electricity north west

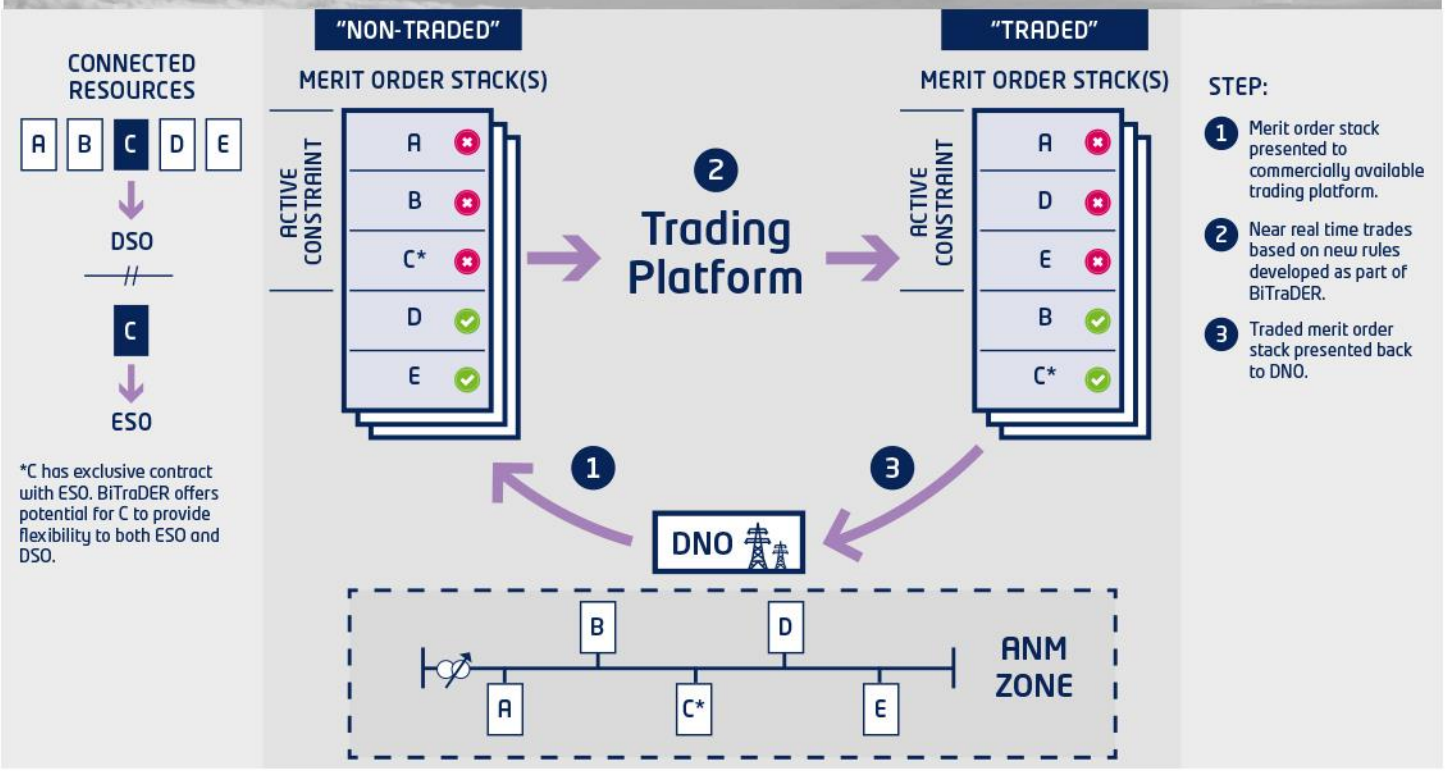
Bringing energy to your door

# BiTraDER

## Deliverable 3

### Interim Report – Trading Platform Design

February 2024




## Project Partners

AFRY AF PÖYRY

ELECTRON

LCPDelta

## Version

| Version | Date | Author | Status | Comments |
|---|---|---|---|---|
| V0.1 | 20th February 2024 | Chris Greenfield | Draft | For review |
| V0.2 | 22nd February 2024 | Chris Greenfield | Draft | Updated following comments from partners |
| V1.0 | 27th February 2024 | Chris Greenfield | Final | |
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## Approval

| Name | Role | Signature & date |
|---|---|---|
| Chris Greenfield | Innovation Project Manager | Christopher Greenfield<br>Digitally signed by Christopher Greenfield<br>DN: cn=Christopher Greenfield, o=ENWL, ou=Innovation, email=christopher.greenfield@enwl.co.uk, c=GB<br>Date: 2024.02.27 15:00:53 Z |
| Geraldine Paterson | Innovation Development Manager | Geraldine Paterson 27/02/24 |
| Victoria Turnham | Head of Network Innovation | Victoria Turnham 27.02.24 |

# 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** | Advanced Programming Interface – A type of software interface between two systems |
| **Aggregators** | Organisations that contract with a number of smaller organisations and use the collective capacity to trade in the flexibility market |
| **Baseline** | The point from which any delivery of flexibility is measured |
| **BaU** | Business as Usual |
| **BESS** | Battery Energy Storage System |
| **'Buyer'** | Party buying the ability to transfer their curtailment obligation to another connectee and accept a more favourable position in the merit order list |
| **CB** | Circuit breaker |
| **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 the ESO, to end users (commercial and domestic properties). |

| | |
|---|---|
| **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) |
| **EHV** | Extra High Voltage – a voltage of 33 00V or 132 000V |
| **ENWL** | Electricity North West Limited |
| **ESO** | Electricity 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. ESO is a natural monopoly in the flexibility market, acting as a neutral facilitator |
| **EV** | Electric Vehicle |
| **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 ESO |
| **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 |
| **GUI** | Graphical user interface |
| **HV** | High Voltage - a voltage of 6 600V or 11 000V |
| **I&C** | Industrial and Commercial – businesses in the industrial and commercial sector |
| **MEC** | Maximum Export Capacity – The maximum amount of electricity that may be exported onto the network |
| **Merit order list** | A list of connectees in a specific order for the ANM system to action |
| **MIC** | Maximum Import Capacity – The maximum amount of electricity that may be imported from the network |
| **'N-1' conditions** | N-1 means that is network is planned, and operated, such that the loss of any one element (e.g. an overhead line, a transformer, an underground cable) still allows the network to operate securely and to continue serving demand |
| **NIC** | Network Innovation Competition |

| | |
|---|---|
| **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) |
| **Peer to peer trading** | Trading between connectees, independent of the DNO or ESO |
| **RTU** | Remote terminal unit |
| **SCADA** | Supervisory Control and Data Acquisition |
| **'Seller'** | Party selling the ability to accept a curtailment obligation from another connectee, within the limits of their connection agreement |

# Executive summary

This report is the third 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 requirements and design of the connected resource interfaces, data formats, data flows and trading platform.

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 |

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 requirements and design of the end-to-end process covering the connected resource interfaces, trading platform, ANM interface, data flows and data formats.

