SP Energy Networks Distribution and Manweb

NIA Annual Summary 2022-23

SP Energy Networks

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At SP Energy Networks we are committed to enabling the path to Net Zero and a Just Transition that addresses societal impacts from climate change by delivering innovation and transformation in our two license distribution areas (SP Distribution plc and SP Manweb plc).

Facilitating greater generation from renewables, providing power to the heat and transport sectors as they electrify, and freeing up capacity before considering reinforcement are critical areas for our business.

Graham Campbell
Director, Processes and Technology

If you have an idea you would like to discuss with my innovation team or, if you'd like more information on a particular project, please get in touch via: spinnovation@spenergynetworks.co.uk

This bold reimagining of our network is supported by our wide and varied portfolio of industry-leading innovation activities that will deliver positive social change through the low-carbon transition. We have the drive and capabilities needed to meet the challenges we anticipate, and we are determined to undertake this transformation, placing our customers at the heart of our plans. This Annual Distribution Report provides an overview of our Network Innovation Allowance (NIA) innovation projects that were initiated, progressed and completed during 2022-23.

We are passionate about innovation and cultivating new ideas into business improvements that help our customers; ensuring they receive value for money. We are eager to demonstrate how our customer-funded NIA activities deliver on their priorities. As the current RIIO-ED1 period draws to a close, we reflect on an innovation track record that has contributed to £27 million of benefits and a 6% fall in our customer's bills since 2015-16. We have transitioned industry-leading innovative solutions across our ED1 strategic priorities of safety, reliability and availability, environment, connections, and customer service into business as usual.

£27m
of benefits through innovation in RIIO-ED1

Our NIA funding helps us target early opportunities in an agile manner; supporting technology development and improving our practices. This has afforded us the in-house knowledge necessary to lead exciting innovation projects, with support from our delivery partners, which provide direct benefits to our customers and align with the strategic realities of our business. Some key highlights from this year's NIA activities which demonstrate this include:

- Our 'Network Constraint Early Warning System 2' project which improves our understanding of low voltage demand whilst visualising alarms in real-time. This project won an IET E&T silver award for innovation last year and enhances oversight of our low-voltage network; allowing us to release capacity for electric vehicles and distributed generation, benefitting our customers.

- Our 'Real Time Fault Level Monitoring' project developed a proof of concept that demonstrated real-time fault level detection and is now undergoing evaluation for business rollout. This is an important capability for lowering barriers to additional renewable generation on our network.

- The transition into business as usual of our 'SINE Post' project which successfully demonstrated a solution to locate 11kV faults more effectively and provides customer benefits via greater efficiency in our operations and improved network performance.

I am proud of the achievements we have secured thus far and as we enter the RIIO-ED2 period for 2023-28 we will continue to deliver an ambitious and impressive innovation portfolio which realises our Net Zero commitments and addresses whole system challenges. Our ED2 Innovation Strategy focusses on the key areas – of heat and transport electrification, hydrogen, power electronics, and consumer vulnerability – that will get us ready for the future and that we are excited to venture into.

Portfolio Summary

Completed projects **27**

Live projects **24**

Collaborations **15**
— 9 led by SPEN
— Partnering on 6 led by other DNOs

Projects Registered 2022-23 **10**

Our commitment to innovation

At SP Energy Networks, innovation is core to our business and embedded in our culture. Innovation is critical to our delivery of a Just Transition for our customers as we evolve into a Net Zero networks business.

We are always innovating to provide benefits for our customers and helping pave the way to a safer, more reliable, and more cost-efficient energy system. We are achieving this by delivering award-winning innovation, fostering a strong culture and strategic focus on innovation, and having a clear process to integrate successful innovation developed by us and others.

Our innovation is award-winning. Most recently, we won at the IET Innovation Awards for our LV Support Room which continues to receive NIA funding into its second phase through our Network Constraint Early Warning System (NCEWS Phase 2) project.

As we move into the new RIIO-ED2 price control period for 2023-28 we have committed to deliver £87.2m of savings by embedding innovation trials into our 'business as usual' (BAU) activities and adopting best practice from industry. We anticipate our innovation will deliver benefits of more than £200m across the ED2 period.

