Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Jul 2023

Project Reference Number

NIA_SSEN_0067

Project Registration

Project Title

ExtenDER

Project Reference Number

NIA_SSEN_0067

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

August 2023

Project Duration

2 years and 5 months

Nominated Project Contact(s)

Tim Sammon, Innovation Programme Delivery Manager at SSEN

Project Budget

£1,410,000.00

Summary

This is a feasibility study to better understand the risks associated with market-based connection services. The purpose of this study is to engage with stakeholders to document the risks and propose strategies to mitigate or remove the risk. If mitigation strategies are approved by SSEN, National Grid Transmission and National Grid ESO, a second live trial phase may be pursued. The project is also attempting to understand market liquidity, which will also be used to determine whether a second phase should be initiated.

Preceding Projects

SSEEN0 - TRANSITION

Third Party Collaborators

baringa

Electron

Nominated Contact Email Address(es)

fnp.pmo@sse.com

Problem Being Solved

Growing energy demand

According to Regen, by 2035 electricity demand in GB will almost double to 450-500TWh a year. This will be driven by the increasing electrification of transport and heat in addition to demand growth from increased economic activity.

Network access for all
The growth in energy demand will require more capacity on both transmission and distribution networks - Anticipation of capacity needs and providing them on the network has already become a challenging task.

Connections queues and other challenges
The cumulative growth in the requirement for new capacity across the distribution network, inevitably results in the need for reinforcement of the upstream transmission system. Resolving these transmission level constraints can be a lengthy and expensive process. An emerging example of this is developing in the Greater London Authority (GLA) area where Transmission constraints are delaying new distribution connections until c2030 https://www.london.gov.uk/media/4975/download. Whilst distribution and transmission licensees are working hard to resolve these issues conventionally, there is an opportunity to explore other options to address these constraints using a Market based approach to connections.
If successfully developed, these can be compared to the existing Active Network Managed connections and Constraint Managed Zone tools for addressing constrained networks.

Method(s)

Phase 1 – Feasibility Study
'Market-Based Connections' – a potential new type of connection arrangement that permits assets to connect to the grid on a non-firm basis (with no limited capacity guarantee from DNO) and trade their way to the required import capacity by trading with others already connected to the network in a local flexibility market on the constrained side of the network constraint that is limiting the connection.

The purpose of the project is to evaluate the risks associated with market-based connections and test if it is feasible to implement a connection agreement that can facilitate these types of connections. We will also demonstrate potential market viability by confirming that capable sellers and buyers exist in constrained locations.

The project will also consider the legal/regulatory implications and operational requirements for offering market-based connections such as changes to terms and conditions, penalties, intra zone trading limitations, network monitoring, control requirements and interactions with other markets.

Comprehensive stakeholder engagement with both DNO and TNO connection teams will be required with risk mitigation options signed off prior to trialing this type of connection approach.

Phase 2 – Live Trials
Note: This is not part of this project. If phase 1 is successful we may proceed to a phase 2.
The purpose of Phase 2 of the project is to demonstrate market-based connections with demand customers and run a flexibility market trial. The purpose of the market trial is to understand whether these markets can generate sufficient liquidity and further understand the types of assets that could seed these markets. This will be achieved initially by comprehensive stakeholder consultation and practical trials designed to simulate the true bankable proposition that participants seek.

The market design created for this project will be replicable given that it can be used behind any demand constraint, as the non-firm assets will all need the same solution i.e. Grid access rights to allow import power to their sites, mostly via demand-turn-down of other assets on the network. Energy efficiency investment may also prove to be a tradeable commodity.

The proposed project will employ a combination of commercial and technical methods to test the value of 'Market-based Connections'. In the first half of the project, we will engage with demand customers to understand scenarios and arrangements under which newly connecting customers would consider a 'Market-based Connection'. We will also consult with potential trading parties to understand the most effective route to participation and establishment of a bankable proposition for all parties.

In the second half of the project, we will run a flexibility market trial to test whether a local flexibility market could be operated live. The market will be hosted on the ElectronConnect Market Trading Platform.

Example Use Cases

Refer to figure 1

Refer to figure 2

Project plan:
Phase 1

WP1: Constraint Problem Evaluation
- Provide Baringa with data/reports on GLA constraints
- Identify and report examples of capable sellers and buyers
- Evaluate and report ability of market-based connections to address constraints and connect customers in advance of reinforcement
- Create report detailing risks of using market approach and options for mitigation
- Provide a skeleton Market Connection Agreement acceptable to TOs, DNOs, sellers, and buyers.
- Demonstrate that capable sellers and buyers exist, using the GLA constraint as an example.

