SIF Round 3 Project Registration

Date of Submission

Mar 2024

Project Reference Number

NGN_SIF_10107024

Initial Project Details

Project Title

Regional Energy Strategic Modelling (RESM) Discovery

Project Contact

Innovation@northerngas.co.uk

Challenge Area

Whole system network planning and utilisation to facilitate faster and cheaper network transformation and asset rollout

Strategy Theme

Whole energy systems

Lead Sector

Gas Distribution

Other Related Sectors

Electricity Distribution

Project Start Date

01/03/2024

Project Duration (Months)

2

Lead Funding Licensee

Northern Gas Networks

Funding Mechanism

SIF Discovery - Round 3

Collaborating Networks

Northern Powergrid

Technology Areas

Modelling

Gas Distribution Networks

Project Summary

Regional Energy Strategic Modelling (RESM) aims to develop and test a system dynamics tool that could be used by a Regional Energy Strategic Planner (RESP) to deliver socio-economic development of regional decarbonisation pathways across Britain.

The RESM will place vulnerable consumers at the core of its decision-making, whilst establishing a top-down approach to deliver more coordinated local energy planning which is cognisant of the needs of a modern, flexible multi-vector national transmission system. This first-of-its-kind project aims to deliver the first regional energy plan for North East England, establishing joined up thinking between gas, electricity and water distribution networks.

Project Budget

£124,098.00

SIF Funding

£110,526.00

Project Approaches and Desired Outcomes

Problem statement

Government's ambitions to connect 50 GW of offshore wind and deliver 10 GW of low carbon hydrogen production capacity by 2030 will shape the evolution of our national electricity and gas transmission systems, whilst increasing the strain on our vital potable water resources to meet electrolysis needs. Whole energy systems thinking on a national level is underway, driven by needs of the Future System Operator (FSO) which will hold responsibility for the strategic planning for the transport of both molecules and electrons.

At a regional level, gas and electricity distribution networks are encouraged to establish collaborative relationships, and a whole system approach was introduced into the RIIO-2 price control framework. This must develop much faster at a regional level to keep pace with the demands on the evolving transmission system, by delivering smart and flexible regional energy systems which deliver strong outputs for communities and are cognisant of the availability of resources; natural (wind, solar, water) and infrastructure development (labour, materials) and demands (domestic, industry, transport) specific to each region.

The role of long-duration hydrogen storage for electricity peaking is recognised in many credible net zero scenarios, the electrolysis of water to create green hydrogen will place further strain on the water distribution networks. The transition may involve partial decommissioning gas distribution networks and substantial reinforcement of the electricity distribution networks, whilst new opportunities will emerge for coupling of networks using power-to-gas devices and hydrogen-fired peaking plants, and heat networks.

These interventions will require unprecedented levels of investment in infrastructure, from private sector, national and local governments, communities, and individual consumers. Britain must deliver an equitable energy transition that places vulnerable customers at the core of its decision-making, starting with most deprived areas. This will mean a divergence from typical cost-driven models, towards socio-economic models which ensure that no unaffordable costs are placed on vulnerable stakeholders.

This project will enable and support a Regional Energy Strategic Planner (RESP) for North East England to ensure that scenario-based planning backgrounds for individual vectors are robust, transparent and deliverable at a local level, cognisant of national decarbonisation ambitions, and enable an affordable transition for all consumers.

As a whole-energy system initiative, this project covers elements of all Ofgem's four innovation challenges, but directly and primarily addresses Challenge #1 (Whole System Planning) aim: Improve coordination, modelling and planning capability across networks to support holistic and timely system development.

