SSEN DISTRIBUTION

NETWORK INNOVATION ALLOWANCE

SUMMARY REPORT

1 APRIL 2023 TO 31 MARCH 2024

Scottish & Southern
Electricity Networks

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FOREWORD

During the previous year we have continued to develop and progress a broadly based and diverse portfolio of innovation projects. The change that is required to enable a successful net zero transition cannot be underestimated, nor can the route to achieving this.

Demand on our network is set to increase significantly by 2035. Alongside this, reliance on the electricity grid is growing at pace as customers continue to transition to low carbon technology. Enabling this transition is a complex challenge and one that requires engagement across many areas and a key element of this is innovation. Our innovation portfolio continues to focus on net zero but also looks at ensuring fairness, inclusivity and equality in the energy system transition, aligning our projects with the Energy Networks Innovation Strategy.

Our HOMEflex project addresses potential gaps in fairness during the development of domestic Flexibility Services. The Code of Conduct developed has been shared to industry and is actively used in the recruitment of flexibility provision. We are further developing this in the HOMEflex Compliance project to fully embed the code into the procurement and operation of flexibility services.

The Whole System Growth Scenario Modelling Phase 2 project continues to break new ground. The tool developed in the project are being incorporated into SSEN's Local Energy net zero Accelerator (LENZA) platform. LENZA is designed to support users in their strategic energy planning endeavours, including the creation of Local Area Energy Plans (LAEPs) and where relevant, Local Heat and Energy Efficiency Strategies (LHEES). The platform provides local authorities and their delivery partners with data and modelling tools that support informed decision making, including information on network capacity, building stock, and energy consumption.

The tool empowers users to plan decarbonisation pathways, which in turn drive SSEN Distribution's longer-term strategic network planning that will power local net zero ambition. The learning from our Near Real-time Data Access (NeRDA) 2 project is already being used to support our Open Data commitments and is being incorporated into Business as Usual (BaU) to share data from our growing fleet of Low Voltage (LV) monitoring devices. Our work on Vulnerability Future Network Scenarios (VFES) and Storm Artificial Intelligence (AI) have also made significant progress and are nearing a stage where they could be deployed in the business, which in turn, would further improve SSEN's digital and data sharing capabilities. In our programme, we have made progress with projects such as Distribution Fault Analysis and SYNAPS 2 which aim to better predict and pre-empt faults and avoid customer interruptions which would also have the potential of bringing significant benefits to consumers by making the network more resilient to extreme weather.

Throughout, we have continued to work with various external project partners and stakeholders to develop and co-create our innovation projects to ensure that we are addressing their needs. For further details on our approach to innovation going forward or if you have an idea or area where you think we should be focusing innovation, then we want to hear from you via **www.ssen-innovation.co.uk**.

Stewart A Reid
Head of Future Networks
Scottish and Southern Electricity Networks

INTRODUCTION

DELIVERING A SAFE, RESILIENT AND RESPONSIVE NETWORK

Understanding the health of our existing assets is key to improving our overall network reliability through better coordination of remedial and investment actions. We are developing new approaches to monitor the health of our assets. This enables us to better understand condition and anticipate failure and allows us to proactively intervene, thus minimising customer disruption.

One of the suites of tools that the HV Feeder Monitoring project aims to test is "Distribution Fault Anticipation" (DFA), to monitor feeders to pre-empt faults. To date we have installed 16 devices on our network leading to 81 successfully modelled faults. Of these, 62 were investigated and 52 were located and proactively responded to. This has enabled us to repair elements of our network which otherwise would have resulted in unplanned interruptions of supply.

Applying similar techniques, SYNAPS 2 is exploring the benefits of monitoring our underground Low Voltage (LV) Networks through Waveform Analysis. We now have 24 SYNAPS units installed on our network.

The SYNAPS 2 and HV Feeder Monitoring projects have not only shown how we can vastly improve network restoration times by more accurately identifying damage locations, but also go one step beyond this and start to anticipate faults, and potentially categorise their cause and location before they result in an outage. This challenges us and our regulatory framework to develop new proactive ways of working on faults.

Alongside this we continue to refine our fault location capabilities building on our earlier LV Underground Fault location project.

PROVIDING A VALUED AND TRUSTED SERVICE FOR CUSTOMERS AND COMMUNITIES

In our Smart Hammer project, we have continued our partnership with a local Small to Medium Enterprise (SME) based on the Western Isles to develop a tool which can be used as a consistent and reliable alternative to traditional wood pole inspection techniques.

We now have 50 Smart Hammers being used by our inspection teams with over 4,200 pole inspections carried out. This has allowed us to collate an extensive data set on the health of our wooden poles, which has allowed the creation of a scoring algorithm that will provide earlier detection of deteriorating poles enabling proactive replacement to reduce unplanned supply interruptions and thus improve network reliability. During the previous year we have worked with leading academics at the University of Strathclyde to utilise advanced data analytic tools including the use of neural networks to validate our initial findings. This has been crucial in progressing the project toward deployment.

MAKING A POSITIVE IMPACT ON SOCIETY

When looking at our aim to make a positive impact on society, fairness, inclusivity and equality are three of the most important principals where energy provision is concerned. Our HOMEflex Code of Conduct project has now been deployed into the market and is being actively used in the ongoing procurement of flexibility, and we are continuing to build on this in our HOMEflex Compliance project.

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

The SSEN NeRDA project is already helping to make near real-time DNO network data available to stakeholders via SSEN's Open Data Portal. Open Data is one of the key focus areas for driving decarbonisation and accelerating progress towards a net zero world. The learning from NeRDA helps us to understand a variety of stakeholder needs for network data. Working closely with our stakeholders over the last year has developed key learning on how stakeholders' access and understand network data, specifically around the need to provide this along with connectivity data and other data sources to contextualize the network data and unlock its value.

Our Whole Systems Growth Scenario Modelling Phase 2 (WSGSM2 aka RESOP) has been further extended to develop SSEN's Local Energy net zero Accelerator (LENZA) platform. LENZA is designed to support users in their strategic energy planning endeavours, including the creation of Local Area Energy Plans (LAEPs) and, where relevant, Local Heat and Energy Efficiency Strategies (LHEES). The platform provides local authorities and their delivery partners with data and modelling tools that support informed decision making, including information on network capacity, building stock, and energy consumption. The tool empowers users to plan decarbonisation pathways, which in turn drive SSEN Distribution's longer-term strategic network planning that will power local net zero ambition.

High penetration of low carbon technologies (LCTs) on the LV Network has the potential to impact on the power quality. In our LV PQ project, we are doing very detailed analysis of the impact on power quality from a range of LCTs currently available in the market, and then working with Power Networks Demonstration Centre (PNDC) looking at testing a number of interventions which will allow DNOs to better manage the issues.

SUMMARY OF PROGRESS

In the the year ending 31 March 2024, there were 24 projects funded under SEPD and SHEPD Network Innovation Allowance (NIA). Of these, 22 projects were led by us and the remaining 2 were managed by other DNOs.

