Origami

POWER OVER ENERGY

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energynetworks association

ENA WS1A P6

Market Simulations Report v3.1

28-Apr-21

Version History

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Executive Summary

In 2019 the UK legislated to reduce the net emissions of greenhouse gases by 100% relative to 1990 levels by 2050[1] and have since strengthened this commitment with a Ten Point Plan to accelerate the path towards Net Zero[2]. To support this commitment, distribution network companies are exploring how they can increase the utilisation of their network and enable the significant increase in both low carbon distributed generation and demand through the electrification of heat and transport while maintaining the security of the networks. This transformation of the distribution network will require significant changes in the way the network is managed, with the use of flexibility being seen as integral to the future network.

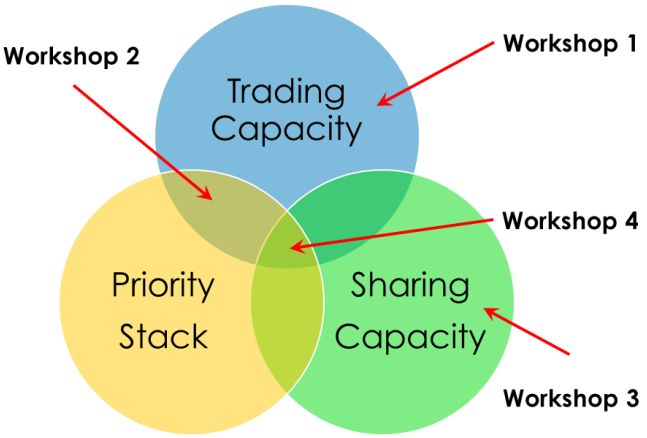
This is being considered by the Energy Networks Association Open Networks Project[3] (ON-P), a collaborative project which has a workstream dedicated to looking at the transition from today's Distribution Network Operator (DNO) to a future using Distribution System Operation (DSO) and the associated challenges this will entail, including interaction with the ESO. Workstream 1A of this ON-P is working on various aspects of flexibility for managing network congestion and constraints, with product 6 (WS1A P6) considering non-DSO Services. To build on previous work (see Appendix 1), WS1A P6 will undertake the following work during 2021:

- market simulation exercises for trading and sharing of capacity and risk of curtailment during Q1 2021;
- live trials in Q2 2021 and Q3 2021; and
- develop guidelines for business as usual implementation.

Origami developed and delivered market simulation exercises for trading and sharing of capacity and risk of curtailment during Q1 2021 to solicit feedback on these new market developments. There were five sessions: a briefing session and four workshops that each considered different aspects of trading or sharing of firm and / or non-firm capacity. The market simulation exercises were designed to be interactive sessions focused on obtaining stakeholder feedback on work undertaken by the Non-Access SCR working group who developed principles and rules that could be used to govern trading and sharing of capacity. The four workshops and their relationship to each other is shown in the figure below.

[1] "The Climate Change Act 2008 (2050 Target Amendment) Order 2019", published by HM Government, June 2019
[2] "The Ten Point Plan for a Green Industrial Revolution", published by HM Government, November 2020
[3] https://www.energynetworks.org/creating-tomorrows-networks/open-networks

- Workshop 1 considered 'Trading Firm Capacity' where users with excess Firm Capacity could commercialise it and users with insufficient Firm Capacity could pay for more capacity to increase demand or generation at the site.



- Workshop 2 considered 'Trading Risk of Curtailment (Non-Firm Capacity)' where users with a low risk of curtailment could commercialise their position and users with a high risk of curtailment could create more certainty for demand or generation at the site.
- Workshop 3 considered 'Shared Capacity' where a group of participants agree to a combine their Firm Capacity and Non-Firm Capacity and share in a collective Shared capacity.
- Workshop 4 considered the 'Potential Customer and Network Benefits' where participants reviewed the feedback from Workshops 1 to 3 and identified the resulting potential benefits and wider barriers.

The workshops provided a very high level of interaction and participation from stakeholders. The main points raised during the workshops can be summarised as follows;

Appetite/ Interest	DNO	Trading
Inconclusive; there is some appetite for Trading and Sharing of Capacity, but less for Trading Risk of Curtailment.	Require clarity on what constitutes hoarding, market rules and trading mechanisms.	Need visibility of market information, users willing to trade, and the trades conducted; no price information to DNO.
There is a risk there may be more sellers than buyers.	The expertise, neutrality, and resource of the DNO should be considered when assessing their role in this future market.	Trading and Sharing Capacity could increase LCT penetration, increase network usage and replace some ANM schemes.
Other changes, e.g. Profiling Capacity and outcome of the SCR, could reduce appetite for Trading and Sharing Capacity.	Impact of trading or sharing capacity on all market actors needs to be considered.	Short-Term / Medium-Term trades suit temporary / ad hoc requirements when risks are lower and Long-Term trades suit investment decisions.
The definition of and effect of Sensitivity Factors and lead time for system studies / approval could affect appetite.	The definition of and effect of Sensitivity Factors and lead time for system studies / approval could affect market growth.	A clearly defined set of Market Rules, standard P2P contract and standard trading periods would reduce barriers to entry and encourage greater market participation.

Trading and sharing firm and / or non-firm capacity are new market products and therefore there is little detail proposed of the market framework and supporting or affected processes. Previous work was paused because of uncertain appetite. The comments received during workshops provide areas for further consideration to inform the market design and they include (dependant on appetite and sufficient resources to progress);

- **Appetite** – engage with key stakeholder groups and individual organisations represented at workshops to determine the appetite and the level of interest in trading and / or sharing capacity and the potential value.
- **System Study Requirements and Sensitivity Factors** – provide clarity on how these can provide an early indication of the network acceptability of a capacity trade and determine how they can support market growth without adversely affecting appetite trading and sharing of capacity.
- **Standardisation for Trading** - work with key market actors to develop a standard P2P trade agreement, determine acceptable minimum duration and determine minimum trading periods or blocks.
- **Market Operation and Rules** - develop a clear set of market rules to enable the trading and sharing of capacity and consider how the market / access mechanism would operate and be facilitated to ensure a fair marketplace for all market actors.
- **Data Availability** – the information shared between all market actors, its visibility and the processes for sharing it must be determined to ensure a workable and fair marketplace for all market actors.
- **Aligning Changes** – develop a roadmap of other work (including innovation projects) and known future changes that could affect the appetite for or duration of trading, e.g. phased capacity, and when they are due to be announced. This will enable users to make informed decisions on trading and sharing of capacity, reduce stagnation through uncertainty and inform any business as usual implementation.
- **Identify Potential Trial Participants** for live trials in Q2 2021 and Q3 2021.
- **Phased Introduction** – consider using a phased introduction of the changes to avoid overloading DNOs with system studies, allow further consideration of the effect of trading on ANM systems and provide visibility of other changes that may be more attractive, e.g. profiled capacity.

