

## NIA Project Registration and PEA Document

### Date of Submission

Aug 2024

### Project Reference Number

NIA2\_NGESO067

## Project Registration

### Project Title

Mass mobility data for demand forecasting

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NIA2\_NGESO067

### Project Licensee(s)

National Energy System Operator

### Project Start

July 2024

### Project Duration

1 year and 1 month

### Nominated Project Contact(s)

Innovation@nationalgrideso.com

### Project Budget

£250,000.00

## Summary

The ESOs ability to forecast electricity demand has reduced as a consequence of the COVID-19 pandemic. Historically, the underlying demand profile was driven primarily by day of week and time of day. That demand has become harder to forecast partly because working patterns have not returned to pre-pandemic levels and also because we are seeing new technologies such as Electric Vehicles (EVs) come onto the system. This project seeks to utilise mass mobility data (anonymised telematics vehicle monitoring data) to generate new features for electricity demand forecasting models. It will investigate potential features of value supporting electricity demand estimation and will use historical data to correlate and evidence potential predictive value from said features.

### Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

## Problem Being Solved

The ESOs ability to forecast electricity demand has reduced as a consequence of the COVID-19 pandemic, and the integration of new low carbon technologies into the electricity network. Pre-COVID, the ESO could forecast demand with a Mean Absolute Error of ~600 MW. Post-COVID, the ESO is forecasting with a Mean Absolute Error of ~650 MW. Historically, the underlying demand profile was driven primarily by day of week and time of day. Demand has become harder to forecast partly because working patterns have not returned to pre-pandemic levels and because we are seeing new technologies such as EVs come onto the system.

## Method(s)

The project will follow a number of work package areas and subtasks, gathering initial requirements and investigating the value of vehicle mobility data for electricity demand forecasting. This process will remain under continuous quality review with regular formal meetings to detail progress towards goals, deviations, risks, mitigations and results. The project will use historical vehicle mobility and electricity demand data to correlate and evidence potential predictive value from new data features created as part of the deliverables.

**Work Package 1:** Candidate feature specification – requirements document

Longlisting of potential mobility data features for investigation.

Understand and specify ESO data pipeline requirements and constraints.

Identify potential mobility data aggregations and detail potential value to demand forecasting.

Deliverable 1: Requirements document (Deliverable type: document)

**Work Package 2:** Candidate feature specification – feature register and attribute tables

Refinement of possible first pass candidate features from mobility data meeting the needs of WP1.

Testing methodology development against each candidate feature.

Deliverable 2: Feature register and attribute tables (Deliverable type: register)

**Work Package 3:** Historical Mobility data and feature curation

Gather offline mobility data.

Test potential value of different candidate features.

Deliverable 3: Mobility data features to testing modelling, including revision of the features (Deliverable type: data)

**Work Package 4:** Integration into demand model and feature testing

Gather offline energy data.

Model developments to test potential value of candidate features.

Deliverable 4: Energy values in model to test data against, including revision of materials if features evolve (Deliverable type: data)

**Work Package 5:** Data/feature refinement

Analyse candidate outputs and plots.

Testing and refinement of candidate features detailed in earlier work packs.

Deliverable 5: Candidate analysis outputs and plots (Deliverable type: analysis)

**Work Package 6:** Evaluation

Evaluation of candidate features for ESO usage considering value determination.

Deliverable 6: Evaluation of deliverable 5 finalised outputs and plots (Deliverable type: analysis)

**Work Package 7:** Final reporting

Reporting on experimental output.

Validation review of results.

Gap analysis to real world operational forecasting deployment.

Deliverable 7: Report on evaluation of features, impact and gap analysis with summarised next steps to enable operational deployment (Deliverable type: document)

In line with the ENA's ENIP document, the risk rating is scored Low:

TRL steps = 2 (3 TRL steps)

Cost = 1 (<£500k)

Suppliers = 1 (2 suppliers)

Data assumptions = 2

Total = 6

Following successful completion of the initial project outlined above, with potential downstream applications of the dataset identified, and value of traffic data proven, there may be potential to investigate an additional project phase with a second funding release to deliver, test and evaluate a prototype data pipeline for ESO demand forecasting. This would include specification of requirements, implementation of data pipeline into ESO forecasting systems, model testing, and further refinement.