Phase 2 (Future Project)

WP2: Customer Engagement
- Agree method for approaching flex buyer
- Agree method of approaching market participant
- Carry out agreed plan (likely to be SSEN making initial contact
- Recruited asset handholding (Electron/SSEN
- Stakeholder events
- Summary report of findings

WP3: Market design and market interaction assessment.
- In parallel to WP2
- Connectivity model behind constraint- SSEN
- Power factory simulation/model-SSEN
- Electron to work out how to build this into market design and ElectronConnect
- High level market design and parameters for trading

WP4: Market and network performance
- View/opinion and responsibilities, accountabilities options for this and preferred approach

WP5 Regulatory and Legal implications
- Key attributes needed for future market-based connection agreement-legal (draft agreement)
- Undertaking a study to identify all potential new failure modes that would be associated with this new approach and recommend mitigation for new failure modes to guarantee network integrity
- Stage gate and comment on integration requirements

WP6: Platform Configuration & Integration
- Integration needs to be decided based on WP2-5
- Electron configure platform to market design

WP7: Market Trial
- 12 months of real trading (summer/winter)

WP8: Business Model
- Draft business model for software licence and software access and ongoing maintenance/user
- Proposal for DNO incentives to support a wider rollout

WP9: Final Report & Dissemination

Scope

This project will focus on the Greater London Authority (GLA) area, where there are known constraints caused by Transmission related reinforcements. The project is focussed on market-based connections only and therefore will not consider DNO flexibility methods i.e. ANM or CMZ. However, it may suggest DNO flexibility methods where market-based connections are not suitable. This is a phase 1 feasibility assessment of market-based connection tools, which may potentially lead to a much larger second phase involving live trials of such a connection approach.

Pre-registration assessment estimates potential benefits of the ExtenDER approach could deliver up to £1.2bn of economic benefit to connecting parties over seven years, or £174m per year if its feasibility can be demonstrated. If feasibility is demonstrated, a refreshed estimation of potential benefits and the costs associated with accessing them will be reported.

Objective(s)

Phase 1

• Confirm the potential viability of a market for market-based connections. Report examples of capable sellers and buyers.

• Report the risks of market based connections to TOs, DNOs, buyers and sellers and discuss mitigation options.
• Propose a skeleton market-based connection agreement acceptable to TOs, DNOs, buyers, and sellers.

Phase 2 (Future Project)
• Understand the value of market-based connections to both buyers and sellers of energy capacity (i.e., is there enough support and buy-in for such a service).
• Compare value of market-based connections to costs of achieving the same connections using ANM and/or CMZ.
• Create a replicable market design.
• Create a market-based connection tool that can communicate with a Power Systems Analysis tool to automatically provide go/no-go decision on trades.
• Understand the interaction between existing connection agreements and the impact on other customers.
• Create a clear process from start to finish for market-based connections to operate.
• Understand what risk of market failure and its impact on the market-based element of the connection agreement is acceptable to users.
• Create a Framework for market-based connection operation including monitoring and legal implementation.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project, if successful, has the potential to connect more customers earlier to the grid. This has the potential to make social housing available quicker than would otherwise be possible. However, it would require a second phase for these benefits to materialise. For this feasibility phase there will be no change to consumer vulnerability impact as shown below.

Refer to figure 3

Success Criteria

The project will be deemed successful if:

Phase 1
• The solution is shown to have no detrimental impacts on the electrical network for which a mitigation has not been identified and tested, with sufficient confidence to proceed to a second trial phase.

Phase 2
• Market Based Connections are considered as viable and useful for demand customers (i.e., the business proposition works)
• Market participation for those providing flexibility find the process accessible, and valuable.
• Market design produced is replicable.
• Market solution tool can communicate with Power Systems Analysis tool to automatically provide go/no-go decision on trades.
• The interaction between existing connection agreements and the impact on other customers is acceptable.
• A clear path for entry into and exit from a Market based connection is defined.
• The risk of market failure and its subsequent impact on the Market based element of the connection agreement is a risk that is acceptable to customers.
• Framework created for Market Based Connection operation including monitoring and legal implementation alongside Access SCR.

