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.
Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

NIA Project Close Down Report Document

Date of Submission

Jul 2025

Project Reference Number

NIA2_NESO098

Project Progress

Project Title

Options for optimising GB Data Centres

Project Reference Number

NIA2_NESO098

Funding Licensee(s)

NESO - National Energy System Operator

Project Start Date

December 2024

Project Duration

0 years and 2 months

Nominated Project Contact(s)

innovation@neso.energy

Scope

This project seeks to understand:

1. The current view of data centres in GB in terms of their energy consumption, sustainability, efficiency and grid connectivity.

2. The potential for data centre growth in GB and whether the current grid could accommodate these demand projections.

The project will map GB data centres projects and future demand to reveal how location impacts the network and grid connectivity.

Objectives

This project will deliver a summary document, which will outline:

1) Energy consumption patterns across a variety of GB data centres, including new and legacy installations.

2) A geospatial analysis of GB data centres and future plans, providing insights into how location affects grid connectivity and network impacts.

3) The current factors that data developers use to choose data centre locations and a view of the benefits of relocation of data centres.

4) Benchmarking and best practices considering grid connection challenges, opportunities, and current solutions used by data centres, identifying potential enhancements to minimise strain on the national grid.

Success Criteria

This project will be considered a success in the production of a summary document, which will outline:

1) Energy consumption patterns across a variety of GB data centres, including new and legacy installations.

2) A geospatial analysis of GB data centres and future plans, providing insights into how location affects grid connectivity and network impacts.

3) The current factors that data developers use to choose data centre locations and a view of the benefits of relocation of data centres.

4) Benchmarking and best practices considering grid connection challenges, opportunities, and current solutions used by data centres, identifying potential enhancements to minimise strain on the national grid.

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

National Energy System Operator ("NESO") has endeavoured to prepare the published report ("Report") in respect of Options for optimising GB Data Centres, NIA2_NESO098 ("Project") in a manner which is, as far as possible, objective, using information collected and compiled by NESO and its Project partners ("Publishers"). Any intellectual property rights developed in the course of the Project and used in the Report shall be owned by the Publishers (as agreed between NESO and the Project partners).

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The project was delivered in three work packages as outlined at the start of the project. The scope of these work packages is summarised below:

Workstream 1 - Benchmarking and best practices: Produced a data-driven model benchmarking GB data centres, identify efficiency gaps and assess best practices.

Through primary and secondary research, best practices around a full range of powering and flexibility solutions used by data centres in the UK and internationally were assessed. This included cooling & district heating integration as well as powering solutions such as co-located batteries & micro-generation. A comprehensive scan of international approaches to Data Centre policy was conducted.

Workstream 2 – Optimised grid solutions: Defined demand forecasts and analyse existing and current forecasts of grid constraints against demand forecasts.

In order to build a view on future data centre demand, we focused on two areas for the project:

Creating a baseline of the current data centre estate

To create a baseline of the current data centre estate we used a mixture of primary and secondary resources. This provided a global view of demand including data centre component shipment and power consumption data. The global and eventual GB view of demand was built from interviews with sector experts, existing public research (e.g, IEA), press articles and commercial data sets (e.g., S&P Global 451).

Baseline data includes research and assumptions on data centres by type (e.g., Hyperscalers, Co-locaters, and enterprise owned). It also includes research and assumptions around Power Usage Effectiveness (PUE) and IT Utilisation Levels across the estate.

Data centre locations across GB were analysed as part of the geospatial analysis.

Creating potential growth scenarios for data centres in GB

Multiple scenarios were built for data centre growth in GB based on expected growth in user demand for AI and digital services, and the expected amount that demand could be supplied in GB. The starting point for the forecast was based on the global demand

outlook from McKinsey, IDC & Gartner reports, expert interviews, and NVIDIA capital markets reports. McKinsey used public data sources or has access to this data through pre-existing arrangements.

Growth in user demand was based on AI adoption by sector over the next 5 years using expert interviews and proprietary data from McKinsey Global Institute, and other secondary sources including CIS / IHS Markit and Oxford Economics. McKinsey used public data sources or has access to this data through pre-existing arrangements.

A key aspect of understanding forecast supply of data centres was understanding the latency restrictions of user demand. Four categories were created including locally constrained, regionally constrained, nationally constrained, and no geographic restrictions. This categorisation is based on McKinsey data, 451 data centre supply 2024, ONS data, and other secondary sources. Expert interviews were used to verify the analysis.

The forecast was then verified against connection queue data including assumptions on attrition at each stage of the process.

Workstream 3 – Geospatial analysis & locational models: Built scenarios and detailed geospatial analysis with insights into how location affects energy efficiency and grid connectivity.

