# NIA Project Annual Progress Report Document

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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.

### Date of Submission

Jul 2024

### Project Reference Number

NIA2_NGESO057

## Project Progress

### Project Title

Alternative Metering (Baselines)

### Project Reference Number

NIA2_NGESO057

### Project Start Date

September 2023

### Project Duration

0 years and 7 months

### Nominated Project Contact(s)

Gus Clunies-Ross

### Scope

This project will focus on reviewing the theoretical options and developing suitable ones into a usable PoC algorithm which can be implemented as a Minimum Viable Product (MVP) to begin trials for provider generated operational delivery data.

The final deliverable will be the development and coding of the chosen algorithmic model in a suitable format and language for delivery in to the existing ESO performance monitoring systems to allow external submission trials to begin.

The algorithm should use metered data, possibly combined with historical delivery data to output a score indicating the probability of manipulation. The algorithm must also be calibrated to set an appropriate threshold for the score to suggest if further investigation should be conducted

**WP1: Scoping**
Workshops will be undertaken to generate a process map indicating: the data sources available; any short- and long-term outputs likely generated by the analysis algorithm that will require presentation or storage; and interoperation of data streams with the algorithm itself.

**WP2: Solution identification**
There are several possible algorithmic avenues to quantify baseline legitimacy. With scope and data availability known, one or more suitable approaches will be designed based on mathematical analysis and machine learning.

Solutions could include:

- Direct correlation analysis between submitted baseline and response
- Unit capability and service attribution
- Time series analysis
- Hybrid methodology

**WP3: Implementation and evaluation**
Following design agreement, the chosen solution will be delivered as end-to-end demonstration scripts. These will clearly show both pre-training on historic data, if applicable to the selected methodology, and the regular assessment process. This will initially be deployed as a proof of concept but could be expanded to a full production solution.

If a successful solution is developed, the ESO IT teams will undertake the delivery and testing required for implementation on the IT systems, upon completion of the project.

If there is a successful solution developed, found then, following the conclusion of this Innovation project, internal If appropriate, this will be progressed through to the live data analytics platform system to complement the existing data analysis tools.

## Objectives

- Validate metering data from service providers to ensure that submitted data has not been falsified
- Develop a PoC algorithm which can be implemented as an MVP to start accepting trials for provider generated operational delivery data
- Develop the chosen algorithmic model in a suitable format and language for delivery into the existing performance monitoring systems to allow external submission trials to begin.

## Success Criteria

The primary success criteria for the project will be the creation of an algorithm in line with the objectives which can reliably detect falsification in synthetic frequency Response metering data to allow trials to be conducted with participants using proposed methodologies for data derived metering.

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

National Grid Electricity System Operator (“NGESO”) has endeavoured to prepare the published report (“Report”) in respect of Alternative Metering (Baselines) NIA2_NGESO057 (“Project”) in a manner which is, as far as possible, objective, using information collected and compiled by NG 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 NG and the Project partners).

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The ESO is committed to unlocking flexibility and improving competition in our markets. This project aims to build our capability to accept new types of flexible resource into our ancillary services.

Specifically, in this project, we investigate monitoring the performance of units where they are unable to provide a firm baseline in advance of real time. This includes from units whose service delivery is not metered separately from other activities. In these cases, for example where there is a battery which provides frequency response but at the same time serves an unpredictable load, we must be able to specify the changes in demand or output that reflect the service provision, vs other changes in output such as those related to serving a different load. Where we can do so effectively, we can potentially unlock considerable volumes of capacity for participation in our markets.

In 2023, we introduced a change to our Dynamic Response Services Service Terms, which allows for participants to submit (subject to ESO approval) data derived metering data. The purpose of this change was to drive participation by the sort of unit referred to above, ie where the metered data would capture both the service delivery and any other load or output associated with the unit. But for us to allow such participation, it is necessary that we have confidence the unit is delivering the service, and is not manipulating its submitted data to misrepresent the effectiveness of the delivery of the service.

In this project, we aimed to build a model that can detect gaming. The project reviewed  the theoretical options for evaluating data derived metering and baseline submissions, determined an appropriate option (or package of options), and developed it into a suitable solution. The project included building of a usable proof of concept (PoC) algorithm which can be implemented to enable

submission and evaluation of provider generated delivery data. The final deliverable was the development and coding of the chosen algorithmic model in a suitable format and language for delivery into the existing ESO performance monitoring systems.

The project was carried out over 3 phases with all the phases completed satisfactorily.

**Stage 1: Scoping**

This stage was done through regular internal workshops with performance monitoring teams, business analysts, IT product owners, and market policy officers. We defined the technical requirements of the solution, including its performance and scalability. It involved:

Detailing the 'exam question' of this engagement.

In this part, the objective was to consider the scenarios where units may have varying baselines, such that service delivery cannot be measured from a fixed baseline submitted one hour ahead.

Identifying data requirements

We listed the data available for each participating unit, which would be relevant for the method, and record their sourcing for future ESO IT use.