# 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 at 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.

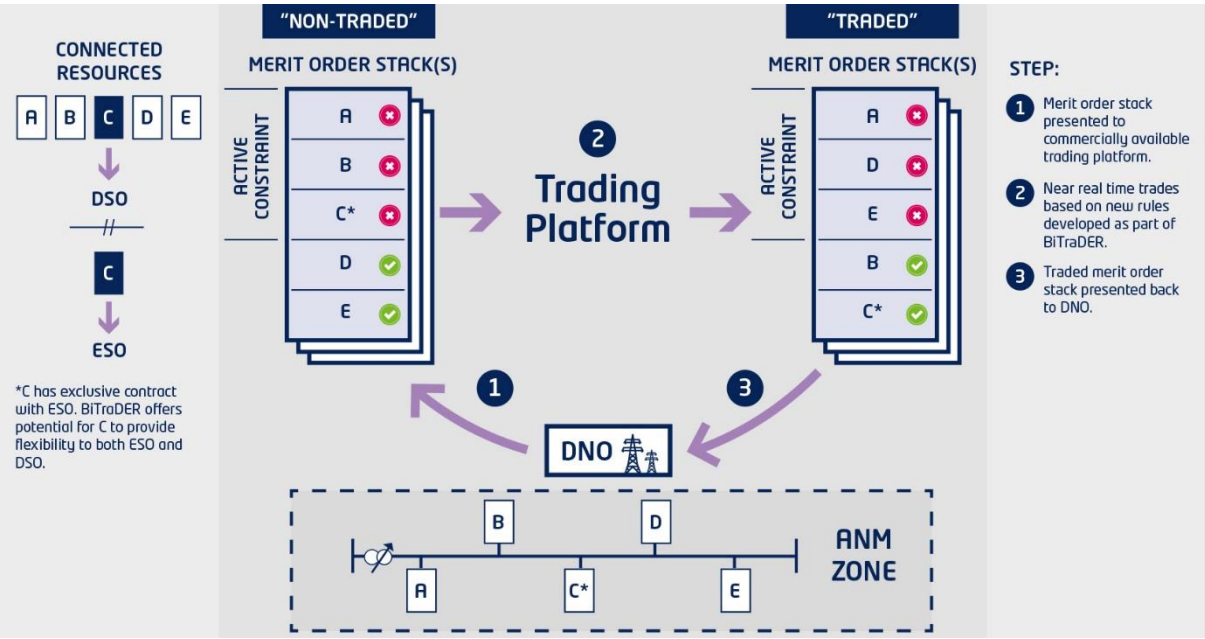
# 2 Overview of BiTraDER

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 ESO 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. Figure  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 Business as Usual (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 Trials

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

i. *Mini trials:* Ran as a one-day workshop on January 31st 2024.

ii. *Simulation trials:* Scheduled to run from August 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 BiTraDER Trials Plan, Trading Rules and Initial Specification report, the mini trials were added into the project as an additional stage after completion of the trading rules. The purpose was to de-risk the rules developed by carrying out some manual trading scenarios with a set of experienced participants which included asset owners, operators and aggregators.

In total 7 participants attended the event.

### 3.1.1 Scenarios

Two simple networks reflecting the ENWL network were developed and for each there were 6 scenarios shown in figure 2. The idea was to start simple and then move towards more complex scenarios such as the change in network topology or the constraint magnitude being bigger than expected.

*Figure 2 Scenario descriptions*

| Scenario | Description |
|---|---|
| 1 | Simple scenario with utilisation only payment method |
| 2 | Scenario 1 repeated with updated merit order position |
| 3 | Simple scenario with two-part pricing payment method |
| 4 | Scenario 3 repeated with updated merit order position |
| 5 | Change in network topology |
| 6 | Constraint is bigger than expected |

### 3.1.2 Profile cards

For each network, profile cards, as per figure 3, were given to the participants which contained information on their asset, whether they were a buyer or a seller, their operating value and the available capacity they were able to trade. Each participant was represented by a colour. Along with

the 7 participants, one member of the project team played an additional colour making 8 participants in total who actively traded.

*Figure 3 Buyer and seller profile cards*

| Profile ID:Orange | |
|---|---|
| Constraint ID | Scenario 1 |
| Asset type | Battery export |
| Contract type | Curtailable generation |
| Position | Buyer |
| Export value (MW) | 30 |
| Trade value | Drop to a maximum of 26MW |
| Merit order position | 1 |
| Curtailment index (%) | 9.99 |

| Profile ID:Yellow | |
|---|---|
| Constraint ID | Scenario 1 |
| Asset Type | Commercial demand |
| Contract Type | Non-curtailable demand |
| Position | Seller |
| Service | Demand turn up |
| Import Value (MW) | 6 |
| Trade Value | Turn up by a maximum of 4MW |

### 3.1.3 Trade notification cards

For each scenario, a trade notification card, as per figure 4 was given to each participant detailing the constraint. The information provided included the curtailment window and time, the size and type of constraint and information related to the position of the asset in the merit order list.

Additional market information for each asset was detailed in the notification card so the participants could get a view as to what their cost baseline would be. For buyers this would give an indication of how much they could lose in the markets should they be curtailed. For sellers this would indicate how much money they need to make from BiTraDER compared to the markets to make it a worthwhile trade.

*Figure 4 Buyer and seller trade notification cards*

| Buyer Trade Notification:Orange | |
|---|---|
| Constraint ID | Scenario 1 |
| Curtailment window | 08:00 - 08:30 |
| Constraint size (MW) | 16 |
| Direction | Export (too much generation) |
| Position in the merit order list (MOL) | 1 |
| Sum of MWs ahead of you in the MOL | 12 |
| Forecast curtailment (MW) | 4 |
| Number of sellers in the MOL | 4 |
| Sum of sellers MWs in the MOL | 14 |
| **Market information** | |
| Market information | Frequency services |
| Price (£/MWh) | £45 |

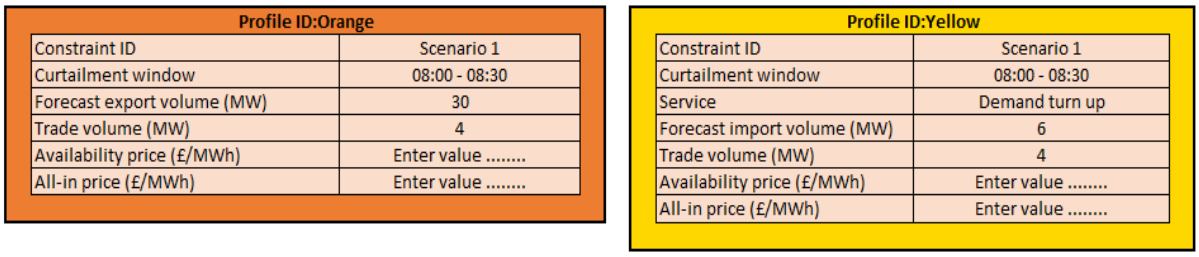
| Profile ID:Yellow | |
|---|---|
| Constraint ID | Scenario 1 |
| Curtailment window | 08:00 - 08:30 |
| Constraint size (MW) | 16 |
| Direction | Export (too much generation) |
| Number of buyers in the MOL | 4 |
| Sum of buyers MWs in the MOL | 16 |
| **Market information** | |
| Market information | Load shifting |
| Price (£/MWh) | £35 |

### 3.1.4 Bid/Offer submission cards

After the profile and constraint information, the participants were given bid/offer submission cards, as shown in figure 5 and instructed to submit their bids and offers in a sealed envelope to the "market operator" within a set timeframe. The market operator role was played by a member of the project team.

This was important to the team as we were trying to make the day realistic and give the sense to the participants of submitting real trades.