Project Partners and External Funding

Phase 1 Partners
SSEN – Lead partner, providing data and subject matter experts (SMEs)
Electron – Provide consultancy support for use of market tool Electron Connect
Baringa – Doing the research and creating the project evaluation paper

Phase 2 Partners

SSEN – Lead partner, testing market based platform and reviewing project outputs
Electron – Develop Electron Connect and assist with Live Trials
Baringa – Provide research support
RINA – Provide modelling support

Potential for New Learning

Phase 1
An understanding of the potential risks and opportunities for market-based connections.

Phase 2

An understanding of facilitation requirements including:
• Network monitoring
• Legal implications
• Any penalties/actions required by DNO
• Regulatory change required
• Interactions between existing and proposed market models (ESO, Wholesale, CMZs)
• Learnings to support work on Access SCR implementation
• Learnings will be shared in publicly available reports and at industry presentations.
• A commercial proposition that works for demand customers in constrained areas across the UK

Learnings will be disseminated through NIA progress and closedown reports and also through workshops with relevant stakeholders.

Scale of Project

The project has significantly reduced in scope from original concept. Rather than doing a large live trial project, we are mitigating risk of project failure by carrying out a feasibility stage first. If the feasibility stage is successful, we may then pursue a larger project.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

This project will be a desktop study using data from the London area, within the SEPD Region.

Revenue Allowed for the RIIO Settlement

No revenue was allowed for this activity.

Indicative Total NIA Project Expenditure

Phase 1 and 2 combined 90% of £1.41m = £1.269m

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The project aims to connect more customers under constrained conditions, with the potential to connect more renewable generation and / or Low Carbon Technologies (LCTs) that previously were unable to connect. However, a second phase will be required to realise these benefits.

How the Project has potential to benefit consumer in vulnerable situations:

N/A

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

If the feasibility stage is successful it can enable additional benefits i.e., facilitate the connection of new customers in areas where network reinforcement is required. It is assumed that the reinforcement programme itself is unaffected by this scheme, with the profile of reinforcement activities proceeding in line with existing plans. Market based connections for demand assets enables potential customers (e.g. housing developers) to connect to constrained parts of the network whilst those reinforcement works are still pending. In order to estimate the saving, therefore, we have considered the value of faster (or less delayed) connections to customers. The cost of delays will depend on the specific customer type. The benefit of this proposed approach will therefore depend on the pipeline of customers wishing to connect. However, the majority of connections that would benefit from this scheme are expected to relate to housing developments.

Analysis from Lichfields* considered the economic impact of housing delays (arising because of planning delays rather than connection constraints). The analysis looked at an estimated 70,000 homes being held up in the planning system across 11 Local Authorities. Lichfields estimates that

- The construction activities associated with these developments would have an annual Economic Output (GVA) of £1.95bn.
- Ongoing expenditure by new residents would be £796m annually (not including initial "first occupation" expenditure of £380m)
- Council tax revenue would be £146m annually.

The identified costs of delays cannot be strictly added together (since GVA, resident expenditure and council tax revenue are different metrics and may include some overlap), so conservatively we can use the construction GVA estimate of ~£2bn per annum. Our estimate of the benefit is based on the assumption that without market-based connections the typical connection delay would be 7 years. The cost to the economy, therefore, can be estimated by considering the discounted value of creating this GVA today rather than in 7 years' time. Our estimate, therefore, is as follows:

- £1.95bn of additional economic benefit annually is brought forward by 7 years
- Conservatively, a social discount rate of 3.5% is assumed
- The NPV of those benefits would have been £9.7bn (with the 7yr delay) but this is increased to £12.3bn by starting to generate those

benefits in Year 1
• The NPV benefit of the scheme, if applied to these 70,000 homes, therefore, would be £2.6bn
• **Per household, this corresponds to a total benefit of £38,000, or an annual benefit of £5,400**. This is wider economic benefit rather than a benefit for individual households.

Assuming an ADMD for these households of 3kW, we can assume an annual benefit of £1,800 per kW of connection. Whilst the ExtenDER approach is unlikely to be suitable for the majority of domestic sites, it is nevertheless a reasonable proxy for the value that a connecting party might place on being able to connect promptly.