We discussed mechanisms to include in synthetic data generation for development and evaluation of the model

The output of this was a data map, representing flows of data relevant for the checks, that would ensure feasibility and utility in Productionisation

**Stage 2: Solution identification**

In phase 2, the purpose was to first identify different options to check legitimacy of provider submitted data for gaming then to recommend a specific solution. There were several possible algorithmic avenues to quantify legitimacy of provider data. Reflecting mathematical and machine learning techniques, several options were generated including:

- Correlation analysis between performance monitoring and operational data
- Correlation analysis between submitted baseline and ideal response
- Reviewing extent performance data is within performance bounds
- Anomaly detections to identify more complex gaming behaviour

For the anomaly detections, it was assumed that if most units are not engaging in gaming behaviour than those that do will exhibit behaviour that appears anomalous. To detect anomalies, different approaches were considered such as detection on time-series data (e.g., identifying departures from historic data) and clustering/density-based algorithms. Different anomaly methods were considered, with qualitative comparison reflecting relative benefits such as with respect to use for large data sets.

To test the different options, it was necessary to build synthetic data in order to calibrate the different solutions such that they could distinguish between normal and suspicious behaviour. As such, reflecting conversations with relevant subject matter experts in the ESO, a range of normal scenarios were established. Historic data – such as reported frequency, baselines (Physical Notifications) and operational metering was reviewed for creation of synthetic data to make it is representative as possible. Gaming scenarios were established in meetings reflecting a set of plausible actions that a malicious actor might take to game the system.

**Stage 3: Implementation and evaluation.**

Following design agreement, the solution was implemented as end-to-end demonstration scripts. The POC was delivered as a Python code package, along with the demos illustrating the functioning of the code. The project delivered as per the original objectives and as expected.

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

No modifications in the planned approach, deliverables matched those which were set out in the project plan. The planned approach was necessarily broad, with stage 1 of the project identifying the specific data to be used and analytical approaches.

## Lessons Learnt for Future Projects

Future projects could test the solutions in practice (and train the models) in our Dynamic Response markets (ie with historical, rather than synthetic data) to inform any revisions such as weighting some checks more than others, identifying thresholds at which we consider gaming is more likely, ie reflecting where events are confirmed or discarded. This could provide ESO more confidence in the robustness of the checks and ultimately reduce barriers for participation from units with variable baselines in our dynamic response services.

- Other projects could explore similar techniques being applied to other ancillary services. Projects would need to consider different data flows and IT integration, but the fundamental principles of gaming detection and solutions reviewed in this project could be applicable to other services.

Future projects could consider the applicability of the solution developed in this project for different use cases. The principal use-case considered in this project was that of a battery which is providing an ancillary service while at the same time serving a variable load. We could compare the effectiveness of the solution for different use-cases to consider whether refinements are required including whether different checks should be done, or weighted differently, for different use cases.

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 final outcome of the project is the implementation of (at a proof-of concept level) the process, algorithmic model and scoring system enabling ESO to identify gaming in the submission of post event baselines.

The resulting tool, written in Python, flags suspicious unit behavior to ESO, highlighting points for further investigation. Specific features include:

- A data collation module for fetching and processing necessary data
- Algorithms for running gaming checks
- A metric that aggregates scores across all checks into a single value, indicating the likelihood of gaming
- Demos with visualizations of checks and scores

The finalised checks to be implemented included:

- Correlation between baseline and ideal response

An ideal response is how the unit should respond to frequency deviations per its contract. The baseline should be independent of the ideal response, and a correlation should indicate gaming.

- Difference between reported and expected baseline

While this project is about allowing participation from providers for whom submitting fixed baselines an hour ahead is difficult, we can still check whether the difference between reported and expected baselines are characteristic or unusual as an indicator of potential gaming

- Difference between reported and expected active power

Anomaly detection methods to identify subtle behaviour changes

- Difference between reported active power and metered active power

Reported active power (PM) and metered active power (OM) should be equal most of the time (minor differences may be due to measurement error). Significant, consistent or regularly-occurring differences could indicate gaming behaviour.

- Unavailability checks

These checks use anomaly detection methods to identify cases where declarations of unavailability indicate systemic, deliberate gaming.

- Correlation with market prices

Prices in the wholesale electricity market should not affect delivery. We can however recognise units may be incentivised to alter their response delivery to take advantage of wholesale prices, and thus should be considered alongside other gaming checks.

The method uses a combination of the above checks. The output Aggregated Gaming Scores are values between 0 and 1 representing how suspicious the unit's behavior is based on their data, for each date and time. Depending on data collation time (e.g., API connection strength), checks take 1-2 minutes to run. The Aggregated Gaming Score computation takes less than 5 minutes.

## 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 National Grid can be found in our publicly available “Data sharing policy related to NIC/NIA projects” and www.nationalgrideso.com/innovation.

National Grid Electricity System Operator already publishes much of the data arising from our NIC/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

A python code package and a presentation were delivered as part of outcome. A final report is currently under review and will be published shortly to present the outcomes of the projects.