

NIA Project Registration and PEA Document

Date of Submission

Sep 2023

Project Reference Number

NIA_UKPN0091

Project Registration

Project Title

Satellite

Project Reference Number

NIA_UKPN0091

Project Licensee(s)

UK Power Networks

Project Start

September 2023

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Loukas Douvaras

Project Budget

£413,000.00

Summary

Vegetation management by electricity networks is used to minimise contact between trees/other vegetation and our overhead power lines to minimise disruption to our customers and improve safety. The current solution used by many networks to scan overhead lines and nearby vegetation is remote sensing Light Detection and Ranging (LiDAR) and there are concerns that the cost of future scans could double. Networks are also seeking to reduce their carbon footprint and LiDAR scans are typically performed by aircraft that produce greenhouse gases and can cause noise pollution. Satellite aims to test satellite technology as an alternative to LiDAR and demonstrate whether the technology can accurately measure vegetation proximity to UK Power Networks' overhead lines whilst exploring the costs and benefits of the technology.

Nominated Contact Email Address(es)

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Problem Being Solved

To maintain safe and uninterrupted network operation and power supply, distribution network operators (DNOs) are required to inspect their network regularly to detect proximity of vegetation to their overhead power lines and other assets. The current vegetation scanning solution used by UK Power Networks is a remote sensing LiDAR system with a scan taking place every two years. There are concerns that the cost for future scans could double due to inflation and energy prices. Networks are also seeking to reduce their carbon footprint and LiDAR scans are typically performed by aircraft that produce greenhouse gases and can cause noise pollution. Alternative vegetation management technologies need to be investigated to understand whether they can reduce costs and are sufficiently mature and accurate to be applied to electricity networks.

Method(s)

The project aims to test remote sensing via satellite technology via trial to reveal whether it has made sufficient advancement to inform network vegetation management. The trial will demonstrate the ability to identify where, how much, and when to trim vegetation at a

span level, including various other use cases. Model results will be validated with recent vegetation data as well as through field observations along with the operation and vegetation teams during the trial. Outcomes from analysis will be demonstrated through an existing platform built by Boston Consulting Group (BCG), the project partner. The project will also develop a business case and roadmap for scaling the solution to the whole of UK Power Networks' licence areas with vegetation and overhead lines. All work packages will be led by BCG and supported by UK Power Networks. Activities performed solely by UK Power Networks are stated in brackets.

Work Package 1 – Specification, Data & Imagery Gathering

Identify criteria for analysing vegetation management data (customer impact-based "criticality score" etc.)

Identify network circuits that will be tested during the trial

[Gather GIS files for those circuits]

[Gather associated customer and operational data]

Procure satellite imagery for trial circuits

Work Package 2 – Execute & validate trial analytics

Process imagery and prepare data:

Review GIS files to accurately reflect conductor positions

Acquire & process images

Conduct initial analytics

Develop analytics to:

Identify "where to trim" by clearly showcasing type of growth (side growth, through growth, under growth, no vegetation)

Identify "how much to trim" by clearly specifying the vegetation clearance buckets up to span level

Outline "when to trim" by specifying ideal trim year at circuit, segment and span level growth modelling, trim type and work type

Validate analytics in field by assessing subset of sections to compare digital analytics to field observations (activity will be performed with the support of external supplier undertaking field validations)

Work Package 3 – Develop business case and roadmap for scaling

Build business case baseline:

Understand key drivers of UK Power Networks' vegetation management spend today

Review current and future budgets

Assess historical spend for in-scope sections by work type

Align view of current spend and confirm baseline in scope for trial

Quantify business case value:

Assess quantitative & qualitative benefits based on trial

Extrapolate results to full UK Power Networks service territory with vegetation and overhead lines

Assess required investment to scale solution

Baseline UK Power Networks' vegetation management practices, operational constraints and guidelines and IS requirements

Showcase Trim planning, pre post audit, hazard tree and other modules from beta version vegetation management workflow tool to perform the workflows

