Distribution

Network Innovation Allowance Summary Report

1 April 2019 to 31 March 2020

Scottish & Southern
Electricity Networks

Contents

Foreword

Scottish & Southern Electricity Networks

This report presents a summary of all Network Innovation Allowance (NIA) activities carried out in Scottish and Southern Electric Networks' (SSEN) licence areas: Scottish Hydro Electric Power Distribution (SHEPD) in the North of Scotland and Southern Electric Power Distribution (SEPD) in the South of England during the period between 1 April 2019 and 31 March 2020.
Our current portfolio consists of 22 NIA projects, 16 of which we are leading and six led by other Distribution Network Operators (DNOs). These are intended to drive innovation across a range of challenges associated with transitioning to a low carbon network, whilst continuing to look at innovations that will improve efficiency and maintain network reliability to reduce costs and improve customer service. We are also committed to creating a more flexible, cost effective and secure electricity network, which adopts and responds to our stakeholders' needs, whilst supporting the delivery of the UK's net zero carbon targets.

It is important that we continue to bring benefits to our customers and stakeholders by converting the learning from our innovation portfolio to Business as Usual (BaU). We expect to report over £40m benefits this year. Notably in the last year this included SSEN placing our first economically viable Constraint Managed Zone (CMZ) contracts, for a total of 6MW worth of services on the Isle of Islay. The CMZ deployment draws on learning from a number of projects in our NIA portfolio. Further CMZs are planned across both our north and south licence areas, with approximately ten more planned in 2020/21.

This year we have seen an increased uptake of Electric Vehicles (EV) and have entered into a Strategic EV Partnership with the Scottish Government. As part of the EV Partnership we launched the E-Tourism project to explore potential seasonal and geographical network challenges, resulting from increased numbers of tourists driving EVs.

The shift towards a low carbon economy also continues to promote growth in the connection of distributed energy resources (DER) such as renewable generation sources and large-scale batteries. To better manage the seamless integration of these disparate systems, SSEN, in keeping with other DNOs, is transitioning towards a Distribution System Operator (DSO) model which will transform the way we operate. To understand and de-risk the transition to the DSO we have launched two projects; MERLIN, which will test the economic impact of a variety of flexibility scenarios of a future DSO world, and TraDER, which is is a small-scale trial of a new financial market concept aimed at enhanced co-ordination of DER. These two projects will help inform our flagship DSO projects: **TRANSITION** and **LEO,** which will help inform our RIIO ED2 plan and de-risk our transition to DSO.

Within SEPD and SHEPD, one of the measures of innovation success is to take project learning and translate it into BaU. As an example this year we introduced documentation and processes following the Social Constraint Managed Zone (SCMZ) project; whereby suppliers of all shapes and sizes, including community groups, delivering anything from battery storage to energy efficiency in customers' homes, can offer flexible services to the network within identified regions in return for commercial rewards.

Innovation is never 'done'. In the year ahead we will continue to engage with our stakeholders and collaborate with interested parties in the energy supply chain, academia and authorities, to ensure our innovation efforts can deliver the best possible value to the communities we serve.

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

1 Our Strategy and Priorities 2019/20

Distribution Innovation Strategy

Our innovation strategy aligns with the six RIIO-ED1 primary outputs and along with stakeholder input, the commitments we have made acts as the screening criteria for potential innovation projects. In this document the RIIO-ED1 primary outputs will be referred to as innovation focus areas and are as follows:

- Connections
- Customer Service and Social Obligation Priorities
- Environment
- Reliability
- Safety

We have combined Customer Service and Social Obligation as they are very closely related. Within Section 1, we have set out details of our strategy and priorities for 2019/20, linked to each of the regulatory outputs for RIIO-ED1 innovation focus areas. Each innovation focus area contains further details on specific aspects we have targeted to ensure we are addressing stakeholder needs, priorities and delivering value. We have also created an icon to pictorially represent each of the innovation focus areas.

Connections

During 2019/20 our engagement work has shown that there is a clear demand from our stakeholders for more flexible connection solutions and improved understanding of the network impacts relating to use of EV's and other Low Carbon Technologies. We also focused on reduction of the connection timescales and have made a number of flexible solutions available for our generation customers via our website and in addition we have enabled opportunities for customers to become involved in provision of flexibility services. We also need to be better informed and prepared for the energy system transition and our NIA portfolio is a vital element of this, for example our E-Tourism project explores the network expansion challenges associated with EV charging points, which may arise from large volumes of electric vehicles being driven by tourists in the north of Scotland.

Customer Service and Social Obligation Priorities

During 2019/20, reducing customer interruptions on our LV Network remained one of the ways we improved customer service. An example of this is our LV Underground Fault Location Technologies project (LVUFLT), which explored the potential to use well proven HV Fault finding acoustic equipment in an LV environment. This will lead to more accurate fault location, benefitting customers by restoring supplies quicker with less disruption. The objective of the project is to establish the technical and commercial viability of these techniques, as part of our wider portfolio of established LV fault location technologies. Beyond this, our Social CMZ project has specifically looked at providing a means for communities to become involved in the emerging flexibility markets.

Environment

Throughout 2019/20 we have continually looked at ways in which we can operate whilst minimising our impact on the surrounding environment and support the transition to Net Zero. NIA has been employed by SSEN to reduce the environmental footprint of our activities in a number of innovative ways. The most recent example of this can be seen in our Feasibility of Utilising Compressed Dry Air in 33kV Insulated Switchgear project. The learning from the project will help inform our future approach to reducing the use of SF_6 on our 33kV network.

Reliability

During 2019/20 improving network reliability has been an essential element of our innovation portfolio. As an example, our Informed Lightning Protection project is developing a 'point in time' lightning analysis tool that will identify the optimal location for lightning protection equipment. When deployed, this solution will reduce the number of supply interruptions caused by lightning related faults on our network. In addition, remote areas of our network have seen a growth in the connection of distributed generation which can adversely impact power quality. The installation of the 11kV Power Electronics project has demonstrated the ability to manage power flows to maintain the quality of supply for our customers.

Safety

Keeping our people, our customers and our communities safe is our number one priority. During 2019/20 this was reflected within our NIA portfolio with projects such as the Smart Hammer project, which is developing a hand-held tool which evaluates the internal condition of wood poles to ensure they are safe for the surrounding community and also safe for staff to climb when carrying out work. Similarly, our SUBsense project uses advanced fibre optic technology to monitor our submarine cables, notifying us of any interference with our equipment that could pose a risk to other marine users or result in subsequent failure.

2
Innovation benefits

Our Innovation portfolio continues to deliver benefits across all areas of our business. To date, in RIIO-ED1 we have invested over £12.9m of NIA Funding in around 45 projects covering a wide range of topics. In the same period, we expect to report over £40m benefits this year (as will be outlined in our 2020 Regulatory Reporting Pack submission to Ofgem) from the deployment of innovations. This is based on a combination of improved efficiency and capital deferral and will ultimately produce benefits for customers through lower total expenditure (TotEx) and bills. We will continue the roll out of solutions for the remainder of RIIO-ED1, with further deployments already in progress to ensure that we continue to deliver benefits for our customers.