*Figure 5 Buyer and seller bid/offer submission cards*



| Profile ID:Orange | |
|---|---|
| Constraint ID | Scenario 1 |
| Curtailment window | 08:00 - 08:30 |
| Forecast export volume (MW) | 30 |
| Trade volume (MW) | 4 |
| Availability price (£/MWh) | Enter value ..... |
| All-in price (£/MWh) | Enter value ..... |

| Profile ID:Yellow | |
|---|---|
| Constraint ID | Scenario 1 |
| Curtailment window | 08:00 - 08:30 |
| Service | Demand turn up |
| Forecast import volume (MW) | 6 |
| Trade volume (MW) | 4 |
| Availability price (£/MWh) | Enter value ..... |
| All-in price (£/MWh) | Enter value ..... |

### 3.1.5 Participant feedback

Following the mini trials, the participants were asked to provide feedback which the project team would use to inform whether any amendments were required to the trading rules before commencing the build of any of the components in preparation for the simulation trials. We received feedback from six out of the seven participants, the most pertinent of which is summarised below.

There were two components that the team was particularly keen get feedback on:

- *The most favourable price structure*

  All responses indicated that a two-part pricing structure with an availability payment was the preferred payment method. Further details about the price structures can be found in section 4.7 of the Trading Rules report.

- *The most favourable format to use of the simulation trials*

  Participants were all keen for a workshop style format.

These two components are important when considering the design and methodology of the simulation trials and further details can be found in section **Error! Reference source not found.**.

There was a high number of participants with storage assets who flagged an issue to the team around day ahead baselining. The response of the sellers traded volume will be measured against a self-declared baseline of their intended demand/generation in the day ahead trading window. Some of the participants saw this as a challenge and preferred on the day baselining based off outturn metering.

Another concern was around the liquidity of the market. Since BiTraDER is a new market, there is still a limited number of assets available for trading with, however it is anticipated that the number of flexible connections on DNO networks will increase and a solution such as BiTraDER will be an enabling solution for curtailment obligation trading.

Overall, the participants rated the workshop highly and provided the ratings shown in **Error! Reference source not found.** 6.

*Figure 6 Post workshop survey results*

| Survey question | Rating out of 5 |
|---|---|
| Content of the workshop | 2 participants rated 5, 4 participants rated 4 |
| Delivery of the workshop | 2 participants rated 5, 4 participants rated 4 |

| Survey question | Rating out of 5 |
|---|---|
| Communication in the workshop | 1 participant rated 5, 5 participants rated 4 |
| Relevance of the session | 5 participants rated 4, 1 participant rated 3 |

## 3.2 Simulation trials

The simulation trials will see the trading algorithms built into the trading platform that customers will interface with to submit bids / offers. The platform will be integrated via API to the ENWL IT systems where the end-to-end data flows can then be tested throughout the 9 month trial period. This will be done by trading different network scenarios such as those used in the mini trials.

### 3.2.1 Test network

At this stage the assets that the participants will trade on will still be theoretical and no real money will change hands, hence there will be no settlement.

A test network will be set up on the NMS system in an area of the network with a high number of existing demand and generation assets of multiple technology types. For example, a primary substation and its associated HV feeders in a generation heavy area.

It is important that the test network has the capability to enable different scenario trading through its existing assets and also has interconnected network to demonstrate the effect of topology changes.

In the test system, each existing asset would represent a trial participant and by manipulating the demand and generation magnitude the constraints can be simulated and a look ahead generated and sent to the trading platform.

### 3.2.2 Format

The most favoured trial format at this time is what the team refer to as a hybrid approach and consists of:

1. An introductory in person workshop in early Autumn 2024 to run through an example scenario and introduce the trading platform. This will give the participants an opportunity to register onto the platform and run through the trade process.

2. Following this, we will conduct a monthly trading scenarios where the platform would receive the look ahead report and merit order list from the ANM system 48 hours before the "constraint time" and then issue the relevant constraint information to each participant.

3. Participants would then submit bids and offers via the trading platform before the trading window closes day ahead of the constraint.

4. The trading platform would then determine successful trades and send the updated merit order list to the ANM system.

5. At the "constraint time" ENWL will send an email to the participants informing them of the action we would have instructed them to take if the constraint was real

6. The day after the constraint we will hold a virtual meeting to discuss the successful trades and walkthrough the matching process carried out.

As with the mini trials the scenarios will start off simple and become more complex as we move through the trials.

There were initial concerns raised around the hybrid approach as the real time nature may increase the risk of non-responses. As we are expecting the participants to trade every month, a level of continuous engagement will be required to ensure that interest is maintained. To help with this engagement we introduced the virtual meeting to discuss the trades and matching.

The alternative approach under consideration is to conduct the full trading process done via a monthly virtual workshop with a shorter look ahead and bids / offers submitted during the meeting. This would mitigate the risk of non-responses compared to the real time approach, however, does not truly represent the BiTraDER process.

At this time, we have not reached a final decision on which approach we will adopt.

### 3.2.3 Pricing Structure

As indicated in the feedback from the mini trials, a two-part pricing structure with an availability payment is the preferred method for trading and as such, this will be built into the trading platform algorithm.

## 3.3 Live network trials

The live network trials provide the opportunity to test bilateral trading under real network conditions with real money changing hands.

However, 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.

Although we have initially identified the Harker/Hutton GSP network feeding the Cumbria Ring for the live network trials, this selection is still under consideration as other better candidate may arise during the project lifetime.

The progress into the live network trials is being monitored and a strategy is being considered for exactly how these will run.

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.

A focus going into the next phase will be to increase our engagement with customers specifically connected to the ENWL network and promote the project to these existing customers. Discussions are ongoing internally in ENWL to enable this.

# 4 BiTraDER system design

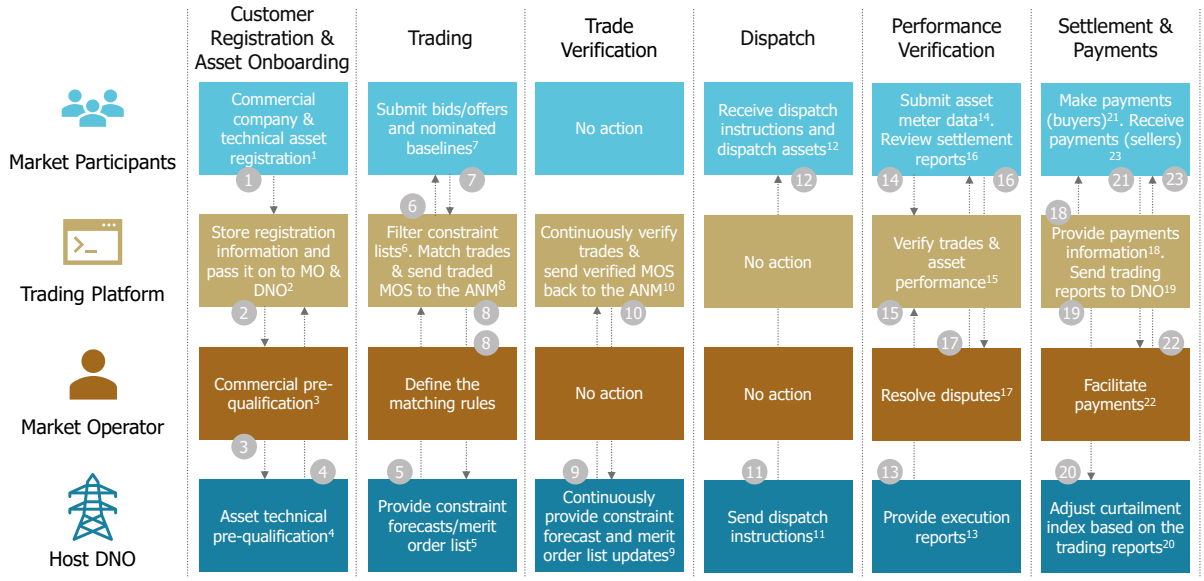
BiTraDER project partner, Electron, worked with the ENWL IT team to further develop the system architecture design and the trading platform design. This section provides a summary of the full design with more details provided in the Trading Platform Design and Data Model report.

