

NIA Project Close Down Report Document

Date of Submission

Jun 2023

Project Reference Number

NIA_NGGT0184

Project Progress

Project Title

Gas and electricity transmission infrastructure outlook

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NIA_NGGT0184

Funding Licensee(s)

NG ESO - National Grid ESO

Project Start Date

February 2022

Project Duration

1 year and 0 months

Nominated Project Contact(s)

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Scope

The project will be split into 5 Phases

1) Phase 1: Kick-off and align on assumptions, data sources and requirements (Duration – 1 month)

- Create an efficient launch of project: Agree on project scope, data, modelling approach
- Determine key data sets and their quality
- Determine the activities and methods by which to achieve the outcomes of the future project phases
- Tasks 1.1. Agree on functional requirements

Prepare, conduct a project kick-off with Guidehouse and the NG parties. Formalise project set up: Project scope, planning & schedule.

✓ Agree table of contents and storyline for the purpose of Ph.5

✓ Agree scenarios, sensitivities and modelling approach. All stakeholders agree to freeze the scenarios to ensure alignment on next steps.

✓ Envisaged stakeholder selection for the purpose of Ph.4

✓ Timing and organisation of progress meetings

✓ Schedule key meetings with project team (no surprises, and clarity on delivery)

- Task 1.2. Review and engage with other relevant work

To ensure relevance of our work and to maximize the project value we review and benchmark past and ongoing work done on the whole system approach and integrated modelling of electricity and gas infrastructure. For relevant ongoing work we assess if collaboration is possible to create synergies.

- Task 1.3. Identify and collect relevant data

Hold data gathering exercises with key ET, GT, ESO and GSO teams to acquire and agree upon the most relevant data sets. Define and gather relevant input data: investment costs, fuel price projections, emission factors, national H2 plans and climate targets

- Task 1.4. Log and agree on assumptions and setup data management

2) Phase 2: Develop insights into future integrated energy network (Duration – 4 months)

- Provide an evidence-based vision on how a pathway towards a “Net Zero Energy Transmission Network” could look like
- Develop insights into the future interaction between gas and electricity transmission, storage and conversion infrastructure to meet future demand in the various sectors
- Highlight the benefits of the whole system approach to maximize consumer benefits, i.e. of an integrated planning and operation of gas and electricity infrastructure

- Task 2.1. Develop NUTS1 datasets for selected scenarios and setup LCP model:

Review the datasets acquired in Ph.1 and develop NUTS1 dataset for each selected scenario. Setup the LCP model. Enhance and build upon the existing NG data, from Guidehouse and external sources.

- Task 2.2. Review developed datasets and LCP model setup with NG teams:

Engage with GSO/ESO, GT/ET future and regulation teams to get feedback on the developed datasets and proposed LCP model configuration. Update datasets and LCP model configuration based on feedback. Hold initial stakeholder engagement activity to align on models assumptions/inputs

- Task 2.3. Modelling pathways towards a “Net Zero Energy Network”:

Apply the LCP model for integrated capacity expansion and dispatch optimisation for gas and electricity transmission, storage and conversion infrastructure to match future energy supply and demand for each considered scenario. Major model outputs: installed transmission capacity btw. model regions, installed storage and conversion capacity in each model region; insights into operation of the future integrated energy network.

- Task 2.4 Perform sensitivity analyses:

Vary costs of infrastructure types and assess the option of offshore P2G to gain further insights into the configuration of the future integrated energy network.

- Task 2.5. Analyse results and develop vision for the “Net Zero Energy Network”, phase 2 report: Formulate an evidence-based vision on how an integrated UK energy network could develop until 2050 based on the quantitative outcomes of the previous tasks. The delivered Ph. 2 report specifies the major characteristics of the future integrated energy network, highlights the interaction between infrastructure and the resulting benefits but also clearly detail any limitations of the study and propose areas for further work. Validation of model and results by Imperial College.

3) Phase 3: External Engagement (Duration – 2 months)

- Conduct bilateral meetings: across phase 2 - to avoid any surprises during the stakeholder engagement event - Guidehouse to conduct bilateral meetings with key stakeholders to align and achieve buy-in through the following process:

1. Prioritise National Grid’s 84 stakeholders from Project Union ahead of workshop(s)
2. Together with National Grid characterize into ‘allies, enemies and swing voters’ who have a whole system mindset
3. Identify critical stakeholders, evaluate their value drivers and pain points and identify strategies to ‘swing’ them towards an overarching consensus

- Facilitate stakeholder engagement event

1. Present findings from Phase 2
2. Facilitate workshop with key stakeholders and incorporate their feedback into the final report
3. Leverage appropriate tools and techniques to ensure stakeholder alignment during Phase 3 such as carousel and ‘way forward’

- Collate stakeholder insights and determine action plan following completion of workshop(s) including any gaps in stakeholder engagement to inform future work

- Product Phase 3 report: Inclusive of stakeholder insights, gaps in feedback, and key areas to consider development of the future state network base on stakeholder input.