We have continued to develop our portfolio in an incremental and structured manner building on earlier work, engaging more closely with a broader range of stakeholders to create the flexibility to address new and emerging challenges and to better prepare for a wider range of potential future network scenarios, especially around the adoption of Low Carbon Technologies (LCTs) and the transition to DSO. At the same time, we continue to progress projects from innovation to BaU to increase the efficiency and resilience of our network and improve customer service.

The majority of these projects were co-created with our stakeholders and have been scoped to ensure that we include their needs; these stakeholders cover a wide spectrum of organisations ranging from local communities to government. For example, Project Modelling the Economic Reaction Linking Individual Networks (MERLIN) seeks to solve the problem of managing the variable value of services in a smarter energy system and has received approximately £1m funding from the Department of Business, Energy and Industrial Strategy's Power Forward Challenge. The project brings together industry specialist Opus One Solutions, Open Grid Systems, University of Cambridge and Hydro Ottawa.

Innovation Deployment – throughout RIIO-ED1 we have deployed innovations to improve quality of service and network resilience with ongoing use of devices such as Bydong and thermal cameras. Notably, in 2019/20 we continued to develop our use of Flexibility with SSEN placing its first BaU funded Constraint Managed Zone (CMZ) contracts, for a total of 6MW worth of services on the Isle of Islay. Further CMZ deployments are planned during 2020/21 in up to ten locations across our north and south licence areas. Additionally, we have:

- expanded our deployment of secondary substation monitoring, and are on track to have 3,650 feeders equipped with monitoring devices by the end of 2020/21;
- added to our fleet of hybrid generators with five units now being utilised across our southern licence areas to support vulnerable customers during unplanned interruptions;
- further embedded the use of new supply restoration techniques like Bydong and Toucan in our day to day operations; and
- utilised Live Line harvesting and forestry mulchers to reduce the overall cost of our vegetation management activities.

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Net Zero/Energy System Transition – in August 2019, SSEN joined with Scottish Government, Transport Scotland and SP Energy Networks to form a £7.5m strategic partnership to facilitate EV infrastructure in Scotland. As an example, SSEN will be working in the north of Scotland examining what electricity network infrastructure will be needed to support the increasing number of tourists expected to be using EVs. Infrastructure needed for new charging points along the route of the first-of-its-kind Electric A9 will also be identified and mapped.

Additionally, we commissioned a report from Grid Edge Policy, entitled "An Electric Heat Pathway" which examines the opportunities presented by the control, operation and use of domestic electric storage heating as a viable alternative to heat pump technology and as a valuable tool to help achieve the UK's carbon target.

The knowledge gained from our portfolio has helped SSEN and the wider industry to deliver real benefits in RIIO-ED1 and become better prepared for the transition to DSO and a wide range of future energy scenarios, particularly associated with the low carbon future and enabling the country to meet its Net Zero Targets. The outcomes and learning from our portfolio will also help inform and develop our emerging plans for RIIO-ED2 by improving our understanding of the impact of decarbonisation via projects such as E-Tourism and Electric Heat Pathway, and also by providing a wider range of options for network investment and operation.

Our portfolio also contains a range of projects which will improve network efficiency and resilience, and bring financial, environmental and safety benefits. Projects like Informed Lightning Protection will help to avoid unplanned outages caused by lightning damage, by better informing the location of preventative equipment. Similarly, our Low Voltage Underground Fault Location Technologies project will build on earlier deployments of fault location tools such as Toucan to further reduce the customer impact and associated disruption from outages due to faults on the LV network. SSEN actively participates in wider industry initiatives such as Open Networks and works closely with other network licensees to maximise the efficiency and effectiveness of our innovation portfolio. We engage in a number of collaborative projects such as UKPN's Optimise Prime project, which is looking at the network impact of the electrification of fleet vehicles, and the WPD-led Wildlife Protection project, which is looking to develop a risk assessment based methodology for the implementation of wildlife protection measures and also reviewing international best practice to identify a wider range of potential interventions.

3 Summary of progress

Up to the year ending 31 March 2020, there were 22 projects funded under SEPD and SHEPD Network Innovation Allowance (NIA). Of these, 16 projects were led by us and the remaining six were managed by our collaboration partners. Over the year, three of our NIA projects have been successfully completed and ten new projects have been registered.

Each project accumulates knowledge and learning which aligns with one or more innovation focus areas as outlined in Section 1. The appropriate innovation focus area is denoted via the inclusion of its icon.

Connections

Customer Service and Social Obligation Priorities

Environment

Reliability

Safety

3.1 NIA_SSEPD_0020 Overhead Line Vibration Monitoring System (CNI Guard)

Key activities

This is a follow on from a previously funded project Overhead Line Monitor, that in-situ can differentiate between natural everyday overhead line movement and unusual/significant disturbances. The concept was developed in the field with a daisy chain-type onward communication medium. The overhead line unit was self-powering with low energy signal requirements. This monitoring system was specifically designed as an additional community safety measure in remote rural parts of the network in the event of accidental contact with the overhead line circuit.

Expected outcomes

The project's aim was to trigger notifications of line and pole disturbance in a robust and reliable way, therefore increasing accuracy in fault location. There was the additional requirement that the overhead line vibration monitoring system needed to demonstrate that its output could be incorporated into the Control Room to aid visibility of the network and provide information on the likely type of fault, reducing the length of the unplanned outage for customers.

Progress

The project was trialled in the field and the unusual movement notifications were successfully relayed and recorded in the SSEN data historian and viewable by the control room. The successful element of this project was the ability of the field mounted device to differentiate between normal and abnormal movement. Where the trialled solution had limitations was in the communication medium selected, as a large volume of infrastructure was required to relay the information.

Innovation Focus Areas

Funding
£300,000

Start/end date
November 2015 / November 2019

Website
https://www.smarternetworks.org/project/nia_ssepd_0020

3.2 NIA_SSEPD_0025 Applied Integrated Vegetation Management (IVM)

Key activities

The project addressed the problem of trees in the vicinity of overhead electricity lines, whilst also ensuring that regulatory standards were met. This project investigated the use of integrated vegetation management (IVM). This is the practice of promoting desirable, stable, low-growing plant communities that will resist the invasion of tall-growing species through the use of appropriate, environmentally sound, and cost-effective control methods. Tall-growing species are often the cause of supply interruptions during high winds as they touch overhead lines, reducing these will increase system reliability.

Expected outcomes

Financial savings were anticipated due to the reduction in using cost-intensive mulching methods. Environmental benefits were anticipated increasing the variety of flora and fauna. This project also avoids the risk associated with using large scale agricultural machinery in inaccessible locations.

Progress

Over the duration of the project the selected IVM approach required regular site maintenance visits, with the aim of establishing low to medium height bushes which would prevent fast growing trees. Positively the annual flora analysis showed the IVM was achieving the aim of more low-level vegetation. This year the benefits around the IVM were revisited to establish if the approach was still cost-effective. It was concluded that the SSEN tree cutting department had modernised their approaches to vegetation management, adopting elements of the IVM with much lower requirements for regular site maintenance, therefore following the findings the decision was taken to conclude the project earlier than planned.

