NIA Project Registration and PEA Document

Date of Submission

Jul 2024

Project Reference Number

NPG_NIA_ 49

Project Registration

Project Title

Detecting LCTs from Smart Meter Consumption Data

Project Reference Number

NPG_NIA_ 49

Project Licensee(s)

Northern Powergrid

Project Start

September 2024

Project Duration

0 years and 2 months

Nominated Project Contact(s)

Phil Groves

Project Budget

£40,000.00

Summary

Following a major gas outage incident in the Stannington area of Sheffield, Northern Powergrid gained permission from DESNZ to collect disaggregated consumption data from smart meters located in this area. This proposal is to undertake a data modelling exercise to compare the disaggregated and aggregated consumption data, ElectraLink data, registers of embedded generation and known locations of electric vehicles to train machine learning models and prediction algorithms.

The analysis will cover 14 months of consumption data collected for 1500 smart meters within the Stannington suburb of Sheffield with a time period from November 2022 to the end December 2023. The proposal will look at identifying LCTs on disaggregated smart meter data and use that to investigate the possibility of identifying LCTs on aggregated data.

Nominated Contact Email Address(es)

yourpowergrid@northernpowergrid.com

Problem Being Solved

In early December 2022 a Yorkshire Water high-pressure pipe burst in Stannington, Sheffield, causing water to leak into a gas pipe owned by Cadent Gas. The mains gas supply was interrupted to more than 3,000 homes and the affected customers were unable to heat their homes or use gas cooking hobs. As a result, Cadent Gas provided electric appliances to customers for cooking and heat.

The nature of the incident led to detailed smart meter energy consumption data being gathered for the area concerned. This was subsequently analysed by Northern PowerGrid (NPG) to gain insights on energy usage behaviour during the crisis as well as provide important information for potential future impacts of the electrification of heating.

This proposal is to undertake a more detailed data modelling exercise to compare the disaggregated and aggregated consumption data, ElectraLink data, registers of embedded generation and known locations of electric vehicles to train machine learning models and prediction algorithms.

The study will survey previous research into methods for detecting EV charging and embedded generation from smart meter data including a previous projects undertaken by Western Power Distribution and Northern Ireland Electricity.

This project, however, would be different in that the Stannington consumption data is half-hourly UK-based smart meter data disaggregated to individual property level and will have substation and feeder data associated with each property which means it can be aggregated in the same way as prescribed in the Data Privacy Plan. This allows research into the relationship of disaggregated LCT patterns with aggregated data.

Method(s)

A team of analytics experts will carry out an academic literature review for methods of automating detection of electric vehicles and embedded generation from smart meter data. An initial workshop will be held with NPG to confirm quality and confirm modelling objectives. The Stannington smart meter consumption data and any LCT installation data will be anonymised and standardised for analysis. Weather data for the period and location of interest will be acquired.

Profile and clustering methods derived from the academic literature will be trialled on the available data. If there are insufficient cases of embedded generation and electric vehicles in the study area to provide sufficient statistical power for predictive models the feasibility of training methods on other external third-party smart meter datasets and then applying these to the study data will be investigated.

Disaggregated data will provide half-hourly consumption readings for individual properties. It will be used to see how low carbon technologies are used by customers and the consumption patterns of different types of LCTs over the day/week/month/year. The LCT information on each property (e.g. solar, EV, heatpump, no LCT) will be used to categorise consumption patterns with near certainty. Those patterns will reflect real-life customers and can then be used to identify LCT customers on the network if disaggregated data is available and to investigate if those disaggregated patterns flow through to the aggregated data, which is more readily available and would help located areas with LCTs.

The Stannington dataset contains 14 months of disaggregated consumption data for c1500 properties with the substation and feeder data known for each property.

On completion a final report on lessons learnt and recommendations for further work will be delivered.

Scope

The analysis will cover 14 months of consumption data collected for 1500 smart meters within the Stannington suburb of Sheffield. The time period covers November 2022 - end December 2023.

The proposal will look at identifying LCTs on disaggregated smart meter data and use that to investigate the possibility of identifying LCTs on aggregated data.

