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

Jan 0001

Project Reference

NIA_NGSO0028

Project Registration

Project Title

NIA_NGSO0028

Project Reference

NIA_NGSO0028

Project Licensee(s)

National Grid Electricity System Operator

Project Start Date

October 2019

Project Duration

0 years and 10 months

Nominated Project Contact(s)

Jason Hicks

Project Budget

£180,000.00

Summary

The overall aim of this project is to identify potential alternatives and opportunities for new planning methodologies that evaluate both technical and economic aspects in a more integrated manner and introduce flexibility and risk awareness in dealing with large-scale planning uncertainty.

Nominated Contact Email Address(es)

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Problem(s)

In the future, larger volumes of Renewable Energy Systems (RES) will mean increased operational uncertainty, and network and system issues (e.g., inertia, flexibility, transfer constraints, etc.) may arise at times other than winter peak and require new operational arrangements (e.g., type/allocation of reserves). Given the tighter interaction between system constraints and operational/market aspects, and in order to achieve an efficient plan from both technical and economic perspectives, it is desirable to evaluate both technical and economic model aspects (i.e. capturing system needs and costs) in planning, in a more systematic and credible way, rather than based on hypothetical scaling as is done currently.

In the planning timescales, with increasing levels of uncertainty due to various factors (e.g., penetration, type and location of RES, changes in demand levels and profiles due to electrification, adoption of new energy vectors such as hydrogen etc.), different approaches to decision-making under uncertainty other than Least-Worst Regret (LWR) could emerge as more suitable. These elements could at the same time provide more flexibility, robustness and efficiency in the solution, explicitly introduce risk appetite in the CBA, and provide a methodology to consistently compare network and non-network solutions.

Transmission planning technical analysis is currently based on winter snapshot deterministic scenarios in the Electricity Ten Year Statement 'ETYS' process. It does this analysis by evaluating network 'boundaries' based on scaled generation and demand, with no inputs from, or interactions with, market data or market simulation. Based on this technical evaluation, the Network Operability Assessment 'NOA' CBA process then identifies the optimal paths of network reinforcement options, by applying a Least-Worst Regret (LWR) approach. This NOA process is a time-consuming, manual and iterative process, where planning uncertainty is treated in as an ad-hoc with little room for integration of network and non-network solutions.

Method(s)

In order to identify how the transmission system planning process could be improved, this project will investigate introducing greater detail in the technical analysis, coupling the technical analysis more tightly with the NOA CBA process, and considering alternative options to incorporate planning uncertainty.

The project will undertake the following work:

- Literature review of current industry and regulatory processes for network planning under uncertainty and relevant modelling techniques, as well as of other relevant ongoing and past projects.
- Academic and industry-related literature review on decision making under uncertainty, with focus on stochastic optimization, robust optimization, decision theory techniques, risk analysis, and practical applications worldwide.
- Transmission system technical model review: identification of key issues and gaps with current single-snapshot modelling and consideration for enhancing its scope into a more comprehensive operational model with techno-economic aspects; consideration of future options based on emerging technical modelling constraints (e.g., flexibility, reserve and frequency response constraints, area transfer constraints, etc.) and modelling options (e.g., AC/DC power flows, linear programme (LP) or mixed integer linear programme (MILP) optimal power flows, etc.), also depending on the potential requirements to include new technologies such as storage, Demand Side Response (DSR), inter-trip schemes, etc.
- Transmission system planning model review: identification of key issues and gaps with current process and pros and cons of LWR approach; consideration for different approaches in the stochastic planning model, which will also integrate the operational technical model. Different approaches will be considered that might be adopted in future planning methodologies, e.g., optimization via simulation (e.g., through recursive algorithms to explore investment stochastic trees) or formal mathematical programming techniques (e.g., Benders decomposition in the case of MILP formulation that embeds an operational LP formulation).
- Outline of new potential system planning process options, highlighting the most desirable features of the new methodology to deal with low-carbon system operation and long-term planning uncertainty taking into account available tools.

Scope

The overall aim of this project is to identify potential alternatives and opportunities for new planning methodologies that evaluate both technical and economic aspects in a more integrated manner and introduce flexibility and risk awareness in dealing with large-scale planning uncertainty. Differently from other projects that may look at testing specific solutions, this project will investigate more fundamental and wider aspects of how the current planning process could be improved to deal with an evolving energy system, new technologies and potential operational solutions, and addressing long-term uncertainties in a more systematic way. Clear recommendations will be produced for how new techniques could be adopted to enhance the overall planning process in light of all the relevant emerging issues and opportunities.