Video Description

https://vimeo.com/919125666/464b06d63c?share=copy

Innovation justification

This project will explore the higher systems-level planning functions of a RESP and its broad function as a regional cog in the national energy system, over the long-term horizon to 2050 and beyond. A first-of-its-kind, it will develop a regional multi-vector strategic energy plan for the North East England, strategically steering the development of regional backbone infrastructure, cognisant of demographic and social characteristics unique to an individual region, and with vulnerable customers placed at the core of its decision-making. It will complement the exploratory work being delivered on the community-level functions; for instance combined-authority York & North Yorkshire Local Area Energy Plan (https://democracy.york.gov.uk/documents/s164227/Annex%20A_LAEP%20Overarching.pdf) and the PRIDE and RESOP innovation projects, led by National Grid Electricity Distribution (NGED) and Scottish and Southern Energy Networks (SSEN), respectively.

The Common Planning Pathway, a DNV project led by National Gas Transmission (NGT), illustrated the importance and significance of human-factors in a plausible trajectory of a net zero pathway for the UK energy system. Our project will leverage the system dynamics methodology from this project and develop a topdown approach to join-up national objectives with local area energy planning for each region of Britain, beginning with North East England. The outcome will be an innovative tool for

developing regional pathways, factoring in the critical role of 'system inertia', which sets it apart from many existing 'back-casted' alternatives currently used in energy system discourse.

The regional energy system model will be informed by unique datasets for North East England. Leveraging the customer vulnerability mapping tool developed by NGN, we will ensure that the impact of this project is felt foremost among theregion's most deprived areas. The model will be adaptable to each region of Britain and enable robust scenario-based planning to ensure that proposedinfrastructure investments are coordinated and follow an established, affordable region-specific trajectory to net zero. Outputs will ensure that the evidence base for strategic projects is holistic and robust, to underpin decisions made (primarily) through the RIIO-3 (and ED2) price control mechanisms. We aim to progress the TRL from level 4 to level 5.

Without this project, a newly established RESP will be limited in its tools and capabilities to challenge the status quo; i.e. continued development of gas, electricity and water networks plans in silos, with some (limited) smart optimisation.

Impacts and benefits selection (not scored)

Financial - future reductions in the cost of operating the network

Financial - cost savings per annum on energy bills for consumers

Financial - cost savings per annum for users of network services

Environmental - carbon reduction – indirect CO2 savings per annum

Revenues - improved access to revenues for users of network services

New to market – processes

Others that are not SIF specific

Impacts and benefits description

Wide-ranging benefits can be envisaged in terms of societal, environmental and economic effects, which will enable Britain to advance towards a more resilient and democratised energy system.

Societal - The regional energy system model delivers societal benefits, in the form of a feedback loop to support development of LAEP's, enabling democratisation of energy at a local level and protecting vulnerable customers, whilst conforming to the needs of the national energy system and delivering on Government ambitions for decarbonisation.

Economic - The strategic planning function of a RESP is a critical enabler for the timely development of infrastructure with adequate capacity to support the flow of molecules and electrons between national systems and local systems. Developing a coordinated approach towards energy system planning could result in net economic benefits to consumers of between £0.9-3.2bn/year to £163-252bn over a 25-year-period according to Future of local energy institutions and governance (ofgem.gov.uk) (https://www.ofgem.gov.uk/sites/default/files/2023-02/Future%20of%20local%20energy%20institutions%20and%20governance.pdf).

Economic - Establishing much stronger coordination with water utilities will lead to more cost-optimal regional decision making on the siting of electrolysers for green hydrogen production whilst being cognisant of water availability, storage and infrastructure capacity. To put the scale of this challenge into context, to unlock the Government's 2030 target of 5GW of electrolyser capacity in a single region will require more than 750,000 litres of water per hour at full operational capacity, approximately equivalent to the water needs of a populated town the size of Middlesborough.

Environmental - Whilst no trivial task, we can approximate at a high-level that energy-related CO**l** emissions in the UK are distributed regionally more or less proportional to the region's share in methane demand, which is in the order of 30 million tonnes of CO**l** per year in North East England. The pastoral role of the utilities and a RESP has never been more important than now in driving down regional emissions whilst protecting the needs of energy consumers in vulnerable communities. Coordinated planning of decommissioning of carbon-emitting assets where needed will be a key outcome of this project.