Objective(s)

The overall aim is to attempt to use the data patterns collected from this incident to determine the completeness of existing records and identify the potential confidence levels of future predictive models. This will help model the impact of this incident on NPG's network and plan for handling any similar events in the future.

Specific objectives are to provide the NPG team with data insights to: determine the discrete half hour consumption profiles of different types of embedded generation; trial the feasibility of using disaggregated and aggregated smart metering consumption data to identify the presence of electric vehicles; and

assess the accuracy of NPG records by using known datasets and the disaggregated and aggregated smart metering consumption data.

Where LCTs are identified, undertake manual verification where possible to test the algorithm for accuracy (e.g. using satellite or aerial imagery).

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

There is expected to be no effects of the Method(s) and Solution(s) upon consumers in vulnerable situations from the Project. As this project doesn't deliver a solution there will not be any distributional impacts.

Success Criteria

Successful demonstration of whether it is possible for an algorithm to able to accurately determine the presence of LCTs (e.g. solar

panels, EV charging) given currently available datasets. If proven, this will provide network operators with a potential new tool for modelling the presence of small scale, behind-the-meter embedded generation and storage across network areas. This will then be used to support future network planning.

Project Partners and External Funding

N/A

Potential for New Learning

The study will develop a new model/algorithm for enhancing consumption profiles of customers and assessing the presence of LCTs at properties.

Scale of Project

Small scale desk-based data modelling and analysis exercise completed over c.2 months.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

Data from the suburb of Stannington, Sheffield will be utilised. It is hoped that once concept is proven the method will be applicable across the whole of the network.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£40,200

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:

This Project has the potential to identify unknown low carbon technologies connected to the electricity network. This information could be used to improve the management of the network to support the energy system transition

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

Not Applicable

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

This is a low TRL research Project and is not expected to have any immediate benefits.

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

If the Project hypothesis is proven then any potential follow-on development should be able to be applied across all electricity DNOs using smart meter data.

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

Unknown at this stage.

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

If proven, the study could provide network operators with a potential new tool for modelling the presence of small scale, behind-the-meter embedded generation and storage across network areas. This will then be used to support future network planning.

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.

This Project is different to other research in this area in that the Stannington consumption data is recently collected (2023) half-hourly UK-based smart meter data disaggregated to individual property level and will have substation and feeder data associated with each property which means it can be aggregated in the same way as prescribed in the Smart Meter Data Privacy Plan. This allows research into the relationship of disaggregated LCT patterns with aggregated data.

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

Additional Governance And Document Upload

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

The unique circumstances of the Stannington pipe burst incident which have never been encountered in any previous project mean the analysis conducted in the proposed study represents a very rare opportunity to understand and quantify the effects of LCT and EV usage on load.

The study will survey previous research into methods for detecting EV charging and embedded generation from smart meter data including a previous projects undertaken by Western Power Distribution and Northern Ireland Electricity.

This project, however, would be different in that the Stannington consumption data is half-hourly UK-based smart meter data disaggregated to individual property level and will have substation and feeder data associated with each property which means it can be aggregated in the same way as prescribed in the Data Privacy Plan. This allows research into the relationship of disaggregated LCT patterns with aggregated data.

Relevant Foreground IPR

N/A

Data Access Details

This Project will be using disaggregated consumption data that has been collected with permission from properties within the Northern Powergrid Yorkshire Licence Area. This data is considered to be personal data and will need additional approval for release to interested parties. However, it is unlikely that this data will be shared at this level. It may be possible to share the aggregated view of the data or de-sensitised versions of the data used in the research. It is intended that summary data and findings will be presented in a way that can be shared with interested parties.

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

This is a unique dataset that has been collected with permission from DESNZ. It would be beneficial to all DNOs and customers for innovative findings to come from research on this dataset. It would also support the benefits case for smart meters.

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

This project sits outside of the normal business usual activities and requires skillsets not in the business. There is a high probability that the project will prove that there will be limited success in detecting LCTs from aggregated data. The support of the NIA allows for this project to be undertaken without having to recruit specialist resources into the company and with no financial risk if the project fails. However, if the project succeeds then it will benefit all DNOs.

This project has been approved by a senior member of staff

☑ Yes