

NIA Project Registration and PEA Document

Date of Submission

Mar 2026

Project Reference Number

NIA2_NESO126

Project Registration

Project Title

Market Behaviour Simulation Tool

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NIA2_NESO126

Project Licensee(s)

National Energy System Operator

Project Start

March 2026

Project Duration

1 year and 6 months

Nominated Project Contact(s)

Innovation@neso.energy

Project Budget

£800,000.00

Summary

Traditional planning models often struggle to reflect how developers make commercial and strategic decisions, limiting the ability to understand how market participants may respond to future policy or market design changes. This project will address that challenge by creating a proof of concept (POC) Developer Behaviour Simulation Tool that uses advanced modelling techniques to represent realistic investor behaviour across different market conditions. Running from March 2026 to August 2027, the project will deliver a Modelling Definitions Report, a demonstration model, and an Insight Report. The tool will help assess long term impacts of market and connection reforms, highlight potential unintended incentives, and provide a stronger evidence base for policy development. Expected benefits include improved forecasting, reduced system risks, and more credible long term planning.

Third Party Collaborators

Smith Institute

Nominated Contact Email Address(es)

Innovation@neso.energy

Problem Being Solved

Power markets are highly complex, shaped by many decision makers operating with different information about markets, policies, and subsidy schemes. NESO's current modelling tools do not fully reflect this complexity, as they struggle to represent the diverse market

participants and the impact of policy and subsidy design. As a result, critical insights into how the market is likely to evolve, and how participants will respond to change, are missing.

Method(s)

Method

The project will develop a simulation model (POC) which will be built on three complementary methodological pillars. These approaches will ensure that the model captures realistic developer behaviour, can represent diverse market designs, and remains fully transparent for NESO analysts.

- **Agent-Based Simulation.** The tool will aim to model developers as decision-making agents with technology-specific characteristics, cost structures, revenue expectations, and risk preferences. Each agent will evaluate siting and investment choices under defined market rules and network conditions, with agent competition emerging through market interactions.
- **Stochastic Market Modelling.** Future revenues and the underlying service prices will be represented through probabilistic price and volume distributions, capturing realistic variability and uncertainty. This aims to give NESO a spectrum of likely outcomes, not just a single prediction, and supports scenario-based planning under uncertainty.
- **Game-Theoretic Interactions.** The model will include strategic effects like competition for ancillary services and connection capacity limits. These interactions should ensure that the simulation reflects feedback loops such as queue congestion, making it suitable for assessing market design options where participant behaviour affects market outcomes.

Each simulated scenario will aim to produce metrics showing how different markets may influence development pathways, with a concise dashboard presenting simulation results in an accessible format. The intention is that the outputs can then slot directly into NESO's market design and advisory workflows, with NESO able to compare scenarios and explore their uncertainties

WP1: Discovery and Market Design Framing

This work package aims to establish a shared understanding of the current market landscape and potential future developments within the scope of the project. It will seek to define the market rules, system scenarios, and model requirements that will underpin all subsequent modelling work.

Key deliverables:

- Modelling Definitions Report setting out the policy scenarios to be modelled, alongside market design assumptions, network progression pathways, and clearly defined participant archetypes (e.g. wind, solar, storage).
- Simulation Design Note documenting the core simulation architecture and overall model engineering approach.

WP2: Core Engine Development and Calibration

This work package will focus on building and calibrating the foundational simulation engine that represents developer decision-making under current market arrangements.

Key activities:

- Build a modular simulation engine.
- Implement a market revenue modules framework.
- Integrate a simplified network and curtailment layer.
- Develop a base dashboard interface.
- Calibrate model outputs against historical data.

Outputs:

- Demonstration of baseline market behaviour simulated under current rules.

- Initial Performance Report comparing simulated outcomes with historical market data.

WP3: Policy Module Expansion and Strategic Behaviour

This work package extends the model by introducing strategic behaviour, additional market services, and configurable policy levers.

Key activities:

- Extend simulation functionality to capture strategic developer behaviour.
- Integrate demand and network projection scenarios.
- Introduce configurable policy parameters.
- Conduct initial sensitivity testing.

Outputs:

- Demonstration of enhanced multi-market and multi-participant behaviour under future system projection scenarios.
- Updated Performance Report comparing simulated and historical outcomes, including draft insights relevant to network strategy.

WP4: Demonstration, Insights, and Handover

This final work package finalises the prototype model, validates outcomes against NESO's long-term system requirements, and aims to deliver a usable tool ready for use.

Key Activities:

- Refine dashboard interface for policy scenario selection, key performance indicator visualisation, and results export.
- Run final simulation suite across all agreed scenarios, quantifying sensitivities.
- Evaluate alignment with system requirements (e.g., capacity adequacy, flexibility, locational balance) derived from FES/SSEP/CSNP.
- Produce insight summaries explaining system-level impacts of different market and connection rule combinations.
- Finalise documentation, and software for delivery.

Outputs:

- Delivered proof-of-concept software with interactive dashboard, alongside user documentation.
- Final Insight Report: key findings, policy implications, and recommended next steps.
- Adoption Roadmap outlining options for model scaling and integration into NESO's existing analytical systems, and a clear pathway for transition into business-as-usual operations, including support and training.

