Network Innovation Allowance

Summary Report

1 April 2018 to 31 March 2019

Scottish and Southern Electricity Networks

Scottish Hydro Electric Power Distribution
Southern Electric Power Distribution

FOREWORD

This report is a summary of the progress that has been achieved by Scottish Hydro Electric Power Distribution (SHEPD) and Southern Electric Power Distribution (SEPD) in NIA projects during the period between April 2018 and March 2019. SHEPD and SEPD are both part of Scottish and Southern Electricity Networks (SSEN) and they own and operate the distribution networks in the North of Scotland and the South of England respectively. Since the onset of RIIO-ED1 in April 2015, Distribution NIA has been funding smaller technical, commercial and operational innovation projects with potential to deliver benefits to Distribution Licensees and their customers.

In line with SSEN's core value to provide the energy people need in a reliable and sustainable way, we have set targeted innovation objectives in our Innovation Strategy submitted as part of the RIIO-ED1 plan. In Mach 2016 an innovation progress up-date was issued. In recent times, we have seen a rise in the adoption of low carbon technologies such as Electric Vehicles and Heat Pumps and a step change in our Stakeholders' commitment to the transition to a low carbon economy. There is also a steadily rising penetration of distributed energy resources (DER) such as renewable generation sources and other non-conventional assets like large scale batteries, all connected at distribution level. To better manage the seamless integration of these disparate systems, the GB electricity market is reforming with the transition towards a Distribution System Operator (DSO) model which will transform the way Distribution Network Operators (DNOs) operate. All these developments have introduced new challenges which need to be addressed to ensure that there is minimal disruption to the service that our customers have come to expect from us. We continue to value collaboration and have been integral to the collaborative industrial effort led by ENA to develop an industry-wide joint innovation strategy.

In the year to 31st March 2019, we had a portfolio of twenty-two live NIA projects at various stages in their lifecycles. Thirteen of those projects were led by SSEN with the remainder being led by our collaboration partners. Our priority since the onset of RIIO-ED1 has been to ensure our Distribution NIA portfolio actively supports the changes of the GB Electricity market. We have been moving away from individual technology trials towards market and system trials, so we can learn and understand the impact and/or opportunities that will be unlocked by our transition to DSO.

Within SEPD and SHEPD, one of the measures of innovation success is to take project learning and translate it into business as usual. We are pleased to say that we have successfully rolled out new support tools and amended processes to accommodate the learning from NIA investigations in both network licence areas of SSEN. Meanwhile, we continue to absorb learning generated by other network licensees and fast-follow whenever viable. Innovation is never "done" so we continue to engage with our stakeholders and collaborate with interested parties in the energy supply chain so that our innovation efforts can deliver the best possible value to our customers.

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

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1 NIA Project Portfolio

As part of the RIIO-ED1 Innovation Strategy, following extensive engagement activities with the key Stakeholders, six primary focus areas where identified. The main drivers for each of the six primary focus areas are presented below;

Connections – Primarily seeking to maximise efficiencies associated with new generation connections. As an example, investigating use of monitoring technologies or commercial incentives to influence generation operations with the aim of reducing associated connection infrastructure costs. More recently with the ever-changing use of the distribution system, notably an increase of energy flowing from the end user back into the main system. The latest NIA Distribution Projects have been focused on future system operational scenarios and identifying the bridging technology / protocols and agreements to facilitate this.

Customer Service – SSENs number one priority is 'keeping the lights on' therefore research into technologies that aid this objective which range from increasing process automation through to looking into mobile phone Apps that allow faults to be reported is key.

Environment – with a large network of overhead circuits, underground cables and various sized electrical substations SSEN has a notable intrusion on the natural environment. Great efforts are made to look for ways to continue to operate whilst minimising our impact on the surrounding environment. NIA Projects have ranged from hybrid-bidirectional generation to sourcing alternatives to the traditional wooden pole.

Reliability – our customers' expectations are that their electrical energy requirements will be met at a flick of the 'on' switch. To ensure this is the case, the complex distribution system that SSEN owns and operates must be highly reliable, with sufficient capacity to meet the customers' needs. Several NIA Distribution Projects have focused on integrating new technologies into existing processes and established system controls to increase network reliance. As the industry moves towards a Distribution System Operator this has triggered investigation into LV network modelling and remote monitoring.

Safety – SSEN places a huge amount of onus on operating the system safely, as well as keeping the employees and general public safe. To support SSEN's safety culture NIA Distribution Projects have focused on trialling new equipment with enhanced safety features through to remotely monitoring the system, to aid detection and prevention of increased conductor sag for instance.

Social Obligation – as electricity is a basic requirement today to heat homes and provide a hot meal, SSEN wishes to ensure that the most vulnerable people's needs are maintained. Our Stakeholders also foresaw an opportunity for some innovation projects which could focus on reducing the costs of electricity whilst also improving social connections. Addressing this is more of a challenge in our Scottish network, given the dispersed nature of the population and islanded communities.

SSENs NIA Distribution Projects have had objectives in one specific or several focus areas. Below in **Table 1**. is a summary of the active NIA Distribution Projects this year and their objectives mapped into the RIIO-ED1 Innovation Strategy focus areas.

Project No.	Name	Connections	Customer Service	Environment	Reliability	Safety	Social Obligation
NIA_SSEPD_0003	Network Damage Reporter		■		▲	▲	
NIA_SSEPD_0009	Automated Loop Restoration		▲		■		
NIA_SSEPD_0020	Overhead Line Vibration Monitoring System (CNI Guard)		▲			■	
NIA_SSEPD_0025	Applied Integrated Vegetation Management			■			▲
NIA_SSEPD_0026	Smart EV Charging	■	▲				▲
NIA_SSEPD_0027	Low Cost LV Substation Monitoring		▲		■	▲	
NIA_SSEPD_0029	11kV Power Electronics	■	▲			▲	
NIA_SSEN_0030	Whole System Growth Scenario Modelling	■	▲		▲		
NIA_SSEN_0031	Risk Assessment and Modelling of Smart nEtwork Solutions (RAMSES)	▲			■		▲
NIA_SSEN_0032	Phase ID for LV Fault Locations (HAYSYS)		■	▲		▲	
NIA_SSEN_0034	SUBsense			■	▲	▲	
NIA_SSEN_0035	Informed Lightning Protection		▲		▲	■	
NIA_SSEN_0036	Social CMZ	▲	■				▲

■ Primary Area ▲ Secondary Area

Table 1. NIA Distribution Projects mapped onto RIIO-ED1 Innovation Strategy Focus Areas

2 Summary of Progress

Up to the year ending 31 March 2019, there were 21 projects funded under SEPD and SHEPD Network Innovation Allowance (NIA). Of these, 13 projects were led by us and the remaining 9 were managed by our collaboration partners. Over the year, 8 of NIA projects have been completed, 3 new projects have been registered and 2 have been ongoing.