## 4.1 Trading platform design

The BiTraDER trading platform will build 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.

Detailed requirements were developed for the six steps of the BiTraDER market process introduced in the Trials Plan, Trading Rules and Initial Specification report, and repeated in Figure  for ease.

*Figure 7 BiTraDER market process*




### 4.1.1 Customer Registration and Asset Onboarding

To join the market, participants will have to provide their company details, fill out the commercial pre-qualification questionnaire, and sign several legal documents. Applications will then be passed to the market operator for commercial pre-qualification checks and approval.

Once approved, participants will be granted access to the trading platform and will be able to register their resources. The host DNO will then review the resource details and either approve or reject resources from the market. Only qualified resources will be able to take part in trading.

The project team agreed that the commercial and technical pre-qualification questionnaires in BiTraDER will follow standardised pre-qualification process designed by the Energy Network Association's Open Networks programme.

### 4.1.2 Trading

The trading process starts with the host DNO's ANM system identifying upcoming constraints, determining the master merit order list, and sending this information to the trading platform.

Using this information, the trading platform will identify resources that are predicted to get curtailed (buyers of flexibility) and resources that can replace in them in the merit order list (sellers of flexibility).

Buyers and sellers will then be notified by the trading platform that they can submit bids or offers before the submission deadline.

Following the submissions deadline, the trading platform will match trades and re-order the merit order list using the rules and processes set out in the Trading Rules and the Trading Platform Design and Data Model reports. The 'traded' merit order list is then sent back to the host DNO.

### 4.1.3 Trade Verification

The trade verification process starts with the host DNO's ANM system sending updated constraint information to the trading platform before the start of every settlement period. The platform will use this information to verify that all trades, agreed the day before, are still valid on the day and can be dispatched. Once the trades are verified, the trading platform will re-order the merit order list, notify participants in case of trade cancellations and will send the re-ordered list back to host DNO.

The key definitions of a 'valid' trade are:

- *Both counterparties of the trade remain on the same part of the network.*
- *The time window of the trade matches the time window of buyer's curtailment.*

If a trade is cancelled the trading platform will place the relevant counterparties in their original merit order list positions.

We are not intending on building this functionality into the trading platform for the simulation trials, but it will be implemented for the live network trials.

### 4.1.4 Dispatch

The dispatch process is out of scope for the BiTraDER trading platform as the host DNO's ANM system will issue dispatch instructions to participants.

### 4.1.5 Performance Verification

After trades are completed, the trading platform will measure and verify trade performance using execution reports produced by the host DNO's ANM system along with meter readings and asset monitoring data from market participants. The execution reports will list dispatch instructions issued by the ANM system during the trading window and include information such as instruction times, direction, and sizes. The trading platform will then measure the service provided, by comparing asset meter readings against the baseline to calculate the volume delivered during the trade.

### 4.1.6 Settlement and Payments

After measuring trade performance, the trading platform will issue settlement reports detailing provided service volumes and payments due.

Settlement will be based on the 'Service Fulfilment (%)' the seller achieved during the trade. Payments will be proportional to the achieved 'Service Fulfilment (%)', but will depend on the payment type:

- Utilisation payments will be based on the achieved minute-by-minute 'Service Fulfilment (%)'.
- Availability payments will be based on the achieved 'Service Fulfilment (%)' but if a seller is not instructed to dispatch, they will receive their full availability.

## 4.2 User Journeys

This section describes the user journeys for each user type and to aid with the understanding the following should be noted:

- There are 3 types of interfaces to interact with the BiTraDER market:
    1. Trading platform's web application, referred to as a Graphical User Interface (GUI).
    2. Trading platform's application programming interface (API).
    3. 'Off-platform' interface, all other non-trading platform interfaces, e.g. email to receive notifications or interfaces provided by third parties.
- Internal market processes, such as the trade matching process, which are not exposed to users are marked with the 'BiTraDER market algorithm' symbol.
- These user journey interfaces assume the business-as-usual (BAU) phase of the market. During the simulation and live trials, some processes will be tested off-platform and simplified to ensure that market participants' time and efforts are focused on testing the core parts of the market workflow. A summary of which processes are going to be facilitated on-platform during the simulation trials is provided.

### 4.2.1 Market Participants' Journey

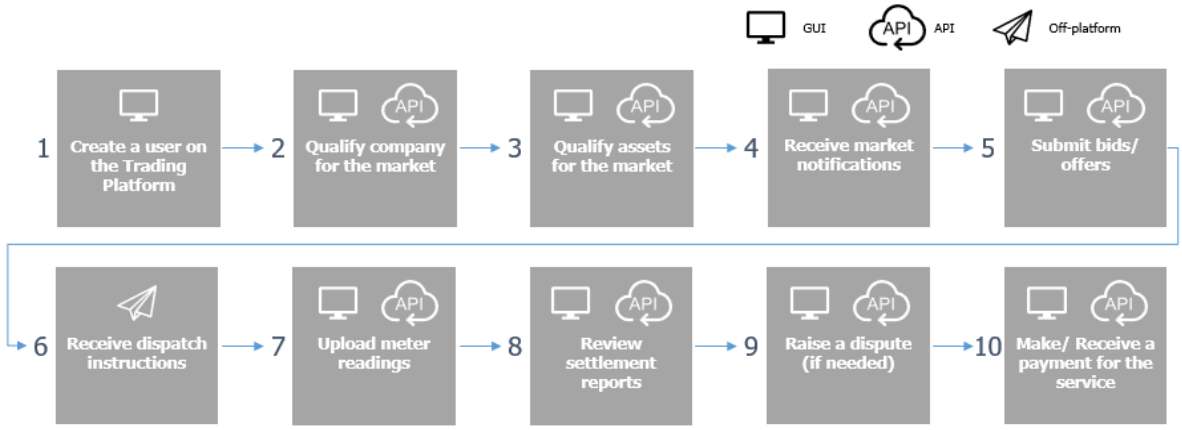
Market participants must be able to interact with the trading platform using either the GUI or the API where possible to improve the user experience for market participants and reduce participation barriers. Dispatch instructions will be issued via the host DNO's ANM system, hence, step 6 is marked as 'off-platform' within the trading platform's scope.

BiTraDER market could support on-platform payments for services, but this process could be also handled off-platform.

*The market participant user journey in*

Figure  includes a suggested interface type for each step; where two interface types have been specified the user will be able to choose which they use.

*Figure 8 Market participants' journey (BAU stage). Source: Electron*




The focus of the simulation trials will be on the trading workflow, steps 1 -5.

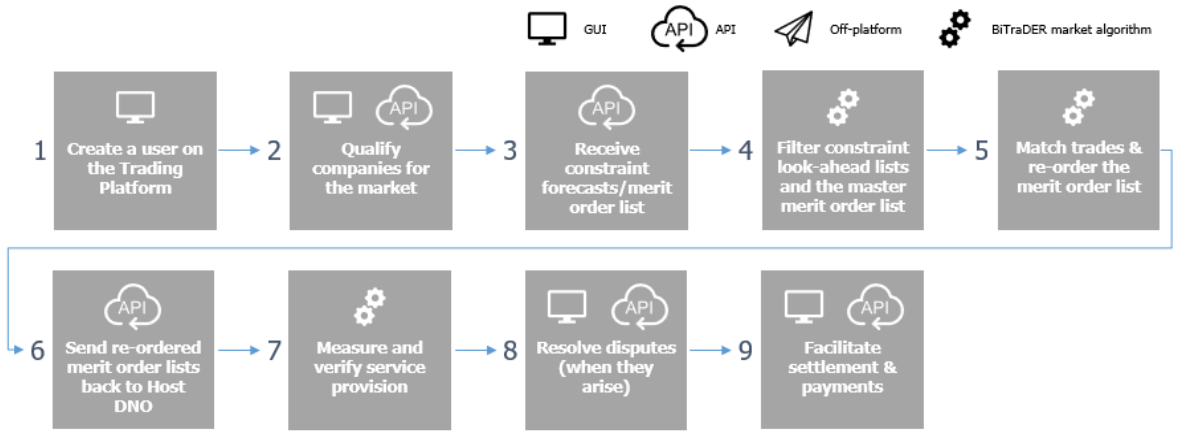
### 4.2.2 Market Operator's Journey (Incl. BiTraDER Market Algorithm)

The market operator will need access to information stored on the trading platform, such as market participant's company information, bid/ offer submissions, transactions data, meter readings, and more.