Teams and resources

NGN has assembled a diverse team with industry-leading whole energy system planning expertise, underpinned by core competence in gas, electricity and water network planning and supported by academia. This project will establish the platform for execution of our Whole Energy Systems Strategy developed in consultation with our Customer Engagement Group (CEG).

DNV, as technical advisor to this project, brings expertise in whole energy system planning, recently supporting the ESO in the methodology of a 'whole systems' FSO-led Centralised Strategic Network Plan, and the development of a NGT-led balanced vector Common Planning Pathway. NGN has been working collaboratively with Northern Powergrid (NPg) and DNV to deliver the Hydrogen Village Trials, which explores the distribution of hydrogen to homes in the village of Redcar.

In the Humber region some of the first utility-scale electrolysers are being deployed to support decarbonisation of industrial clusters. However, water stress is already emerging as a challenge, with the Environment Agency indicating the region is on course for a water deficit before 2030. Water also has a role in cooling processes and for carbon capture and storage at these industrial hubs. It is therefore vital that water is embedded within a whole systems approach, which is why we have engaged our partner Northumbrian Water to support this work.

Durham University brings academic expertise through several ongoing whole energy system projects, notably the UKRI-funded Virtual Power Plant with Artificial Intelligence for Resilience and Decarbonisation project (VPP-WARD). This is a highly collaborative £1.85m project in partnership with DNV, NPg, Northumbrian Water, Durham County Council and others, which utilises innovative physicsinformed Artificial Intelligence to aggregate and manage vast arrays of distributed energy resources (DER) across networks.

At the InTEGReL test facility in Low Thornley, NGN has been working closely with NPg on the 'Microresilience' NIA project which explores practical issues and economic considerations of transferring energy between vectors to deliver more efficient low carbon heating and electricity. The project is assessing the technical viability and comparative economics (including non-financial benefits) of smart technology enabled resilience on vulnerable connections of critical and remote customers.

NGN will engage with a wider pool of stakeholders by holding a workshop during the Discovery phase to foster support for the project and seek critical review on findings and future scope. Subject to availability, participants would include; ESO, NGT, ENA, Utilities, Ofgem and DESNZ.

Project Plans and Milestones

Project management and delivery

WP1 Scope Definition of a Regional Energy Strategic Planner

Lead: NGN

High-level review of gas, electricity and water distribution planning processes to identify gaps and opportunities for co-optimisation that could influence whole system planning at a regional level. Development of a blueprint of the anticipated interactions of a RESP with the FSO, NGT, GDNs, DNOs, and water utilities.

Since the gas, electricity and water licence areas, as well as local authorities are not coterminous, this work package will undertake a scoping exercise to inform options for boundaries and assess modelling impact of Ofgem's proposal for 10 to 13 RESPs across GB.

WP2 Scope Definition of a Regional Energy System Model

Lead: DNV

WP2 will establish the scope of the system dynamics model, including the sectors and the level of detail in each sector. We will determine the model's boundaries, timeframe, and wireframe structure. At a high-level, we will survey data required for model specification and calibration against available data sources.

From this exercise we can establish some of the core input assumptions that can later be used for scenario analysis whilst engaging with NGN's Customer Engagement Group (CEG). This will enable DNV to set out the roadmap for development of the regional energy system model for the North East.

WP3 Energy Transition Risk Assessment and Stakeholder Engagement
Lead: DNV
We will articulate where existing processes can be done better, faster, and more efficiently to support the FSO in its role as strategic planner. We will prepare and communicate a qualitative risk assessment of continuing along the pathway of a counterfactual to ensure that the scope of further work is agreed with key stakeholders. We will leverage our vulnerable customers tool to incorporate key societal considerations into the assessment. This work package will establish a firm basis for the progression of the project through to Alpha and
Beta phases.

Stakeholder engagement is crucial to this work across all work packages. Two inperson project workshops at intervals through the project. A industry stakeholder engagement workshop will be held, where we present the findings of the work packages with a view to refinements required in an Alpha phase.