Objective(s)

The project will undertake the following objectives:

- Review/identify issues with the current deterministic planning processes and standards
- Review the state-of-the-art methodologies for energy system planning under uncertainty
- Review/identify issues with the current (i.e., one snapshot-based) technical modelling used in planning
- Outline a general decision-making framework for planning under uncertainty, e.g., to inform/extend the current NOA process
- Define the key and most desirable elements and methodological options for such a framework, for example based on stochastic optimization, decision theory techniques, and risk analysis.

Success Criteria

The project will be considered successful if at the end we will be able to:

- Clearly evaluate the pros and cons of using a LWR approach, whilst identifying and proposing alternative decision making approaches that could improve the recommendations output in the NOA
- Better understand potential issues in using a deterministic approach to planning while there are increasing uncertainties in the longer time scales
- Better understand potential issues in using a single-snapshot approach or oversimplified assumptions for the technical modelling while the system becomes increasingly more complex
- Identify the most desirable features for a new framework that can consider more integrated technical and economic modelling as

well as better incorporate uncertainty and risk in planning

- Outline a roadmap and the required steps for actual implementation of the identified framework.

Technology Readiness Level at Start

TRL 3

Technology Readiness Level at End

TRL 4

Potential for New Learning

True

Scale of Project

The research that will be undertaken will be desk-based and build upon previous experience from studies to improve planning techniques on the Australian systems and internationally. Results will be tailored specifically for GB, identifying best possible options to advance network modelling techniques used in planning, and improving the information available to GB energy system stakeholders.

Geographical Area

Research for this project will be undertaken collaboratively by researchers located in the UK and Australia, building on experience from prior studies and findings from MEI's ongoing partnerships other international TSOs.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

£180,000.00

Project Eligibility Assessment 1

Specific Requirements 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 the GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and 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 Licensee's System

☐ A specific novel commercial arrangement

Specific Requirements 2

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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

Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

This project will address several strategic innovation areas in the SO Innovation Priorities 2019/20, namely: 2. Whole electricity system, 3. Future markets, 4. Forecasting of supply and demand, and 8. Constraint management.

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment 2

Potential Benefit to Customers

Please provide an estimate of the saving if the Problem is solved.

It is envisaged that several economic and environmental benefits may be gained through implementation of the learning outcomes that are expected from the project:

- By considering planning uncertainty more explicitly, the decision-making process can be improved and future constraint costs and risk of stranded asset reduced, with value for SO and consumers
- By considering multiple future investment options in a more automatized way, better planning solutions, with lower costs for the SO and consumers can be obtained, and reduced resources will be required for planning, with value for the SO from more automatization of the planning process
- By outlining a unified planning modelling framework, consistent with and extending the current NOA process, where different approaches to decision making under uncertainty and risk appetite can be demonstrated and compared, there will be significant value for the SO in better assessing investment risk
- By considering systematically flexibility, adaptability, risk, and robustness in planning and the pros and cons of different approaches, so as to be able to assess whether new approaches to the NOA process may be more efficient for the consumers, there will be more value for consumers as uncertainty and risk are now not clearly modelled
- By reviewing and comparing current and new methodologies, identifying issues with both the planning standards and the regulatory process, or in any case providing suggestions for improvements, value for the SO, Ofgem, and consumers alike can be created
- By improving the planning technical model to consider several operational situations (rather than one snapshot), potential operational solutions, and integration with market aspects, lower levels of constraints, lower emissions, lower levels of renewables curtailment, and lower operational costs for the SO and consumers can ultimately be obtained.

Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost - Method Cost, Against Agreed Baseline).

Not required for research projects.

Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

The project will benefit all GB network licensees , helping them better understand the impact of improved planning practices to consider uncertainty and risk. The outcomes of the project will be made available such that all licensees and other industry stakeholders can access learnings from the project. The framework proposed could in principle be applied to all transmission and distribution planning applications. Regulatory changes that may be identified by subsequent projects would also apply to both transmission and distribution networks.

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

The costs to design a roadmap for actual implementation of the learnings from this project into National Grid SO's BAU systems and activities have been budgeted for, along with relevant dissemination costs. The project outcomes would already be relevant to the network planning process for the GB transmission system.

Additional Governance Requirements

Please identify

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

ii) Please identify why the Network Licensee will not fund such a Project as part of its business as usual activities

iii) Please identify why the Project can only be undertaken with the support of the NIA, including reference to the specific risks (eg commercial, technical, operational or regulatory) associated with the Project

This project has been approved by a senior member of staff

☑ Yes