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 Annual Progress Report Document

Date of Submission

Jun 2025

Project Reference Number

NIA2_NGESO070

Project Progress

Project Title

Incorporating the impact of climate change in power system modelling

Project Reference Number

NIA2_NGESO070

Funding Licensee(s)

NESO - National Energy System Operator

Project Start Date

August 2024

Project Duration

1 year and 1 month

Nominated Project Contact(s)

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Scope

This project aims to provide ESO with improved accessibility to state-of-the-art weather data for modelling the power system (particularly security of supply) on time scales of present day to 2035. The project will analyse how weather and climate data is currently used in ESO and make recommendations as to how this can be improved by harnessing state-of-the-art data. The project will provide details of the benefit of the new datasets and how to implement the changes in ESO models. Additionally, the project will produce a best practice document, which will highlight how to access weather and climate data, how to post-process the data for modelling purposes and how to ensure the ESO updates their data at the right cadence.

Objectives

The objectives for the project are as follows:

- To provide recommendations of the best datasets and information sources that can be used to improve existing ESO modelling work through the incorporation of weather data capturing the credible spread of future weather from the present day to 2035.
- Analysis as to the limitations of existing datasets and any gaps in terms of missing information or tools.
- Case studies illustrating how the recommended datasets can improve ESO modelling.

Success Criteria

The project can be deemed successful if:

- Suitable datasets can be found which capture the credible variability of potential weather experienced by GB from the present day to 2035, incorporating climate change.
- These recommended datasets can be easily incorporated into existing ESO modelling pipelines to improve modelling capabilities.
- There is clear guidance as to the benefits and limitations of the recommended datasets, and understanding from ESO stakeholders as to the potential implementation.

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 Incorporating the impact of climate change, NIA2_NESO070 ("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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Project Overview:

There is a growing sensitivity of supply and demand to meteorological conditions (both electricity and gas), occurring at a time of rapid global climate change. Current modelling methodologies have a reliance on historic conditions and do not account for how the credible range of weather will change in the future.

The project aims to identify the best available meteorological data to model power systems at a range of time horizons, from two weeks ahead through to 2035. A firm understanding of the changing weather patterns and climate is a crucial part of being able to implement and manage a resilient energy network which delivers security and reliability of supply.

Project Plan:

To achieve its objective, the project was divided in 4 phases, conducted by NESO's consultant-partner with close supervision from NESO:

Work Package 1 – The objective of this phase was to perform a structured review with key stakeholders to identify the range of current and future requirements for weather and climate weather data in NESO. The project partner used engagement strategies such as surveys, workshops and interviews to understand the processes and deliverables informed by weather data. This process identified 3 common themes across the modelling teams: (1) requirement for climate projections, (2) post-processing of weather data and (3) requirement to understand full range of conditions including extreme events.

The insights were written up in a report "Climate data for power system modelling: requirement scoping" and were used to inform the investigation completed as part of Work Package 2.

Work Package 2 – A literature review was carried out to identify all potential sources of weather and climate data to meet the needs outlined in phase 1. This included discussions with leading scientists and sector experts in the Met Office, Met Office Academic Partners, and other organisations. Several key datasets were identified including but not limited to; Reanalysis data produced by ECMWF, sub-seasonal forecasts and enhanced climatologies produced by the UNSEEN method developed by the Met Office.

All findings were summarised in the report "Climate data for power system modelling: literature review"

Work Package 3 – A review of findings and gap analysis. The Met Office used tried and tested tools to assess the gap between what data are available and the power system modelling needs. A series of case studies were performed to outline how the new weather data sources could be incorporated. These case studies included the use of the enhanced climatology to derive key security of supply metrics such as Average Cold Spell peak demand and composite weather variable.

The output of this phase is a series of datasets provided to NESO which can be used for other case studies.

Work Package 4 – Report detailing findings and recommendations from WP1-3. This outlines the relevant data sources and results of gap analysis, plus top-level recommendations for where further work could address the gaps and methodologies for using the data.