This report summarises the development of these workshops and the feedback obtained from each. It also suggests future considerations to be explored before and during the live trials and when developing the guidelines for business as usual implementation in response to customer projects.

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1 Background

DNOs are exploring how they can increase the utilisation of their network and support the delivery of Net Zero through enabling the significant increase in both distributed generation and demand through the electrification of heat and transport. This is being considered by the Energy Networks Association Open Networks Project[4] (ON-P), a collaborative project which looks at the transition from today's DNO to a future using DSO and the associated challenges this will entail. ON-P has six workstreams to deliver the 2021 Project Initiation Document[5].

Workstream 1A is working on various aspects of flexibility, with product 6 (WS1A P6) considering non-DSO Services. In previous years, WS1A P6 has built on the work of the Non-Access SCR working group (see Appendix 1) and has worked with a range of current innovation projects to establish how DNOs can best support non-DSO services. As part of the recommendations from the Non-SCR group, WS1A P6 will undertake the following work during 2021:

- market simulation exercises for trading and sharing of capacity and risk of curtailment during Q1 2021;
- live trials in Q2 2021 and Q3 2021; and
- develop guidelines for business as usual implementation.

Origami was asked to respond to a request for a proposal to run market simulations to test and explore the trading and sharing of import and export capacity based on highly successful and similar stakeholder engagement events they developed and delivered for the Ofgem Network Innovation funded project TRANSITION[6].

2 Development of the Market Simulation Events

The market simulation events were based on materials already in the public domain (see Appendix 1) which contained high-level concepts and principles on the potential market framework and supporting / affected processes; feedback will be used to identify areas for further consideration and inform the market design.

These were used to develop five workshops; a briefing session and four workshops each considering different aspects of trading or sharing firm and / or non-firm capacity. Over 110

[4] https://www.energynetworks.org/creating-tomorrows-networks/open-networks
[5] "Open Networks Project 2021 Project Initiation Document January 2021 Version 1" (pre-consultation version) and can be found here
[6] https://ssen-transition.com/

stakeholders (including users, industry bodies and Ofgem) were invited with 59 unique attendees from 40 organisations and between 22 and 45 attendees at each workshop.

The trading and sharing of capacity apply to demand and generation sites. The workshops used generation assets in the scenarios as they are currently affected more by capacity issues and are easier to conceptualise. Demand and generation will be considered as this activity progresses.

2.1 Briefing Meeting

The Briefing Meeting provided the context of the workshops, an overview of capacity trading and sharing and how they relate to the trading and sharing of firm and non-firm capacity (see Figure 1). The presentation for the workshop is included in the Addendum to this report.

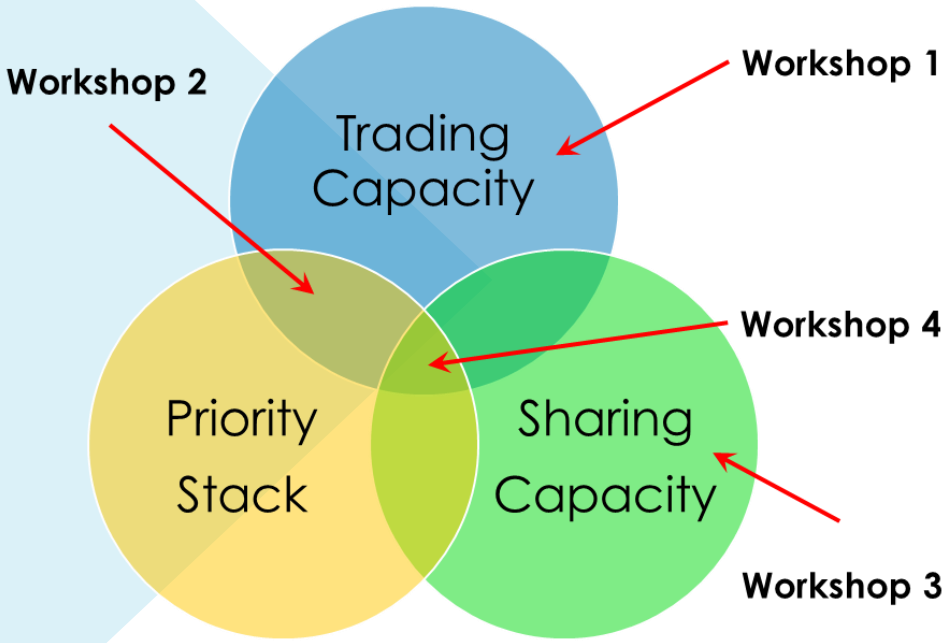

Figure 1: How the workshops addressed trading or sharing of firm or non-firm capacity

This was an open format workshop that benefitted from a good level of engagement from participants who asked a number of questions that were considered during the development of the market simulation workshops. These questions, and others raised during the market simulation workshops, are provided (together with answers) in Appendix 2.

2.2 Workshop 1 - Trading Firm Capacity

2.2.1 Main Concepts

The main concepts for Trading Firm Capacity are outlined in Table 1. The questions addressed during the Breakout Sessions are detailed in Appendix 3.