In line with the ENA's ENIP document, the risk rating is scored Low.

TRL Steps = 1 (1-2)

Cost = 1 (<£1m)

Suppliers = 1 (1 supplier)

Data Assumptions = 2 (Assumptions known but will be defined within project)

Total = 5 (Low (L))

Scope

This project is aiming to deliver a proof of concept, configurable simulation tool to model developer behaviour under evolving market

and connection arrangements. This will be supported by a modular dashboard and codebase for long term (2030–2050) scenario analysis and decision support. The project scope includes validation of modelling outputs through workshops and stakeholder engagement, as well as an adoption roadmap outlining how the tool could be integrated into NESO’s business as usual analytical workflows.

The project does not include productionising the proof of concept into operational systems, conducting short or medium term scenario analysis, or producing publishable external assessments of current policies.

Objective(s)

The objectives that are expected to be achieved are:

- Develop a configurable simulation tool that models developer behaviour under evolving market and connection arrangements.
- Deliver a modular dashboard and codebase to support transparent scenario analysis and strategic decision-making.
- Validate modelling outputs through collaborative workshops and structured engagement with NESO stakeholders.
- Define an adoption roadmap that sets out how the tool could be integrated into NESO’s business as usual analytical workflows.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations because it is a demonstration modelling tool project.

Success Criteria

The project will be deemed successful if:

- It is delivered in line with the objectives, timescales, and budget set out in the approved proposal.
- The Modelling Definitions Report and Simulation Design Note are approved, confirming alignment with the agreed scope and methodological approach.
- A formal review with the NESO Markets Team confirms the core model is fit for purpose and technically sound.
- The software is successfully demonstrated, clearly evidencing intended functionality and use cases.

The Final Insight Report and Adoption Roadmap are approved.

Project Partners and External Funding

Smith Institute will carry out the project and no external funding is required.

Potential for New Learning

If successful, the project will demonstrate the suitability of agent-based modelling for understanding market behaviour in the context of regulatory change. It will establish a “market behaviour lab” capable of testing and exploring the impacts of policy and market design options on developer decision-making and wider market outcomes. The outputs will enable deeper understanding across the sector.

Final learnings and recommendations will be documented in a delivered report, with all relevant materials made available via the ENA Smarter Networks Portal.

Scale of Project

This project will take 17 months with one project partner (Smith Institute) delivering the work

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

This project will be conducted within GB.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£800,000

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:

By expanding the tools available to account for potential behavioural responses and asymmetric information faced by decision makers, the project has the potential to demonstrate a robust method for quantitatively assessing policy decisions. This approach can support more effective policy design and implementation, helping to enable the transition to a clean power system.

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

This demonstration project will produce a modelling tool. The agreed baseline is the current absence of this form of analysis, under which no equivalent modelling capability exists. The base cost therefore reflects the do nothing scenario, while the method cost is primarily the server and hosting costs required to run the model.

At this stage, benefits are not monetised as the analysis is not yet deployed operationally. However, the intended recipients of the benefits are NESO strategy and market design teams, with potential downstream benefits to network planning and policy decision making through improved analytical capability and evidence quality.

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

The method from this project is designed for broad applicability across Great Britain, making it suitable for a wide range of network licensees involved in regulatory consultation processes.

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

The costs of methodology in future projects will depend on the time and resources required. At this given time we are unable to provide an outline of the costs as this is a desk-based research project.

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

Network licensees who also participate in policy design will be able to deploy the tool to understand the potential behaviour around investment in the power system.

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.

There is currently no developed model that provides the flexibility and level of detail required to represent the GB investor market. This project will enable further innovation and research into market design, allowing policies and market arrangements to be tested and better understood from a GB specific perspective.

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

N/A

Additional Governance And Document Upload

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

- Simulating agents' behaviour is not widely adopted in industry. Instead, deterministic least-cost optimisation models are predominantly used
- This is future-focused and addresses unknowns the energy system is evolving, and traditional planning tools cannot anticipate all strategic investor behaviour under new market designs.

Relevant Foreground IPR

- Development of Strategic Behaviour Modelling tool
- A final executive summary report will be produced.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

1. A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click 'Contact Lead Network'. National Energy System Operator already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
2. Via our Innovation website at <https://www.neso.energy/about/innovation>.
3. Via our managed mailbox innovation@neso.energy

Details on the terms on which such data will be made available by National Energy System Operator can be found on our website: [Data Sharing Approach | National Energy System Operator](#).

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

This project requires new modelling techniques that go beyond NESO's existing tools and expertise. The approach is exploratory, involves unproven methods, and carries technical and analytical risks that cannot be delivered through BAU activities. Innovation funding is therefore needed to develop and test this capability before it can be considered for wider adoption.

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

This project explores a novel modelling approach that has not yet been tested within NESO and carries methodological and analytical uncertainty. Because this work goes beyond established tools, processes, and BAU capabilities, it requires NIA support to develop, trial, and validate a new technique before it can be considered for wider use.

This project has been approved by a senior member of staff

Yes