2.1 NIA_SSEPD_0003 Network Damage Reporter

Start Date: April 2015

Duration: 38 Months

Description:
The scope of the project is to produce a smartphone application for Android and Apple tablets and smart phones that will allow third parties such as members of the public and the emergency services to easily provide us with reports of damage to our networks.

Expected Benefits:
- Develop new procedures and processes to make use of the data submitted by users, such that the fault report submitted is integrated into the company fault management system
- Develop a publicity strategy to publicise the availability of the application
- Evaluate the viability of fault reporting using smartphones

Progress:
The enhanced mobile application went live to the public on 5 July 2018, and successfully transitioned to business as usual (BAU). Post go live, internal processes have been amended and revaluated, training has been given to storm support roles and the app has continued to be promoted through social media channels and the winter campaign. The app has also been shared at various stakeholder events including the Nationwide Emergency Services Conference, at the NEC Birmingham in September 2018.

The level of interest from the public is growing, to date the application has been downloaded 11,450 times, with over 29,259 users (Includes web users). The app has received 97 confirmed damage reports which has aided quicker fault identification. Outage information has been viewed more than 321,552 times and the power cuts map has been viewed more than 664,387.

Development is continuing via evaluation workshops to identify areas of improvement, following on from which up-grades will be incorporated as part of a BAU project.

Figure 1: Images that have been received via the Network Damage Reporter App,
top – fallen overhead line cable,
bottom – an electrical box that has come away from the wooden pole

2.2 NIA_SSEPD_0009 Automated Loop Restoration

Start Date: June 2015

Duration: 40 Months

Description:
This is an automation scheme for reducing customer interruptions and customer hours lost (CI/CHLs) by automatically restoring supply to sections of the network initially affected by a fault but not actually having a fault. This project makes use of loop reconnection which does not rely on communication links to transfer data to enable automatic restoration of supplies.

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Seven pole mounted circuit breakers will be installed on two sections of 11kV overhead line networks on the Kintyre Peninsula to create an overall scheme of eight sections.

Expected Benefits:
The method in this project is expected to reduce CI and CHLs.

Progress:
This project was concluded early as recent development in the implementation of automated restoration systems based on conventional hardware and the existing Distribution Management System (DMS) made further development of this project redundant.

2.3 NIA_SSEPD_0020 Overhead Line Vibration Monitoring System

Start Date: November 2015

Duration: 48 Months

Description:
This project develops the initial IFI project (2014_08) to produce a production ready line mounted sensor and communication system to mitigate susceptibility of rural overhead lines to damage by wind debris, inadvertent collision by farm and forestry vehicles, kites etc. The newly developed sensors will be encased within environmental protective cases, and are powered by solar panels, which trickle charge backup batteries within the cases. They will then be installed on overhead lines in several areas of the distribution network and left for an extended period of time to determine the suitability for use, in terms of effect on the installed infrastructure, ability to withstand weather events, and ability to maintain power on during the winter months.

Expected Benefits:
There will be potential cost savings through:

- Reduction in costs due to damage from vegetation
- Reduction in costs due to not undergrounding in high risk areas

There will also be better safety performance through reduction in the risk of safety incidents due to wires drooping close to the ground due to pole movement or collisions with the wires by vehicles.

Progress:
To maximise on the learning, the overhead line monitoring device, the necessary pole mounted relay boxes and the communication gateway which links into the SSEN SCADA system, were installed at Perth's SSEN Network Training Centre. The overhead line and pole mounted units have been continually disturbed which has enabled the whole system to be rigorously tested. There are elements of the product that merit further investigation into other avenues of

application, however the device as it is presently for overhead lines, will not be progressed as it requires infrastructure every 80-100m to relay the signal.

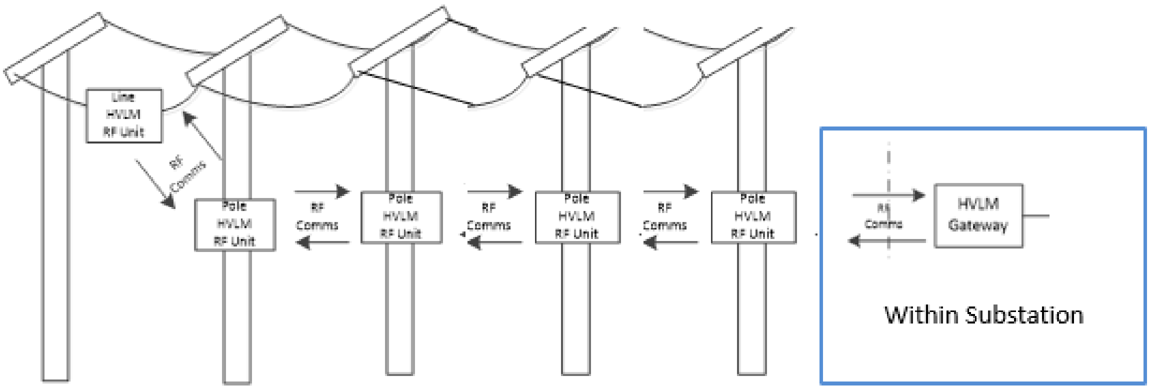


Figure 2. Concept of the Overhead Line Monitoring System

Figure 3. The overhead line monitoring unit

2.4 NIA_SSEPD_0025 Applied Integrated Vegetation Management (IVM)

Start Date: January 2016

Duration: 87 Months

Description:
The project addresses the problem of trees in the vicinity of overhead electricity lines and also ensuring that regulatory standards are met. One of the potential solutions is the use of machine mulchers to clear all vegetation but this is costly and is not desirable from either an ecological or landscape point of view. This project proposes the use of integrated vegetation management (IVM). This is the practice of promoting desirable, stable, low-growing plant communities that will resist the invasion by tall-growing species through the use of appropriate, environmentally sound, and cost-effective control methods.