Table 1: Main Concepts for Firm Capacity Trading and Structure of Breakout Sessions

Firm Capacity Trading	Potential Benefits	Technical Considerations	Trading Principles	Breakout Sessions
▪ Users have a level of import and / or export capacity. Firm Capacity is guaranteed to be available, subject only to planned maintenance and faults on the distribution network. ▪ One user with excess Firm Capacity can trade with another user that needs additional Firm Capacity. One use case is a new connection or a solar PV installation that has more installed generation than existing Firm Capacity. ▪ Trading should be driven by a physical need for Firm Capacity and Firm Capacity should not be considered a tradable commodity or hoarded.	▪ A user with excess of Firm Capacity can monetise it on an enduring (years) or permanent basis. ▪ A user with a shortage of Firm Capacity can obtain more on an enduring (years) or permanent basis for a fee. ▪ Both users in a trade can improve their business case either through increased capacity or cashflow benefits. ▪ Enables more generation on the network that could contribute to Net Zero.	▪ Level of Firm Capacity that can be Traded can vary for each site. ▪ Location of the users will have different effect on local voltage levels. ▪ The technologies involved could have a significant effect on the level, pattern and certainty of generation over the year and the technical parameters could adversely affect the network. ▪ The DNO needs to conduct a system study to ensure the effect of the trade is no greater than prior to the trade.	▪ Principle 1 - transparent information sharing. ▪ Principle 2 - ability to maintain network continuity. ▪ Principle 3 - visibility of other potential trading parties. ▪ Principle 4 - transparent exchange arrangements.	▪ Two scenarios were used across three Breakout Sessions to consider scenario-specific questions (see Appendix 2) and obtain feedback on the Principles and rules. ▪ Scenario 1 considers a run of river hydro that wants to sell 400kW in summer and 200kW in spring and autumn and a solar PV installation that wants to buy 500kW in summer). ▪ Scenario 2 considers a landfill gas installation with depleting gas that wished to sell (2MW all year) and a solar PV installation that wishes to buy (500kW in summer).

2.2.2 *Feedback from the Trading of Firm Capacity Breakout Sessions*

The key questions and feedback from all three Breakout Sessions is summarised in Table 2 which does not represent an exhaustive, consensus, or majority view.

Table 2: Feedback from Trading of Firm Capacity Breakout Sessions

Trades	DNO	Duration and Profiling	Interest Level
A Master P2P Trade Agreement will enable trading, provide certainty and address financial issues (including going bust).	Participants were uncertain whether the DNO should conduct the system study before or after the trade has been completed.	Enduring (years) / permanent trades for investment certainty.	Users need to engage more with how they specify and use MIC / MEC.
Need visibility of those willing to consider trading.	The DNO should receive a fee for system studies and could receive an admin charge during the life of the trade.	Short-Term / Medium-Term trades are suited to ad hoc purposes or whilst waiting for network upgrades.	Requires more transparency (potential trading partners, where there is spare capacity).
Trading could be more economic or viable than alternatives.	BaU timescales for system study (65 Business Days) is too long and could slow market growth.	Trading over blocks of hours, days, weeks and / or months could suit some users.	Long-term trades may not be efficient; they may be a one-time as organisations focus on business as usual.
Need clarity on what constitutes hoarding, market rules and trading mechanisms.	Some attendees were firmly of the opinion that the DNO should not receive prices for trades.	Can the MIC / MEC be split over time, e.g. trade day with one user and night with another.	Participants requested what incentives and disincentives there are to return excess MIC / MEC to the DNO.
Managing demand could increase trading opportunities for generation.	Share information on capacity and users willing to trade with all market actors to increase liquidity and transparency.		Needs an independent platform for trading as this is a non-core activity for the DNO.
Need to simplify Sensitivity Factors so users can make rational decisions regarding trading capacities.	Needs to re-assess the capacities at end of a trade.		

Specific questions raised during this workshop are provided (together with answers) in Appendix 2.

2.3 Workshop 2 - Trading Risk of Curtailment (Non-Firm Capacity)

2.3.1 *Main Concepts*

The main concepts for Trading of Risk Curtailment are outlined in Table 3. The questions addressed during the Breakout Sessions are detailed in Appendix 3.

Table 3: Main Concepts for Trading Risk of Curtailment and Structure of Breakout Sessions

Trading Risk of Curtailment	Potential Benefits	Technical Considerations	Trading Principles	Breakout Sessions
▪ Users requiring additional or new capacity who require the connection quicker or cheaper an upgrade for Firm Capacity can elect for a Non-Firm connection that has a Risk of Curtailment. ▪ Two users in the same constraint zone can change their position in a Priority Stack by trading their Risk of Curtailment for a fee; one user increases their risk and the other reduces their risk. ▪ Users with a zero Risk of Curtailment have Firm Capacity and can trade with users with a non-zero Risk of Curtailment. ▪ Trading should be driven by a physical need for Firm Capacity and Firm Capacity should not be considered a tradable commodity or hoarded.	▪ Users can monetise their low Priority Stack position on an enduring (years) or permanent basis. This may suit users with flexibility or a seasonal demand or generation pattern. ▪ A user with a high Risk of Curtailment n can reduce their Risk of Curtailment for a fee on an enduring (years) or permanent basis.. ▪ Both users in a trade can improve their business case either through increased capacity or cashflow benefits. ▪ Enables more generation on the network that could contribute to Net Zero.	▪ Trading of Risk of Curtailment requires a system study to ensure the effect is nor greater than prior to the trade. ▪ Location of the users will have different effect on local voltage levels. ▪ The technologies involved could have a significant effect on the level, pattern and certainty of generation over the year and the technical parameters could adversely affect the network. ▪ The DNO needs to conduct a system study to ensure the effect of the trade on the network is no greater than prior to the trade.	▪ Principle 1 - transparent information sharing. ▪ Principle 2 - ability to maintain network continuity. ▪ Principle 3 - visibility of other potential trading parties. ▪ Principle 4 - transparent trading arrangements.	▪ Two scenarios were used across three Breakout Sessions to consider scenario-specific questions (see Appendix 2) and obtain feedback on the Principles and rules. ▪ Scenario 1 considers a solar PV installation that wants to reduce its Risk of Curtailment and increase generation and a run of river hydro that wants to increase its risk when it is unlikely to generate. ▪ Scenario 2 considers a solar PV installation that wants to reduce its Risk of Curtailment and increase generation and a landfill gas installation that wishes to use operational and fuel flexibility to increase its risk.