Each project accumulates knowledge and learning which aligns with one or more of our Strategic Objectives. The relevant primary Strategic Objective is denoted via the inclusion of its icon.

DELIVERING A SAFE, RESILIENT AND RESPONSIVE NETWORK

PROVIDING A VALUED AND TRUSTED SERVICE FOR CUSTOMERS AND COMMUNITIES

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

MAKING A POSITIVE IMPACT ON SOCIETY

2.1 NIA SSEN 0059 CAGE CAPTURE SF_6 PAINT DETECTION

KEY ACTIVITIES

CageCapture™ 'Detection' solution will improve the speed of response to reduce sulphur hexafluoride (SF_6) emissions by enabling early detection and location of SF_6 leakage points in assets. The project will deliver a leak detection coating that can be applied to switchgear pipework and flanges for the detection of SF_6 leaks, indicated by exhibiting an Ultraviolet fluorescence or colour change. Stage 1 will validate the proof of concept in a suitable test environment; Stage 2 will evaluate the function of the product after application to switchgear on the distribution networks.

EXPECTED BENEFITS

The project has the potential to deliver up to £11m in financial benefits to GB distribution customers based on early detection of leaked SF_6 gas.

PROGRESS

There is no planned implementation as the project was closed early due to inadequate performance of the original material. Some research into possible alternatives was undertaken, from this it was found that TDAE (Tetrakis(dimethylamino)ethylene) has shown quick obvious colour change with SF_6 in solution. It is recommended that further research in this area would be targeted at TDAE to determine if it could be incorporated into a porous cage and if loaded would still show a colour change to SF_6.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

COLLABORATORS

EIC Together we innovate

UNIVERSITY OF LIVERPOOL

PROJECT BUDGET
£437,219

START/END DATE
September 2022 – February 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0059

PROJECT MANAGER
Fraser Macintyre

2.2 NIA SSEN 0058 CAGE CAPTURE SF_6 FLANGE GUARD

KEY ACTIVITIES

CageCapture™ 'Capture' solution will improve the speed of response to reduce sulphur hexafluoride (SF_6) emissions by enabling early capture of SF_6 leakage from assets. The project will deliver a leak capture solution that can be applied to switchgear pipework and flanges for the capture of SF_6 leaks. Stage 1 will validate the proof of concept in a suitable test environment and Stage 2 will evaluate application of the product to switchgear on the distribution networks.

EXPECTED BENEFITS

The project has the potential to deliver up to £11m in financial benefits to GB distribution customers based on early detection of leaked SF_6 gas.

PROGRESS

The project closed down seven months early due to the inability of the linked detection project to deliver (CageCapture SF_6 paint detection project looked to develop a paint that would indicate SF_6 leaks in equipment). This hampered the ability to employ the capture element. While the capture project demonstrated good absorption rates in the lab, there was no clear route to prototype this in the real world, and the project was closed early.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

COLLABORATORS

EIC Together we innovate

UNIVERSITY OF LIVERPOOL

PROJECT BUDGET
£439,611

START/END DATE
September 2022 – February 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0058

PROJECT MANAGER
Fraser Macintyre

2.3 NIA SSEN 0063 VULNERABILITY FUTURE ENERGY SCENARIOS

KEY ACTIVITIES

Vulnerability Future Energy Scenarios (VFES) aims to better understand and forecast potential changes and impacts to vulnerability using innovative forecasting techniques, as current Distribution Future Energy Scenarios (DFES) don't effectively take consumer vulnerability into account. The project has delivered 3 research reports which have informed changes to our DFES for 2024.

EXPECTED BENEFITS

VFES is a vulnerability-based project with aims of benefiting consumers in vulnerable situations by predicting the scale and location of such situations as well as what new situations may cause vulnerability. This is a research project to assess the initial viability of the approach.

If successful, VFES could inform better DFES and may also allow better informed investment planning which takes vulnerability into account and won't leave vulnerable customers and communities behind.

PROGRESS

VFES was based on three key pieces of research:

- The Smith Institute concluded Machine Learning activities attaining a mathematically sound and data driven understanding of the vulnerability landscape across SSEN's areas of operation.
- Foresighting work by a team from Imperial College London produced a report that explores how lifestyles might change in the future, and how this will shape our relationships with energy. It delivers a set of strategic visions for the energy sector that can be used as tools to embed vulnerability considerations into future network planning.
- An expert review compared the Machine Learning and Academic Research, along with the differing messages coming from calculations and foresighting. The review produced a paper highlighting where there is commonality between the research methods and suggestions that can be used within the energy industry to benefit consumers.

The project successfully delivered changes, fresh insights, and data into our DFES for 2024.

PRIMARY STRATEGIC OBJECTIVE

MAKING A POSITIVE IMPACT ON SOCIETY

COLLABORATORS

Imperial College London

National Energy Action – Action for Warm Homes

PROJECT BUDGET
£144,000

START/END DATE
2022 – 2023

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0063

PROJECT MANAGER
Simon O'Loughlin

2.4 NIA SSEN 0061 HOMEflex

KEY ACTIVITIES

HOMEflex seeks to address gaps in fairness during the development of domestic Flexibility Services and aims to create an inclusive, fair, and transparent marketplace. It will achieve this by developing a Code of Practice for Domestic Flexibility Services, including a framework and business case for an accompanying Compliance Scheme. HOMEflex draws on previous findings including Flex Assure for industrial and commercial customers, "Smart and Fair?" and CrowdFlex. This proposal resulted from engagement with Open Networks members and is seen as important for delivering domestic and microbusiness flexibility fairly.

EXPECTED BENEFITS

The ultimate benefit of this project will be the development of an inclusive, healthy, publicly trusted and liquid domestic Flexibility Services marketplace.

PROGRESS

HOMEflex: All chapters of the HOMEflex Code of Conduct were consulted on and agreed with the working group on time and as planned, completing in August 2023. Following an open consultation the final version of the HOMEflex Code of Conduct was launched in November 2023.

This allowed HOMEflex to progress even better than expected with the advent of ESO Demand Flexibility Service allowing HOMEflex to be used in a live environment helping suppliers and aggregators follow best practice and inclusivity during the winter of 2023/24.

The work involved in embedding this also allowed for further engagement and learning opportunities. Now that the HOMEflex Code of Conduct is delivered and being used successfully, we are progressing with a subsequent project – HOMEflex Compliance. HOMEflex Compliance will deliver a framework for a Compliance Scheme, allowing the HOMEflex Code of Conduct to be embedded further into the industry of the benefit of consumers.

PRIMARY STRATEGIC OBJECTIVE

MAKING A POSITIVE IMPACT ON SOCIETY

COLLABORATORS

Flex Assure

HOMEflex

PROJECT BUDGET
£331,000

START/END DATE
June 2022 – May 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0061

PROJECT MANAGER
Simon O'Loughlin

2.5 NIA SSEN 0060 PORTABLE – LOW VOLTAGE FAULT PASSAGE INDICATORS (PORTABLE – LV FPI)

KEY ACTIVITIES

Project Portable – Low Voltage Fault Passage Indicators (Portable – FPI) is developing portable fault passage indicators that can be used on the low voltage underground network. The equipment will be designed to be used by DNO operational staff to help locate faults on complex radial networks by measuring fault current flow in spurs. This has the potential to enable more efficient fault locating activities and therefore provide better service for customers. This project will last fifteen months. A previous NIA project, Low Voltage – Underground Fault Location Technologies (LV-UFLT) NIA_SSEN_0037, proved the concept of this innovation.