Expected Benefits:
- Financial savings through reduction in use of cost-intensive mulching methods
- Environmental benefits due to reduced disruption to protected wildlife species

Progress:
Surveying and analysis of the trial locations where IVM regimes have been applied have shown limited differences in biodiversity and animal species. To determine how best to progress changes, the Tree Cutting Team's policies and processes are being evaluated and public opinion sought on the importance of expenditure versus the increase in biodiversity.

Figure 4. Surveyed area

2.5 NIA_SSEPD_0026 Management of plug-in vehicle uptake on distribution networks

Start Date: March 2016

Duration: 31 Months

Description:
This project will seek to inform an ENA Engineering Recommendation (or equivalent) for the connection, charging and control of new, large, plug-in vehicle (PIV) load to domestic properties. The focus of this project is on the collaborative approach required to achieve consensus on a solution that can be used to facilitate the roll out of controlled PIV charging.

Expected Benefits:
There are financial savings expected if network reinforcements necessitated by uptake of plug-in vehicles, can be deferred based on implementing the monitoring and control methodology proposed in this project.

Progress:
The project has now concluded with many of the original objectives achieved. A significant amount of learning has been obtained over the course of the project, during which time EVs have been elevated in importance which means interest in the development of Codes and Practices, therefore integration into business as usual is not practical presently.

The decision to investigate the use of the Smart Metering infrastructure highlighted inadequacies with the Smart Energy Code which allowed only suppliers to control load. An amendment has been raised (SECMP0046) and is currently progressing independent of the project. The timescale for a decision on the acceptability of DNOs controlling load is difficult to ascertain but is probably in the region of 12/18 months.

Similarly, while the main output of the project, the industry agreed material submitted to the ENA for use in an Engineering Recommendation has been met, it is unclear if this will be utilised as a definitive standard for SMART EV Charging due to the ongoing work by other parties including B.E.I.S., OLEV and the Low Carbon Vehicle Partnership.

In particular, the Automated and Electric Vehicle Act which became law in July 2018 mandated that EV Chargers shall be ''SMART'' without defining what functionality is required. It is likely that future OLEV grant aid for installing EV Chargers will be dependent on meeting the ''SMART'' requirement.

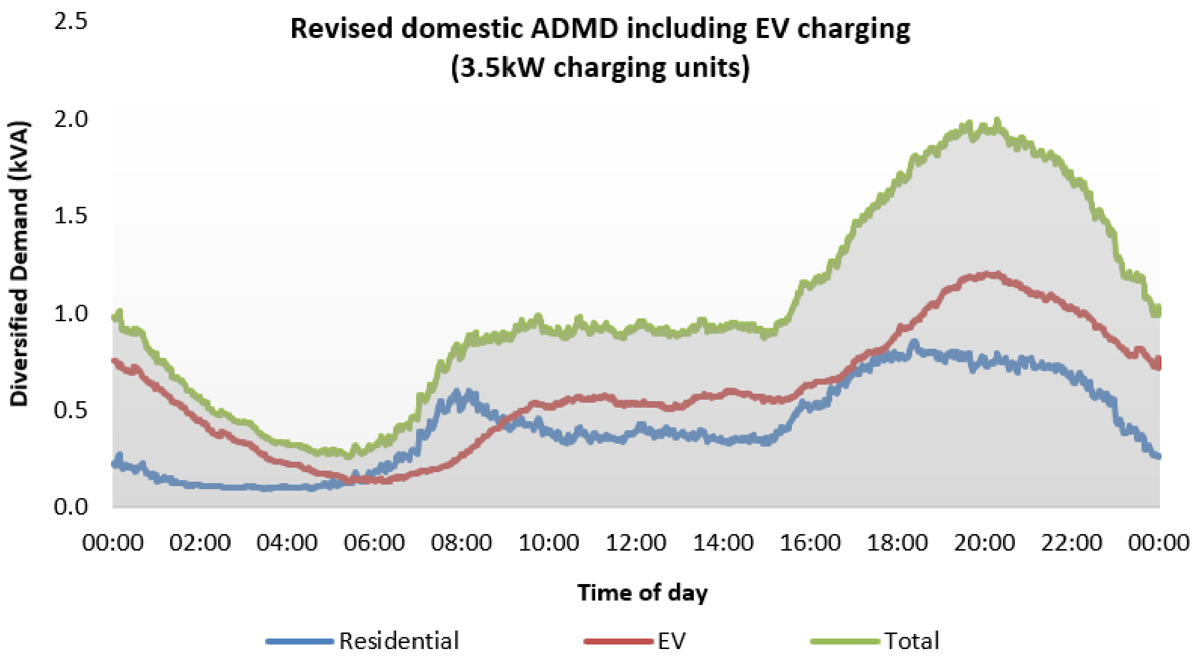
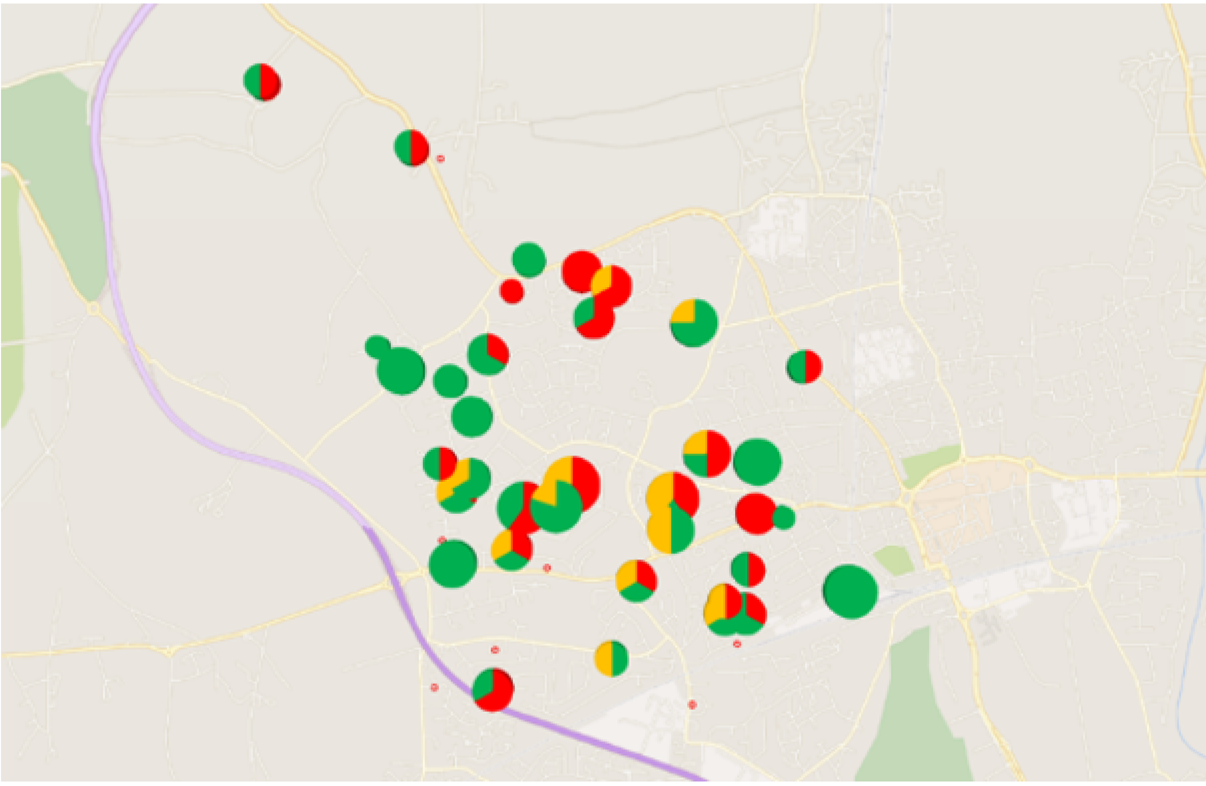