Innovation Focus Areas

Funding
£187,759

Start/end date
January 2016 / July 2019

Website
https://www.smarternetworks.org/project/nia_ssepd_0025

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

Key activities

The aim of the project is to demonstrate that a new power electronic reactive compensation unit can be deployed across a range of locations and to deal with a range of potential voltage problems.

Expected outcomes

Power quality monitoring will be carried out at each site before and after installation, to ensure that harmonic emissions are within acceptable limits. Improving power quality will reduce the number of electrical interruptions to our customers, whilst also having the potential to increase output capacity from solar and small scale wind generation connections. The 11kV Power Electronics can also reduce rapid voltage changes which frequently cause customer complaints associated with flickering lights. Where the units are installed our customers should see improvements in their quality of supply. The ability to harmonise the network, limiting voltage and current fluctuation, reducing wear and tear on electrical equipment and keeping SSEN employees safe whilst working in the field.

Progress

Following initial testing and investigation of the devices at the Power Network Distribution Centre (PNDC), one 11kV DVAR Unit was installed at a wind turbine site at Shawbost on the Isle of Lewis to specifically address customer complaints associated with voltage quality. Progress to date shows that the new units have reliably improved the voltage profile seen by our customers both in terms of absolute voltage, and the magnitude of apparent voltage changes.

Funding
£732,000

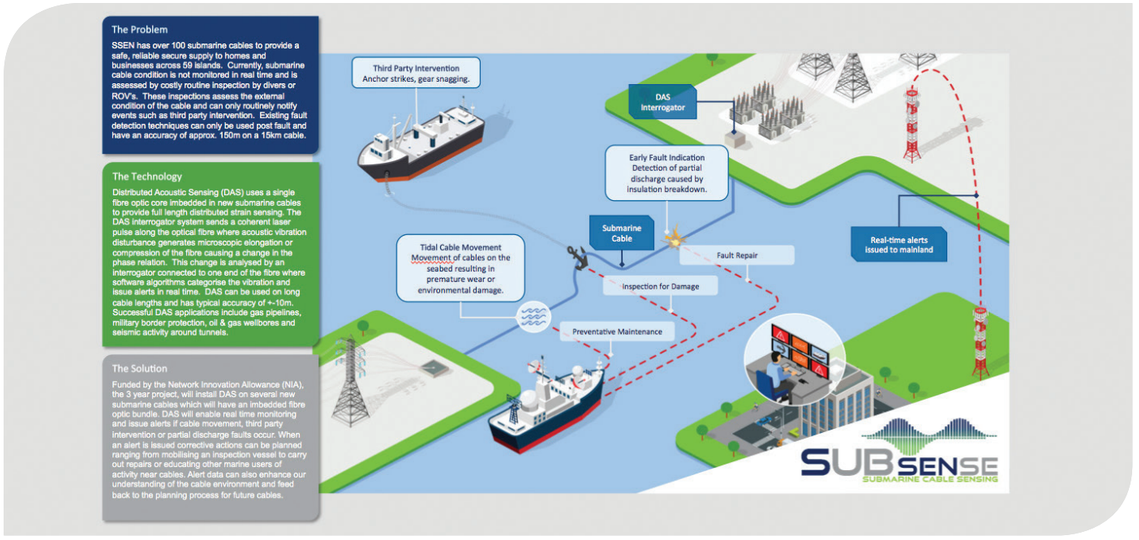
Start/end date
June 2016 / September 2020

Website
https://www.smarternetworks.org/project/nia_ssepd_0029

Innovation Focus Areas

- Connections
- Customer Service and Social Obligation Priorities
- Environment
- Reliability
- Safety

3.4 NIA_SSEN_0034 SubSense



Key activities

The project aims to install a real time monitoring system utilising Distributed Acoustic Sensing (DAS) on several new subsea cables. The DAS system will utilise the single mode fibre optics embedded within the cable. A DAS interrogator unit connects 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. The backscatter observations detect minute cable strains induced by acoustic events, which when passed through to a processing unit can provide interpretations and visualisation of the signal.

Expected outcomes

Real time monitoring of submarine cables will give SSEN a greater understanding of the conditions in which our cables operate and proactively manage mechanical wear and tear of the cable, thus preventing associated lost or interrupted supplies. This monitoring will notify us when there is an immediate concern to the health of the submarine cable or safety of nearby marine users. Submarine cables are one of the costliest assets within the Distribution network and currently command the highest Asset Health Points per unit in the Common Network Asset Indices Methodology (CNAIM). Being able to identify a fault location in real time will allow us to carry out repairs quickly and effectively, before they pose a potential risk to other marine users.

Progress

Communications testing and system integration of the DAS systems have been completed. The DAS systems will be rolled out to the remote test locations in 2020/21.

Funding
£1,458,218

Start/end date
August 2018 / August 2021

Website
https://www.subsense.co.uk

Innovation Focus Areas

- Connections
- Customer Service and Social Obligation Priorities
- Environment
- Reliability
- Safety

3.5 NIA_SSEN_0035 Informed Lightning Protection

Key activities

Lightning strikes are known to cause a significant number of supply interruptions to our customers and damage to the network which is costly to resolve. In our Scottish Network, lightning strikes are the second highest cause of customer interruptions and minutes lost, whilst in our Southern Network it is the fifth highest cause. Therefore, avoiding the impact that unplanned outages have on our customers is an important issue for SSEN.

Expected outcomes

This project aims to develop a 'point in time' lightning analysis tool that can be used to locate the optimal location for lightning protection equipment. Following on from the identification of the best place for lightning protection, current surge arresters will be installed with the aim of reducing electricity interruptions and network damage caused by lightning. Then the monitoring and analysis phase will begin using fault data to confirm effectiveness of lightning protection.

Progress

The data analytics phase of the project has successfully completed. It has been possible to identify a number of locations that are suitable for the installation of surge arresters which will protect the circuit against a lightning strike.

Innovation Focus Areas

- Connections
- **Customer Service and Social Obligation Priorities**
- Environment
- **Reliability**
- Safety

Funding
£521,000

Start/end date
March 2019 / March 2023

Website
https://www.smarternetworks.org/project/nia_ssen_0035

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3.6 NIA_SSEN_0036 Social Constrained Managed Zones (CMZs)

Key activities

This project was initiated to test the appetite for small scale community led initiatives to participate in electrical constraint managed zones (CMZs), with the goal of influencing the area's electrical usage profile, potentially increasing the viability of local community renewable projects which will help progress towards net zero.

Expected outcomes

The project's aim was to reduce the barriers to participation in the CMZ process for smaller community groups by producing documentation that will aid their understanding of the process and requirements of the Social CMZ process. It also provided direct support to interested community groups in the two selected areas, through seed funding and/or consultant support.