The report “Climate data for power system modelling: recommendations” outlines a series of recommendations as to how NESO can use alternative sources of weather and climate data to improve their modelling. These recommendations can be condensed into the following categories:

- Standardising the application of historical weather data.
- Harnessing the added value of enhanced climatologies.
- Accounting for climate change.
- Benefits of sub-seasonal to decadal forecasts

Project activities

The project has used both qualitative and quantitative analysis to achieve its aims, including:

- Extensive stakeholder engagement across NESO including interviews, surveys and workshops
- Literature review and discussions with energy sector stakeholders to determine the state-of-the-art.
- Interviews and surveys with key academics to identify new developments in the area.
- Demonstrator modelling. A series of short modelling projects were completed to highlight how the new weather data could be used and the potential impact on a number of key energy system modelling metrics.
- The results have been written up into a series of reports which have been circulated internally in NESO.
- The results were disseminated to the wider energy industry at a workshop event in London.

Meeting objectives

- This project has produced a series of recommendations as to how NESO can improve their modelling of the gas and electricity with the use of state-of-the-art weather and climate datasets. For each recommendation, the Met Office has provided NESO with guidance as to which dataset to use, how it should be post-processed and the limitations of the data.
- The datasets highlighted capture the credible variability of potential weather experienced by GB from the present day to 2035, incorporating climate change. The datasets can be easily incorporated into existing NESO modelling pipelines.
- By carrying out a series of demonstrator modelling projects, the potential improvement to key electricity and gas system metrics has been highlighted.

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

The project followed the plan. The demonstrator modelling projects were selected based on the results of phase and phase 2.

Lessons Learnt for Future Projects

A key learning from this project is the importance of defining a flexible scope, particularly for a project which considers a vast range of modelling applications. Leaving flexibility to allow for a change in direction or a deep dive into a particular topic is useful even for relatively short 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 first phase of the project identified how weather and climate data is currently being used by NESO for security of supply modelling across timescales from 2 weeks ahead to 15 years ahead. This included an understanding of; (1) the source of the data, (2) how it has been post-processed (e.g., bias correction, variable transformations), (3) how large is the dataset (e.g., number of years and spatial region) and (4) how the different datasets at combined during periods where the analysis time frame overlaps.

This analysis highlighted that for modelling projects which are outside of the operational weather forecast timescale (e.g., greater than 14 days), there is a reliance on historic weather data (from climate reanalysis) to represent the possible variability of weather. There is currently no operational modelling which uses seasonal forecasting products or climate projections.

The second phase of the project produced a comprehensive review of all of the weather and climate data which is available to meet the needs of the Energy Security of Supply modelling. The review provides detailed information as to how the datasets were created, how they are updated and where they can be accessed.

The third phase made use of follow-up workshops and interviews with the NESO teams to jointly identify gaps in their current pipelines

with respect to the best possible uses of weather and climate data. Furthermore, a set of short demonstrator projects were designed and developed with some of the teams to highlight some sensitivities to the choice of data and the potential improvements that could arise from changes in existing methods and data.

The final phase of the project identified a set of recommendations as to how the enhanced use of weather and climate data could benefit energy modelling efforts not only within NESO but also across the wider energy sector. The recommendations were:

- Consistency in the use of historical data: Ensuring a standardized approach to the use of historical data including methodological decisions such as bias adjustment of datasets, temporal and spatial downscaling, variable transformations and the selection of climatological reference periods. Consistent use of historical data ensures comparability across teams. It helps align all teams to the same dataset protocols, making their decisions more reliable and reproducible.
- The added value of enhanced climatologies: Integrating climatological datasets, such as ensemble climate hindcasts. These datasets can provide a more complete representation of the weather features of a reference period and capture unprecedented events, offering a deeper understanding of the current climate and extreme events that may not be evident in historical datasets.
- The need to account for climate change: Supporting the integration of climate projections when appropriate and ensuring data pipelines that consider historical data properly account for potential trends associated with climate change.
- Exploring potential benefits of the use of sub-seasonal to decadal forecasts. Investigating the opportunity of integrating forecasts at longer lead times for teams making decisions that range from two weeks to ten years ahead. Potential to improve risk management decisions at longer lead times for example identifying periods of tight margins or peak gas demand in an upcoming winter.

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

The following reports are expected to be published on to the Smarter Networks Portal [at the end of the project]:

- Climate data for power system modelling: literature review
- Climate data for power system modelling: recommendations