Figure 5. The demand profile for a residential house (blue line) and the Electric Vehicle (EV) charging profile (red line) with the combined electricity demand in green.



Figures 6. Working with the demand curves shown in Figure 5 to predict how electrically loaded the residential demand points could become as EVs increase

2.6 NIA_SSEPD_0027 Low Cost LV Substation Monitoring

Start Date: March 2016

Duration: 33 Months

Description:
This project proposes a technical method to develop and test a number of low-cost devices from different manufacturers which will measure voltage and current at the outgoing feeders from a number of secondary substations. Data will be transmitted via the GPRS network from each substation to a central data centre where it will be available to the network planners and other relevant licensee staff. This will allow informed decisions to be made by network planners and other staff with respect to operations, network planning and customer service.

Expected Benefits:
Improved visibility of the Low Voltage (LV) network will help in the identification of areas where smart technologies can be implemented. Such technologies will allow deferral of underground cable reinforcement which will result in financial savings.

Progress:
The project closed during the year with a successful outcome. Data has been collected over the contract period and is proving useful in confirming electric vehicle (EV) hotspots, and also network imbalance leading to high electrical losses and asset loadings. With the ongoing progress on the installation of smart meters and the availability of half hour data from that source there will be learning to be pursued related to the interaction between the two data sources.

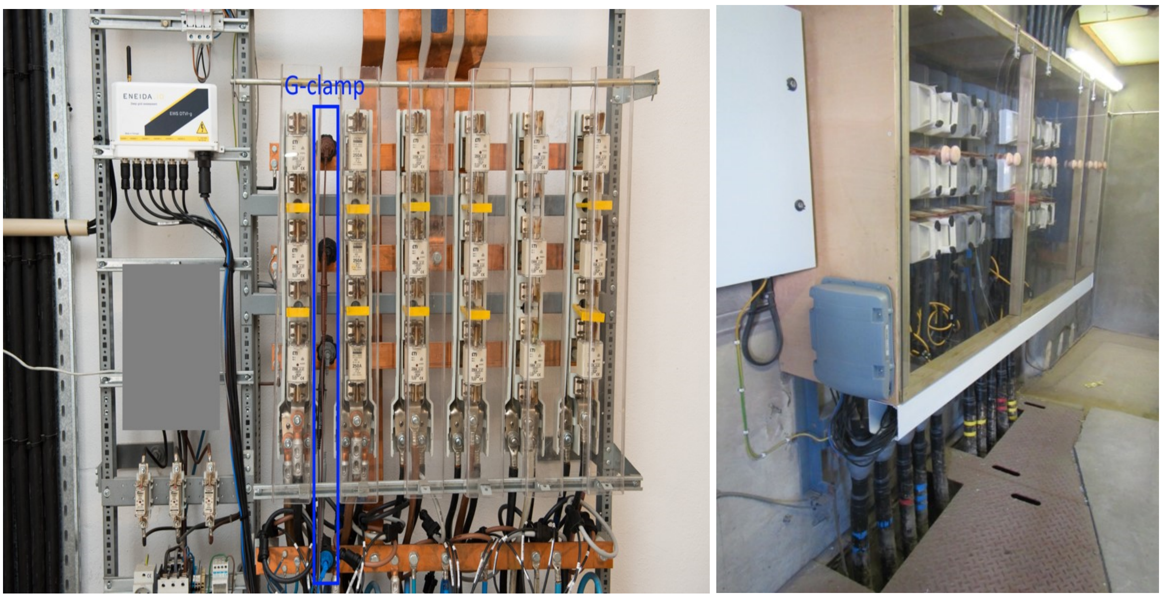


Figure 7. The types of electrical equipment being monitored as part of the LV Project

2.7 NIA_SSEPD_0029 11kV Power Electronics Providing Reactive Compensation for Voltage Control

Start Date: June 2016

Duration: 42 Months

Description:
This project proposes a technical method to deploy a newly developed power electronic reactive power compensation unit of a novel design which operates with a direct connection at 11kV. The aim of the project is to manage voltage changes due to changing customer loads and generation which may go outside of statutory limits in some cases. The device will be tested at Power Networks Demonstration Centre (PNDC) to ensure that it can operate over the full voltage and frequency envelope it is designed for.