Steps 3 – 7 in the user journey shown in Figure  will be fully automated and will not require market operator's manual facilitation.

The market operator will need access to tools that would enable them to communicate with market participants. This can be supported on-platform in the form of messaging and platform notifications or done off-platform in the form of emails.

*Figure 9 Market operator's journey (BAU stage). Source: Electron*



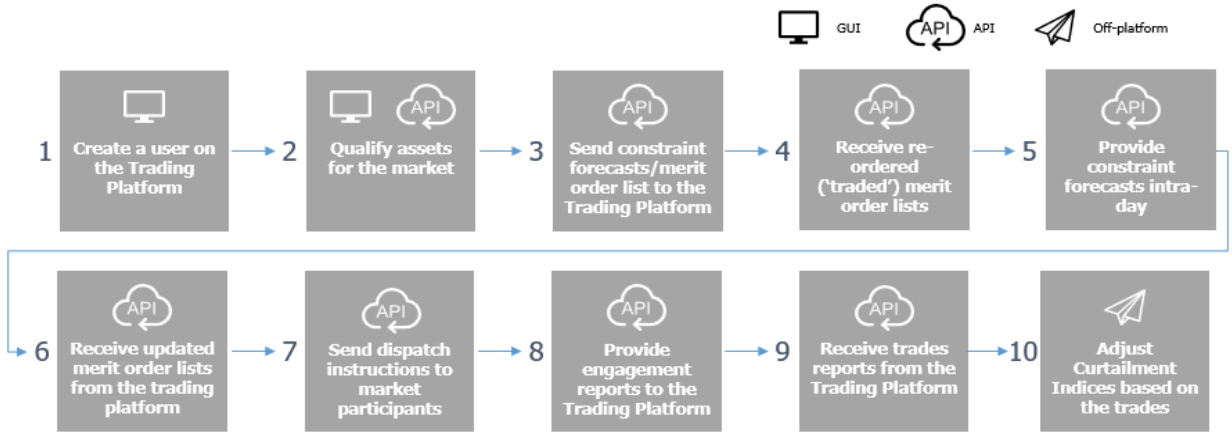

In the simulation trials, steps 3 – 7 will be fully automated and facilitated on-platform. Steps 1, 2, 8, 9 will either be facilitated off-platform or skipped altogether to direct market participants' efforts (and time) to testing core market processes.

### 4.2.3 Host DNO's Journey

Steps 3 – 6 and 8 – 9 in the user journey shown in Figure  will be fully automated and will not require manual facilitation. The trading platform and the host DNO's ANM system will communicate directly using APIs.

The host DNO will support the market operator in the qualification process, specifically by pre-qualifying participants' assets into the market (technical pre-qualification). To enable this, the host DNO will need to be able to access technical asset information on-platform and update or download it. Dispatch instructions will be issued by the host DNO using either SCADA or APIs (step 7). Curtailment Index adjustments will be done off-platform and is internal to the host DNO (step 10).

*Figure 10 Host DNO's journey (BAU stage). Source: Electron*




In the simulation trials,

- steps 3 – 4 will be automated and facilitated on-platform.
- step 2 will not be tested on-platform as participants will use simulated assets to trade.

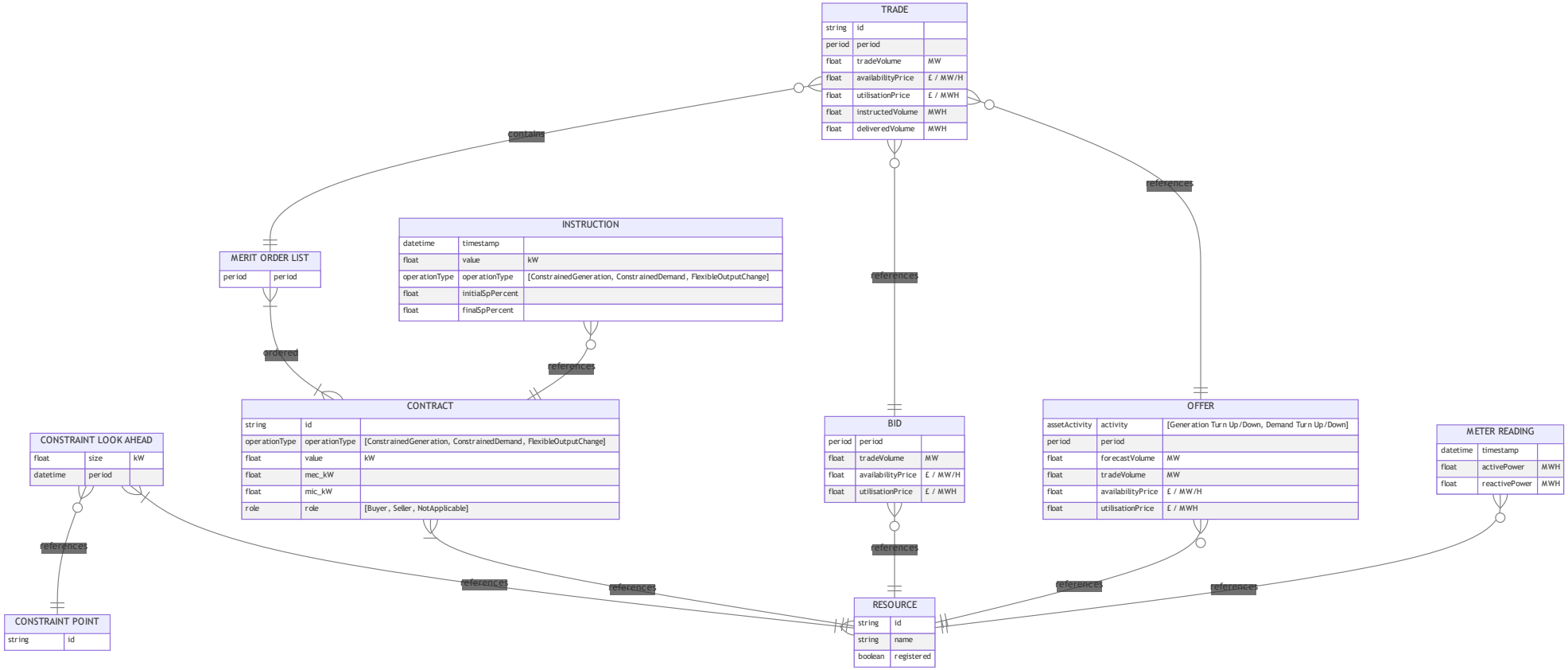
- steps 5 – 6 will not be tested in the simulation trials because the trade verification process is still not fully defined at this stage of the project.
- dispatch instructions (step 7) will be issued to participants via email to test the process.
- other user journey steps (8 – 10) will partially be tested on-platform.