EXPECTED BENEFITS

The project will develop a commercially viable portable fault passage indicators for use in conjunction with existing proven low voltage fault location technologies. This has the potential to enable more efficient fault locating activities and therefore provide better service for customers. Benefits targeted are reduced excavations, leading to quicker repairs; and avoided costs due to prevented faults, saving up to £1m every 5 years.

PROGRESS

The project has successfully created a step-by-step workflow process for using Portable LV-FPI technologies which brings about improvements in finding the location of LV underground faults.

Through field trials of the fault passage indicator's fault location detection equipment, it has been possible to confirm that it is a suitable method for LV underground cable fault location. Previously, Time-Domain Reflectometers (TDRs) were used to located faults on a network, however LV FPI fills a specific niche which allows engineers to strategically manipulate fault locators in a reduced time. Field trials are to continue with the equipment that has been developed within the project. These trials will be tracked and used to produce a benefits case that could potentially lead to further investment in additional Portable LV-FPIs.

The evidence gathered, processes, procedures and training material developed under this project will be used to support the adoption of the Portable LV-FPIs devices into Business as Usual (BaU) and this includes knowledge capture sessions with relevant stakeholders to produce a draft technical guidance document including FAQs.

PRIMARY STRATEGIC OBJECTIVE

DELIVERING A SAFE, RESILIENT AND RESPONSIVE NETWORK

PROJECT BUDGET
£353,750

START/END DATE
May 2022 – April 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0060

PROJECT MANAGER
Kevin Dennis

2.6 NIA SSEN 0055 NET ZERO SERVICE TERMINATION

KEY ACTIVITIES

The project delivered a report capturing learnings on the suitability of service cables and cut-outs to accommodate the increased network loading as a result of the connection of Electric Vehicles (EVs) and heat pumps.

EXPECTED BENEFITS

SSEN's demand growth forecasts (Distribution Future Energy Scenarios) for achieving net zero by 2050 suggest that around 70% of homes will require Low Carbon Technology (LCT) connections. This equates to 2.8m homes (of the current housing stock). Experience of connecting LCT to existing homes has shown that domestic loading assessments are required in 42.6% of cases and cut-out upgrades in 6% of cases. The outputs of this project, combined with SP Energy Networks 'iDentify' project, could avoid the need for individual loading assessments for new LCT connections. This could save up to £10.8m in loading assessment costs in SSEN's license areas between 2021 and 2030.

PROGRESS

Project planning workshops identified the three-service cable installation test scenarios recommended within the service cable Installation Literature Survey and these have been discussed and implemented.

Testing of service terminations and service cables is complete, and has been reported.

Review of results has prompted the stakeholder steering group to start a second project which will study data taken from smart meters to assess the loads that service terminations and cables are experiencing.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£625,000

START/END DATE
August 2021 – August 2023

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0055

PROJECT MANAGER
Tim Watts

2.7 NIA SSEN 0052 OPEN CIRCUIT DETECTION

KEY ACTIVITIES

Distribution Network Operators (DNOs) currently identify open circuit fault locations using equipment from different manufacturers with varying accuracy of results, which sometimes requires an excavation for the equipment to work. This project will investigate different types and ways of sending signals during cable fault location events to investigate which of them is best at pinpointing and locating the position of the cable open circuit fault.

EXPECTED BENEFITS

During this project the following benefits could be realised:

- More accurate location of underground cable open circuit faults on a variety of cables of various shielding construction and understanding any limitations of the device
- More efficient planning of remedial repairs
- Greatly reduced Customer Minutes Lost (CMLs).

PROGRESS

The ability to accurately detect open circuit cable faults, including in buried cables, has successfully been proven in the lab environment. However, although the result accuracy can be better than anticipated, there remains a design fault where the design accuracy is unstable. This has been investigated and the issue is understood, with the solution being tested.

Much of the physical electronic hardware development has been completed for both the injector and the detector equipment.

The success during field trials has been limited to being able to find Open Circuits on the low voltage network. There has been intermittent instability with measuring the signalling that enables the Open Circuit Finder (OCF) to locate Open Circuit faults. The design finalisation will continue outside of this project, funded in Business as Usual (BaU). It is expected that the outcome of the development will transition to BaU, making the OCF available to all DNOs.

PRIMARY STRATEGIC OBJECTIVE

PROVIDING A VALUED AND TRUSTED SERVICE FOR CUSTOMERS AND COMMUNITIES

COLLABORATOR

HAYSYS

PROJECT BUDGET
£408,169

START/END DATE
December 2020 – March 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0052

PROJECT MANAGER
Kevin Dennis

2.8 NIA SSEN 0051 SYNAPS 2 – FAULT DETECTION, CLASSIFICATION & LOCATION SOLUTION

KEY ACTIVITIES

The SYNAPS Fault Detection, Classification & Location Solution (SYNAPS 1 NIA_UKPN0037) project was successful in trialling a solution which predicted fault locations from electrical waveforms gathered through monitoring equipment prior to any noticeable LV activity, detecting transient or "pecking" fault events of short duration and low energy that did not rupture a fuse or trigger an LV network circuit breaker.

EXPECTED BENEFITS

The project has the potential to develop a commercial underground cable fault-finding device with improved accuracy, along with developing procedures for operational staff to use the technology. This has the potential to enable more efficient fault locating activities and therefore provide better service for customers by reducing Customer Interruptions (CIs) and Customer Minutes Lost (CMLs).

PROGRESS

The SYNAPS 2 NIA project has made significant improvements since the SYNAPS 1 NIA Project and has demonstrated that the SYNAPS solution consistently detects, classifies, and locates events (pre-fault events) before other technologies such as reclosers and temporary fuses. COPPsystem MCUs between December 2023 and March 2024 detected 7,382 events and classified 475 as fault events.

Speed of location has improved from three weeks in SYNAPS 1 to less than 1 day in SYNAPS 2 during 2022. The model now provides instantaneous fault locations (subject to successful validation of models).

The technology has been installed and validated on meshed networks within the UK Power Networks region.

Technology validated in radial networks, validation on meshed networks in progress and different cable types and architectures covered. Enhanced calibration is being investigated to improve fault locations on all types of networks.

Fault Locations identified and excavated – there have been 13 fault locations modelled. Out of the fault locations modelled, 11 have been successfully excavated and validated as the cause of the fault. These have been validated at RINA or by DNO Engineers.

The purchase of SYNAPS by Lucy Electric Ltd has moved the project to Technology Readiness Level (TRL) 9 and has embedded the solution into their products.