Expected Benefits:
The proposed method will trial a new device with ability to quickly respond to voltage changes by supplying or absorbing reactive power. This technology can be retrospectively fitted on existing problematic circuits thereby allowing deferral of transformer, overhead line and underground cable reinforcement which will result in financial savings.

Progress:
The first network installation has been commissioned on the Isle of Lewis, to replace a failed static compensator (STATCOM) which provided voltage regulation for a small community-owned wind farm. This installation will now be under close monitoring but so far, the rated VAR capacity and dynamic response time of the device are sufficient to meet the operational requirements for this application. Preparations are now underway for installations at the second and third sites.

2.8 NIA_SSEN_0030 Whole System Growth Scenario Modelling

Start Date: October 2017

Duration: 18 Months

Description:
A key role of a Distribution System Operator (DSO) is to undertake “Whole system planning”. This means considering factors broader than the immediate demands on the local electrical network when considering how to meet customers’ needs. Whole system planning requires the DSO to:

- Make decisions on investment in network assets, or flexibility
- Consider local energy scenarios to realise optionality value and make least-regret investments

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- Consider all reasonable solutions across Distribution, Transmission, and other energy networks and sources
- Provide local investors, customers and communities with visibility to inform decisions in relation to their own investments

The foregoing has to be done in a manner which balances cost and reliability across all relevant energy networks. In this project, the analysis will consider the overall energy requirements of a local geographical area, considering the community; planning policy; transport policy; and other energy sources or sinks (such as gas networks). This has not yet been undertaken and will become increasingly important as decarbonisation shifts energy demands between fuels, and as additional decentralised generation seek to connect.

The project will develop a method for undertaking whole-system modelling of an area defined by a Grid Supply Point, including stakeholder engagement; local generation and demand; existing asset condition and replacement needs; and investment options, including distributed energy resources and demand response. The model will focus on the 33kV voltage level and will not address the individual building level. It will use the Future Energy Scenarios to project forwards from the present day. The method will be tested on three areas: Fort William, Dundee and Islay.

Expected Benefits:

This is an enabling project for the DSO transition and will allow the company to examine the scope for applying flexible and distributed energy resources to meet system balancing requirements in the areas modelled.

The proposed study will gather evidence to assess the need for anticipatory investments and identify possible investment triggering factors. This will ensure that the risk of creating stranded assets is kept as low as possible through making the most effective use of flexible resources, demand side response, active network management, and constraints. It will enable an electricity DNO to assess the impact of whole system factors including the extension of gas networks; the uptake of electric vehicles; heat networks; and local development plans.

Progress:

The project has now completed and has successfully modelled future energy scenarios and possible smart intervention techniques at three Grid Primary Substations. These three locations include Islay - an islanded network, Fort William- a rural network and Dundee - an urban network. Plans to engage with local councils are now taking place to see how these learnings can be applied.

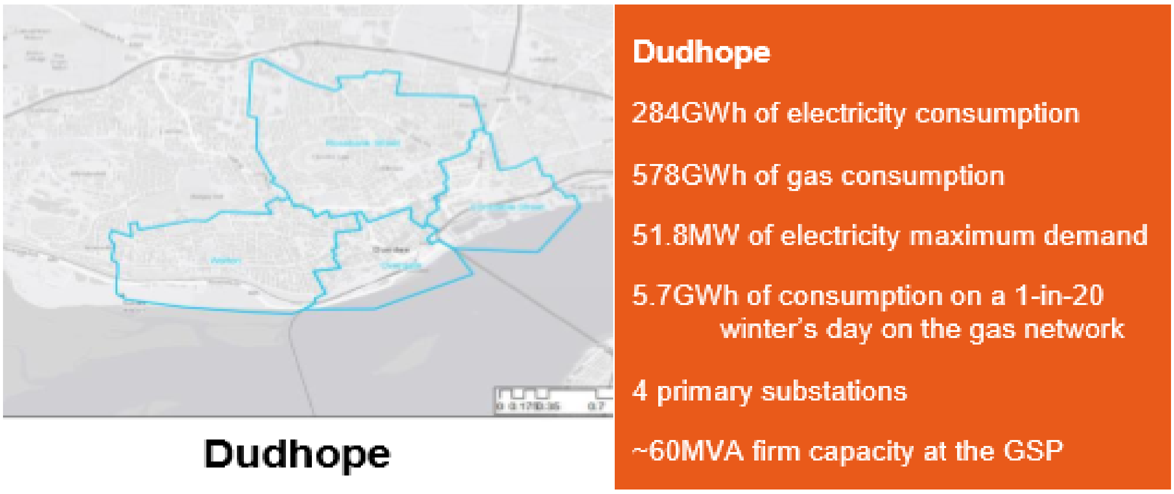

Figure 8. Shows the area in Dundee that has been modelled and the electricity and gas consumption information