Incorporating innovation into BAU also allows us to help address the climate change challenge facing society. We will support efforts to decarbonise our economy by facilitating a Net Zero network by 2035 whilst also facilitating the delivery of energy to up to 1.5 million electric vehicles (EVs) and 0.9 million heat-pumps by 2030 as the electrification of the heat and transport sectors gathers pace.

Savings we will deliver in ED2

£87m

Reduced costs from efficiencies in our final ED2 submission

£201m

Our focus on innovation and climate action also anticipates the social implications of a shift to a low-carbon future. We are ensuring that the energy transition is a just transition, taking into account different groups and communities so that no-one is left behind.

This year marks the conclusion of a very successful RIIO-ED1 price control period for our NIA portfolio. As we finalise those projects from ED1, we have established a bold, new Innovation Strategy that will deliver new benefits for our stakeholders and enable us to meet the challenges of a Net Zero future, faster.

The knowledge and learnings gained from our experience in ED1, together with engagements with over 19,000 customers and stakeholders has been invaluable in shaping our latest plan. Our independent Customer Engagement Group (CEG) has also fed into this process by scrutinising our innovation strategy and ensuring our plan is robust.

Our RIIO-ED2 Innovation Strategy, developed in collaboration with our stakeholders, is helping us to shape our innovation portfolio to the needs of our business, consumers and industry across six strategic focus areas:

- **Distribution System Operator (DSO)**
- **Sustainability**
- **Digitalisation**
- **Whole Energy System**
- **Network Modernisation**
- **Consumer Vulnerability**

Network Innovation Allowance (NIA) funding continues to be at the core of our innovation strategy. Through NIA funding we are developing agile, small-scale projects and accelerating the Technology Readiness Levels (TRL) to bring our innovations to the next level – whether that's further development through innovation funding mechanisms like the Strategic Innovation Fund, or direct into Business as Usual (BaU).

Project Highlights

Our projects across our network range in scale and scope to deliver the most impact and benefit to our customers and stakeholders. For this summary report we have focused in on 10 to provide a broad view of the strategies being employed and the outcomes being delivered.

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Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0050	£1,980,000	May 2020	December 2023	Live	https://smarter.energynetworks.org/projects/nia_spen_0050-rtflm-stage-2

DSO Projects

Real Time Fault Level Monitoring Stage 2

Deploying innovative fault-level measurement devices on our network to monitor and predict network fault level in real-time.

Overview

Fault Level is already one of the greatest network challenges. The network has a safe fault level design limit which cannot be exceeded without splitting up the network, reducing the fault in-feeds or adding new equipment. Generation growth is expected to continue and accelerate as UK generation decentralises to meet Net Zero 2050 targets. Innovation is needed to avoid fault level becoming a barrier to the low carbon transition.

The Real Time Fault Level Monitoring (RTFLM) Stage 1 project demonstrated a proof-of-concept design to measure fault level in real time. This has been successful, with changes in network fault level registering within a number of seconds. Two prototype devices were built with measurements taken at both 11kV and 33kV in SPEN's SPM network. As SPM operates an interconnected network, this also demonstrated success with this network type.

RTFLM Stage 2 will extend the trials across multiple networks and network locations. Trials will be extended to include 132kV, split board configurations and different substation design scenarios. SPEN also intend to undertake a combined trial with a separately NIA funded project looking at Active Network Management based on Fault Level.

Benefits

Potential to identify available capacity on the network by providing more accurate fault level assessments in real time.

Progress

This project has continued to progress well. Following the completion of live tests designed to examine the ability of the Real Time Fault Level Monitor to correctly predict the network fault level under different conditions in previous years, the focus over the last 12 months has been progressing the work needed to transition the device from a working prototype to a device ready for BAU deployment. The strong performance in the tests gave us the confidence in the device needed to support our ambition to roll out this technology across the network over the coming years.

As there is no existing manufacturer standard for such a novel device, an extensive review of standards relating to similar switchgear was undertaken and used to define the requirements for Electromagnetic Compatibility (EMC) testing. EMC testing was subsequently completed at test facilities in both the UK and the Netherlands.

Design and build of further devices for deployment on both SP Energy Networks and UK Power Networks distribution networks has then progressed. SP Energy Networks has now fully deployed 2 of 8 trial devices, both of which are now switched on for continuous monitoring, a major milestone for this project.