4) Phase 4: Data and Engagement Insight Review and Gap Analysis (Duration – 2 months)

- Review stakeholder insights and feedback and understand impact on proposed network structure
- Update proposed transmission network and model (if needed) following review of stakeholder feedback. Undertake gap analysis to identify knowledge gaps that would still need to be addressed
- Product report having consolidated findings, clearly providing recommendations for further analysis from 1) future policy shaping angle and 2) innovation project pipeline for use cases across the following sectors:
 - Power
 - Heat
 - Transport
 - Industry

5) Phase 5: Standards & Reporting (Duration – 1 month)

- Complete final technical report write-up
- Provide a final summary report
- Populate an ENA closure report document (if required)

Help National Grid identify if any standards need to be updated based on results presented in the report.

Objectives

The key objectives for this activity are as follows:

- To provide an internal and external vision of the future net zero energy transmission system that will deliver net zero energy to industry, transport, heat and power
- To consider the main interactions between the future decarbonised electricity and gas transmission systems
- To determine what are the main areas of system interaction that need further consideration and potential policy and market / regulatory framework development

To better inform gas and electricity modelling for future scenarios, providing information such as likely production locations and end users, including an understanding of the balancing requirement and how this could best be managed with separately regulated businesses to enable and ensure the UK energy systems reliability and robustness

Success Criteria

The following key criteria need to be met for the project to be considered successful:

- Study objectives met to time and cost
- Clear understanding of the data sets utilised and why
- Stakeholder engagement and alignment
- Robust narrative that provides guidance for future interactions

Performance Compared to the Original Project Aims, Objectives and Success Criteria

The project has met its objectives, as shown below:

- To provide an internal and external vision of the future net zero energy transmission system that will deliver net zero energy to industry, transport, heat and power - The project provided an evidence-based view of the evolution of gas and electricity transmission systems, based on the three net-zero compliant FES scenarios: System Transformation, Consumer Transformation and Leading the Way
- To consider the main interactions between the future decarbonised electricity and gas transmission systems – The project applied a whole systems lens to the development of gas and electricity transmission systems in the future; all scenarios used in this analysis consider how the development of one system impacts the development of the other. This is reflected throughout the final report (e.g., executive summary messages, electricity & hydrogen development sections, gap analysis and recommendations).

- To determine what are the main areas of system interaction that need further consideration and potential policy and market / regulatory framework development – The gap analysis and recommendations sections determined main areas of system interaction that need further consideration in terms of policy, market/regulatory framework development. These were identified as part of the modelling exercise as well as the stakeholder dialogue (see common themes from Virtual Stakeholder Event)
- To better inform gas and electricity modelling for future scenarios, providing information such as likely production locations and end users, including an understanding of the balancing requirement and how this could best be managed with separately regulated businesses to enable and ensure the UK energy systems reliability and robustness – The use of three FES scenarios as well as additional sensitivities (5) highlighted areas of attention across gas and electricity. The analysis has also provided likely production locations and capacities across a range of low-carbon technologies, and assessed the UK energy system from an energy security and resilience perspective.

The project has also met the success criteria defined in Section 3:

- Study objectives met to time and cost – See above. Objective has been met to time and cost.
- Clear understanding of the data sets utilised and why – This has been provided as part of Phase 1 deliverable
- Stakeholder engagement and alignment – Stakeholder engagement and alignment was a key feature of the project. This has been met through a series of results workshops to achieve alignment on model results as part of Phase 2. Phase 3 involved extensive stakeholder engagement with internal (within National Grid) and external (BEIS, Ofgem, other networks) engagement which led to a successful virtual stakeholder event in October 2022. Several stakeholder sessions have taken place to achieve alignment on project messaging.
- Robust narrative that provides guidance for future interactions – The narrative developed provides guidance for future interactions e.g., gap analysis and recommendations sections specify areas for future interaction. In addition, limitations of the study have been outlined in the methodology section of the report.

Required Modifications to the Planned Approach During the Course of the Project

The project amended the scope from original to utilise FES 2022 data instead of FES 2021 data. During the course of the project, ESO released updated FES information, it was considered more credible to use the latest information. This decision to use FES 2022 data was agreed by all three network parties after the publication of the British Energy Security Strategy in April 2022.

Lessons Learnt for Future Projects

The project applied a regional and whole-systems lens to gas and electricity network infrastructure modelling in a way that has not been applied previously, which may open up opportunities for further work in the future. It also encouraged more dialogue among stakeholders (NGT, NGET, ESO, BEIS, Ofgem, and other networks) through a series of result workshops, stakeholder briefings and a virtual stakeholder event attended by 70+ stakeholders. As part of this project, several potential innovation project ideas have been identified. These ideas have been grouped into themes that are shown below:

- Integrated whole system studies
- Whole system / hydrogen focused studies
- Whole system / power focused studies
- Future System Operator focused studies
- Public-sector focused studies

The themes listed above may provide opportunities for further collaboration among gas and electricity network companies, in future (innovation) studies.