Platform intro:

Training sessions with UK Power Networks' professionals to showcase platform for analytics

Peer example benchmarking

Build scaling roadmap: Design rollout plan of features across services & regions and identify KPIs to measure post project benefits

Work Package 4 – Project wrap up

Develop final report compiling all deliverables in a report, detailing insights from the project, lessons learned and recommended next steps

Present project discoveries and insights to the wider public and UK Power Networks management team and discuss about Business as Usual (BAU) implementation

Measurement Quality Statement and Data Quality Statement

Data relating to the trial will be reviewed by the project partner inhouse data assurance team to ensure that they meet the minimum requirements in terms of format and quality. The project data will be kept securely and in accordance with data protection requirements. Anonymised data, aggregated where appropriate, will be included in project reports for wider distribution.

UK Power Networks will ensure the following terms are agreed in working with any project partners to protect data quality and security:

Where data is held remotely, it shall be made readily accessible to UK Power Networks;

Project partners shall maintain back-up copies of data and undertake reasonable measures to protect it from corruption, external interference and unauthorised use;

UK Power Networks will have the right to arrange for independent data audits throughout a project if deemed necessary

Scope

The trial scope is over 400km of circuit, ideally a mix of urban and rural sites to have a representative set of UK Power Networks' network at Extra High Voltage (EHV) and High Voltage (HV) levels. The project will also dive into UK Power Networks' vegetation management processes and procedures to develop a roadmap and business case for full implementation of solution.

The project deliverables include:

Work Package 1 – Specification, Data & Imagery Gathering

- Deliverable D1.1: Trial GIS/shapefiles – Required to procure satellite imagery for the trial areas (UK Power Networks deliverable)
- Deliverable D1.2: Customer and operational data – Required to develop business case in later work package (UK Power Networks deliverable)

Work Package 2 – Execute & validate trial analytics

- Deliverable D2.1: Analytics & field validation pack – This will include:
 - o Predicted model clearance and growth type for 400 km line miles at circuit, segment and span level
 - o Predicted model trim year cycle and year for each circuit/segment in for the 400km line mile
 - o Field validation packs to test model predictions with operations team (span by span output)
- Deliverable D2.2: Field validation report – Execution of Field validation and development of model accuracy for growth type and clearance

Work Package 3 – Develop business case and roadmap for scaling

- Deliverable D3.1: Demo of custom software platform to showcase select modules on web-platform (e.g. Trim planning, pre-post audit, Hazard tree)
- Deliverable D3.2: Roadmap and Cost Benefit Analysis for full scale execution – This will include the cost-benefit analysis and scaling and roll-out plan for full implementation of solution in UK Power Networks' licence areas

Work Package 4 – Project wrap up

- Deliverable D4.1: Draft report compiling all deliverables in a report, detailing insights from the project, lessons learned and recommended next steps
- Deliverable D4.2: Final report compiling all deliverables in a report, detailing insights from the project, lessons learned and recommended next steps

The benefits to consumers would be:

- Reduction in CO2 emissions related to LiDAR flights as satellites move with the earth's natural gravity after put in orbit and attributable CO2 is negligible. The reduction in noise pollution from aircraft will also be considered during the project.
- Improvement in the network resilience due to reduction in CIs and CMLs, thus providing continuous power supply to customers

and reducing barriers to the energy transition.

The net benefits for DNOs if satellite technology is adopted during ED2 are £4.3m and this would be due to reduction in CIs, CMLs, avoidance of LiDAR related CO2 emissions and optimisation cost savings in the tree cutting budget. More details on the benefits are included in section 3 of the PEA.

Objective(s)

The objectives of the project are to demonstrate:

- That the satellite imagery technology is sufficiently mature and accurate for measuring vegetation proximity to UK Power Networks' overhead line network in a similar way to LiDAR currently does. This will be measured through the information gathered and validated about the predicted tree clearance and tree growth type.
- How the solution can be implemented in UK Power Networks and what would be the potential costs and benefits. These will be documented in a final report.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The impact assessment shows that there will be no effect of the Method(s) and Solution(s) upon consumers in vulnerable situations.