## 4.3 BiTraDER Logical Data Model

BiTraDER's logical data model, Figure , establishes the structure of key data elements and the relationships among them. It also provides a high-level view of the data structures, independent of physical database which details specific implementation details. The BiTraDER logical data model consists of 12 components:

- *Resource:* A Distributed Energy Resource (DER) connected to host DNO's network.
- *Merit Order List:* An ordered list of contracts that may be required to perform flexible actions.
- *Incoming:* Incoming merit order list provided to the trading platform by the host DNO.
- *Outgoing:* Re-ordered merit order list provided to the host DNO by the trading platform following trading.
- *Contract:* An agreement between a Resource and the host DNO to provide an agreed volume of flexible service or curtailment in the event of a constraint.
- *Constraint Look Ahead:* A predicted network constraint for a specified time period and volume. References a list of Resources that can be used to resolve a network constraint.
- *Constraint Point:* A physical point on the network.
- *Bid:* A submission by a Buyer to request another Resource to provide flexibility services in BiTraDER.
- *Offer:* A submission by a Seller to provide flexibility services in BiTraDER for other Resources.
- *Trade:* An agreement between two Contracts, via a matched Bid and Offer, to provide a specified volume of service at an agreed availability and utilisation Price for a particular time period.
- *Instruction:* A message sent to a Resource requiring it to perform a flexible service action of a specified magnitude and direction.
- *Meter Reading:* The cumulative amount of active and reactive power measured at a single instant.

*Figure 11 BiTraDER logical data model.  Source: Electron*

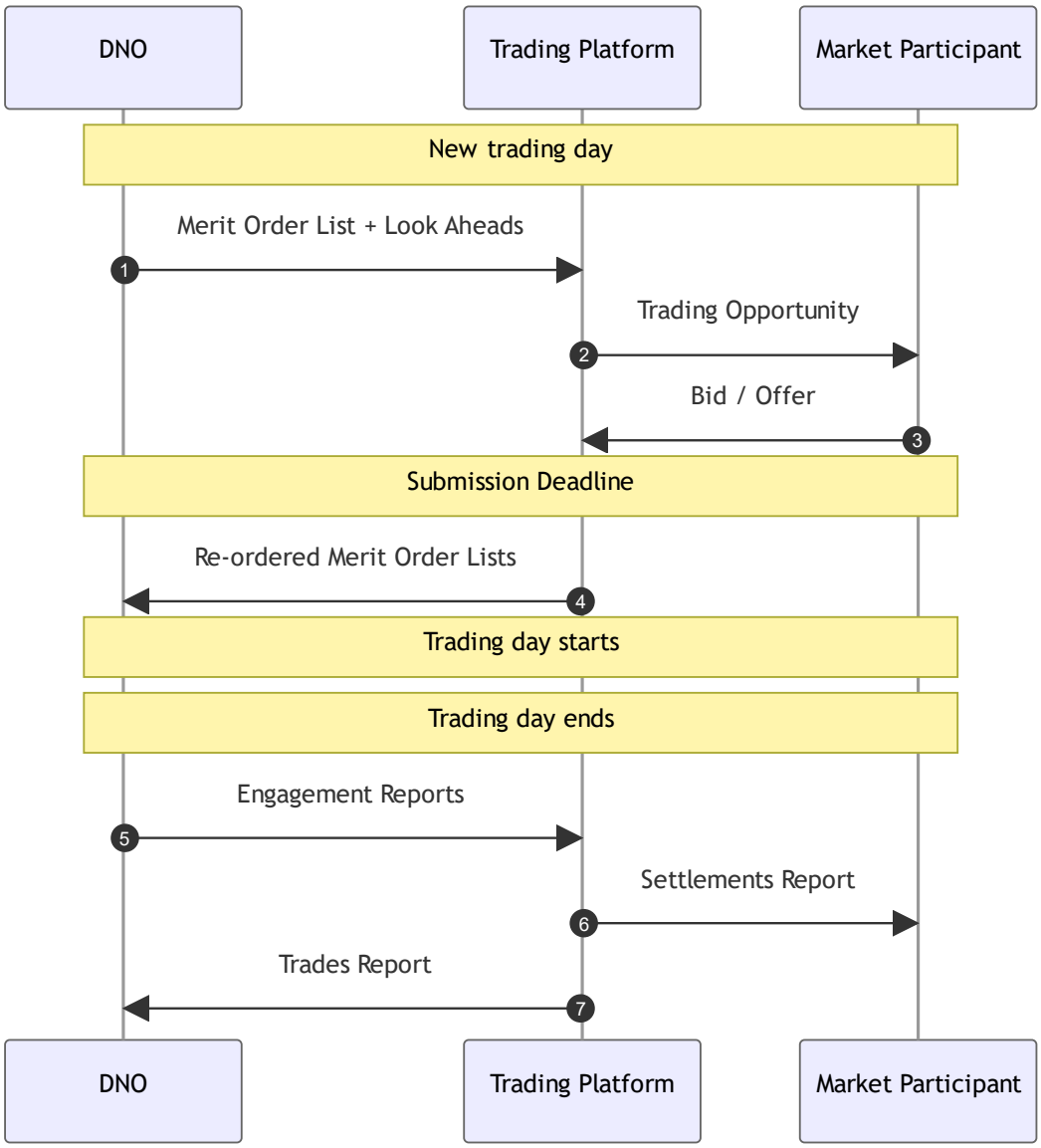


## 4.4 BiTraDER Data Flow

The data flow diagram, Figure , maps out the flow of information in the BiTraDER market and focuses on the core market workflow.

The data flows related to the trade verification process are out of scope for the simulation trials and the APIs for them have not been designed yet, these will be added for the live trials.

*Figure 12 BiTraDER data flow diagram. Source: Electron*




## 4.5 BiTraDER Functional Requirements

The BiTraDER functional requirements are presented in the Trading Platform Design and Data Model report and is final as of February 2024.

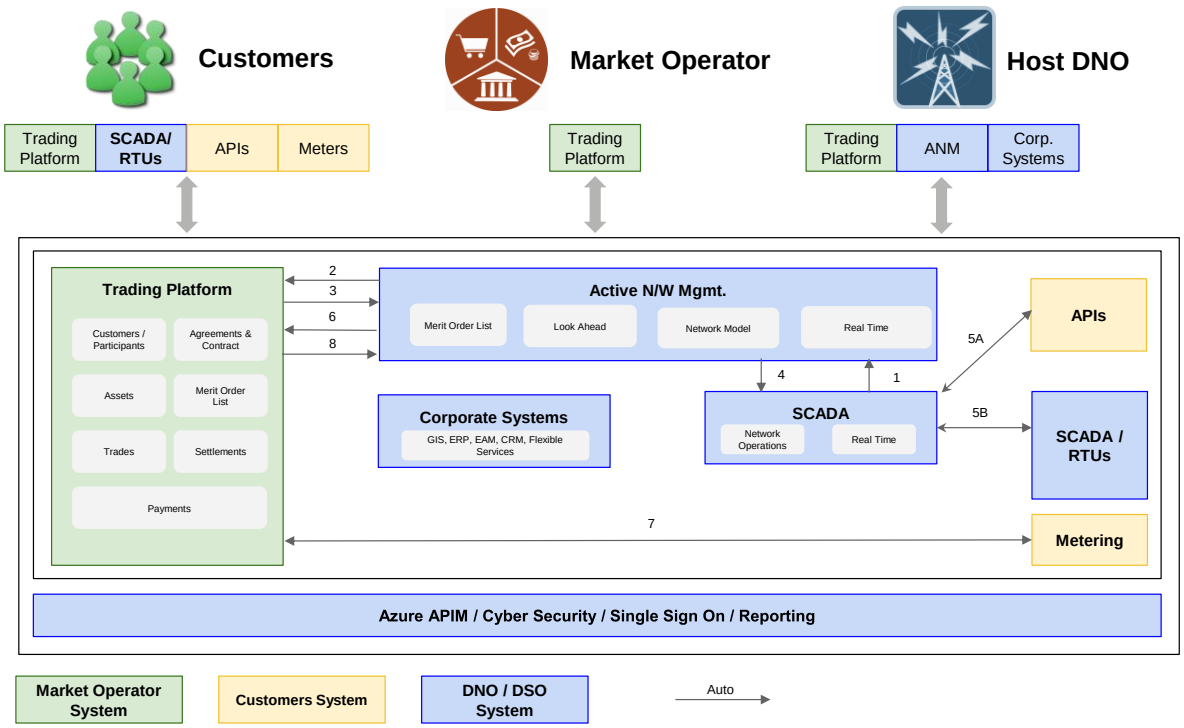
The list defines the functionality needed for the business-as-usual deployment of BiTraDER and the project team will continue to make changes and amendments to the functional requirements as more information becomes available, specifically during the simulation trials of the project.