As part of setting the current baseline for the current data centre estate, and predicting where future data centres will be located, a geospatial analysis was conducted. Through engagement with industry stakeholders and sector expert input, nine prioritisation criteria were identified that govern how data centres locations are chosen. These criteria are:

1. Power cost & time to power
2. Fibre connectivity
3. Proximity to end customers
4. Construction labour availability & cost
5. Developable land availability & cost
6. Local regulations/ policy
7. Water access
8. Sustainability
9. Climate

Some future data centre types were found to be constrained within GB due to data sovereignty or protection requirements; others were locally constrained due to high latency sensitivity (e.g. financial trading in London, robotic surgery across the UK). A number of principle-based geospatial scenarios were created to model data centre demand by region with varying assumptions on the locations of nationally flexible data centres.

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

N/A

Lessons Learnt for Future Projects

Since data centres are a growing area of demand, there is scope for better collaboration across government and industry on data collection and sharing. This requires preparation to avoid delays with data provision and thorough review for consistency. Having a single, consolidated view on the data centre estate that could be updated annually would be a good first step. This would help inform future forecasts from Government and within NESO.

Since data centres are a growing area of demand, there is scope for better collaboration across government and industry on data collection and sharing. This requires preparation to avoid delays with data provision and thorough review for consistency. Having a single, consolidated view on the data centre estate that could be updated annually would be a good first step. This would help inform future forecasts from Government and within NESO.

The AI and data centre market is also very dynamic, which highlights the need for regularly revisiting forecasting and underlying assumptions. During the project at least two major events (DeepSeek launch, AI Growth Zones) were announced that could have a significant impact on future data centre projects. Greater co-ordination and regular reporting can help ensure the industry is better prepared to serve the digital and AI sector with new developments.

Building a view of the future data centre estate was challenging due to repeated speculative applications across regions, and assumed duplication in the connections queue.

AI developers and other third parties can sometimes quote MW size of a data centre based on its IT power requirements, which ignores non-IT loads like cooling for example. This led to some confusion early in the project when quantities were quoted by stakeholders without specifying what type it was.

The geospatial model was adapted for different output formats, as it became a resource for multiple teams.

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 outcomes of the project were as follows:

1. The resulting demand scenarios have provided useful insight which have fed into FES 2025. It has also been used in consultation with DESNZ and DSIT to inform the recommendations in the AI Opportunities Action Plan.
2. The report and findings were considered when the decision on the SSEP's approach to modelling data centres was being made. Specifically, it was used to understand the 2030 vision and projected capacities, as well as expected latency requirements of data centres (percentage of capacity that is locationally flexible). This information supported us during our engagement with government, as well as industry stakeholders.
3. The outputs of this report are being used, alongside input from elsewhere, to consider implications for future connections processes.

The report draws on multiple sources, including market analysis from McKinsey & Company. NESO are responsible for the conclusions and recommendations of the research.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by NESO can be found in our publicly available “Data sharing policy related to NIA projects (and formerly NIC)” and Innovation | National Energy System Operator.

National Energy System Operator 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.

Foreground IPR

- Output slide packs.
- Connections model providing an aggregated view of the connections register of data centres.
- Demand model projecting data centre growth in GB between 2024 and 2040.
- Geospatial data at a regional level.

Planned Implementation

The outputs of this report are being used, alongside input from elsewhere, to consider implications for future connections processes. Any proposed changes would need to consider in the context of other demand types beyond data centres.

Net Benefit Statement

The project has enabled NESO to understand the potential for data centre growth within GB, a top-down forecast matrix and a more robust model for understanding data center sitting, thereby aiding our future planning.

Improved future planning could result in:

- Improving the efficiency of connections and smoothing consumption can reduce pressure on the grid, allowing data centres to expand without causing grid congestion or contributing to the risk of outages, particularly during periods of high demand.
- Improved grid connections and the adoption of energy storage/backup systems will increase the resilience to fluctuations in grid supply, ensuring business continuity and reducing downtime risks.

Other Comments

The Project outcomes and results contain confidential information and intellectual property rights that cannot be disclosed in this Report due to their proprietary nature. Should the viewer of this Report (“Viewer”) require further details this may be provided on a case by case basis following consultation of all Publishers. In the event such further information is provided each and any Publisher that owns such confidential information or intellectual property rights shall be entitled to request the Viewer enter into terms that govern the sharing of such confidential information and/ or intellectual property rights including where appropriate formal licence terms or confidentiality provisions. Dependent upon the nature of such request the Publishers may be entitled to request a fee from the Viewer

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