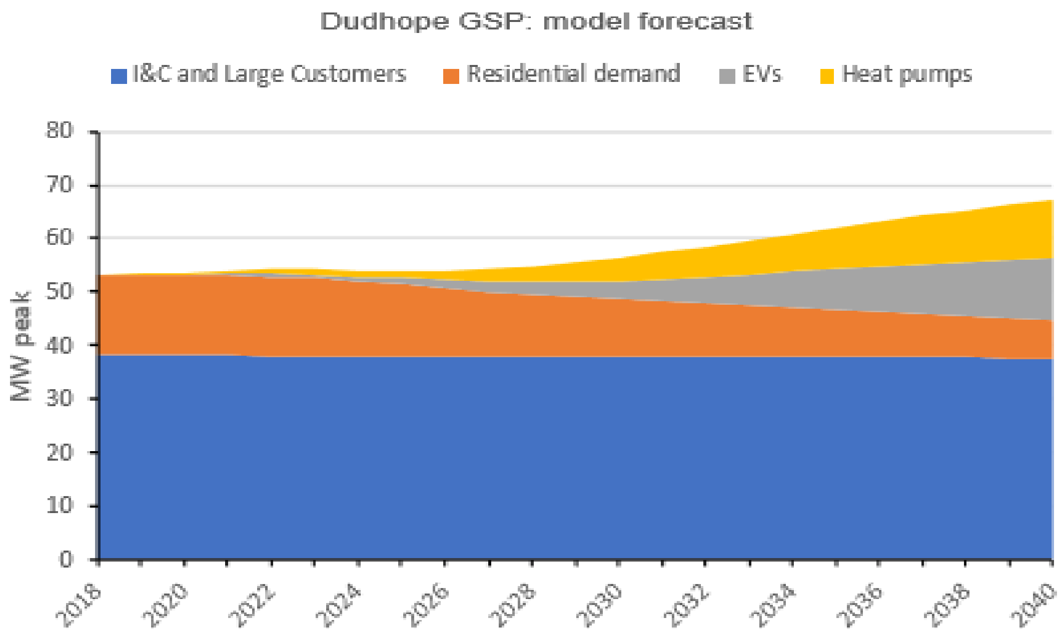

Figure 9. The forecast of future energy use in the Dundee Area

2.9 NIA_SSEN_0031 Risk Assessment Modelling of Smart nEtwork Solutions (RAMSES)

Start Date: October 2017

Duration: 15 months

Description:
The RAMSES project aims to improve the understanding of risks associated with assets not owned by the DNO e.g. energy storage, demand side response, etc. It does this by using advanced modelling to simulate the effects of third-party technologies on the network.

Expected Benefits:
Reduced investment and operational risk when contracting with third parties e.g. CMZ, energy storage, etc. Risks of outages will be reduced, by ensuring best practice standards (identified by the project) are followed by being written into contract agreements.

Progress:
The project has now closed and has successfully modelled the financial risks associated with energy storage and demand side response at circuit level. There are plans to build on the learnings to develop a tool that can be used for investment purposes.

A **financial model** was developed to test a variety of grid reinforcement strategies using non-network solutions to **determine the value** of these strategies and communicate their benefits.

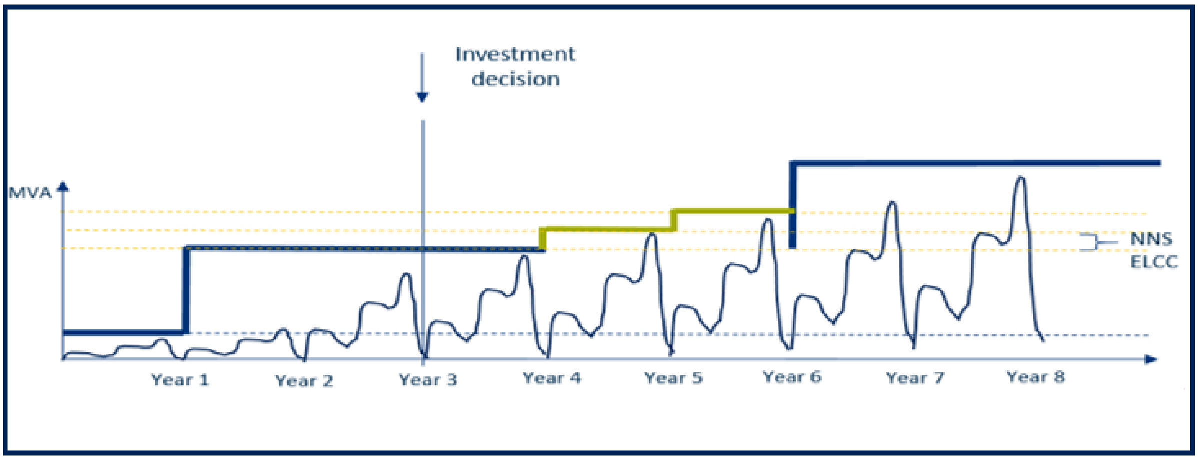

Figure 10. The output from financial model, indicating the investment decision point and how using non-network solutions (NNS), the green line, could help

2.10 NIA_SSEN_0032 Phase Identification Unit to Assist in Underground Fault Location

Start Date: February 2018

Duration: 15 Months

Description:
The HAYden SYStems Phase Identification Unit is used to identify which phase a building is on without having to interact with the owners, thus minimising disruption (particularly when people are out during the day or asleep during the night). This project uses this technology to identify a number of primary and secondary goals:

- Primary - Location of sustained LV faults (generally the hardest and most expensive to find) – the aim is to minimise the digging required to identify the fault location
- Secondary – Confirmation of supply loss/restoration without disrupting the customer (or having to look in a window for lights)
- Secondary – Provides connectivity map of area which has undergone a fault which is important for future balancing works

The trial is expected to show if there is a CI/CML improvement through the use of this device.

Expected Benefits:
- With Unit costs around £1,300, payback achieved with two avoided digs.
- Future benefits from minimisation of customer disruption and ability to understand if users are back on supply without entry into the properties

Progress:
The 'Phase Identification Unit (PIU) to Assist in Underground Fault Location' project concluded that you can use a PIU to help locate underground cable faults; they are reliable devices with a high level of accuracy.

The PIU is ideal where customers' supplies cannot be restored due to an open circuit fault. Using the PIU to identity the last customer off can reduce the overall repair time. The PIU can also be used to manage faults on the network;
- A low voltage distribution network fault where one of the phase cores within the underground mains cable has become open circuit. The PIU can accurately assess the customer supply status enabling engineers to make correct decisions to progress fault repairs.
- An opportunity where fused links in link boxes are used to quickly restore supplies on unplanned interruptions involving inter-connected networks. Prior to installing the fuse links the PIU can be used to identify which customers are off supply and phase information.

Using the PIU will save on excavation and reduce the duration of the unplanned outage.

Figure 11. Hand held Phase Identification Unit (PIU)

2.11 NIA_SSEN_0034 SubSense

Start Date: August 2018.

Duration: 36 Months.

Description:
The project aims to install a real time monitoring system utilising Distributed Acoustic Sensing (DAS) on several new subsea cables which will have single mode fibre optics embedded in the cable. A DAS interrogator unit is connected to the optical fibre which essentially turns the fibre into an array of virtual microphones. Short pulses of highly coherent light are transmitted down the fibre by an interrogator unit, and backscatter returns are observed coming from the inherent physical imperfections present in any standard fibre optic. The backscatter observations detect minute cable strains induced by acoustic events. The backscatter is then passed through to a processing unit which provides interpretations and visualisation of the signal.