## Scope

- This project seeks to utilise third-party mobility measurement data (telematics data capturing journey information) with a hypothesis of strong potential added value to support enhanced geographically-resolved electricity demand forecasting.
- Mass mobility data consisting of anonymised telematics vehicle monitoring data will be explored to generate new features for electricity demand forecasting models. This has the potential to bring new insights into normal, and temporally abnormal, behaviour patterns concerning citizens in transit, home, workplace, and state transitions across the population that have strong potential to impact current and near future energy demands.
- These impacts are both indirect (i.e. behavioural) and increasingly direct through the adoption of electric vehicles.
- These new measurements for behaviour will be prepared and collated to evaluate utility in electricity demand forecasting.

- The project seeks to ensure technical means to supply aggregated anonymised behavioural data.
- It will investigate potential features of value supporting energy demand estimation and use historical data to correlate and evidence potential predictive value from created new data features.
- It will test the data features providing input by regions of interest in 30 minute estimation updates (potentially to be available in near real time) to support fit to commercial usage.
- While the main project focus is not EV usage, it can explore features related to EV charging behaviour and the associated impacts on demand. Given journey and effort tracking by region, estimated EV battery usage can be indicated that should forecast later recharge needs.

## Objective(s)

The objectives of the project are:

- To investigate whether inclusion of aggregated anonymised telematics data can improve the electricity demand forecast.
- Create relevant candidate feature specification, including requirements, feature register, and attribute tables.
- Evaluate candidate features, considering data, outputs and plots.
- With the telematics data, provide a demand forecast model with new data which can help in better forecasting the human behavioural aspect of demand and EV charging effects. Create gap analysis between telematics data feature inclusion in the test model, and real world operational forecasting.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations because it is a transmission project.

## Success Criteria

- New features using anonymised, historic telematics vehicle monitoring data generated for electricity demand forecasting models.
- Reduction in regional electricity demand forecast error realised from new data features including within the model, evaluated using historic data provided for the project.
- Reduction in mean absolute error for national demand forecast, evaluated using historic data provided for the project.
- Clear gap analysis completed to detail route to real world deployment following innovation project.

## Project Partners and External Funding

The Floow

University of Sheffield

No external funding

## Potential for New Learning

The correlation between vehicle telematics mobility data and electricity demand is not well proven, with a very low level of foundational research done to explore this. The use of this telematics data has the potential to provide new features for demand forecasting beyond those explored in academic literature. The use of telematics derived features can potentially provide complete spatial coverage over relevant regions, with minimal sampling bias due to its diverse geographic sampling.

The project modelling and feature integration will be undertaken using the existing demand model at The University of Sheffield, this model is structured in a similar way to the ESO demand forecasting model and so key learnings should be easy to translate into benefits for the ESO demand forecasting model.

## Scale of Project

This project will be delivered over 12 months, with the potential to extend further and investigate further delivery, testing, and prototype data pipelines into ESO.

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL5 Pilot Scale

## Geographical Area

This project is being delivered by UK based suppliers, using UK telematics data, and is funded by National Grid ESO, it therefore has

a geographical scope of Great Britain. The project will also provide features into GB regional forecasting as the vehicle telematics data is regionally resolved.

### **Revenue Allowed for the RIIO Settlement**

None

### **Indicative Total NIA Project Expenditure**

£250,000

## Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

### Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

#### How the Project has the potential to facilitate the energy system transition:

By utilising the mass mobility data, the project output will generate new features to be considered for electricity demand forecasting models. It will investigate potential benefits of including these features to the forecasts, using historic data to correlate and evidence potential predictive value from created new data features and hence better demand forecasting. It is anticipated that telematics data might help to forecast the human behavioural aspects of demand, along with EV charging effects on the overall energy demand. Through improving forecast models by including new and innovative new data sets, more optimal decision making in the control room will be enabled, thus helping to reduce overall balancing costs, reserve holding, and constraint management.