2.3.2 Feedback from the Trading of Risk Curtailment Breakout Sessions

The key feedback from all three Breakout Sessions is summarised in Table 4 which does not represent an exhaustive, consensus, or majority view.

Table 4: Feedback from Trading of Risk Curtailment Breakout Sessions

Trades	DNO	Duration and Profiling	Interest Level
Need visibility of those willing to consider trading and total capacity traded to indicate market liquidity and level of interest.	Participants asked if the Sensitivity Factors could be allocated to all users in the trading area, so they are pre-qualified before seeking counterparties.	Creating standard trading blocks comprising hours, days, weeks and / or months could suit some users.	The remaining risk of curtailment could reduce appetite, particularly to provide flexibility services.
The impact of trading on the Risk of Curtailment of third parties needs to be considered (commercial and technical impact).	Participants thought the existing timescales for a system study is too long and could slow market growth and asked if DNOs could dedicate resources to enable system studies or employ a third party.	The market could be limited by the capability of power system analysis tools and the capacity for the DNO to conduct system studies.	This could be of interest to developers of small-scale flexible energy facilities who could layer trading their Risk of Curtailment with flexibility.
Users increasing their Risk of Curtailment can demonstrate their ability to respond to curtailment instructions when they join an ANM scheme.	Concern was raised as to whether a DNO could / should be able to operate as a Neutral Market Facilitator if they are also trading in the market under their role as a flexibility services buyer.	A minimum duration for trades could be imposed to avoid overburdening DNO resources but this would affect market growth.	Apprehension about trades taking too long and not being dynamic enough.
Need to simplify Sensitivity Factors so users can make rational decisions regarding trading capacities.	Some attendees were firmly of the opinion that the DNO should not receive prices for trades of Risk of Curtailment.	Short / Medium Term trades are suitable for ad hoc purposes or a temporary solution whilst waiting for a connection providing Firm Capacity.	Participants questioned whether reducing the amount generation from LCTs was a sustainable solution.

Specific questions raised during this workshop are provided (together with answers) in Appendix 2.

2.4 Workshop 3 - Shared Capacity

2.4.1 Main Concepts

The main concepts for Shared Capacity are outlined in Table 5. The questions addressed during the Breakout Sessions are detailed in Appendix 3.

Table 5: Main Concepts for Shared Capacity and Structure of Breakout Sessions

Shared Capacity	Potential Benefits	Technical Considerations	Trading Principles	Breakout Sessions
▪ Users with Firm Capacity or a Risk of Curtailment in the same Primary Substation or Bulk Supply Point area pool their MIC and / or MEC. ▪ Users trade or adjust their MIC / MEC within a Shared Capacity limit and can trade excess capacity with third parties or new connectees. ▪ Requires a Shared Capacity agreement that considers; how capacity is traded, who will interact with DNO and market (and their remit) and what will happen at the end of the agreement. ▪ Any trading within Sharing Group should be driven by a physical need for capacity and capacity should not be considered a tradable commodity or hoarded.	▪ Users can monetise excess Firm Capacity or low Priority Stack position on an enduring (years) or permanent basis. ▪ Users can increase demand / generation by increasing their Firm Capacity or reducing their Priority Stack position on an enduring (years) or permanent basis for a fee. ▪ Maximises use of Shared Capacity between users who could profile capacity to meet their specific needs and use excess capacity to trade or enable a new connection. ▪ Enables more generation on the network that could contribute to Net Zero.	▪ Initial establishment of Sharing Group requires a system study to determine Shared Capacity. ▪ Users require DNO approval to exceed their original MIC / MEC. ▪ The DNO needs to conduct a system study to ensure the effect of any trade (within or external to the Sharing Group) is no greater than prior to the trade and does not adversely affect the network.	▪ Principle 1 - transparent information sharing. ▪ Principle 2 - ability to maintain network continuity. ▪ Principle 3 - visibility of the Sharing Group to other potential trading parties. ▪ Principle 4 - transparent sharing arrangements.	▪ One scenario was used across three Breakout Sessions to consider specific questions (see Appendix 2) and obtain feedback on the Principles and rules. ▪ The scenario considers three existing generators with a collective 15MW Firm Capacity, all of which wish to reduce their Firm Capacity and use it to enable a new connection and to trade the excess.

2.4.2 *Feedback from the Shared Capacity Breakout Sessions*

The key feedback from all three Breakout Sessions is summarised in Table 6 which does not represent an exhaustive, consensus, or majority view.

Table 6: Feedback from Shared Capacity Breakout Sessions

Shared Group	DNO	Duration and Profiling	Interest Level
Shared Capacity agreements could be instigated bilaterally or through the use of a platform and need to reflect significant changes to the network.	Changes to connection agreements and to Shared Capacity agreements would need to be approved by the DNO.	Trading over standard periods (blocks of hours, days, weeks and / or months) could suit some users.	Attractive for users with; dynamic management of multiple sites, additional sites for existing users and new connections or complex trading requirements.
Need visibility of users willing to consider sharing and the total capacity traded to indicate liquidity and level of interest.	Changing Connection Agreements (which may necessitate a system study / sensitivity factor analysis) must be quicker than at present to enable market growth.	The capability of power system analysis tools and staffing levels may slow approvals and changes to Connection Agreements.	More suited to complex trading requirements or those involving multiple users.
Participants queried whether a Sharing Group could purchase additional capacity from the market or sterilise capacity from the general market.	Sharing Groups would need to present evidence if they required additional Shared Capacity to avoid hoarding of capacity.	The minimum term of a Shared Capacity agreement will rely on the economics of transactions or membership requirements	Less attractive for; users that have simple requirements and platform providers (it is a closed arrangement).
This solution could suit a mix of technologies in the Sharing Group, e.g. solar, wind and storage.	Internalised Trading could be pre-approved by the DNO to enable dynamic trading within the Sharing Group up to set limits.	Capacity profiling could optimise the sharing of capacity within the Sharing Group and lessen the burden on the network.	

