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NIA Project Registration and PEA Document

Date of Submission

Aug 2024

Project Reference Number

NIA2_NGESO076

Project Registration

Project Title

Battery Storage Modelling for Enhanced Connection Assessments (BaTSeC)

Project Reference Number

NIA2_NGESO076

Project Licensee(s)

National Energy System Operator

Project Start

May 2024

Project Duration

0 years and 9 months

Nominated Project Contact(s)

innovation@nationalgrideso.com

Project Budget

£310,000.00

Summary

BaTSeC will provide an improved capability for understanding the effect of possible battery storage scenarios by developing a new battery model which combines data analysis techniques with market understanding in three modules:

- Markets module will be trained on historic market data which will output either historic or synthetic pricing signals. The probability of specific market scenarios can be quantified and therefore determine a “reasonable worst case”.
- Battery module takes into account battery parameters and behaviours. When producing output for multiple batteries, behaviour will be sampled from a probability distribution to give a realistic representation of coincidence.
- Dispatch integration module will convert the battery output into a set of half hourly power flow and link these into the ESO’s dispatch model.

Preceding Projects

NIA_WPD_004 - Solar Storage

NIA2_NGET0017 - System value from V2G peak reduction in future scenarios based on strategic transport and energy demand modelling

10067856 - INCENTIVE - Innovative Control and Energy Storage for Ancillary Services in Offshore Wind

Third Party Collaborators

British Solar Renewables

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

Connection queues are significant due to the volume of low carbon technology, including energy storage, requesting connections. These added connections require reinforcement of the grid. In many cases, customers are being given connection dates into the mid-2030s.

At the transmission-level, the ESO use conservative modelling of electricity storage for the purposes of connection assessments. The traditional conservative network analysis assumes “worst case” values for battery output, often maximum import and maximum export conditions, which frequently results in a perceived requirement for network reinforcement, or some locations being deemed unsuitable. These conservatisms, combined with an oversubscribed contracted background, have contributed towards extended connection dates.

Battery behaviour can be difficult to predict. A battery operator can decide to stack services including arbitrage and frequency response which are controlled by wider market signals not necessarily related to the network area in which they are connected. This is further complicated by the co-location of battery storage and generation assets.

Method(s)

The model will be developed through four sequential work packages.

Work package 1: Research and Model Design

During this work package, the specific model and software requirements will be defined.

Research and analysis of battery behaviour, performance, optimisation, and service stacking modelling approaches will be undertaken which will enable the development of statistical profiles.

A workshop will be held to discuss the initial investigations into profiles and assumptions in the model. This workshop will provide an opportunity for review of the modelling approach, provide feedback, and steer the direction of future work packages.

Following the workshop, and a review of the feasibility of integrating the proposed model with the ESO dispatch model, a software specification will be produced to be reviewed and agreed with the ESO. This will enable a clear software development plan for the remaining work packages thus assuring mutual agreement of how each of the model requirements will be achieved, and that the uncertain aspects of model development will be considered sufficiently early in the project e.g. the feasibility of integrating the model into business-as-usual processes.

Main Deliverables: A technical note outlining the key findings, software specification and software development plan.

Work package 2: Model Build

During this work package an “alpha” version of the model will be developed, including initial versions of the market, battery, and dispatch modules. The “alpha” version will enable historic and synthetic market conditions to be generated and fed into the battery module to simulate dispatch profiles. The dispatch module will convert these into CSV outputs (or other agreed upon formats). The “alpha” model will have functionality to consider co-location of batteries with wind and solar. Co-incidence and the ability to simulate “reasonable worst case” market scenarios through the model will not be included in the “alpha” version. Integration testing of the model on ESO systems will be performed at the end of Work Package 2 to de-risk final delivery and obtain feedback.

Main Deliverables: Demonstration and user testing of the “alpha” version of the model.

Work package 3: Model Characterisation and Scenario Development

During this work package a “beta” version of the model will be developed. The “beta” version is anticipated to include co-incidence and the ability to simulate “reasonable worst case” market scenarios. The “reasonable worst case” market scenario will be informed by the market module in the “alpha” version (developed from historic data) and discussions with the ESO during a second workshop. This workshop will also enable collection of feedback on the “alpha” version of the model from a wider group of stakeholders than in sprint review meetings to supplement our own testing and analysis.

Model characterisation activities will be undertaken during this work package to quantify the sensitivity of the model to various market inputs, understand the effects of uncertainty in the dispatch output, and capture general model performance. Given the recent expansion in connected batteries and changes to markets, the insights provided by the model on battery performance and operation, while participating in markets should be of significant interest and could help guide further market development in future work.

Main Deliverables: Demonstration and user acceptance testing of the “beta” version of the model and a technical note outlining the model characterisation findings.

Work package 4: Model Delivery and Reporting.

During this work package, the final version of the model will be delivered. It will be ready for integration (as outlined in the software specifications from Work Package 1) with ESO dispatch model. One final sprint of development activity will be undertaken to address

any issues identified in user testing of the “beta” version of the model.

Main Deliverables: Final version of the model (including source code), a report and an overview slide set.

Scope

This is a significant departure from existing network design practices for utility scale BESS in GB. Individual components of this project have been tested but not combined at a whole system level before as the commercial incentives are to develop models for individual batteries. The analysis of historic market data in order to take a probabilistic approach to coincidence thereby being able to generate "reasonable worst case" scenarios for connection assessments is a novel approach to connections. This will provide an invaluable model to ESO as BESS connection applications increase and should reduce the connection timescales and costs. The modular approach to the model will allow each of the components to be adjusted in the future, for example, updating the market module given future market conditions.