#### How the Project has potential to benefit consumer in vulnerable situations:

n/a

### Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

#### Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

#### Please provide a calculation of the expected benefits the Solution

Not required as this is a research project.

#### Please provide an estimate of how replicable the Method is across GB

The mobility data used is regionally resolved and covers all of GB. The project will likely consider a subset of regions with high quality electricity demand data available when assessing the usefulness of telematics data in predicting electricity demand, but considerations will be taken to ensure the conclusions are valid across the GB electricity network and that any features designed as part of the project can be used in regional electricity demand forecasting across GB.

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

This project is considering demand forecasts for the whole GB electricity system. The project will consider the route to operational roll out at the close of the project, this will help to provide potential cost indications of including any new features and data sets into the ESO demand forecasting operational models

### Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-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 GB the Network Licensee must justify

repeating it as part of a project) equipment (including control and communications system 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 Licensees system
- A specific novel commercial arrangement

#### RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

### Specific Requirements 4 / 2a

#### Please explain how the learning that will be generated could be used by the relevant Network Licensees

While the primary focus of this project is around data features for ESO electricity demand forecasting, the overall learnings of using these for electricity demand forecasting may also be relevant to other network licensees considering both national and regional demand forecasting. Similarly, where the project is looking to explore features related to EV usage and associated impact on energy demand might be of benefit for network licenses. Final project reports will be published on the smarter networks portal.

#### Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

n/a

#### Is the default IPR position being applied?

- Yes

### Project Eligibility Assessment Part 2

#### Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

#### Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

Prior academic work on the subject of this innovation project is very limited, with just four papers authored between 2018 and 2023. These used fixed station sensor embedded within the road network, and there are no prior studies of the use of mobile in-vehicle telemetry. There have been academic studies for local correlation between electricity demand and traffic volume using fixed station sensor data, but no studies at national or large-scale regional level. Similarly, no applied studies or attempts to integrate results into BAU are known.

There are no similar projects registered on the ENA smarter networks portal.

#### If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

n/a

### Additional Governance And Document Upload

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

The project is Innovative because:

The use of mobility data for energy demand estimation has only been studied in outline small region academic trials.

Prior studies have utilised only fixed point monitoring data which has poor spatial coverage across the transport network thus not capable to represent widespread traffic behaviours of people (fixed point monitoring has a focus on highest traffic routes and urban centres only - this fails to capture rural travel, some connective travel and the vast majority of short journeys).

The use of telematics data provides new potential features beyond those explored in academic literature (fixed point surveys use only count data not full telemetry and mobility patterns).

The use of telematics derived features can provide complete spatial coverage over energy regions with minimal sampling bias due to its diverse geographic sampling.

## Relevant Foreground IPR

Final report detailing project results, including experimental output, validation review, impact, and gap analysis to be published at the conclusion of the project.

## Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click 'Contact Lead Network'. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.

Via our Innovation website at <https://www.nationalgrideso.com/future-energy/innovation>

Via our managed mailbox [innovation@nationalgrideso.com](mailto:innovation@nationalgrideso.com)

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" at <https://www.nationalgrideso.com/document/168191/download>.

## Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

usual activities?

This project is investigating the value of a new data set not readily available to the ESO for energy forecasting features. Prior work has not used vehicle telematics data, and so results for electricity demand forecasting have a high level of uncertainty. Considering these, it is not suitable for development under BAU activities.

## Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The starting TRL of this project is low and therefore is more suited to innovation funding workstreams. The new data set being considered within this project is not well understood by the ESO or the energy industry, and therefore requires expertise from specialist partners and academia that is enabled by NIA funding. Further to this, there are technological risks around the data required, and the feasibility and value of adding this data into the energy demand forecast models. By using NIA a level of flexibility can be considered to address these and ensure the models developed can be adapted to suit any emerging requirements.

The use of NIA will also ensure that the project outcomes and learnings can be shared with the industry.

## This project has been approved by a senior member of staff

Yes