Specific questions raised during this workshop are provided (together with answers) in Appendix 2.

2.5 Workshop 4 - Potential Customer and Network Benefits

The purpose of this workshop was to;

- summarise the feedback from each of the trading and sharing of capacity workshops for those who were unable to attend all workshops. This feedback is presented in Table 2, Table 4 and Table 6.
- solicit further feedback on potential customer and network benefits. The questions addressed during the Breakout Sessions are detailed in Appendix 3.

2.5.1 Feedback from the Sessions

The key feedback from all three Breakout Sessions is summarised in Table 7. Please note that this feedback is a snapshot of some of the comments received during the sessions and does not represent an exhaustive, consensus, or majority view.

Table 7: Feedback from Customer and Network Potential Benefits Breakout Sessions

Trading and Constraints	DNO	Duration and Profiling	Interest Level
The value of trading may be directly correlated to network constraints.	Trading capacity could help the DNO move away from ANM schemes.	The ability to trade dynamically is essential to stakeholders.	Stakeholders have yet to engage with their customers to determine the interest in trading.
If there is no constraint, there may be little or no value in trading which could present a barrier to their successful uptake.	Users require visibility of DNO investment plans, network headroom and connection applications in each area of the network.	It may be difficult to find sufficient buyers or match the distinct needs of the customers.	Trading Capacity could provide certainty and unlock investment that was affected by Non-Firm Capacity.
Some changes to the constraint could have an adverse effect on trading appetite and value, e.g. change in connections and / or operations.	Long-Term Development Statements of DNOs and Heat Maps could be published more frequently to reflect capacity trades and help users understand potential location of opportunities.	There may be a shortage of those willing to reduce their capacity at peak times.	Trading / Sharing capacity is only useful if customers can access the level of capacity to suit their requirements which will require a mix of technologies.
Trading is one of a range of solutions and there should be a roadmap of future changes being considered to support user decision-making.	Could register the agreement through the DNO to mitigate the risks of trading / sharing capacity (e.g., the trading party going bankrupt).		Demand customers could monetise their flexibility to support trading and would increase network usage.
Trading capacity could increase the penetration of low carbon technologies if conducted in a structured way.	A review of security standards and a review of essential and non-essential loads may net additional capacity at very little or no risk to the network.		Mandating new premises to include flexibility will help manage the network peaks and increase the penetration of low carbon technologies.
The cost of transactions needs to be low to avoid this becoming a barrier to trading capacity.			Given the different drivers for generation and demand, these markets should be approached differently to maximise the effectiveness of the engagement.

Specific questions raised during this workshop (and answers) are provided in Appendix 2.

2.6 Summary of Feedback from all Workshops

There are a number of common themes that were discussed during all workshops and these are summarised in Table 8.

Table 8: Summary of Common Themes Discussed at Workshops

Appetite/ Interest	DNO	Trading
Inconclusive; there is some appetite for Trading and Sharing of Capacity, but less for Trading Risk of Curtailment.	Require clarity on what constitutes hoarding, market rules and trading mechanisms.	Need visibility of market information, users willing to trade, and the trades conducted; no price information to DNO.
There is a risk there may be more sellers than buyers.	The expertise, neutrality, and resource of the DNO should be considered when assessing their role in this future market.	Trading and Sharing Capacity could increase LCT penetration, increase network usage and replace some ANM schemes.
Other changes, e.g. Profiling Capacity and outcome of the SCR, could reduce appetite for Trading and Sharing Capacity.	Impact of trading or sharing capacity on all market actors needs to be considered.	Short-Term / Medium-Term trades suit temporary / ad hoc requirements when risks are lower and Long-Term trades suit investment decisions.
The definition of and effect of Sensitivity Factors and lead time for system studies / approval could affect appetite.	The definition of and effect of Sensitivity Factors and lead time for system studies / approval could affect market growth.	A clearly defined set of Market Rules, standard P2P contract and standard trading periods would reduce barriers to entry and encourage greater market participation.

3 Considerations and Next Steps

It is recommended WS1A P6 considers the following areas identified during the Market Simulation workshops during the live trials to be conducted in Q2 2021 and Q3 2021 and when developing guidelines for business as usual implementation;

- **System Study Requirements** – these studies are required for any trading or sharing of capacity; however, their long lead time may discourage customer appetite. Furthermore, multiple study requests could overwhelm the DNO, especially if there are "interactivity" issues - as one trade impacts another. Consider how managed market growth could be accommodated without adversely affecting the potential appetite for trading and sharing of capacity. This could be beneficial beyond the use cases outlined in this document, e.g., reducing the time needed for studies would benefit new connections. This work should also consider how any potential effect on the ESO would be addressed.

- **Sensitivity Factors** – these are referenced in the documents in Appendix 1 but have not been developed since, although they exist in some ANM schemes. These could present a challenge to the trading and sharing of capacity, as calculating them may take some time depending on the configuration and complexity of the network. Consider how these could be developed to provide an early indication of the capacity users could trade to support market development and confidence.
- **Standardisation for Trading** – there is a need for standardisation to develop (contract, duration of trades and periods of trade during each day, including patterns of trade over a period). Work with key market actors to develop a standard P2P trade agreement, determine acceptable minimum duration and determine minimum trading periods.
- **Market Operation and Rules** – the workshop discussed how the market could work and the principles and rules developed in the documents in Appendix 1. Further detail is required to ensure stakeholders understand the costs involved and risks and rewards of Trading / Sharing Capacity. Develop a clear set of market rules to enable the trading and sharing of capacity and consider how the market would operate, who should facilitate the market, the effect on ANM schemes and the interaction with the existing market rules.
- **Data Availability** – open data is being actively discussed but further progress will lower barriers to entry and support trading. The exact information to be shared between market actors, the visibility of this information and processes for sharing it must be determined to ensure a workable and fair marketplace for all market actors.
- **Appetite** – the simple canvassing during workshops identified a high level of uncertainty that did not help in determining the level of interest and value of trading and sharing capacity. It is proposed that WS1A P6 engages with key stakeholder groups and individual organisations represented at workshops to determine to determine the appetite and level of interest in trading and sharing capacity and to understand the potential value.
- **Aligning Changes** – develop a roadmap of other work and known future changes that could affect the appetite for or duration of trading, e.g. phased capacity or Access and Forward Looking Charges reform, and when they are due to be announced. This will enable users to make informed decisions on trading and sharing of capacity and reduce stagnation through uncertainty.
- **Identify Potential Trial Participants** for live trials in Q2 2021 and Q3 2021.
- **Phased Introduction of Trading and Sharing Options (post-trials)** - consider the value of this and how this could be implemented to avoid overload of the DNOs (e.g. system studies or

changes to ANM schemes) and allow further consideration of the effect of trading on ANM systems.