PRIMARY STRATEGIC OBJECTIVE

PROVIDING A VALUED AND TRUSTED SERVICE FOR CUSTOMERS AND COMMUNITIES

COLLABORATORS

UK Power Networks, Powerline Technologies Limited, EIC Together we innovate

PROJECT BUDGET
£1,160,432

START/END DATE
December 2020 – March 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0051

PROJECT MANAGER
Kevin Dennis

2.9 NIA SSEN 0050 NEAR REAL-TIME DATA ACCESS (NeRDA)

KEY ACTIVITIES

This is a small-scale demonstrator project which will make near real-time network usage data available to stakeholders. This will be tested by engaging with stakeholders including those already involved in ongoing local energy innovation projects.

EXPECTED BENEFITS

- The project will make near real-time data for the Oxfordshire area available to stakeholders and will assess its usefulness to them.
- This will be enabled through the implementation of a technology solution for near real-time DNO data within the SEPD licence area to enable its collation and presentation through an Application Protocol Interface (API).
- The project will assess the usability of the data through this API with stakeholder groups such as local community energy action initiatives Local Energy Oxfordshire (Project LEO)

PROGRESS

The NeRDA project was successful in delivering its objectives. The NeRDA portal makes available real time power flow data from our EHV, HV, and LV networks. This data is collected from numerous sources, including SCADA (Supervisory Control and Data Acquisition), our PowerOn system, our recently installed low voltage monitoring equipment, load models, forecasting tools, network connectivity models, and our Long-Term Development Statements (LTDS). Open Grid Systems (OGS) were engaged to develop the NeRDA solution. The OGS CIMphony platform was used as a model-driven data management tool to deliver NeRDA. CIMphony is OGS's original model-driven desktop data management tool for editing and analysing Common Information Model (CIM) data, using CIMphony allowed NeRDA to provide the real-time data to our stakeholders in a CIM format. OGS were provided with static data sets about our network (i.e. geographic references of assets, network configuration, ratings and unique identification of assets) and the ability to stream HV and LV data from SSEN systems into the CIMphony platform was created. OGS also set up a dashboard view that provides users with a geographical view of the network and data that is available. HV data is updated every 3 minutes and LV data every 10 minutes. A follow on project, NeRDA 2, has been registered in RIIO-ED2 to look at how we increase the amount of LV data that we can make available to stakeholders and its use cases.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£744,105

START/END DATE
November 2020 – March 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0050

PROJECT MANAGER
Fraser Macintyre

NERDA
NEAR REAL-TIME DATA ACCESS

2.10 NIA SSEN 0044 SMART HAMMER

KEY ACTIVITIES

The Smart Hammer project has developed a new hammer tool for testing and inspecting the asset health of wooden poles. The project has field trialled the Smart Hammer across the SSEN Operational Regions. Repeatedly striking a pole with the hammer measures the health of the pole and its asset health score is recorded in an accompanying Smart Hammer app.

EXPECTED BENEFITS

Benefits of this project will be the establishment of a technically and commercially viable Smart Hammer, with accurate and repeatable results to help detect internal rot or damage to wooden poles. The project aims to identify if the Smart Hammer is a consistent and reliable alternative to the traditional method of wood pole inspections, which use a conventional hammer and the operator's interpretation of the strike. Earlier detection of deteriorating poles will enable proactive replacement, preventing unplanned supply interruptions due to broken poles thus improving system reliability.

PROGRESS

The Smart Hammer has been rolled out to operational staff across SEPD and SHEPD with 50 hammers in circulation. All staff using the Smart Hammer received training in its use and continue to receive ongoing support. This generated over 4,200 Smart Hammer inspections in the Smart Hammer portal. This number of inspections gives the project a statistically significant data set to assess and improve the scoring algorithms. In additional to this, key feedback was captured from the pole inspection staff on the use and reliability of the Smart Hammer.

The results of the project were very positive, the Smart Hammer has been found to outperform the current traditional method of inspecting a wood pole using a lump hammer. After destructive tests of wooden poles, the Smart Hammer was found to have identified rot in poles that had been missed by the traditional testing method. The project was successful in raising the TRL of Smart Hammer from a TRL 5 to TRL 8 ready for Business as Usual (BaU) implementation. It is the intention to implement Smart Hammer into the BaU process for the testing of wooden poles. A funding application has made to the Storm Arwen re-opener to fund the deployment of Smart Hammer. It is the intention to provide a further additional close down report detailing the Smart Hammer development and the validation activities that were carried out during the project.

PRIMARY STRATEGIC OBJECTIVE

PROVIDING A VALUED AND TRUSTED SERVICE FOR CUSTOMERS AND COMMUNITIES

COLLABORATOR

Spectral Line System Ltd

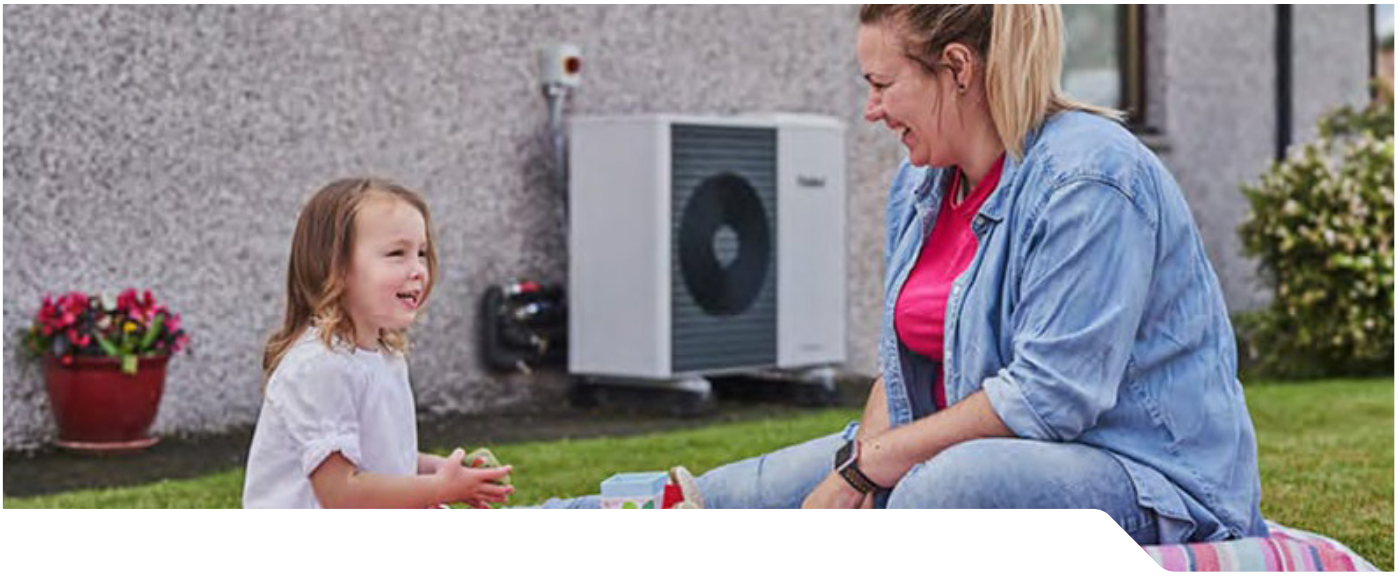
PROJECT BUDGET
£930,000

START/END DATE
February 2020 – March 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0044

PROJECT MANAGER
Kevin Dennis

2.11 NIA SSEN 0043 WHOLE SYSTEM GROWTH SCENARIO MODELLING PHASE 2 (WSGSM 2)



KEY ACTIVITIES

This project followed on from NIA_SSEN_0030 Whole-System Growth Scenario Modelling, which developed an initial modelling tool that demonstrated network impacts and informed possible investment decisions over a two-decade time period. The Phase 2 project intended to develop a method of deploying the modelling tool to enable Local Area Energy Planning.