Objective(s)

The project aims to deliver a model that can achieve the following objectives:

- Analyse historic market data to be able to quantify the likelihood of market scenarios.
- Be able to generate synthetic pricing signals to produce a “reasonable worst case” scenario for use within the model.
- Be able to adjust battery parameters and behaviours to get representative operating profiles.
- Use a probability distribution to account for variations in response to market behaviours.
- Generate power flows from the market and battery information.
- Integrate the generated power flows into the ESO dispatch model.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

No direct impact on consumers in vulnerable situations. Indirectly, this project has the potential to reduce bills for all electricity customers by avoiding or deferring the need for physical network reinforcement via more efficient use of existing infrastructure.

Success Criteria

Develop a model which generates battery half hourly timeseries based upon battery and market parameter selection. These timeseries will be suitable for use in the ESO’s dispatch model.

Project Partners and External Funding

Frazer-Nash Consultancy Ltd and Red Vector Consulting will be delivering the project, no external funding required.

Potential for New Learning

The project seeks to understand the effect of battery behaviour under different market conditions thereby better quantify operating profiles and connection requirements.
For dissemination:

- A slide pack will be produced for internal / external dissemination.
- Standard reporting, as required by NIA governance, will be produced.
- Key stakeholders will be engaged during the 2 workshops scheduled in the project.

Scale of Project

The project spans 9 months with two project partners. The project consists of desk-based research and workshops with the relevant teams across the ESO. The topic being investigated has a potentially broad scope, but the project aims to focus on one key aspect that will provide meaningful benefits. Examples of areas that have been purposefully omitted are BESS market prediction and BESS market design.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The project will be based upon the GB ESO area of operations.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£310,000

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:

The project will reduce the conservatism of assumptions regarding battery storage, leading to:

- Enhanced connection process based on improved assumptions
- Reduced reinforcement spend on a per connection basis

This will enable the energy transition at a quicker pace and in a more efficiently planned manner.

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

The key expected cost benefit is the reduction in network reinforcement by using a data and market driven approach to understanding how a battery will output onto the network. This will reduce physical infrastructure improvement costs and the cost of managing long connection queues.
If successful, it is anticipated that the cost savings in deferred/avoided infrastructure reinforcement costs and efficiency savings during the energy transition will far outweigh the cost of model development.

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

The model can be used across the whole of the GB network with appropriate inputs. The model is modular so can be adapted for different use cases without re-incurring the initial development costs.

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

The model can be used across the whole of the GB network with appropriate inputs. The model is modular so can be adapted for different use cases without re-incurring the initial development 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

The model focuses on modelling battery behaviour on a half hourly timeseries. The model is modular so can be adapted for different use cases without re-incurring the initial development costs.

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.

The proposed project is novel in that it takes a whole system approach rather than a specific battery case. No model currently exists that will provide the functionality proposed.
The most similar innovation projects were identified as follows:

- System value from V2G peak reduction in future scenarios based on strategic transport and energy demand modelling (NGET) focuses on distributed batteries in electric vehicles rather than utility scale batteries. Some forecasting techniques could be borrowed from this project.
- Solar Storage (NGED) specifically looks at a single battery at 11kV level. There may be useful information about co-location of storage that can be gleamed from this project.
- INCENTIVE (SSEN) is exploring the co-location of batteries with offshore wind to provide ancillary services. Some of the cost modelling could be used as an input to the model.

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

This is the first time developing a battery energy storage system (BESS) at this scale in GB. Literature exists for the optimisation of individual BESS systems and some of this information is also held within commercial organisations. Literature dealing with practical applications is generally lacking at a whole system level.
The project aims to reduce the conservatism of assumptions around battery storage, thus leading to improved connection timelines for connecting customers and reduced reinforcement spend on a per connection basis.

Relevant Foreground IPR

The following Foreground IPR will be generated from the project:

- A technical note outlining the key findings, software specification and software development plan.
- An “alpha” version of the model.
- A “beta” version of the model and a technical note outlining the model characterisation findings.

Final version of the model, a report and an overview slide set.

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:

- 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 Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://www.nationalgrideso.com/future-energy/innovation
- Via our managed mailbox innovation@nationalgrideso.com

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available “Data sharing policy relating to NIC/NIA projects” at https://www.nationalgrideso.com/document/168191/download.

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

This is a significant departure from existing network design practices for utility scale BESS in GB. Individual components of this project have been tested but not applied to this use case or at this scale previously.
Defining the requirements, and developing a proof of concept, for a model such as this is a challenging undertaking, requiring multidisciplinary engagement with a wide range of stakeholders. NIA funding is well suited to bringing the necessary stakeholders and suppliers together and enabling fast paced delivery of the required innovative outputs.

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 is a significant departure from existing network design practices for utility scale BESS in GB. Individual components of this project have been tested but not applied to this use case or at this scale previously.
The requirement to connect batteries to the network in a more informed way and reduce the connection timescales to enable an effective energy transition is key. Diverting ESO resource from their day jobs to a novel project such as this would be an inefficient approach and would most likely not yield the desired results. Leveraging NIA funding and bringing in an external partner with the required skills and experience is a lower risk and more cost-effective approach.

This project has been approved by a senior member of staff

☑ Yes