Not all functionality will be implemented for project trials, primarily to enable a better user experience for market participants. The project team will decide and agree the trials solution scope during the build phase of the project.

## 4.6 Systems Integration design and interfaces

Figure  shows the main system components within the scope of BiTraDER and how they are integrated. Many of the components already exist and many of the interfaces already exist.

*Figure 13 Integration design overview*




For BiTraDER there are the four new interfaces between ANM and the Electron Trading Platform. The full catalogue of interfaces is shown in figure 14.

*Figure 14 Catalogue of required interfaces*

| ID | Source System | Target System | Direction / Auto | Message |
|---|---|---|---|---|
| 1 | SCADA | ANM | 1-way / Auto | Available Resource List / Real Time Operations |
| 2 | ANM | Trading Platform | 1-way / Auto | Look-Ahead and Initial Merit Order List |
| 3 | Trading Platform | ANM | 1-way / Auto | Traded Merit Order List |
| 4 | ANM | SCADA | 1-way / Auto | Execution Command / Switching Sequence List |

| ID | Source System | Target System | Direction / Auto | Message |
|---|---|---|---|---|
| 5A | SCADA | RTUs | 2-way / Auto | Manage Dispatch Starts and Stop signal for curtailable assets (currently in use for flexible connections) |
| 5B | ANM | APIs | 2-way / Auto | Manage Dispatch Starts and Stop signal for non-curtailable assets (these are listed as two separate interfaces in ON22-WS1A-P3) |
| 6 | ANM | Trading Platform | 1-way / Auto | Engagement report |
| 7 | Metering | Trading Platform | 2-way / Auto | Volume of curtailment service delivered by the participants |
| 8 | Trading Platform | ANM | 2-way / Auto | Trades Report |

### 4.6.1 ANM to BiTraDER Trading Platform Interfaces

#### *4.6.1.1 Look ahead list*

The constraint Look-Ahead fields which will be sent from the ANM system to the BiTraDER trading platform are listed and described in figure 15.

*Figure 15 ANM to BiTraDER look ahead list*

| No. | Field | Description and notes |
|---|---|---|
| 1 | seconds1970 | Timestamp in seconds1970 format. |
| 2 | Timestamp | This is the time when the report was run. |
| 3 | Period | This is the time the constraint is predicted to start. |
| 4 | Constraint ID | This is the unique constraint point identifier which relates to a physical point on the network. |
| 5 | Constraint size | This is the magnitude of the constraint. The value can be either positive (generation constraint) or negative (demand constraint). |
| 6 | Units | The units the magnitude is measured in (kW or kVAr). |
| 7 | Resource Identifier | This is the unique identifier for the resource. Resources listed here are the ones that can be used to resolve the constraint.<br>ANM Look-Ahead and master Merit Order List are connected through the Resource ID. |

| | | |
|---|---|---|
| 8 | Resource Name | The name of the resource which can be used to resolve the constraint. |

#### *4.6.1.2 Merit order list*

After receiving the Constraint Look-Ahead and the Master Merit Order List MOL files from the ANM system, the Trading Platform will identify and filter resources that can take part in the BiTraDER market.

The MOL fields are listed and explained in figure 16.

*Figure 16 ANM to BiTraDER merit order list*

| No. | Field | Description and notes |
|---|---|---|
| 1 | Timestamp | This is the time when the report was run. |
| 2 | Order | Resource's position in the merit order list. It defines assets' curtailment order in the event of a constraint on the network. Highest order (no. 1) gets curtailed first and so on.<br>Merit Order List is not constraint-specific – it's a master list for the whole network. |
| 3 | Resource ID | Resource ID is the unique identifier for the resource. |
| 4 | Contract Operation Type | Resource's contract type. There are 3 options available:<br>• ConstrainedDemand – Demand asset<br>• ConstrainedGeneration – Generation asset<br>• FlexibleOutputChange – DSO flexible service |
| 5 | Value | Value field indicates the maximum size of the flex action the asset would be required to take in the event of a constraint. |
| 6 | Units | The units the Value column is measured in (kW or kVAr). |
| 7 | MEC_kVAr | Reactive power Maximum Export Capacity (MEC) measure in kVAr. |
| 8 | MEC_kW | Active power Maximum Export Capacity measured in kW. |
| 9 | MIC_kVAr | Reactive power Maximum Import Capacity (MIC) measured in kVAr. |
| 10 | MIC_kW | Active power Maximum Import Capacity measured in kW. |

| | | |
|---|---|---|
| 11 | Resource Name | The name of the resource in the master MOL. |
| 12 | Buyer/Seller | A label indicating resource's role in BiTraDER. Available options:<br>• Buyer – the contract can be a buyer in BiTraDER<br>• Seller – the contract can be a seller in BiTraDER<br>• Not Applicable – the contract cannot trade in BiTraDER |
| 13 | Contract ID | Contract ID is the unique identifier for the contract the resource has in place with the DNO. |
| 14 | BiTraDER Registered Asset Flag | A field indicating whether the resource has registered on the Trading Platform. The field will be set to 'True' if the resource successfully passes the technical pre-qualification. |
| 15 | BiTraDER Traded Asset Flag | BiTraDER Traded Asset Flag is a new field in the Master MOL. When set to 'True', it indicates that the contract traded in BiTraDER. |

#### *4.6.1.3 Engagements Report*

Following the end of the trading day, the Trading Platform will receive an Engagements Report from ENWL. The Trading Platform will use Engagements Reports to analyse what instructions the ANM sent to BiTraDER market participants during the trading day.

The Engagements Report fields are listed and explained in figure 17.

*Figure 17 ANM to BiTraDER engagements report*

| No. | Field | Description and notes |
|---|---|---|
| 1 | Resource ID | Resource ID is the unique identifier for the resource. |
| 2 | Type | Resource's contract type. There are 3 options available:<br>• CurtailmentDemand – Demand asset<br>• CurtailmentGeneration – Generation asset<br>• Flexible – DSO Flexible Service |
| 3 | Curtailment | The size of the curtailment instruction sent from the ANM. |
| 4 | Units | The unit of the curtailment instruction (kW or kVAr). |

| | | |
|---|---|---|
| 5 | Initial SP % | Starting set-point percentage, before the instruction is sent. |
| 6 | Final SP % | Set-point percentage which the resource is instructed to reach. |
| 7 | Timestamp | Instruction time in seconds1970 format. |
| 8 | Timestamp | Instruction time. Note: all timestamps will be converted to UTC format. |
| 9 | User | Not relevant for BiTraDER. |
| 10 | Resource Name | The name of the resource in the Engagements Report. |
| 11 | Reason | Not relevant for BiTraDER. |
| 12 | Contract ID | Contract ID is the unique identifier for the contract the resource has in place with the DNO. |

### 4.6.2 BiTraDER Trading Platform to ANM Interfaces

The trading platform will send updated merit order lists to the ANM for each applicable trade period to dispatch the assets in the new traded order. The format for this updated list will follow that described in figure 16.