Success Criteria

1. Reviewed geo-positioning of assets for the 400 km which can be validated by operational teams in the field
2. Built circuit, segment, and span level analysis and 3D modelling to determine vegetation analytics (where to trim, how much to trim and when to trim) based on UK Power Networks' vegetation management operating guidelines
3. Validated vegetation analytics and confirmation that analytics are comparable to what would be observed in the field (eg, trim clearance measured as per the solution vs. observed by a field-user)
4. Delivered value (business) case based on results from the trial with qualitative and quantitative benefits
5. Delivered scaling roadmap for solution implementation in BAU

Project Partners and External Funding

The project is partnering with Boston Consulting Group (BCG). There is no external funding for this project.

Potential for New Learning

The project will enable UK Power Networks to validate the suitability of satellite technology to accurately measure vegetation proximity on fixed overhead lines. There is currently no DNO in the UK using satellite imagery technology for vegetation management activities. The learning will be disseminated through project reports that will be uploaded in UK Power Networks' website, press releases and webinars.

Scale of Project

The project will scan 400km of UK Power Networks' network in different locations and vegetation types. The scale of the project and consequently its investment is based on initial engagements with the project supplier and internal stakeholders. A smaller investment scale wouldn't sufficiently demonstrate the accuracy and suitability of the satellite imagery technology for the vegetation management of the network.

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL9 Operations

Geographical Area

The technology will be tested on 400km of circuit, ideally a mix of urban and rural to have a representative set of UK Power Networks' network. The areas will be in Eastern Power Networks (EPN) and/or South Eastern Power Networks (SPN) licence areas as London Power Networks (LPN) licence area does not have any vegetation issues.

Revenue Allowed for the RII Settlement

No funding was provided within the current RII settlement that will become surplus to requirements as a result of this project.

Indicative Total NIA Project Expenditure

We estimate the UK Power Networks' NIA expenditure to be £413,000, of which £371,700 (90%) will be recovered from NIA.

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:

The project solution has the potential to facilitate the energy system transition by:

- avoiding the CO2 emissions related to LiDAR flights as satellites move with the earth's natural gravity after being put in orbit and attributable CO2 is negligible. The reduction in noise pollution from aircraft will also be considered during the project.
- improving the network resilience due to reduction in CIs and CMLs, thus providing continuous power supply to an increasing electricity demand and reducing barriers to the energy transition

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

The project doesn't have the potential to benefit consumer in vulnerable situations.

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)

This is a RIIO-2 project.

Please provide a calculation of the expected benefits the Solution

Base Cost

- Anticipated future LiDAR inspections every two years ~ £4m
- Annual tree cutting costs for ED2 ~ £20m
- CO2 emissions due to LiDAR activities every two years ~ 223 tonnes

Method Cost

- Implementation cost post project trial ~ £6m
- Annual running costs (Annual scans and interim partial scans for quality audit, full processing of data across HV and EHV network, support, hosting, maintenance and report customisation) ~ £1.5m

Benefits include:

- 15% optimisation savings to the tree cutting costs due to business transformation (efficiencies within vegetation management processes) and tree cutting prioritisation algorithm ~ £1.5m savings per year
- 4% annual reduction in the CIs and CMLs related to vegetation management ~ £111k and £208k respectively

- Societal benefit due to avoidance of 223 tonnes CO2 emissions every two years (satellites move with the earth's natural gravity after being put in orbit and do not emit CO2) ~ £16k every two years

The expected project benefits if satellite technology is adopted during ED2 are £4.3m

A detailed cost benefit analysis will be performed during the project.

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

The solution is replicable across the whole HV and EHV overhead lines of UK Power Network and all networks across GB. It can be even applied in low Voltage Overhead Lines if scans are deemed necessary by the network.

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

The cost of rolling out this Method would include: Implementation cost, cloud, hosting and storage, licensing of the data collection and analysis system per DNO group.