Progress

This project successfully demonstrated that small scale community groups are interested in exploring how they can change their electrical energy usage to positively influence their communities. There was a higher than expected uptake for support to investigate in more detail how individually the small community ventures could help influence electrical usage and prepare their concepts for the initial project prequalification questionnaire (PPQ) stage. Positively, two ideas were formally presented at the PPQ stage. One of the projects then progressed to the tendering phase and internally investigations are underway to progress the suggestion further. Based on the interaction with the small community groups the necessary supporting documentation has been developed to encourage future engagement when a CMZ area is identified. The learning from this project has been included in our future CMZ tenders process.

Innovation Focus Areas

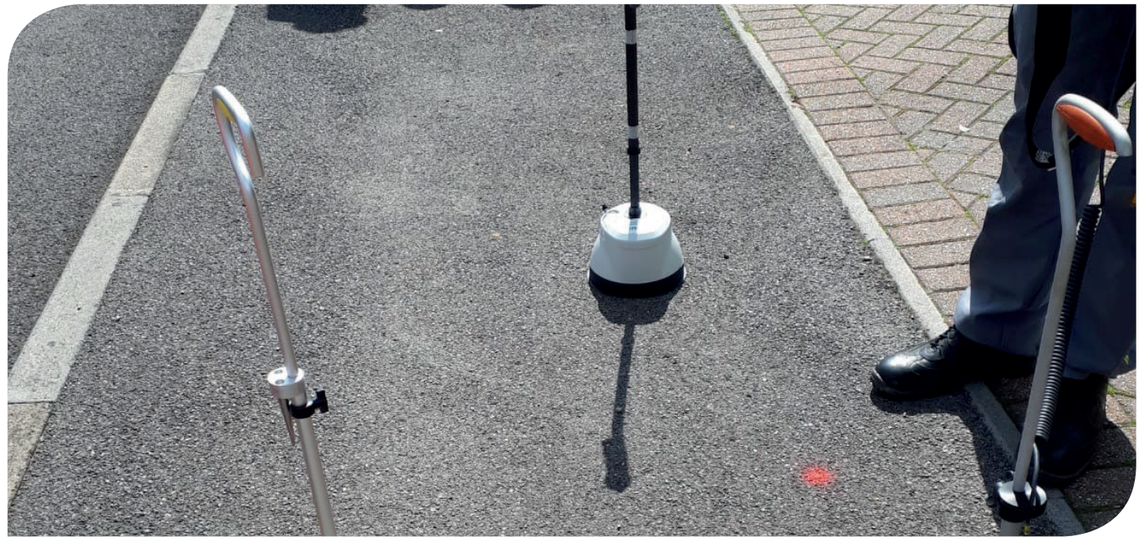
- Connections
- **Customer Service and Social Obligation Priorities**
- **Environment**
- Reliability
- Safety

Funding
£190,000

Start/end date
March 2019 / December 2019

Website
https://www.smarternetworks.org/project/nia_ssen_0036

3.7 NIA_SSEN_0037 LV Underground Fault Location Technologies



Key activities

The project looks to improve the accuracy of low voltage fault location techniques, reducing repair times and shortening outages for our customers. Firstly, a range of acoustic devices and fault passage indicators (FPIs) will be trialled on a test network. The most successful devices will be passed on to the field teams for trialling.

Expected outcomes

This project will establish the technical and commercial viability of a selection of acoustic cable fault location devices and fault passage indicators that can work in conjunction with existing proven LV fault location technologies. It will also look to maximise the portfolio of technologies available for LV fault location and make recommendations for optimal adoption of the suitable devices for business as usual use. Environmentally, being able to more accurately pinpoint an underground cable fault reduces the number of excavations and volume of spoil.

Progress to date

Successful test network trials identified the most technically capable devices, which have been passed to a selection of field teams in both licence areas. As teams cover different network topographies and cable types this was a significant field test of the LV detection tools. Data from the field is being collected, analysed and compared with historical records to establish if there are quantifiable improvements in fault location. In addition, the practical opportunities or challenges of deploying these devices in a real operational environment will be assessed.

Innovation Focus Areas

- Connections
- **Customer Service and Social Obligation Priorities**
- **Environment**
- **Reliability**
- Safety

Funding
£396,000

Start/end date
June 2019 / December 2020

Website
https://www.smarternetworks.org/project/nia_ssen_0037

3.8 NIA_SSEN_0038 E-Tourism

Key activities

The Scottish Government plans to phase out petrol and diesel vehicles by 2032, eight years ahead of the rest of the UK. This project, in partnership with the Scottish Government and other key players, aims to identity how best to plan for electric vehicles (EV) at known tourist spots.

Expected outcomes

This project aims to understand how increased EV uptake combined with tourist behaviour will impact on seasonal peak electric demand on the network. It will also identify the scale, location and duration of any increased charging demand for the North of Scotland followed by an in-depth study of specific locations. It will look to enhance stakeholder engagement by helping local community groups, local authorities and other organisations to understand the impact that heightened EV tourism will have on local demand. It will also inform investment strategies for network development based on expected impacts of EV uptake and tourist patterns, thus co-ordinating future network capacity efficiently.

Progress to date

This project is being progressed as part of the Electric Vehicle (EV) Strategic Partnership with Scottish Government, Transport Scotland, SPEN and SSEN. Initial meetings have selected eight tourist locations. Work is under way to develop future electrical vehicle use trends and the associated electrical network reinforcements.

Innovation Focus Areas

- **Connections**
- **Customer Service and Social Obligation Priorities**
- **Environment**
- Reliability
- Safety

Funding
£410,000

Start/end date
July 2019 / September 2022

Website
https://www.smarternetworks.org/project/nia_ssen_0038

3.9 NIA_SSEN_0039 Electric Heat Pathway

Key activities

In the ongoing debate about future energy policy, it appears there has been a presumption of any electrified heat pathway being based around the use of heat pumps. Therefore, it is deemed essential to establish a pragmatic solution to the immediate problem of Radio Teleswitching System (RTS) switch-off and a long-term model which will allow electric storage heating to play an appropriate role in heat decarbonisation and the shift to a smart, flexible electricity system.

Expected outcomes

The anticipated report produced as part of this project will look to stimulate public debate on storage heating while providing a better understanding of the opportunities and benefits of flexible heating demand and how best to implement them. It is also expected to influence internal policy changes within SSEN and to lobby for change at a wider industry level.

Progress

The report has been produced, which has enabled SSEN to hold two external webinars which were extremely well attended to share the findings. The knowledge sharing sessions were:

1. Storage Heaters – The Cinderella solution in the heat decarbonisation debate

2. An Electric Heat Pathway: Looking Beyond Heat Pumps

Internally, it is currently being considered how we move forward with the recommendations within the report. It will feed positively into the RIIO-ED2 planning, generating and supporting other innovation projects.