Appendix 1 – Background Materials

- "Industry-led Access Rights Allocation Group 2019 Combined report for 'The Trading of Non-firm distributed generation curtailment obligations', and 'The Exchange of Access Rights between Users' Product 1 and 2" published by the ENA on 13 January 2020. http://www.chargingfutures.com/media/1396/product-1-and-product-2-combined-report_version-10.pdf
- "Access and Forward-looking charges Sharing and Trading Explained SCR Access Subgroup" by Charging Futures and published by the ENA on 6 March 2020. http://www.chargingfutures.com/media/1418/scr-access-sharing-and-trading-explained.pdf
- "Access and Forward-looking charges Defining Local Shared Access Rights SCR Access Subgroup" by Charging Futures and published by the ENA on 19 June 2020. http://www.chargingfutures.com/media/1461/scr-access-product-2-defining-local-shared-access-final.pdf
- "Open Networks Project Market Facilitation (Non-DSO Services) Final Report Version 1.3" by WS1A P6 and published by the ENA in December 2020. https://www.energynetworks.org/assets/images/ON20-WS1A-P6%20Non%20DSO%20Services-PUBLISHED.23.12.20.pdf

Appendix 2 – Questions Asked during Workshops and Answers

The following questions were asked during the Briefing Meeting and the four workshops with verbal answers provided for most at the time. Written answers are provided for all questions for completeness.

Capacity Rights	
Could advanced ANM systems have functionality to work out sensitivity factors?	There are some ANM schemes which already employ the use of Sensitivity Factors. In highly congested network areas the Sensitivity Factors are worked out on a dynamic basis (about every 10 minutes).
How will Trading Firm Capacity link to the time profiled access rights being considered by Access SCR?	Trading of capacity and profiling capacity can work together as tools available to users of the network. Trading of capacity is a 2021 deliverable of ON-P and BaU processes will be considered later during 2021. The Access SCR will report in spring/early summer, including on time profiled access.
If there is 0% risk of curtailment, why are they non-firm?	A user with Firm Capacity has a connection that is only subject to outages due to maintenance and faults. It has a 0% risk of curtailment compared to a user with Non-Firm Capacity and was introduced to help understand the concept of Trading Risk of Curtailment.
Is capacity subject to the principles of a Last In First Off (LIFO) arrangement considered Firm Capacity?	A LIFO stack is a form of the Priority Stack introduced in the Trading Risk of Curtailment workshop. It is controlled by an automated network management scheme and manages the allocation of Non-Firm Capacity.
DNOs have recently tried to recover excess or unused capacity and there is some nervousness that trading and sharing of capacity is a means to recover such capacity. How can users be confident this is not the case?	The remit from Ofgem was to create an opportunity for users with excess or insufficient capacity to trade with one another and maximise the use of that capacity to users who have a physical use for the capacity. This would avoid hoarding of capacity and avoid increasing the network capacity for addressing peaks of solar generation or demand. There is no intention that DNOs would use this process to recover excess or unused capacity. Ofgem's decisions on Access and Forward Looking Charges may lead to clearer cost signals in charges.
How has the economic value of the LIFO stack trades between two users been determined to date and what is the role of the DNO?	There have been very few trades around a Priority Stack and these have largely been confided to innovation projects. It is not envisaged that the DNO will be involved in the pricing of Trading Non-Firm Capacity.

Is the DNO expecting to charge a fee to facilitate this service?	This is undecided and there are two possible approaches; ▪ users who trade capacity pay an admin fee per additional unit to cover additional costs; or ▪ the DNO enables trades through ED2 as part of BaU and the costs socialised as the trades would benefit the entire system.
Is the trade a one-off fee or an ongoing revenue?	Payment arrangements are a private matter negotiated between the users involved, but one of the workshops identified that there may be a credit risk if the paying party had financial difficulties or went into administration.
The suggestion for a Master P2P Trade Agreement is a very good one. Who should design that and should Open Networks be looking at a standard contract that the market can use?	A standard agreement that is co-created between the stakeholders (who have a better understanding of their needs) and Open Networks (facilitate and ensure fairness for all).
Will all capacity trades feed through to TCR charges and resultant band changes?	Highly likely, but no different to the outcome of any other access capacity increase or reduction process. the new maximum capacity would be reflected in a new connection agreement and in use of system billing.
General	
Is there information on the proportion of operational projects that have Non-Firm Capacity?	There is no data on all connections, but each DNO has an Embedded Capacity Register[7] that includes details of all flexible connections. Data collected on 31-Mar-21 had an aggregate of 5,190 MPANs of which 4,123 (79.4%)did not have a flexible connection, 855 (16.5%) were classed as TBC and 212 (4.1%) had a flexible connection.
How will trades affect the information in the Long-Term Development Statement (LTDS)?	The effect of trades on the Long Term Development Statement will need to be considered further by WS1A P6 to ensure users wanting a new connection to have relevant information available to them.
Market Simulations	

[7] A list of all generation projects connected to the DNO networks; https://www.energynetworks.org/industry-hub/databases (Embedded Capacity Registers)