EXPECTED BENEFITS

The original project changed so significantly over its course (due to a change of platform provider), that it would be inappropriate to report against the original PEA objectives/benefits. The project is now complete and due to its success, we have moved it into a second phase called NIA_SSEN_0071_Regional Energy System Optimisation Planning (RESOP). The main benefit of WSGSM 2 was to demonstrate that it was possible to combine multiple geo-spatial data sets to help optimally locate low carbon technologies.

PROGRESS

This project has now closed, and a second phase has started, called RESOP (NIA_SSEN_0071). WSGSM 2 proved that a combination of different data sets could be used to help optimally place low carbon technologies (e.g., electricity constraint data) alongside building data and socio-demographic data.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£1,300,000

START/END DATE
January 2020 – June 2023

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0043

PROJECT MANAGER
Rhys Williams

2.12 NIA SSEN 0034 SUBsense

KEY ACTIVITIES

The scope of the project is to install real-time monitoring systems on five submarine electricity cables in a variety of different locations interconnecting the Scottish Islands to monitor for third party intervention, cable movement and early fault detection. These cables will be monitored during the project and the data gathered will be assessed by the relevant teams. An evaluation will be completed at the end of the trial with recommendations of the system's suitability for transfer to Business as Usual (BaU).

EXPECTED BENEFITS

- Install multiple Distributed Acoustic Sensing (DAS) systems onto fibre optic embedded in submarine electricity cables, providing real time monitoring.
- Establish an effective communications method to enable real time alerts from remote islands to be received, investigated and actioned from asset management.
- Document a baseline condition of the monitored submarine cables.
- Monitor for an extended period to assess for alerts from third party intervention, cable movement or cable faults.
- Gain an understanding of the system's suitability as a condition monitoring tool for Business as Usual (BaU) adoption and its impact on asset management.
- Create a specification for condition monitoring best practices to be used on submarine cables.

PROGRESS

Five submarine cables were selected for trials, and two of these have monitoring systems installed. These are using both the DAS and Distributed Temperature Sensing (DTS) systems and are producing data. The project is continuing in Business as Usual (BaU), where this data will be used to inform further deployment of monitoring equipment.

PRIMARY STRATEGIC OBJECTIVE

DELIVERING A SAFE, RESILIENT AND RESPONSIVE NETWORK

COLLABORATORS

AP SENSING advanced photonic

Wireless innovation

PROJECT BUDGET
£1,458,218

START/END DATE
August 2018 – March 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0034

PROJECT MANAGER
Tim Watts

2.13 NIA SSEN 0065 STORM AI

KEY ACTIVITIES

The Storm AI project seeks to understand the potential role that Artificial Intelligence (AI) and Machine Learning (ML) could play in providing better information for customers who have been impacted during a storm.

EXPECTED BENEFITS

The main benefit to customers will be in relation to increased accuracy in the Estimated Time of Restoration (ETR). Benefits to Distribution Network Operators (DNOs) will be due to greater efficiency during storms and weather events, resulting in an estimated 2% saving in Guaranteed Standards and Compensation Payments. These are estimated at £2.1m for the next five years based on assumed similar weather patterns.

PROGRESS

The project looked into the use of Machine Learning techniques – notably those generally grouped under the umbrella of computer vision to classify customer-submitted images of storm-damaged network assets. Two main avenues of classification were considered: paid-for machine-learning-as-a-service (MLaaS) solutions, such as Google's Vertex AI and Amazon's AWS Rekognition, and an in-house solution constructed within the Python programming language. Through the build of the Python package, various other methods were trialled, and the first iteration of the classifier used a custom-built, 10-layer convolutional neural network (CNN) model.

The initial performance of the model on the small set of labelled data available to the model shows promise, with all target sets being predicted with accuracy scores in excess of random chance.

Storm AI is planned to be integrated as a feature of SSEN's Power Track tool, a customer facing outage notification and reporting tool that allows consumers to see reported outages. This will result in a Business as Usual (BaU) deployment of Storm AI.

PRIMARY STRATEGIC OBJECTIVE

PROVIDING A VALUED AND TRUSTED SERVICE FOR CUSTOMERS AND COMMUNITIES

COLLABORATORS

Open Grid Systems

PROJECT BUDGET
£134,451

START/END DATE
December 2022 – March 2023

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0065

PROJECT MANAGER
Fraser Macintyre

2.14 NIA SSEN 0035 INFORMED LIGHTNING PROTECTION

KEY ACTIVITIES

Lightning strikes are known to cause a significant number of supply interruptions to our customers. In our Scottish Network, lighting strikes are the second highest cause of customer interruptions and minutes lost, and in our Southern Network it is the fifth highest cause. Therefore, there is a need to reduce the impact that lighting related faults have on our customers.

EXPECTED BENEFITS

This project is now complete. The project has proven that customer supply interruptions caused by lighting related faults can be significantly reduced by installing surge arresters in strategic locations.

PROGRESS

The project installed c150 surge arresters installed within SEPD and 300 in SHEPD on circuits where lightning faults had occurred frequently. These circuits have experienced a 50% improvement in Interruptions Incentive Scheme (IIS) costs due to lightning vs the previous 3 years where no lightning protection had been installed, and a 76% improvement when comparing against the previous 10 years. This has been calculated by measuring lightning related IIS costs for the years before and after lightning protection devices were installed. However, even with a 50% improvement in IIS costs, the payback period is 16 years, which is about the expected lifespan of the surge arresters. It is probably unfair to compare IIS costs to the previous 10 years as many circuits have been changed over the time (e.g. back-fed to reduce IIS impact). It is clear that lightning protection can play a role for reducing IIS costs, but it needs to be cheaper, have a longer lifespan or be more strategically located to have a significant benefit. With this in mind, we do have plans to roll out lightning protection more strategically to improve the benefits case.