The agreements over the content of the final report between ESO, NGET and NGT took more time than anticipated. The learning is that each network has differing views of the future energy vector mix and more time to find compromises is needed in future collaborative projects.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The project has shown that:

- In all net-zero scenarios, integrated infrastructure planning across electricity and hydrogen transmission can provide energy system savings up to £38 billion by 2050, which will be supported by no regret network investments, common across all scenarios, over the next decade.
- Introducing green hydrogen electrolysis into the energy mix reduces renewable generation curtailment from 26% down to 1% by 2050.
- Maximising renewable generation on the system is key to meeting UK net-zero ambitions. This requires an increase in the importance of dispatchable peak supply with up to 32 GW of hydrogen turbines and a similar magnitude of demand-side flexibility resources.
- Hydrogen storage plays a key role in all net-zero scenarios during low-wind periods by providing nonintermittent hydrogen supply to support both gas and electricity systems when green hydrogen production is limited.

The project provided an evidence-based view of the evolution of a mix of different technologies that would help GB achieve its net-zero target in the most cost-effective way in terms of future infrastructure development (to 2050) across different FES (net-zero compliant) scenarios. The project also highlighted the importance of long-term whole systems planning and the role of stakeholders in realising its benefits and provided a robust demand regionalisation methodology that could be applied to future whole systems projects.

More importantly, the project stimulated more collaboration and fruitful dialogue among Gas Transmission, Electricity Transmission and Electricity System Operator, and promoted communication with BEIS, Ofgem and other networks in the context of future whole system planning. These may be further accelerated if future innovation project ideas identified in this project (see Section 6) materialise.

Value tracking

Data Point	Data Point Definition	
Maternity	TRL 2-3	The project is the 'first' early-stage collaboration between electricity and gas network over infrastructure planning.
Opportunity	100% & multiple asset classes	The project scope encompasses all assets
Deployment costs	-	Vary across FES scenarios
Innovation cost data	£353,333	Cost increase due to pivot to use FES 22 data instead of legacy FES 21
Financial Saving of	£38bn	In the high hydrogen scenario of FES 22 under the LCP modelling £38bn savings could be realised against not having an integrated approach.
Introducing green hydrogen electrolysis into the energy mix reduces renewable generation curtailment from 26% down to 1% by 2050.		

Safety	-	Not focus of project
Environment	-	Not focus of project however integrated planning and pivot to hydrogen and renewables will have CO2 savings.
Compliance	Support compliance	
Skills & Competencies	No change	
Future proof	Must have for the business strategy	

Data Access

Details on how network or consumption data arising in the course of an NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Gas can be found in our publicly available “Data sharing policy relating to NIA projects” at www.nationalgas.com/gasinnovation. National Gas data access is managed IAW provisions under 2.15-2.18 for the current NIA Governance Document.

National Gas already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGT internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to our supplier’s own ISO 9001 certified quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and made available for review.

Foreground IPR

The results of the project will create knowledge in the transmission approach to whole systems that can be utilised as appropriate by UK networks to determine future strategies and approaches. It may also benefit interconnecting networks and systems.

Planned Implementation

No policy or standards would need to be updated as a result of this project. However, recommendations provided as part of this project can be used to inform further whole systems dialogue among industry stakeholders. A summary of project recommendations (by stakeholder group) can be found below:

- Policy:
 - o Policy needs to be binding and should be consistent in the face of political changes.
 - o Policy should seek to align the different interests in electricity and gas, such as through an empowered independent Future System Operator.
 - o National level policy should coordinate the regional strategies to ensure efficient whole system integrated planning.
- Regulation:
 - o Regulatory arrangements need to be established now to support effective hydrogen and carbon markets.
 - o Gas and electricity regulatory cycles need to be further aligned and need to recognise investments needs for the next decades.
 - o The energy market framework should encourage optimal power and hydrogen production location, whole system integration and collaboration
- Generation:
 - o New business models and incentives need to be developed for long-duration storage and low-carbon peaking plants.
 - o Developers should engage actively and work collaboratively with Commercial & Industrial customers, networks and regional authorities to optimise energy production from their assets.
- Networks:
 - o Essential no-regret capital investments should be unlocked now across the country to set us on the path for whole system decarbonisation.
 - o Networks operators should further coordinate and collaborate to ensure geographical integration and accelerate the transition.
- Demand:
 - o Industries should collaborate together to understand a full range of clustering opportunities which reduce system costs.
 - o Higher level of consumer engagement and technology integration is needed to provide the needed system flexibility.

Other Comments

None

Standards Documents

Not Applicable