Do the scenarios consider the use of flexibility as part of a holistic solution to capacity?	The workshops use simple scenarios to demonstrate the concepts and to support discussion around the principles and rules. TRANSITION and LEO are two DNO projects that are looking at this issue.
Will aggregation of capacity be allowed for trading and sharing of capacity?	Aggregation of capacity can be used to support trading and is implicit in the sharing of capacity. Aggregation for the purposes of creating a commodity that is tradable separate to physical use is explicitly forbidden as capacity should not be hoarded.
Will the workshops consider the consequential impacts of trading, e.g. the capability of the MPAN to measure increased capacity?	The workshops focus on the process and the delivery of trades using the principles and rules developed by the Non-Access SCR working group. It will not consider consequential impacts.
System Studies	
At what location does the trade happen, e.g. is it at the connection point, Grid Supply Point or across the whole DNO network? Is a trade considered using current system conditions or some worst-case scenario?	A trade does not happen at a single point as it is the interaction and effect of the trade on the local network (primary substation or higher voltage substation). This is determined by the DNO using a system study and information known about the network at that time.
Is there a very clear, technically precise view of how the sensitivity factors are calculated or this is more of a higher level qualitative concept for present? For what level of "trading" will sensitivity factors will be sufficiently accurate?	Sensitivity Factors are already used in some ANM schemes and were introduced as a concept in the work undertaken by the Non-SCR Working Group. There has been no development on the use of Sensitivity Factors for Trading or Sharing Capacity since June 2020, Sensitivity Factor for a particular site is a combination of the location of the site relative to the substation, the type of asset(s) on the site and their operating parameters. It is uncertain at this stage how often Sensitivity Factors will be determined and communicated to users to enable trading to progress or how they will reflect the output from system studies (if at all).
Traded Capacity	
The value of traded capacity will be constrained by the price differential between a Firm Capacity offer and a Non-Firm Capacity offer from the DNO. Who would pay more for capacity than this level set by the DNO and does this mean the DNO controls the market price?	The price differential between a connection with Firm Capacity and one with Non-Firm Capacity does help to identify a price for capacity. There are other factors that need to be considered, including; speed of connection, level of capacity required and the duration of any trade. The market will determine the value for traded capacity, but the point discussed about price was whether the DNO receives traded prices.

Would users know in advance the users with whom they could trade, or would they only find that out when they submit a trade to the DNO?	The intention is there would be some form of platform that would display the users who had "opted in" to share information with users with whom they could trade. It would be necessary for users to know the effect of the Sensitivity Factor on the trade.
Does trading excess capacity mean it moves from being a cost to an asset?	Yes and it can be traded for a temporary or permanent period to suit the user, perhaps with a profile. However, it is worth noting that at the moment, excess generation capacity has very limited cost.
From a DNO perspective, would they be able to manage daily trades?	During ED2, the DNOs are looking to assume the role of a Neutral Market Facilitator who would coordinate the market. This point was highlighted during the feedback on the Trading Risk of Curtailment workshop.
How prevalent is trading or sharing of capacity at present?	There have been limited instances of trading or sharing of capacity. Innovation projects explore and inform the development of the concepts. Some DNOs offer shared capacity agreements that apply before network upgrades are available to provide Firm Capacity. There was an outage on the Isle of Wight that resulted in the trading of capacity between users for the duration of the outage.
I assume trading will not apply to domestic customers as this was removed for consideration in the Access and Forward Looking Charges SCR.	Yes, Ofgem previously rules out specific network access choices for small customers due to likely complexity and the risk of customers making the wrong choices.
If users perceive enduring or permanent trades are more suited to investment and shorter or medium term trades are more suited to term or ad hoc requirements and these created a more liquid market, would that negate the need for shared capacity agreements?	The workshops identified a desire to be able to trade for much shorter durations than years, even as short as days or weeks. This would negate some of the benefits of Shared Capacity agreements, but these agreements also have a niche application as discussed in the Shared capacity workshop.
It appears a seasonal time of day approach to trading and to enable trading between different times of day, e.g. day / night trades would make sense. Will this be considered?	The workshops explored duration of trades, patterns of trading and standardised blocks to determine the interest in these concepts. This is provided in the feedback in the main body of this report.
System access is not binary: the distinction between Firm Capacity and Non-Firm Capacity is not nearly as	The DNOs cannot predict when a Non-Firm connection could be interrupted but do provide those considering a Non-Firm connection the data available to allow those users to make their own judgement on the risk.

relevant as confidently quantifying the degree of likely interruption. How realistic is it that DNOs would know the times/conditions associated with a Non-Firm connection in advance?	However, one user may have a high risk of curtailment that it wants to reduce whilst another user has a low risk of curtailment and can accept a higher risk than it currently enjoys. This was explored during the Risk of Curtailment workshop.
Visibility of Trades	
Being visible to the market and advertising a willingness to consider trades could highlight that a business is in trouble and this may be commercially sensitive.	Users have to choose to "opt in" and be visible to the market and any concerns about commercial sensitivity should be made at that time. In a liquid market, it is likely to be difficult to detect the reasons for trading.
Would information be available to all who "opt in" as interested in "buying" or "selling" capacity, rather than available to the wider market? Would you be able to opt in without providing information?	The workshops considered whether data should only be made available to those within the same network area. The feedback was that such data should be available to all to provide as great an opportunity as possible. There may be some restrictions to avoid the potential for market abuse, e.g. anonymised data initially available to determine market liquidity with more details made available later. This point should be considered as the market develops to ensure its development is not hampered as data is assumed to be open unless there is a commercial sensitivity.

Appendix 3 – Questions Considered in each Breakout Session

Trading Firm Capacity

Scenario 1

- the Principles outline a means of providing visibility of potential trading parties; would this help the Run of River Hydro and / or Solar Farm and, if so, how?
- what steps should the users that wish to trade Firm Capacity follow?
- if the trade for Firm Capacity was for 10 years, what are the options at the end of the trade for each user? What if more generation has connected on to the network since the trade was signed?
- the Solar Farm wants to connect additional capacity; what options are open to it?

Scenario 2

- what happens if the Hydro has a wet summer and needs to export more?
- should the trading parties be allowed to terminate or amend the trade and, if so, how? What are the options if one of the users that traded wants to change its capacity (up or down)? Should one user be allowed to force a change if the other is being unreasonable?
- what should happen if the trading parties want to extend the trade after the end of the initial duration? What happens at the end of the trade?
- should the trade be able to account for the profiling of Firm Capacity availability from the Run of River Hydro?