The project will be managed by DNV. NGN, as Lead-Partner, will be responsible for providing regular control and support to the day-to-day project management.

Key outputs and dissemination

The following key outputs will be delivered in the Discovery phase (responsible entity):

1. Gap analysis of single-vector planning processes and identification of opportunities for co-optimisation across the gas, electricity and water distribution planning processes (All partners)
2. Risk assessment of continuing on the current regulatory path without the RSP function, with a qualitative assessment of consequence, severity and likelihood of risks occurring (All partners)
3. Review and evaluation of Ofgem's proposed regions for RESP purposes (All partners)
4. Review and gap analysis of existing formal and informal system planning interactions between ESO, NGT, DNOs, GDNs and Water Utilities, to inform the positioning of a RESP stakeholder in the regulatory environment. (DNV, NGN, NPg)
5. Scoping document of requirements of a regional energy system model, including wireframe model (sectors, subsectors, granularity, interlinkages) (DNV)

6. Survey of available data and data gaps for informing the model (DNV, supported by all partners)
7. Briefing materials and an industry-wide engagement workshop with key industry stakeholders (All partners, led by DNV)
8. A value case for a RESM: why the RESP process will benefit substantially from an integrated whole energy system simulation model (DNV)

Key outputs will be delivered in a midpoint progress presentation and a final technical report. Note that inputs to the model will be established in the Discovery phase, but there will be no modelling undertaken; this would take place in a future Alpha stage.

Dissemination will be via NGN's established channels including local and international exhibitions and conferences, newsletters & publications; industry events. Learnings from the project will be uploaded on the ENA's Smarter Networks Portal and SIF Discovery 'Show and Tells'.

Outputs of subsequent phases would include:

Alpha phase: Model Development First iteration of the system dynamics model, based on North East England, deeper stakeholder engagement for refinement and testing of the system dynamics model, inputs and assumptions.

Beta phase: Extending the system dynamics model to all regions of Britain. The true value of an integrated planning model would emerge when it covers the whole of Britain and movements of energy vectors among various regions, which can be accomplished in a beta phase. This can be used to create a tailored multi-year whole energy system infrastructure plan for all regions in Britain containing for example; projections of technology deployment (e.g. onshore wind, solar), trades between transmission and distribution systems, hydrogen point sources and end use demand segments, etc.

Commercials

Intellectual Property Rights (IPR) (not scored)

Each Project Partner shall own all background IPR as well as foreground IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation. We intend to ensure each Project Partner will comply with Chapter 9 SIF Governance Document through the contractual terms governing the project. However, precisely how this is done and the exact allocation of Foreground IPR ownership will be subject to contractual negotiations with the Project Partners on the agreement for the project.

Value for money

The definition and development of the first Regional Energy Strategic Model will underpin the distribution network-specific investment plans that licensed entities seek funding through existing and future price control arrangements. It is paramount that whole energy system thinking is embedded at the heart of infrastructure development across the regions of Great Britain.

The monetary value of these cost-efficiencies will be realised in networks business plans through lower future tariffs for consumers.

In the Discovery Phase, the work will primarily be a desk-top exercise including preparation of briefing materials, stakeholder engagement, attendance at collaborative project meetings and drafting of reports. This will incur professional fees on a 'day rate' basis, there are no 'costs for assets' envisaged to be required in the Discovery Phase.

Currently, this project will not receive any additional funding from other innovation funds, with the 10% minimum contribution to project costs split across all partners from private funds, with the exception of Durham University.

The total project costs are £124,098, with a total SIF funding request of £110,526, with payments to be split across work packages, following review against success criteria. DNV are currently a market leader in systems modelling & network analysis software, therefore their expertise will vastly support the project with success at scale to commercialise the project outputs post-Beta phase, driving value for energy network customers.

Supporting documents

File Upload

SIF Round 3 Project Registration 2024-03-11 12_38 - 61.7 KB
10107024 Regional Energy Strategic Modelling (RESM).pdf - 0.0 bytes

Documents uploaded where applicable?

☑