PRIMARY STRATEGIC OBJECTIVE

DELIVERING A SAFE, RESILIENT AND RESPONSIVE NETWORK

COLLABORATORS

ElectraLink

Open Grid Systems

Tyco Electronics

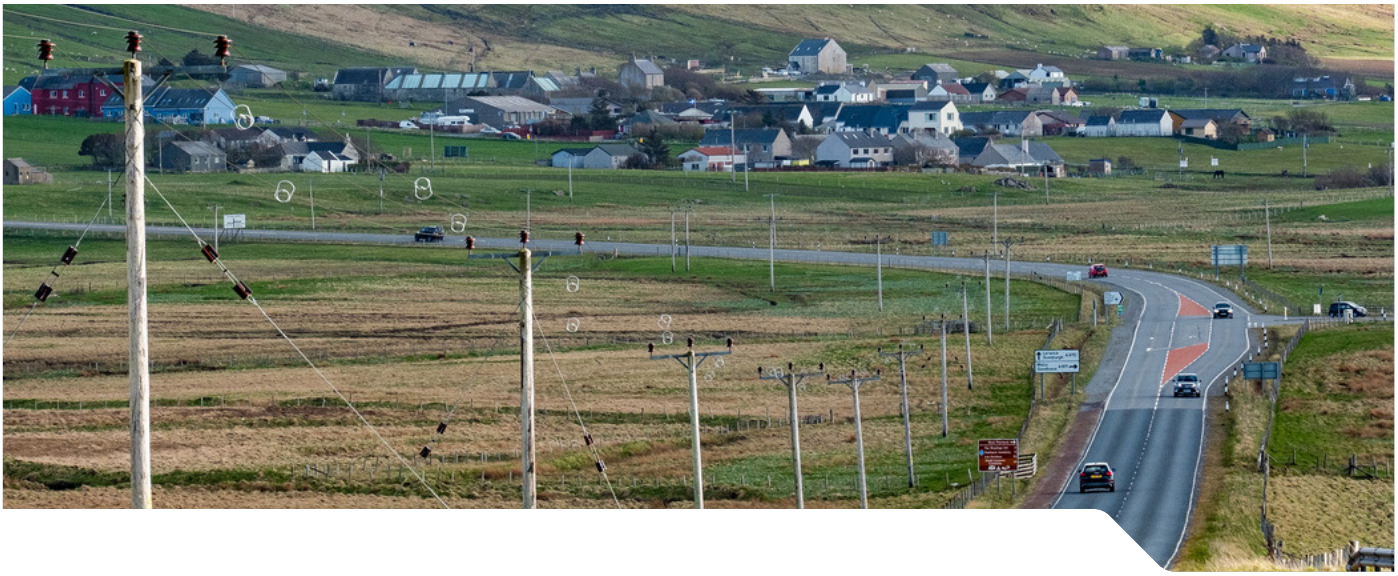
PROJECT BUDGET
£521,000

START/END DATE
March 2019 – February 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0035

PROJECT MANAGER
Rhys Williams

2.15 NIA SSEN 0066 POWER SUPPLY FOR POLE MOUNTED LV MONITORING DEVICES



KEY ACTIVITIES

The project is developing a prototype 230V power supply solution for wooden pole top LV monitoring where no neutral connection is accessible.

EXPECTED BENEFITS

To enable LV monitoring equipment to be installed on wooden poles where no neutral connection is accessible.

PROGRESS

Two prototypes of the solution involving the integration of the 230V power supply into a monitor have been produced by Eneida and installed on poles. These are successfully powering LV monitoring equipment, and their performance will continue to be assessed to inform a potential Business as Usual (BaU) deployment.

PRIMARY STRATEGIC OBJECTIVE

DELIVERING A SAFE, RESILIENT AND RESPONSIVE NETWORK

PROJECT BUDGET
£75,000

START/END DATE
March 2023 – March 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0066

PROJECT MANAGER
Bob Hopkins

2.16 NIA SSEN 0067 ExtenDER

KEY ACTIVITIES

The Extender Project is testing the feasibility of a market-based connection agreement to allow customers to connect earlier under Transmission constraints by enabling peer to peer trading of flexibility. We shall be performing extensive stakeholder engagement to understand risks and mitigation options, as well as obtaining feedback on the design and implementation. A live trial will take place on the Electron Connect Market platform to test how peer to peer trading would operate.

EXPECTED BENEFITS

Phase 1 outcome of the project is a go-no-go evaluation based on stakeholder engagement and a detailed risk assessment to understand the impact of a market-based connection agreement.

Phase 2 outcome of the project is a recommendation to enable a market-based connection agreement for all DNOs based on evidence gathered from live trials, stakeholder feedback and risk assessment work.

PROGRESS

Phase 1 is now complete, with permission to move onto Phase 2. Several risks were identified and mitigation options to alleviate these risks. It was decided that the project had significant benefits that outweighed the risks, due to the potential of connecting customers early.

Phase 2 is now live and in the early stages of stakeholder engagement and design.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£1,410,000

START/END DATE
August 2023 – December 2025

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0067

PROJECT MANAGER
Rhys Williams

2.17 NIA SSEN 0068 NEW APPROACH TO LOSSES

KEY ACTIVITIES

The New Approach to Losses project will investigate the accuracy of the current losses apportionment methodology by using a new approach to calculate and apportion network losses. If the current model is found not to be accurate, then the project will create a new losses apportionment methodology, underpinning engineering models and preparing them to a standard where they can be submitted to Elexon for approval.

EXPECTED BENEFITS

The project will either demonstrate that the current losses apportionment methodology produces accurate results or it will produce a new methodology that will gain internal approval for submission to the Balancing and Settlement Code (BSC) Panel for the project.

PROGRESS

The project has completed its first two Work Packages.

In the Engineering Models Work Package, it has been determined that the Engineering Models that are currently used are suitable for use going forward and give an accurate indication of powerflows on the network for use in a losses apportionment methodology. A report has been created discussing these and giving examples of approaches that could increase the accuracy of the modelling in further work in this area.

For the losses apportionment methodology, a new approach has been taken. The existing 'newLAF' model was built for a distribution system where, predominantly, power entered from the Transmission system and was consumed by demand customers, leading to a very top-down approach to losses apportionment. For the new model, both upward and downward powerflows were considered. This allows generation driven losses to be accounted for as well as demand driven losses. It means that the methodology is appliable for networks that have demand dominant Grid Supply Points (GSPs) as in the 'newLAF' model and also, networks that have generation dominant GSPs, which is an emerging issue in some DNO areas.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£337,500

START/END DATE
September 2023 – June 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0068

PROJECT MANAGER
Ross Bibby

2.18 NIA SSEN 0069 LVPQ

KEY ACTIVITIES

The Low Voltage Power Quality (LVPQ) project aims to test a range of devices that can restore power quality and boost network capacity. Power quality is impacted by new demands on the network including low carbon technologies (LCTs). Conventional reinforcement takes time and may not always be the most economical solution. Therefore, alongside flexibility, we need a suite of technology-based solutions to address these power quality issues including harmonics, voltage and phase imbalance.

Testing will occur at the Power Networks Demonstration Centre (PNDC) and in SSEN's network areas. The project will also develop the processes for the rapid assessment, selection and installation of the most appropriate solutions. The project has decided to focus on the impact Heat Pumps (HP) will have on the network, especially when added as a retrofit heating system to older homes.

EXPECTED BENEFITS

The main benefit to consumers will be the development of a more resilient network and a reduction in delays to the installation of LCT due to the requirement for time consuming reinforcement work.