General

- is the ability to trade Firm Capacity an attractive option?
- are there other benefits from being able to trade Firm Capacity?
- given the Connection Agreement will be revised to reflect the trade of Firm Capacity, do you have any concerns?

Principle 1

- should only users impacted by a potential constraint receive information on Firm Capacity available to trade or all users be informed.
- what information should you provide to the DNO and how often? Should it include price information on a trade?
- what information would you require from the DNO to help you make a decision about whether or not to trade Firm capacity and with whom?
- do you believe that the use of a Platform could benefit the sharing of information? If not, how else could this be achieved?

Principle 2

- the DNO needs to report on the feasibility of a trade of Firm Capacity and to ensure it does not adversely affect the network - is there an alternative means of achieving this objective?
- what timescales would be appropriate for the DNO to report on the feasibility of a trade of Firm Capacity and to ensure it does not adversely affect the network given the equivalent is 65 BDs today?

Principle 3

- would the ability to "opt in" so the DNO can provide visibility of other potential trading parties be of use?
- is there an alternative to the DNO providing visibility of potential trading parties?

Principle 4

- what minimum time should apply before a trade can commence to allow for approval by the DNO and / or before another trade can start (if any)?
- trading is expected to be constructed in multiples of a minimum duration – what time period would be advantageous?

Trading Risk of Curtailment (Non-Firm Capacity)

Scenario 1

- the Principles outline a means of providing visibility of potential trading parties; would this help Gen 5 and / or Gen 8 and, if so, how?
- what steps should the users that wish to trade risk of curtailment follow?
- if the trade risk of curtailment was for 10 years, what are the options at the end of the trade for each user? What if more generation has connected on to the network since the trade was signed?
- Gen 8 wants to connect additional capacity; what options are open to it?

Scenario 2

- what happens if Gen 2 has a need to export more at some point?
- should the trading parties be allowed to terminate or amend the trade and, if so, how? What are the options if one of the users that traded wants to change its capacity (up or down)? Should one user be allowed to force a change if the other is being unreasonable?
- what should happen if the trading parties want to extend the trade after the end of the initial duration? What happens at the end of the trade?
- should the trade be able to account for the profiling of capacity to meet the availability of fuel for Gen 2?

General

- is the ability to trade risk of curtailment an attractive option?
- could a market actor trade capacity several times over a number of years with different counterparties each time (possibly selling all of its original capacity in the process)?
- are there other benefits from being able to trade risk of curtailment than those identified or use cases ?
- is there an alternative to the change required to the Connection Agreement to record trades?
- should a trade of Risk of Curtailment be for all of part of the Non-Firm Capacity being traded?

Principle 1

- should only users impacted by a potential constraint receive information on Firm Capacity available to trade or should all users be informed?
- what information would you require from the DNO to help you make a decision about whether or not to trade risk of curtailment ? How would you use it?
- what information should be shared with the DNO on trades and what should be confidential?

Principle 2

- the DNO needs to pre-authorise a generator wishing to trade; should this be before any counterparty is approached (possibly wasteful) or after a trade has been agreed (conditional trades)?
- could Sensitivity Factors be used to maximise the risk of curtailment that is traded?
- how could a generator prove it can meet a curtailment obligation?
- the DNO needs to pre-authorise a generator wishing to trade; what timescales would be appropriate given the equivalent is 65 BDs today?

Principle 3

- would the "opt in" process be of benefit? Is there an alternative to the "opt in" process?
- is the information identified useful in identifying potential counterparties? What other information would help? How could this information be made available? Should price information be shared with the DNO?

Principle 4

- what minimum time should apply before a trade can commence to allow for approval by the DNO, updates to Connection Agreements and / or before another trade can start (if any)?
- trading is expected to be constructed in multiples of a minimum duration – what time period would be advantageous?

Shared Capacity

Scenario ▪ the Principles outline a means of providing visibility to potential trading parties; would this help the Sharing Group and, if so, how? ▪ what steps should be followed by users that wish to trade Non-Firm Capacity? ▪ if the Sharing Group agreement existed for 10 years, what happens at the end (original capacity, capacity trades and capacity sales)? What if more generation has connected on to the network since the trade was signed? ▪ if Gen A wants to connect additional capacity; what options are open to it? ▪ what steps should users that want to trade Firm Capacity follow? ▪ should a member of the Sharing Group be able to object to a trade for the benefit of the entire Sharing Group? ▪ should there be a minimum term for the Sharing Group? What should happen if the members want to reduce or extend the term for the Sharing Group? ▪ would being able to seasonally profile capacities be of advantage to the members of the Sharing Group and, if so, how often could they be changed and what duration should apply?
General ▪ is a Shared Group an attractive option? ▪ are there other benefits from being part of a Sharing Group than those identified or use cases ? ▪ should the Sharing Group be allowed to purchase more than their collective capacity needs? ▪ how often do you think the parties may want to change their capacities? ▪ is there an alternative to the change required to the Connection Agreement to record trades? ▪ what would happen if a member wanted to increase their installed generator capacity?
Principle 1 ▪ what kind of rules should be included in a Sharing Group agreement to share Access? ▪ details of the Sharing Group should be made available to the DNO as well as the lead party; are there any issues regarding sharing this information? And what details should be confidential?
Principle 2 ▪ the DNO needs to pre-authorise capacity changes; are there any limitations to the scope of such authorisations? What timescale should apply for authorisation? And what if authorisation is withheld? ▪ the DNO needs to pre-authorise new connections; are there any limitations to the scope of such authorisations? What timescale should apply for authorisation? And what if authorisation is withheld?

Principle 3 ▪ how could visibility be provided in the wider market and to individual members of the Sharing Group? ▪ what frequency should the DNO be informed of members of the Sharing Group? ▪ the Sharing Group should inform the DNO of trades on behalf of the Sharing Group (including sales of capacity); should a threshold apply? When should his happen? ▪ who is best placed to act as the lead party on behalf of the Sharing Group?
Principle 4 ▪ the DNO needs to be aware of capacity reallocations and that the capacity of a member is adequate for their needs; is this acceptable or should members be responsible for their own capacity changes?