The exact implications of a BAU rollout will be assessed as part of the project.

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

All electricity networks across GB have to deal with the vegetation management of their network to improve safety and avoid interruption of supply to their customers. A potential success of the satellite imagery technology demonstration means that an additional vegetation management option could be considered by the other networks. This could offer them the opportunity to reduce their respective costs and CO2 emissions as well as improve their network resilience.

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

Not applicable

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.

1. Analytical Approach for Vegetation Management – National Gas Transmission historically investigated whether oblique aerial photography, captured for one specific application (population density), can be appropriately adapted to fulfil an alternative application (vegetation survey). The project identified the need for an AI solution to process the data as it was deemed impractical to build the model based on raw data.

2. Applied Integrated Vegetation Management (IVM): Scottish & Southern Electricity Networks (SSEN) investigated if using IVM can reduce the operational expenditure, number of re-visits, exposure to hazardous activities and impact on the environment compared to traditional techniques. The project did not consider the satellite imagery technology as a potential solution for vegetation management.

3. Eye in the Sky – Utilising satellite data to improve grid resilience: National Grid Transmission investigated the development of innovative remote, automated, nationwide land and asset motion solution based on the use of SAR satellite imagery and different InSAR analysis techniques - network monitoring solution for detection of unauthorised construction and storage of building materials and other risks/changes based on the use of sub meter resolution optical imagery and risk/change detection algorithms. The project investigated 12 use cases in the Discovery Phase and didn't test detailed applicability on vegetation management in the alpha phase as the cost benefit analysis wasn't stacking up for a transmission network which doesn't have the same struggles as DNOs.

Virtual World Asset Management (VWAM) – Scottish Power Energy Networks delivered a VWAM system that also included an indication on their network vegetation. The project did not include any vegetation growth model and had issues with managing large volumes of data.

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

Not applicable

Additional Governance And Document Upload

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

The project is innovative as:

- it will enable UK Power Networks to validate the suitability of satellite technology to accurately measure vegetation proximity on fixed overhead lines.
- the solution uses an Artificial Intelligence (AI) algorithm which improves the accuracy of the results the more validated data is fed into the model
- there is currently no DNO in the UK using satellite imagery technology for vegetation management activities and only a trial will demonstrate its effectiveness and suitability for the networks

the project supplier will dive into the vegetation management processes and identify efficiencies that can be applied into business-as-usual activities

Relevant Foreground IPR

Relevant foreground IPR will be a process map and reports describing a new way of undertaking overhead line scanning using remote sensing satellite imagery supported by data and analytics for network management purposes. Background IPR includes the data needed from UK Power Networks and the current state way of working (e.g. how vegetation budgets, contracting procedures and methods, tree cutting prioritisation techniques) as well as the data analytics platform. The satellite imagery data won't be owned by the project but will be used as inputs to produce the necessary visualisation analytics.

Data Access Details

To view the full Innovation Data Sharing Policy, please visit UK Power Networks' website here:

<https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2021/11/UK-Power-Networks-Innovation-Data-Sharing-Policy-.pdf>

UK Power Networks recognises that Innovation projects may produce network and consumption data, and that this data may be useful to others. This data may be shared with interested parties, whenever it is practicable and legal to do so, and it is in the interest of GB electricity customers. In accordance with the Innovation Data Sharing Policy, UK Power Networks aim to make available all non-personal, non-confidential/non-sensitive data on request, so that interested parties can benefit from this data.

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

The NIA funding will enable UK Power Networks to undertake a project which has technical and operational risks associated with it, in terms of a lack of certainty in the results. As there is no guarantee of the solution success and effectiveness, the business cannot fund the project.

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 NIA funding will enable UK Power Networks to undertake a project which has technical and operational risks associated with it, in terms of a lack of certainty in the results. As there is no guarantee of the solution success and effectiveness, the NIA funding is the only viable solution.

This project has been approved by a senior member of staff

☒ Yes