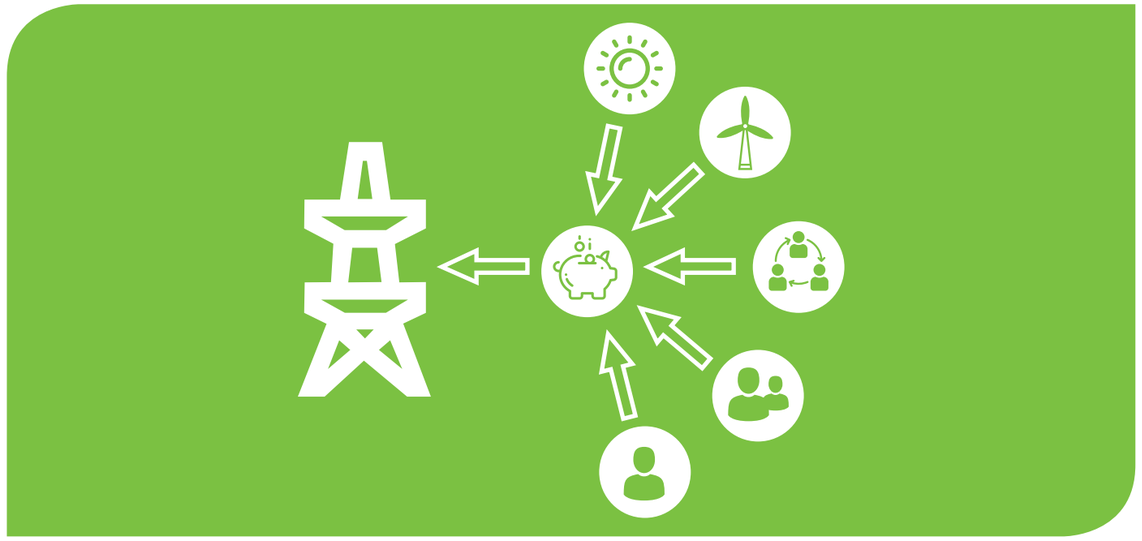
Innovation Focus Areas

Funding
£33,400

Start/end date
October 2019 / April 2020

Website
https://www.smarternetworks.org/project/nia_ssen_0039

3.10 NIA_SSEN_0040 Technical Interfaces to Scale as a DSO



Key activities

This project will determine the requirements to safely and securely communicate with customers' end point devices, such as small generation connections, to enable more flexible connections and flexibility services at a smaller scale and a lower cost. Initially, investigation will occur into into existing international communication protocols and interface devices that could be used for distributed energy resource management. A subset of the protocols and devices identified will be assessed within laboratory-based trials.

Expected outcomes

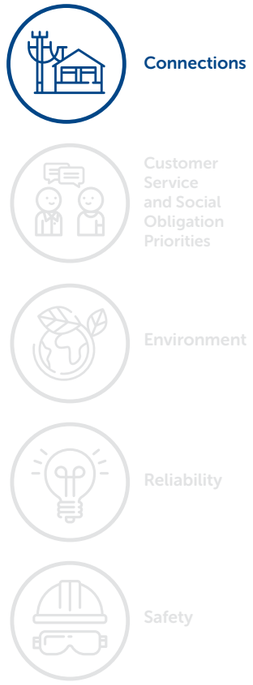
A key outcome of this project is the creation of a technical specification of requirements around communication with customers' end point devices, alternatively known as Technical Interfaces, that can be used by the electricity industry.

The trial aims to assess things such as the readiness of the selected protocols and devices for DSO applications, the compatibility of these interfaces with our existing systems and the cyber security implications of using these interfaces.

Progress

Progress has been made with an initial workshop between all stakeholders. Decisions were made on how to progress the project, namely the types of customer end point devices to be considered and key protocols to be investigated.

Innovation Focus Areas



Funding
£378,000

Start/end date
September 2019 / September 2021

Website
https://www.smarternetworks.org/project/nia_ssen_0040

3.11 NIA_SSEN_0041 Merlin

Key activities

The project is testing the economic impact that a variety of flexibility scenarios could have in a future DSO world. The objective is to inform the wider DSO work that is ongoing, especially the TRANSITION and LEO projects.

Expected outcomes

The project will create a requirements document detailing the functionality of a financial management tool (FMT) that can be used to monitor the financial health of flexibility contracts. It will improve the 11kV network design process by providing insight into automation through Common Information Models (CIM). The impact of various flexibility valuation methods will also be investigated. It will also inform the wider DSO community of the economic impacts associated with flexible services. It then looks to inform the wider DSO community of when to engage in short/long/spot-market contracts. In addition, the learning from MERLIN will help inform future flexible connection options.

Progress

The project is currently in the early stages, with progress being made on collecting the necessary network model data.

Innovation Focus Areas

- **Connections**
- Customer Service and Social Obligation Priorities
- Environment
- Reliability
- Safety

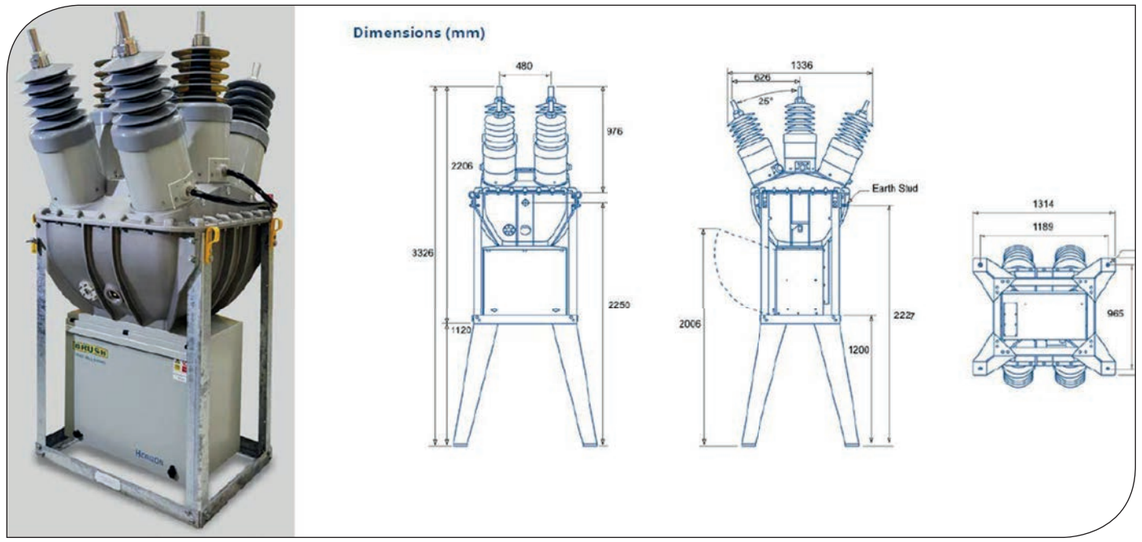
Funding
£338,600

Start/end date
October 2019 / April 2021

Website
https://www.smarternetworks.org/project/nia_ssen_0041

Scottish & Southern Electricity Networks

3.12 NIA_SSEN_0042 Feasibility of Utilising Compressed Dry Air in 33kV Insulated Switchgear



Key activities

The environmental impact of Sulphur Hexafluoride (SF_6) means that its use in the industry is becoming increasingly regulated and restricted. SSEN has more than 10,000 items of switchgear that utilise SF_6 for both insulation and arc interruption. There are a variety of environmental implications associated with managing equipment containing SF_6. This project will determine the viability of utilising dry air as an SF_6 alternative.