SSEN data shows that there is currently 960MVA of capacity waiting to connect, being held up by the constraints on the network (both Transmission and Distribution related constraints). Conservatively, then, we can estimate that 10% of the 960MVA connection potential might be suitable for an ExtenDER approach and might see the benefit of bringing forward the connection date by seven years. On this basis, the ExtenDER approach could deliver £1.2bn of economic benefit to connecting parties over 7 years, or £174m per year.

This is conservative in that it does not account for the additional benefits of commercial and other developments. It also does not account for the impact of individuals unable to move in thereby facing inadequate living conditions.

*https://lichfields.uk/blog/2022/april/26/counting-the-cost-of-delay-the-economic-impact-of-local-plan-delay-to-housing-delivery/

Please provide an estimate of how replicable the Method is across GB

If a phase 2 trial of the project is successful, this methodology can be rolled out across all DNO licence areas. In order to estimate the potential GB-wide benefit, we have made the assumption that the benefit will scale in proportion to the relative connections expenditure planned for ED2 across the DNO areas. This information comes from The RIIO-ED2 Final Determination Core Methodology1.

Connections expenditure in this case refers to the C2 RIGS table, which includes *"the provision of new or upgraded network points of connection which can be metered or unmetered connections with the end customer. It includes reinforcement costs associated with the connections work."*

1 https://www.ofgem.gov.uk/sites/default/files/2022-11/RIIO-ED2%20Final%20Determinations%20Core%20Methodology.pdf

The planned connections-related expenditure in SSEN over ED2 is £154m. Across all network areas, the expected connections expenditure is £555m. Assuming that the benefits of this project scale in proportion to overall connections expenditure, therefore, the GB benefit would be 4.7 times the SSEN benefit. This would scale the £174m annual benefit in SSEN up to £818m for GB as a whole.

Please provide an outline of the costs of rolling out the Method across GB.

Phase 1 and 2 of the project will seek to develop a low risk market-based tool. It is therefore likely that the costs will be incurred by the tool developers/suppliers with costs recouped through trades e.g. x£ for every trade. However, it is still unclear on how this will work and part of this project will investigate how these market-based tools will be funded and who will incur the costs.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☑ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

Learning will assist other DNO's to
• Identify and evaluate risks of market-based connections.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

This project will follow NIA guidance and be posted on the ENA Smarter Networks Portal for other DNOs to review. Likewise we will be able to review other projects posted on this portal to ensure no unnecessary duplication occurs. We are also heavily involved in many collaborative working groups with other DNOs, where we will share learnings to ensure no duplication takes place.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

There are two similar projects, that have been explored in depth to ensure no duplication takes place.

The first project is TRANSITION, which trialled market-based tools and also trialled peer to peer trades. However, these trades were very small scale, with cumbersome business processes that still need more effort to be overcome.
The second project is ENWL's Project BiTraDER, where curtailment trading within ANM zones takes place. Assets that have to be turned down due to network limitations want to trade turndown with someone else. BiTraDER is many-to-many trading and involves merit order stack management.

This project investigates a new form of connection offer and how this can work from a legal and technical perspective, it does not involve any merit order stack management and is applicable in non-ANM zones. Additionally, the flexibility markets can be seeded by 1 asset alone to create a one-to-many flexibility market.

This project is likely to focus on urban areas where generation is scarce.

The Project must keep abreast of, directly acknowledge and build upon other ongoing innovation projects taken forward by energy network companies and other stakeholders exploring flexibility, and ensure dissemination of learnings acquired from work on this project to other innovation projects exploring flexibility.

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

The project is innovative as it is looking to explore the risks of a market-based connections process, which has not been done before.

Relevant Foreground IPR

Foreground IPR includes:
All learning of risks and mitigation options uncovered for market-based connections

Data Access Details

For information how to request data gathered in the course of this project, see Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://ssen-innovation.co.uk/innovation-strategy/.

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

Business as Usual (BaU) funding is not available in RIIO-ED2 for market-based connections as it is an innovation project, which is deemed high risk and low maturity and as such is not business as usual ready.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

Business as Usual (BaU) funding is not available in RIIO-ED2 for market-based connections as it is an innovation project rather than normal BaU work. The project is also high risk as this represents a novel process that needs to be understood through innovation trials prior to Business as Usual (BaU) implementation. NIA presents a unique collaborative opportunity to run a fairly low cost first stage feasibility trial, due to its funding requirements.

This project has been approved by a senior member of staff

☑ Yes