The DAS system has algorithms which can categorise the acoustic vibration events in real time such as third-party intervention, cable movement and fault identification. The location of these events is recorded by the DAS system by way of accurately identifying the distance from the cable end, typically +/- 10m. Such events are time stamped and alerts are issued to control rooms and asset management for further review and investigation.

Expected Benefits:
An estimate of the cost saving from using Distributed Acoustic Sensing can vary dependant on which benefit is realised in each individual case. Repairs or replacement of any submarine cable can cost several million pounds, these costs can rise significantly if there is an emergency repair required or if a cable has no redundancy from another supply cable. DAS can provide asset management with supplementary data regarding the current condition of subsea cables and historical data of the environment in which the cable has been operated. This data will further benefit the planning for cable replacements.

Progress:
Since the project start, the DAS systems have been procured and received. As these systems are on a long lead-time it has taken substantial time to receive the systems. Fibre cabling has been installed at one of the selected test sites, to extend the submarine cable fibre from the shore end to the substation, where the DAS equipment will be deployed. Works are continuing to develop the systems integration and communications network before the DAS systems are deployed at the remote sites. Installations are planned to take place in 2019.

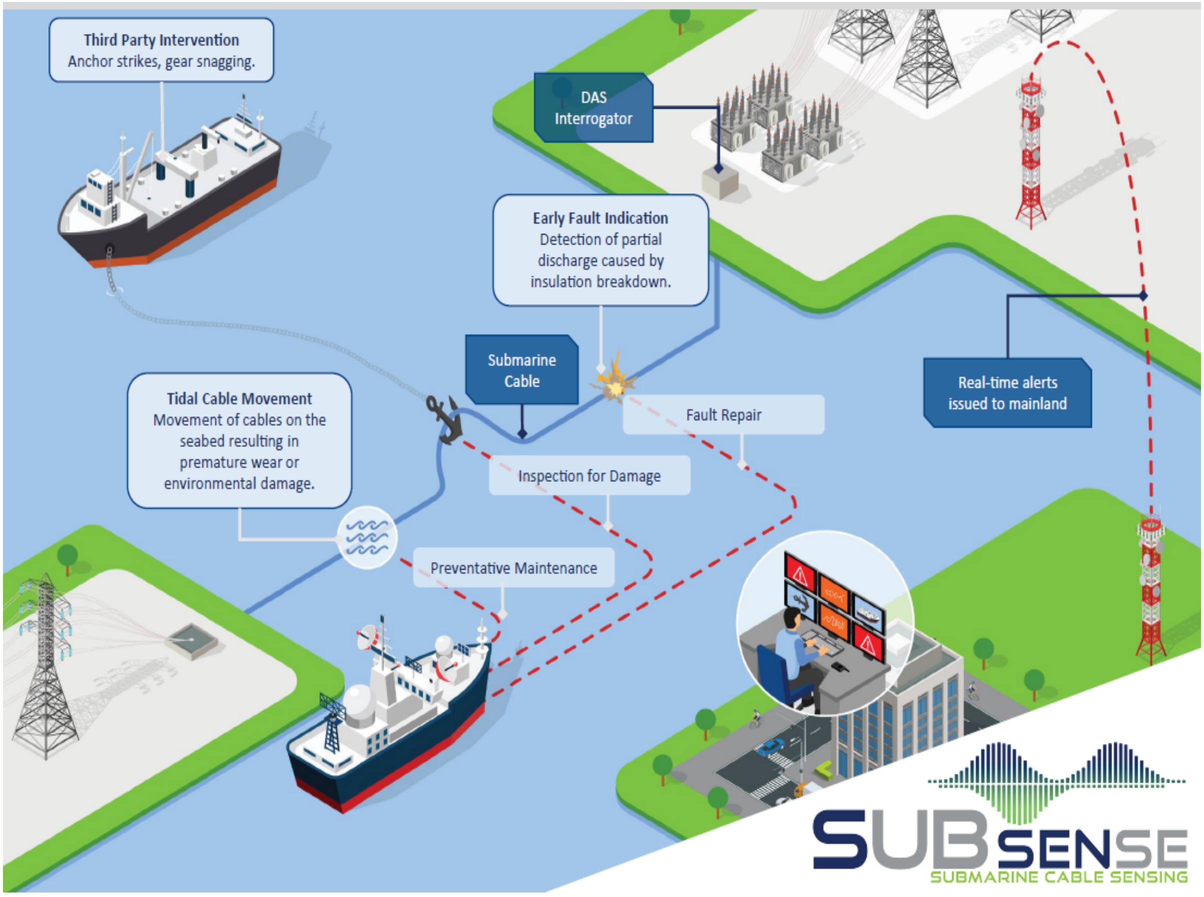

Figure 12. Infographic outlining the aims of the SubSense Project

2.12 NIA_SSEN_0035 Informed Lightning Protection

Start Date: March 2019

Duration: 48 Months

Description:
Informed lightning protection is split into 3 key phases. Phase 1 is utilising data analytics to understand where lightning has the greatest impact on our network. Phase 2 is installing lightning protection equipment in locations identified by phase 1. Phase 3 is monitoring to understand if the analytical results work in a real-world environment.

Expected Benefits:
It is expected that there will be fewer customer interruptions and minutes lost from blackouts caused by lightning related faults. This will improve customer satisfaction by improving network resilience.

Progress:
The project has only recently started, below are the initial project aims to prevent damage to the system.

Anticipated outcomes from Discovery are:
- Load and visualise historic lightning strikes to provide analytics around multi-strikes
- Provide analytics around existing lightning faults and worst effected circuits
- Using historic data, predict areas of the Network that are more at risk to lightning

Figure 13. Extract of project aims to help prevent lightning effecting the system. The photograph on the right shows the effect of a lightning strike on the system.

2.13 NIA_SSEN_0036 Social Constrained Managed Zones (CMZs)

Start Date: March 2019

Duration: 7 Months

Description:
SSEN are investing in flexibility, procuring services from customers to help us manage the network, delaying the need for expensive and disruptive reinforcements. The SCMZ project forms part of the flexibility portfolio at SSEN, aiming to widen the market and make it accessible to more people. It is developing the right internal processes and delivering the message via new channels and means to reach new people. The trial is running in Drayton (Oxfordshire) and Coxmoor Wood (Surrey/Hampshire border) and will feed new applications into the CMZ process.