Expected outcomes

This project will produce an appraising report of new SF_6-free switchgear technologies, inclusive of risk assessments, training requirements, operation and maintenance requirements, ensuring that any alternative is both safe for our staff to operate and maintains network integrity. The report will form part of the road map to deliver SF_6-free Switchgear into business as usual thus aiding the reduction in our operational Carbon Footprint.

Progress

Threepwood have been appointed to carry out the Desktop Study on behalf of SSEN and have had a very positive response from manufacturers. The next phase is to review the responses and to compile the report detailing the feasibility of utilising compressed dry air as an alternative to SF_6.

Innovation Focus Areas

- Connections
- Customer Service and Social Obligation Priorities
- **Environment**
- Reliability
- **Safety**

Funding
£66,700

Start/end date
December 2019 / June 2020

Website
https://www.smarternetworks.org/project/nia_ssen_0042

3.13 NIA_SSEN_0043 Whole System Growth Scenario Modelling (Stage 2)

Key activities

To allow GB to efficiently achieve its low carbon ambitions, a holistic whole system approach is required involving key external stakeholders as well as other energy vectors such as gas. There is a wider awareness of the climate emergency, which has resulted in national, regional and local government bodies beginning to set strict targets to reduce to net zero greenhouse gas emissions to net zero. Many of these targets rely on electrification of heat and transport. Individual local authorities are beginning to create their own strategies for low carbon technologies, e.g. electric vehicles and heat, as well as detailed local energy strategies. This project is a partnership to help explore the range of whole system growth scenarios to both achieve net zero whilst facilitating the economic development plans of the local area.

Expected outcomes

This project will develop a methodology to improve coordination between local energy planning and network development, enabling the Distribution Network Operator (DNO) to engage with local authorities in a structured way. As part of that methodology the project will refine the initial model tool developed in the first stage of the NIA project to produce a local energy network model which will allow stakeholder information to be easily incorporated into network planning and for stakeholders to better understand the network implications of their decisions.

Progress

A project tender is under way to appoint an energy consultant to understand the requirements and data expected to be produced (which could feed into the methodology) for Local Heat and Energy Efficiency Strategies.

Innovation Focus Areas

- **Connections**
- Customer Service and Social Obligation Priorities
- **Environment**
- Reliability
-

Funding
£343,000

Start/end date
January 2020 / July 2021

Website
https://www.smarternetworks.org/project/nia_ssen_0043

Scottish & Southern Electricity Networks

3.14 NIA_SSEN_0044 Smart Hammer

Key activities

The development of a Smart Hammer to identify the condition of a wood pole. The project will progress from factory testing to small sample field tests. To ensure a challenging test environment the field trials will take place across the SSEN Operational Regions.

Expected outcomes

The project's aim is to establish the technical and commercial viability of using a Smart Hammer, with accurate and repeatable results to help detect internal rot or damage to wooden poles. It aims to identify if the Smart Hammer is a consistent and reliable alternative to wood pole inspections, through evaluating its efficiency and accuracy in identifying poles that need secondary testing. Earlier detection of a deteriorating pole will enable proactive replacement, preventing unplanned electric interruptions due to broken poles thus improving system reliability. The Smart Hammer also has the potential to be used by our field staff to more accurately assess the safety risk before climbing a pole.

Progress

This Project has only just started and we are currently at the stage of developing the X-Model Smart Hammer.

Innovation Focus Areas

- Connections
- Customer Service and Social Obligation Priorities
- Environment
- **Reliability**
- **Safety**

Funding
£498,200

Start/end date
February 2020 / October 2021

Website
https://www.smarternetworks.org/project/nia_ssen_0044

3.15 NIA_SSEN_0045 Future Fiscal Forecasting

Key activities

This project will look to implement a new forecasting model from USA, to help inform future solutions across SSEN and the wider industry. The project will use GB Settlements sourced 'fiscal' metering information, in combination with SCADA data and weather data to:

- Forecast energy consumption for a Distribution Service Area (DSA) and disaggregate this into the corresponding Grid Supply Points (GSPs) i.e. the SEPD DSA and 18 GSPs; and
- Forecast energy consumption for a sample of HV feeders with a high uptake of demand or generation (two generation dominated, and two demand dominated).

Expected outcomes

It will assess the availability and suitability of current and future data sources to identify which could provide more detailed fiscal forecasting of energy volume and evaluate the level of accuracy of the new forecasting model. This project has the potential to help the energy fuel mix, promoting net zero opportunities.

Progress

This project has started with the initial data sharing between SSEN and the USA forecasting model developer. This information is currently being analysed for implementation into their platform.

Innovation Focus Areas

Connections

Customer Service and Social Obligation Priorities

Environment

Reliability

Safety

Funding	Start/end date	Website
£131,500	March 2020 / December 2020	https://www.smarternetworks.org/project/nia_ssen_0045

Scottish & Southern Electricity Networks

3.16 NIA_SSEN_0047 TraDER

Key activities

Project TraDER will both develop and trade, in as near real-time as possible, a distribution constraint product. The solution will integrate this market both horizontally (i.e. with other, longer term Distribution System Operator (DSO) products) and vertically (i.e. other trades within the same time period, such as the Balancing Mechanism). TraDER will provide a platform creating a single access point, making it easier for distributed energy resources to provide valuable services such as balancing, stability, and network capacity. In this way, "whole system value" is maximised by enabling price-driven coordination between Electricity System Operator (ESO), DSO and other market participants.

Expected outcomes

SSEN will act as a facilitator to TraDER by delivering data from the Active Network Management (ANM) system currently operating in Orkney and then facilitating changes to the ANM system in order to execute trades created by the TraDER platform. In return, TraDER will deliver outputs which will allow SSEN to assess the impact of how trades can be implemented on the ANM scheme, e.g., changes to Last In First Out (LIFO) connection order, and associated costs to SSEN. It will also assess the scale of the market to ensure implementation costs can be recovered by SSEN and allow SSEN to assess the preferred Neutral Market Facilitator (NFM) model of 3rd parties.

Progress

This NIA project is in the very early stages having only being registered at the end of March 2020.

Innovation Focus Areas

Connections

Customer Service and Social Obligation Priorities

Environment

Reliability

Safety

Funding	Start/end date	Website
£275,000	March 2020 / June 2021	https://www.smarternetworks.org/project/nia_ssen_0047

4 Highlights of the year: Areas of significant new learning

3.17 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.

Project number	Project title	Lead party
NIA_SPEN_008	Appeal (Wood preservatives)	Scottish Power Energy 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_047	Feeder monitoring to pre-empt faults	UK Power Networks
WPD_NIA_044	Wildlife Protection	Western Power Distribution

4.1 An Electric Heat Pathway: Looking Beyond Heat Pumps

In the UK, net zero targets are set for 2050 (2045 in Scotland) and heat decarbonisation will be key to meeting these ambitions. In addition to improving the thermal efficiency of our homes we need to accelerate the installation of low carbon technologies that reduce our reliance on fossil fuels.