PROGRESS

To date key stakeholders, suppliers, processes, and procedures have all been identified and onboarded to the project. The initial analysis of potential power quality issues is due to the begin in late June/early July 2024. Understanding the scale of these issues and how they interplay with existing issues on the network is key to understanding the most efficient solutions and defining suitable testing.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£1,018,500

START/END DATE
October 2023 – May 2026

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0069

PROJECT MANAGER
Phil Clarke

2.19 NIA SSEN 0070 NeRDA 2

KEY ACTIVITIES

The scope of NeRDA 2 is based on users and stakeholder feedback from the NeRDA project, NIA_SSEN_0050. In the original project, it was found that Application Process Interfaces (APIs) are the best mechanism to provide near real-time network data for both High Voltage (HV) and Low Voltage (LV) sites. The original project was limited in the geographical areas that the data was provided for, and the NeRDA 2 project will expand the geographical scope to engage with more stakeholders and understand the value in sharing this data. As well as providing real-time data, NeRDA 2 will provide static data sets through the API, such as capacity and network configuration. This is in response to stakeholder feedback that this will unlock more value from the data. In addition, improvements will be made to the dashboard to make it easier for users to interact with the real-time data and improve their understanding of the level of granularity that they can receive from the NeRDA portal. This will allow the project to assess and understand the value that can be unlocked by stakeholders from accessing the data provided.

EXPECTED BENEFITS

The project's high-level objectives are to provide near real-time network and load model data for both SSEN licence areas sharing all HV and LV network data that is available. Alongside this real-time data, the project will improve the APIs to provide users with static data around network configuration and capacity data. Improvements will also be made to the NeRDA dashboards to allow users to easily interact with the network data and understand the different levels of data that are available to them.

PROGRESS

Significant improvements have been made to the load speed of data in the NeRDA 2 project. The infrastructure to accommodate over 4,000 LV monitoring device data has been built and tested. Wireframes to improve the user experience of the dashboard have been designed which will give users greater access to static network configuration data and demonstrate the granularity of data available in the NeRDA platform.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

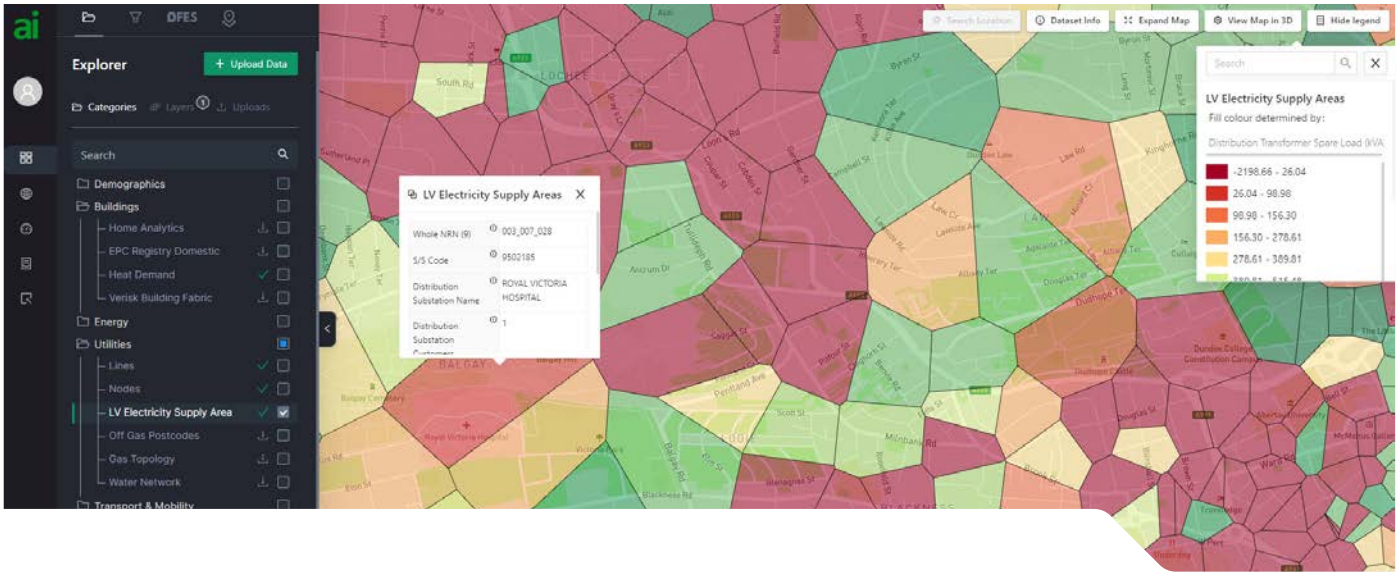
PROJECT BUDGET
£495,000

START/END DATE
August 2023 – February 2025

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0070

PROJECT MANAGER
Fraser Macintyre

2.20 NIA SSEN 0071 RESOP



KEY ACTIVITIES

Regional Energy System Optimisation Planning (RESOP) is a follow on from WSGSM 2 (NIA_SSEN_0043) which itself was a follow on from WSGSM (NIA_SSEN_0030). These projects have developed methodology for local area energy planning on a whole system basis. There are a few key activities that are taking place:

- Develop the Local Energy Net Zero Accelerator (LENZA) tool, so that it can be used to create digital Local Area Energy Plans (LAEPs).
- Work with Scottish Water Horizons to enable a water source heat pump (WSHP) use case.
- Work with Scottish Local Authorities (LAs) and the Department of Energy Security and Net Zero (DESNZ) to geographically display locations of potential Heat Networks.
- Enable an API between LENZA and PowerFactory (the power system planning software from DigSILENT) to perform load flow analysis on Low Carbon Technologies (LCTs) placed within LENZA.
- Make LENZA available to all Local Authorities within SSEN's network area to increase testing, bug fixes and feature requests so that it becomes Business as Usual (BaU) ready.
- Align LENZA with Distribution Future Energy Scenarios (DFES), so it can be used to support future DFES projections.

EXPECTED BENEFITS

The main expected outcome of the project is to enable LENZA to create digital LAEPs at a higher granularity and greater accuracy than current methods used by consultants and to enable all Local Authorities within SSEN's geography to make use of this functionality.

PROGRESS

Significant progress has been achieved to date including:

- Development of Digital LAEP functionality that allows bulk location of LCTs as well as a dashboard to review progress against targets.
- Stakeholder engagement with Scottish Water Horizons that has produced a methodology to place WSHPs.
- Stakeholder engagement with LAs and DESNZ and provision of Heat Network data for geo-spatial viewing.
- Servers and security checks are in the process of being set up to enable APIs.
- LENZA has been offered to all LAs and rolled out to most of them.
- Engagement with Regen on how LENZA can support DFES has been mapped out and DFES building blocks are now being incorporated by LENZA to facilitate this.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£2.9m

START/END DATE
October 2023 – October 2025

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0071

PROJECT MANAGER
Rhys Williams

2.21 NIA SSEN 0072 DEMAND DIVERSIFICATION SERVICE

KEY ACTIVITIES

To establish if Load Managed Areas (LMAs) can be removed by the introduction of Demand Diversification Services (DDS). To do this, Flexibility Service Providers (FSPs) are incentivised to provide enduring demand diversification to areas of the network that are(or will be) constrained. At the same time, consumers within current LMAs are enabled to fully participate in the electricity market and transition to Low Carbon Technologies (LCTs) at their discretion. This will be achieved by detailed network analytics, technical trials, and simulation exercises that are designed to gather early feedback on the feasibility of these services.