Expected Benefits:
The benefits of the project are as follows:

- Widening the market access and participation for the CMZ process in Coxmoor Wood and Drayton, maximising the competition for flexible contracts in these areas
- Developing the processes which will allow the SCMZ to move into BAU across other CMZ areas
- Developing the understanding of the benefits of additional support to smaller organisations who wish to participate in flexibility markets

Progress:
Work has begun with our partner organisation, NEA, to identify organisations and groups within the Drayton and Coxmoor Wood regions to invite to initial stakeholder engagement events.

Figure 14. Hard shoulder of a motorway being used to assist the flow of traffic, the SCMZ concept is based on the same principle ‘looking at how to incentivise the system users to alter their ways on occasions, to keep the network within operating parameters

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2.14 Collaboration projects led by other Network Licensees

Below is a list of other projects that SSEN is participating in. The projects are led by our collaboration partners hence 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 given below next to each project.

- NIA_SPEN_008 Appeal (Wood preservatives) – Scottish Power Energy Networks
- NIA_WPD_008 Improved Statistical Ratings for Distribution Overhead Lines – Western Power Distribution
- NIA_UKPN_0029 Assessment and Testing of Alternative Cut-outs – UK Power Networks
- NIA_WWU_045 Eye in the Sky – Wales and West Utilities
- NIA_SPT_1801 Distributed Ledger Technology-enabled Distribution System Operation (Phase 1) – Scottish Power Energy Networks
- NIA_UKPN_0037 SYNAPS – UK Power Networks
- NIA_UKPN_0039 Engineered Poles – UK Power Networks
- NIA_WWU_0051 Green City Vision – Wales and West Utilities
- NIA_UKPN_047 Feeder monitoring to pre-empt faults – UK Power Networks

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3 Highlights of the year: Areas of significant new learning

3.1 Improving our connection with the public

The UK has become heavily reliant on electricity particularly as new low carbon technologies depend on it for power, heat and transport. 'Keeping the lights on' is a core objective for SSEN. On the rare occasion the power does go out, it is often down to equipment failure which must be investigated quickly and effectively to get supply restored. Any information on the type of equipment or the exact location of the outage or fault is helpful to pin point the problem and therefore dispatch appropriate resource to rectify it.

Traditionally, information from the public about a fault comes in via the telephone only. With our increasing use of mobile phones and tablets, SSEN developed the Power Track app, to help provide information on faults to ensure members of the public are kept up to date.

However, it only provided one-way information from the SSEN to the user. This year the Network Damage Reporter delivered to the business an enhanced tool, to improve the connection with the members of the public and allow information and pictures to be sent in to aid the management of fault event.

The enhanced Power Track app is a smart phone application that can work on Android and Apple devices allowing members of the public and the emergency services to report damage to the electrical network.

Figure 15. Smart phone friendly Power Track

There is significantly more work behind the scenes involved in making a mobile ‘app’ suitable for two-way communication. Below the learning is summarised;

- It is necessary to seek and secure internal support / resource to respond and investigate incoming information, and commitment to provide positive and proactive responses.
- Significant time needs to be given to testing the functionality of the tool to ensure that different types of information can be reliably up-loaded and transferred;
- Testing the users’ functionality under heavily loaded traffic conditions is essential, to ensure larger volumes of information can be managed and actioned;
- Early engagement with IT security is a must, as information will be coming in from a range of Internet Protocol (IP) addresses therefore suitable IT system architecture needed to be in place to manage the incoming data in a way that protects internal systems from malicious attacks;
- Make an early start to documenting processes and procedures to be adhered to when working with the data received, schedule frequent reviews to streamline the guidance material;
- Ensure scenario testing sessions which involve the key personnel, build rigorous trialling of the systems and logic behind the documentation, identifying where improvements could be made; and
- Ensure staff training in specific roles during periods of stormy weather when the volume of data coming in is anticipated to be higher than normal.

The introduction of the additional functionality to the mobile Power Track app has been welcomed by all parties. Internally it is of great benefit when pictures are sent as it provides clear evidence of the problem. It allows the appropriate safety information to be passed onto the person at the location and it also enables the correct team and number of people to be deployed to resolve the fault.

Power Tack has been a finalist in industry awards such as The Electrical Industry Awards, Electrical App of the Year and Institute of Customer Service finalist in effective use of innovation category (March 2019).

3.2 Exploiting power electronics to resolve network constraints

SHEPD has made significant progress in the ‘11kV power electronics providing reactive compensation for voltage control’ project. This project is trialling an American Superconductor (AMSC) device called D-VAR VVO. This 1MVA 15kV device uses power electronics to provide both inductive and capacitive step-free reactive power. It is shunt-connected at 11kV with no need for transformers and has no moving parts such as forced cooling system or batteries thereby making it largely maintenance-free. Due to this, the device can be used in place of step voltage regulators on circuits with intermittent loads or distributed generation. This technology has not been used at 11kV before and there was a need to prove the concept offline before installation in an operational environment. The electrical performance and

Supervisory Control and Data Acquisition (SCADA) integration tests carried out on the device at Power Networks Demonstration Centre (PNDC) demonstrated that the device meets operational standards and can be deployed to mitigate power quality issues on the network.

The results of the D-VAR VVO testing have made it possible to complete the first installation on the Isle of Lewis. The installation was necessitated by a long-standing constraint on a community-owned wind farm. After installation and commissioning, the constraint on the wind farm which was affecting its output was lifted. The ongoing monitoring shows that the device is still in conformance with operational specifications. In addition, the design of the mounting structure for the device has generated learning about the safest and most optimal approach to installing similar devices on 11kV line types commonly found in GB. With the learning so far generated, peer network licensees could replicate the approach taken by SHEPD to mitigate voltage constraints in a like-for-like application scenario. More application scenarios, as stated in the registration document, will be covered as the project progresses. For detailed technical information about what has been learnt to date, SSEN Future Networks can be contacted on the details provided at the end of this summary.

4 Further Information

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

2015 Distribution Innovation Strategy

Innovation Strategy Update published in March 2016

2016 Distribution Innovation Strategy Update

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

ENA Smarter Networks Portal – SSEN Projects

5 Contact Details

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