#### *4.6.2.1 Trades Report*

Following settlement, the Trading Platform will generate a Trades Report and send it to the DNO. The DNO will use the Trades Report to adjust participants curtailment indices. The Trades Report sent to the DNO will include the following information:

- Buyer Resource ID (or Contract ID)
- Seller Resource ID (or Contract ID)
- Start Date & Time
- End Date & Time
- Delivered Volume (MWh)

Information will be reported on half-hourly settlement period basis but extending reporting to minute-by-minute Delivered Volume can be considered too given that performance in the BiTraDER market will be measured on minute-by-minute basis.

# 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 18 applies:

*Figure 18 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 |
| 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 contained 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 Simulation Trials Orchestration

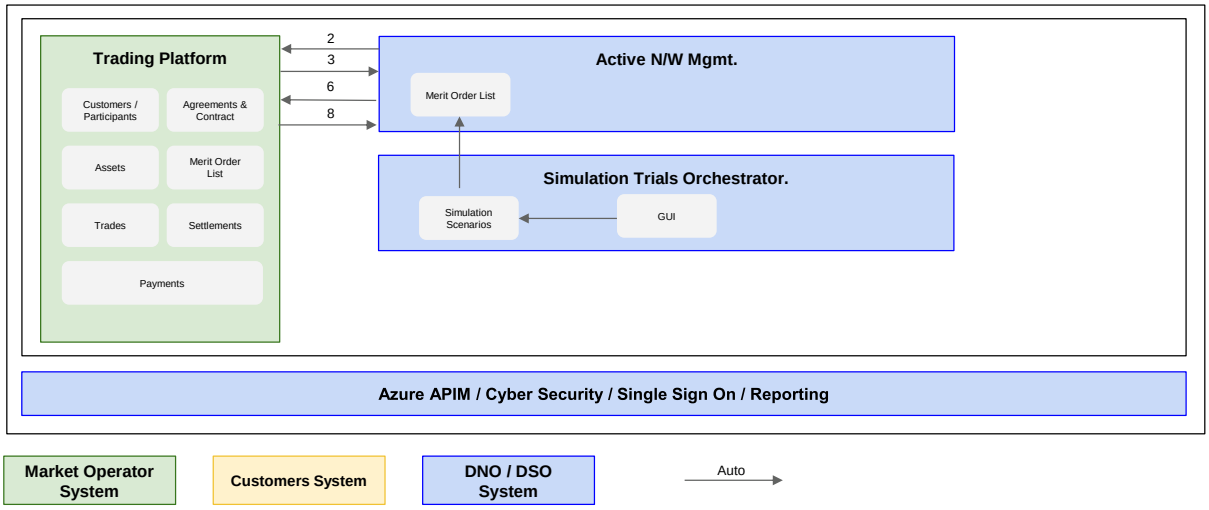
During the Simulation Trials, messages will need to be orchestrated to simulate the actions of the ANM system to be submitted to the Trading Platform at specified times on particular days.

A simple GUI will be created that presents a set of simulation scenarios that can be initiated by a user. Each scenario will generate a specific Look-Ahead message that defines the scenario and associated Merit Order List messages.

All the messages will be submitted to the enhanced Merit Order Management module of ANM and then submitted to the Electron Trading Platform for trading.

The diagram below shows how the Simulation Trials Orchestrator will interface to ANM.

*Figure 19 Simulation trials orchestrator*




# 7 API Management

The BiTraDER APIs enable digital integration by connecting the ANM system and the Electron Trading Platform. It utilises an existing framework provided by AZURE API-M.

The following elements are in scope for the BiTraDER project:

- API-M Security implementation
- Nomenclature - Standardised naming convention
- API versioning
- Developer portal implementation
- API-M Revisioning (staging)
- Zone/Regional redundancy

One of the main purposes of publishing APIs via API-M is to provide the required security controls to mitigate cybersecurity risks, accordingly, the details of the API-M design are not published in this document.

# 8 Performance

The performance objectives and message volumes that shape the design are as follows:

- Phase 1 – simulation trials: less than 100 messages per day
- Phase 2 – Live network trials: less than 200 messages per day

These message volumes are very small and as such do not require detailed analysis as the existing API-M capabilities will deliver these volumes.

# 9 Availability

Figure 20 includes the ENWL Business criticality matrix that applies to new and existing services within the ENWL environment. The BiTraDER system will be deployed in a phased manner.

- Phase 1 – Simulation trials. As this is a simulation the BiTraDER system, with no impact on physical assets, the system is designated as a Tier 4.
- Phase 2 – Live trials. As this is a live trial, but only impacting a small number of customers, the system is designated as a Tier 4.

*Figure 20 ENWL Business criticality matrix*

| | Tier 1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |
|---|---|---|---|---|---|
| **Business Impact (1)** | Serious | Significant | Moderate | Minor | Negligible |
| **Recovery Strategy** | Continues | Recover | Recover | Recover | Suspend |
| **Recovery Time (2)** | 0 – 1 Hours | 1 – 4 Hours | 4 – 24 Hours | 2 – 5 Days | 5 Days + |
| **Validation** | Annual | Annual | 2 Years | 2 Years | None |
| **High Availability** | RP4VM with Synchronous Replication | RP4VM with Asynchronous | RP4VM with Asynchronous | N/A | N/A |

| | | | | | |
|---|---|---|---|---|---|
| | | Replication set to 1 hour | Replication set to 8 hours | | |
| **Backup** | Networker Daily Gold Backup | Networker Daily Gold Backup | Networker Daily Gold Backup | Networker Daily Gold Backup | Networker Daily Gold Backup |

Figure 21 describes the criteria for each Tier.

*Figure 21 Business critically matrix - tier descriptions*

| Tier | Description |
|---|---|
| Tier 1 | Critical to the survival of the business; delays in recovery or continuance of this activity or service would be a threat to our ability to stay in business<br><br>This could have major customer impacts, high financial losses, potential for high reputational damage, and/or lead to large regulatory fine implications due to breaches of regulations |
| Tier 2 | Critical to the business, has significant customer and/or financial impacts, with potential for reputational damage; some regulatory fine implications could be imposed due to breaches of regulations |
| Tier 3 | Important to the business, with minimal customer or financial impacts and minimal reputational damage, possible small fines could be imposed due to breaches of regulations |
| Tier 4 | Important to the business, this is unlikely to have any customer, reputational damage or regulatory fine implications, could have some financial impact |
| Tier 5 | Important to a team, no impact to customers, financial, reputation or regulatory breaches, the main impact is likely to be the productivity of the team |

# 10 Conclusions and next steps

This report addresses the requirements for the BiTraDER D3 deliverable. The next phase of the project will see the components that have been designed be built into a working model to enable customers to trade in BiTraDER. Over the next six to eight months, we will develop:

- The trading platform programmed with the agreed market algorithms
- Upgrades to the ENWL IT systems to enable interfaces with the BiTraDER platform

- The scenarios and methodology for carrying out the simulation trials

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