EXPECTED BENEFITS

To confirm that any new DDS is technically feasible through the current smart metering infrastructure.

To engage with stakeholders and gather feedback that confirms that there is enough interest to establish workable market mechanisms.

That enough suppliers contribute to the simulation exercise to understand the DDS and are therefore, willing to provide services when the need is operational/Business as Usual (BaU) rather than an innovation trial.

Recommendations for what to do next, and in particular what is required before DDS can be launched as a Business as Usual (BaU) service.

PROGRESS

Significant progress towards validating the appetite of FSPs to adopt new DDS commercial models was made by early March 2024 after several internal desktop exercises that culminated in an external Simulation Workshop held at the ENA offices in London. All attendees agreed that the workshop had been successful in presenting the pros and cons of the proposed DDS models and all FSPs expressed an interest in participating in the commercial trial being planned for the next phase of the project.

The project is currently preparing recommendations for the next phase that will prepare for the launch of DDS as a Business as Usual (BaU) service.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

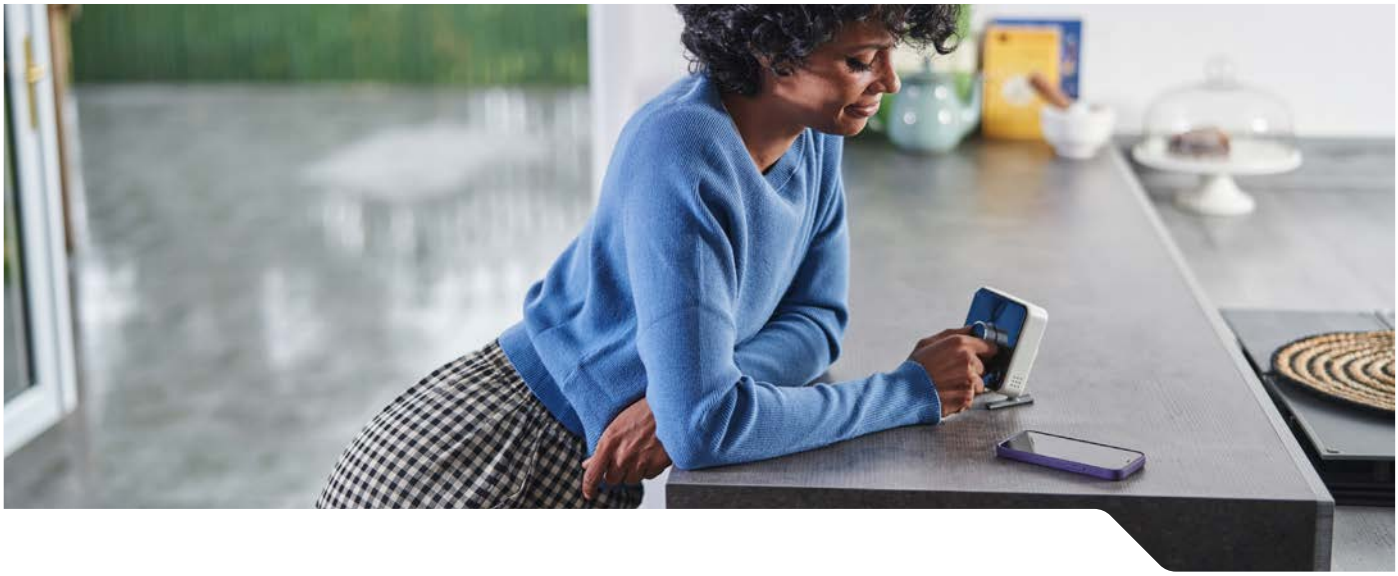
PROJECT BUDGET
£330,500

START/END DATE
February 2024 – September 2024

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0072

PROJECT MANAGER
Kevin Stewart

2.22 NIA SSEN 0073 HOMEFLEX COMPLIANCE



KEY ACTIVITIES

The HOMEflex project (NIA_SSEN_0061) developed the HOMEflex Code of Conduct promoting an inclusive, fair, and transparent domestic flexibility marketplace.

This phase will deliver HOMEflex Compliance, a Scheme to establish standards, help new entrants meet the service levels consumers expect and deserve, and enable electricity networks to confidently procure flexibility ethically, encouraging the domestic flexibility market to grow in a fairer, more sustainable manner.

The Code of Conduct has been well received by Government, stakeholders, and market participants. Electricity System Operator (ESO) will include representation of the HOMEflex Code in the procurement of their 2023/24 Demand Flexibility Service (DFS). Phase 2 assists the 'trial' use of the Code of Conduct, proposing to engage with DFS participants, gaining feedback for the development of a HOMEflex Compliance Scheme.

EXPECTED BENEFITS

HOMEflex Compliance will use the Code of Conduct to deliver a framework for a sustainable Compliance Scheme with the aim of helping the provision of energy flexibility services in the domestic and small business market and evaluating potential benefits.

PROGRESS

Although a new project, HOMEflex Compliance has made a good start. Engagement sessions and a survey with DFS participants have started and plans are formulated for how the feedback can lead to a more holistic Compliance Scheme for the whole market.

PRIMARY STRATEGIC OBJECTIVE

ACCELERATING PROGRESS TOWARDS A NET ZERO WORLD

PROJECT BUDGET
£193,000

START/END DATE
March 2024 – March 2025

WEBSITE
www.smarternetworks.org/project/project/nia_ssen_0073

PROJECT MANAGER
Simon O'Loughlin

2.23 COLLABORATION PROJECTS LED BY OTHER DNOS

Below is a list of other projects that SSEN is participating in. The projects are led by our collaboration partners; further details of those projects can be found in their relevant summaries and project progress reports. To provide some indication of where those details can be found, the leading parties are listed below next to each project.

Project number	Project title	Lead party
NIA_SPEN_008	Appeal (Wood preservatives)	SP Energy Networks
NIA _SPEN_0057	Enabling Renewable Heat	SP Energy Networks
NIA_NGN_422	Vulnerability Visualisation Tool Phase 2	Northern Gas Networks
NIA_NGN_391	Low to no power heat alternatives	Northern Gas Networks

FURTHER INFORMATION

The Innovation Strategy for SEPD and SHEPD can be found at the link below:

SSEN Distribution Innovation Strategy

https://ssen-innovation.co.uk/innovation-strategy/

Further details of all the NIA projects summarised above can be accessed through the following link:

ENA Smarter Networks Portal – SSEN Projects

https://smarter.energynetworks.org/energy-networks-innovation-strategy-2024/

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