There are lots of opportunities to make changes to the way we heat our homes – more than 23 million homes will be required to install new low-carbon heating solutions – however this rollout needs to consider regional differences such as existing infrastructure, geography and existing housing stock. In the current debate there has been the presumption that any electrified heat pathway is based around the use of heat pumps. However, heat pumps are not the only solution and SSEN is aware they might not be suitable for many of our most vulnerable customers for a range of reasons.

As part of this investigation into alternative electric heat pathways, a report has been produced by Maxine Frerk, of Grid Edge Policy, to stimulate the public debate on storage heating and is available to read here: https://www.ssen.co.uk/InnovationLibrary/Distribution

The report highlights that the electrification of heat brings some challenges for the electricity network; particularly around managing the winter peak load. Therefore, flexibility becomes increasingly important and electrification through heat pump pathways often assumes significant levels of thermal storage to limit strain on the grid. This report recommends that storage heating with smarter controls could offer a suitable solution for many properties where heat pumps are unsuitable due to space, higher upfront costs and home efficiency; for example a heat pump is less efficient for older 'leaky' homes. The report also considers the barriers and challenges relating to appliance, building standards, consumer information, regulation and funding to support the more vulnerable consumers.

The use of storage heating with smart controls and metering is endorsed strongly throughout. However, the report does consider the impacts of the decommissioning of the Radio-teleswitch System in 2021/22 which staggers 'turn-on' scheduling to support distribution system requirements such as load shedding and Load Managed Areas. Both are mainly used in the SSEN remote North of Scotland. Losing the Radio-teleswitching will require SSEN to consider other options for flexibility such as Time of Use tariffs, constraint managed zones, etc.

SSEN has shared the learning generated via this project via two external webinars. Both events were extremely well attended, with positive feedback received. The external event covered the following topics:

- Storage Heaters – The Cinderella solution in the heat decarbonisation debate
- An Electric Heat Pathway: Looking Beyond Heat Pumps

Overall the report presented a range of measures and summarised the challenges to improving electrical heat pathways. Internally the project findings are under discussion to identify how best to progress forward with the recommendations. There is interest growing and it is very likely that several of the project's recommendations will be fed into the ED2 planning, which will in turn generate new innovation projects.

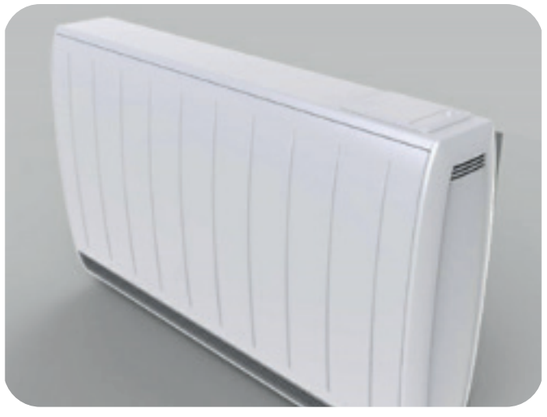


Figure 1. Domestic storage heater

4.2 Supporting the Green Revolution

SSEN's new E-Tourism project is laying out a path to help maximise the green revolution by looking into the future with regard to electric cars and tourism. We are starting to see a significant increase in numbers of Plug-in Electric Vehicles (PEV) nationally. SSEN, as well as other utilities, has a role to ensure that our networks are able to meet growth in demand through the use of local flexibility solutions and investment in electrical network infrastructure. It is really important that the impact PEV has on tourism is discussed now and to that end we are working with stakeholders to anticipate the challenges that occur in the detail of the Low Carbon transition.

This project is being progressed as part of the Electric Vehicle (EV) Strategic Partnership with Scottish Government, Transport Scotland, SPEN and SSEN.

The project has selected a series of eight use cases for PEV associated tourism. The use cases cover both urban and rural visitor attractions, key accommodation stopping points and trunk roads where PEV demand relating to tourism is likely to be recognised first in this sector.

The eight use cases are:

- Uig Ferry Port, Skye which goes to the Outer Hebrides
- Portree, Skye
- The Fairy Pools, Skye
- Dundee City Centre
- Urquhart Castle, Loch Ness
- Some of the A82 (Loch Lomond mostly)
- A9 Perth to Inverness only
- A87 Inverness to Skye

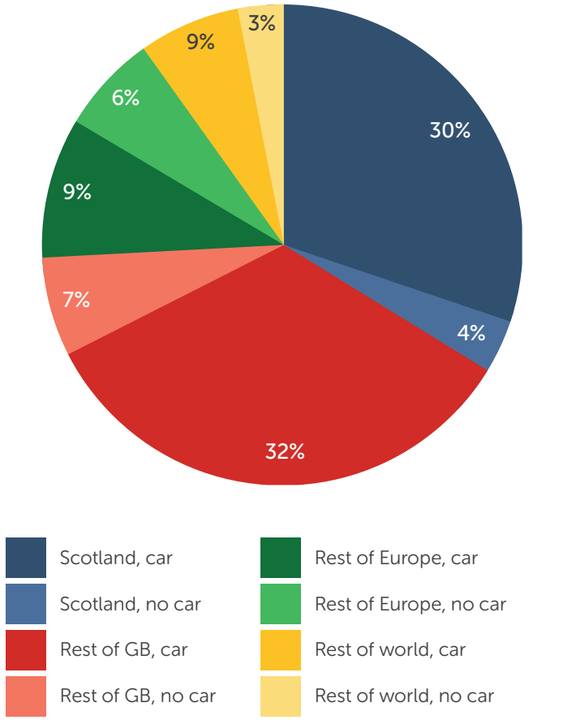


Figure 2. Breakdown of tourist origin countries and car usage

Through stakeholder engagement sessions with Visit Scotland, they confirmed visitor numbers, with data to show number of visitors by country origin and some indication of the mode of transport either car, ferry or plane. This information is very helpful in starting to piece together the importance of cars and how PEV could have an impact the network.

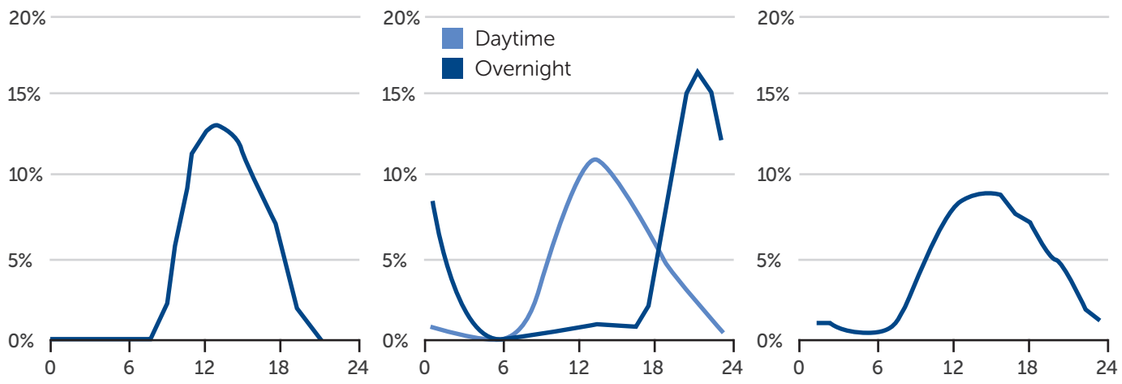
SSEN with the help of Element Energy have worked with Transport Scotland to gather traffic counts, flows and potential origins of vehicles to understand what current traffic flow looks like. This data along with the visitor numbers was assembled to make a series of assumptions around the percentage of car usage and the origin of the visitors. This allows for assumptions to be made on the number of cars going to or through each of the use case locations and the journey distance.

