer-2-2024-10-18	G1_A2	Asset_2	ConstrainedDemand	0	kW	500	500	Buyer	true	true
2024-10-17 21:08:45	1729195725	1	10	Agg_seller_3	G1_Agg3	Aggregate_3	FlexibleOutputChange	0	kW	0	200	Seller	false	true
2024-10-17 21:08:45	1729195725	1	11	Agg_Seller_4	G1_Agg4	Aggregate_4	FlexibleOutputChange	0	kW	0	500	Seller	false	true
2024-10-17 21:08:45	1729195725	1	12	Agg_Seller_5	G1_Agg5	Aggregate_5	FlexibleOutputChange	0	kW	200	0	Seller	false	true

Further details of the internal architecture design and simulation trial test plan can be found in the BiTraDER test plan report.

4.4.2 Security testing

Security Testing involves testing the systems to uncover security vulnerabilities. This will require testing a variety of attack vectors. It should include:

- Validation of the login fields.
- Password strength criteria.
- Password lockout criteria.

This is performed to discover whether the login system can be forced into permitting unauthorised access. It will also ensure that the authorisation model provided for each system can be set up and will function as required.

Additional aspects of Security Testing that may be applied include:

- A Code Review for security vulnerabilities.
- Penetration Testing.
- Ethical Hacking.
- Non-Prod environments prior to decommissioning superseded Prod infrastructure.

5 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 figure 8 applies:

Figure 8 BiTraDER cyber security approach

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

BiTraDER deliverable	Cyber security deliverable	Rationale
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

5.1 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 delivering the project.

6 Lessons learnt

The iterative development process was crucial in enabling the Electron and ENWL IT teams to work collaboratively to create a valuable product that implemented novel trading algorithm logic for a variety of realistic constraint scenarios.

Early integration testing between the ANM Orchestrator and the BiTraDER platform allowed potential issues to be quickly identified and addressed, reducing the risk of major setbacks later in the process.

Splitting the scenario-based testing into two stages – simple and advanced – allowed the development of the BiTraDER platform to be successfully broken down into manageable sections.

Product demonstrations at the end of each development stage validated that the agreed requirements had been met and provided evidence of progress, increasing confidence in solution feasibility.

Regular meetings between ENWL IT and Electron development teams enhanced transparency and allowed for adjustments to the requirements when new information emerged. For example, additional scenarios were incorporated which had not been identified during the design phase.

This flexible approach was especially useful because the ANM and ElectronConnect systems which the BiTraDER Platform is dependent on are both being continually developed.

The development process was also supported by comprehensive documentation created in earlier project phases. An example is the detailed API interface specification which ensured consistent naming conventions and data formats between the ENWL ANM and ElectronConnect trading platform systems.

Additional design documentation and decision logs proved to be invaluable reference sources for explaining the latest design rationale. This was particularly valuable as BiTraDER contains novel trading rules and complex, evolving domain knowledge.

The underlying logic developed during the design phase played a pivotal role in shaping the integration process between the ANM system and the ElectronConnect trading platform. Whilst there was thorough design documentation explaining this logic, some of the test data used to validate asset trade capacities did not consistently follow these agreed rules. This caused confusion during the build and test of the BiTraDER Platform.

The ENWL ANM system is a highly complex system that contains logic specific to the associated DNO and network area. The above example outlines the importance of using high quality test data in innovation projects such as BiTraDER, to ensure clarity among numerous stakeholders from different organisations working with multiple complex systems.

Additionally, establishing a space for collaborative, synchronous updates to working documentation would further support collective product development, and provide a more direct communication path between engineers and DNO subject matter experts.

7 Conclusions and next steps

This report addresses the requirements for the BiTraDER D4 deliverable. The next phase of the project will see the built solution tested with a handful of participants in a realistic simulated environment.

Throughout the next six to eight months, participants will be sent trading opportunities enabling the platform interface and market rules to be tested.

The project team will keep in regular contact with the simulation trial participants seeking further feedback to upgrade or enhance the BiTraDER solution. Along with trial engagement, the team is keen to keep in regular contact with other stakeholders such as NESO. There are ongoing conversations about how BiTraDER could be used in conjunction with NESO's ancillary markets without causing potential conflicts.

The lessons learnt during this next phase will be vital to understand any additional tasks that need to be added into the project plan before further upgrades to the system are implemented in preparation for potential live trials, subject to passing the stage gate.

In preparation for live trials, we will also continue to conduct further customer engagement and recruitment to ensure we have the right mix of customers.