Following on and using the transport models for each of the eight use cases, the project has started to form a picture of daily distance traveled by visitor, energy used for journey, time spent at destination, types of charging per site and the charging required at each site. These assumptions allowed us to form a charging demand profile. Below is a suggested revision but please check to make sure it retains the original intended meaning. For a single attraction it can be based on attraction opening times, destinations which are popular for overnight stays will have a daytime and a nighttime profile, and the routes are based on the traffic flow.

This information starts to unlock the possible PEV charging demand profiles. Work is progressing well looking into each of the eight use cases in more detail, the outcome of which will hopefully be available in the summer of 2020. The project will ensure tourism is not left behind as the world transitions towards greener forms of transport.

Figure 3. Charging demand profiles (normalised to 1 kWh/day) based on use case types

Sites visited during day (Fairy Pools, Urquhart Castle)	Destinations where tourists stay overnight (Portree, Dundee)	Routes (A9, A82, A87)



- Based on opening hours of sites (09:00 – 20:00)
- **Daytime**: most tourist activity assumed between 09:00 and 18:00
- **Overnight**: based on domestic overnight charging profile from a previous study
- Based on analysis of charging events along route

4.3 Breaking down barriers, enhancing community involvement

Social constraint managed zones (SCMZ) has been SSEN's opportunity to test the appetite for small scale community-led initiatives to participate in electrical constraint managed zones (CMZs), with the goal of influencing the area's electrical usage profile.

The concept of Constrained Managed Zones (CMZ) has been developed in the UK. CMZ are geographical areas served by an existing distribution network but with potential needs for network reinforcement in the near future to deal with local capacity constraints. Figure 4 shows a local electrical demand curve which, at peak times, requires more energy that the network can provide (the green area). CMZ schemes look for localised solutions to reduce the energy peak via simulating changes in large customers energy patterns through to the installation of network batteries. In the past this has only been available to large commercial ventures. However, this project's aim was to investigate if smaller community ventures could and would participate.

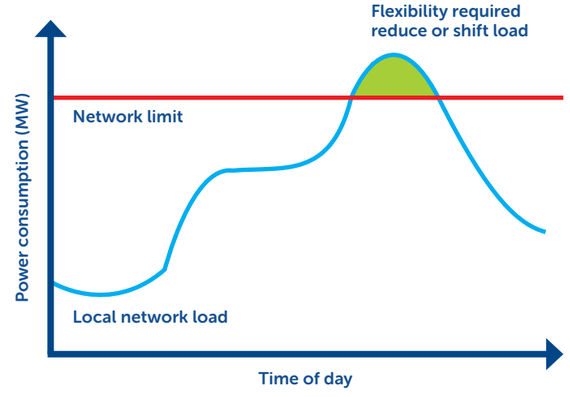


Figure 4. Localised electricity demand curve, highlighting the peak demand which needs to be reduced

Untapped potential of community flex

To investigate the participation of communities in the UK, NEA and SSEN designed a new classification of Social Constraint Management Zone (SCMZ), known as Community Flex, where local organisations are encouraged to develop community-based projects to address local network issues whilst investing in benefitting communities.

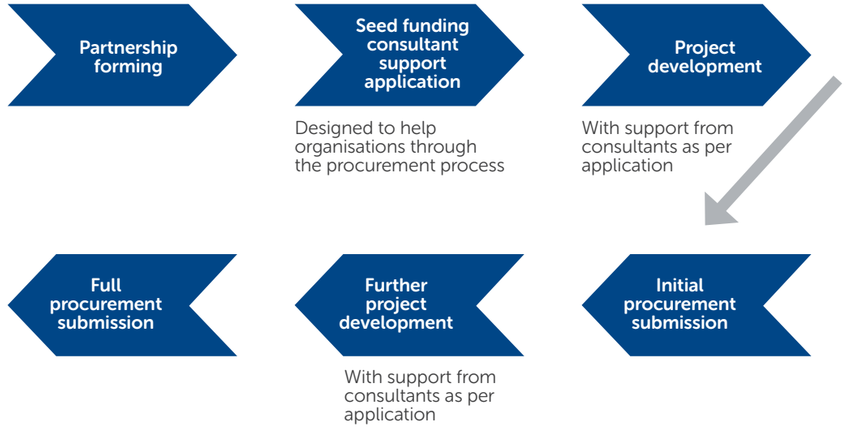
SSEN selected two trial areas Drayton and Coxmoor Wood, in the south of England, and undertook several well-attended stakeholder engagement events. The events explained the benefits of CMZ and addressed the electrical demand challenges which had been identified within the trial areas along with a proposal to support smaller communities. The diagram below shows the support SSEN were able to offer through this project to help the local community ventures to investigate how and if they could respond. The support offered was time with industry experts who would help build out a proposal and navigate the formal application.

A range of local community and residents' groups, local authorities, registered social and private landlords, local businesses and business networks, from both Drayton and Coxmoor Wood, participated in the initial investigation stage to evaluate their solutions. One project, instigated through the SCMZ, has proceeded with an application, which is currently being evaluated for suitability by SSEN.

SSEN expects to integrate SCMZ into its expanding portfolio of congestion management solutions and use it to procure local flexibility, where appropriate, alongside the established CMZ process for large distributed generation providers. To achieve this the barriers for entry will need to be adjusted based on the key learnings from the project:

- As flexibility volumes that can be delivered by community organisations, local businesses and other local providers are typically small, the threshold for participation lowered to 50kW
- The target communities and organisations for participation in SCMZ are often new entrants to (local) flexibility markets, or to the energy sector altogether. To successfully unlock the potential of flexibility, formal requirements for participation should reflect this and a basic level of support during the engagement is highly desirable.
- Contracted flexibility values have been low. To ensure an attractive business case for both flexibility providers and SSEN, the administrative burden of participation should be minimised and a clear path to larger deployments should be identifiable.

The process



5 Further information

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

2015 Distribution Innovation Strategy

http://www.yourfutureenergynetwork.co.uk/12_innovation2014.pdf

Innovation Strategy Update published in March 2016

2016 Distribution Innovation Strategy Update

http://www.yourfutureenergynetwork.co.uk/wp-content/uploads/2016/04/Innovation-Stategy-update-ver-9.pdf

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

ENA Smarter Networks Portal – SSEN Projects

https://www.energynetworks.org/electricity/futures/network-innovation/electricity-networks-innovation-strategy.html

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