Next steps

SP Energy Networks will deploy a third device within April/May 2023, and then the remaining five before the end of the year. This will lay the platform to progress these devices into BAU in 2024.

There will also be a focus on data communications, developing the appropriate protocols for bringing the live fault level data through to the network Control Rooms.

We are rolling out an additional 6 real-time fault level monitors across our network this year.

2
devices deployed

Significant learning

All research, development and technology demonstrations undertaken as part of this project thus far have been effective in meeting the aims of the project. Inherent algorithm accuracy has been independently verified as being within ~1% of actual fault level, and this has now been corroborated with full scale live tests. Various deployment options are being explored, with the first devices now fully deployed on SPEN's network.

Registered id:	Budget:	Start date:	End date:	Status:	Link
SPEN_0066	£297,000	December 2022	August 2023	Live	https://smarter.energynetworks.org/projects/SPEN-0066

DSO Projects

Level Up

A Digital Energy Balancing Platform for Low Carbon Technologies.

Overview

Level Up will develop and trial the ZUoS energy balancing digital platform. It will leverage low carbon assets (Solar PV, Batteries, Heat Pumps) installed by the participants of the OneCarluke Community Energy Club. The ZUoS platform will utilise live energy data-feeds from the energy club's LCT assets and network monitoring. It will integrate the data collected with SP Energy Network's NAVI platform and simulations will be run on the model. This will benefit the network by:

- Developing optimisation strategies to reduce peak demand on the LV network;
- Enhancing energy system modelling in combination with data from LCTs, to build improved LV forecasting capability.

The solution will enhance forecasting accuracy; local energy balancing; and help with resilience planning to inform capacity thresholds more accurately for LCT deployment and LV infrastructure upgrades.

Benefits

The Carluke Community Energy Club will generate savings for its members from day 1 of installation, delivering nearly **£50k of savings in its first year,** to be shared between the club and its members.

The annual income and cost savings would amount to **£252k a year,** a 40% saving on baseline electricity costs, shared between the club and its 165 members. Rolling out this model with relatively moderately-sized clubs (which represent 10% of their community) across 5% of the GB network would accrue **annual savings and income of £100m.**

Our initial analysis to assess the ability of the ZUoS platform to bring financial benefits was conducted across the Carluke area, assessing nine ground mounted substations. Predicted EV and Heat Pump demand was projected onto the present base demand for each substation.

Please note the benefits quantified on the ENA portal represent those anticipated at the time of project registration and have since been superseded by the latest estimates presented within this report.

Progress

The project has so far output the following:

- Report on the commercial and regulatory factors working for and against the future uptake of Community Energy Clubs (CECs).
- Commercial development roadmap highlighting the benefits and issues in the broader acceptance of CECs in a UK context.
- Established operational ZUoS platform protocols capable of communicating with SPEN's NAVI platform.
- Simulation and monitoring of a local energy network and localised management. This includes:
  - Dynamic flexibility modelling for local energy assets and demand loads;
  - Provide simulated inputs to SPEN's NAVI platform with an API managing interactions.

Next steps

The next step for this project is the implementation of an API to manage the interactions between the ZUoS and SPEN NAVI platforms. This API will allow data exchange between the two systems so that the ZUoS data from the LCT assets can be used for modelling in NAVI.

Significant learning

Community Energy Clubs have potential to deliver significant benefits as part of smart energy solutions, including improved energy efficiency, DSO development and reduced need for energy infrastructure reinforcement in addition to cost savings for consumers.

However, the current commercial and regulatory environment is not ready for projects such as these. Difficulties particularly stem from not being able to source energy from multiple suppliers as well as the ability to create an accessible finance and sustainable business model within the current framework.

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0008	£771,020	March 2016	May 2025	Live	https://smarter.energynetworks.org/projects/NIA_SPEN0008

Sustainability Projects

APPEAL – Environmentally Acceptable Wood Pole Pre-Treatment Alternatives to Creosote

Assessing the performance of environmentally-friendly alternatives to creosote for preserving wooden overhead line poles.

Overview

Project APPEAL is a collaborative project between SP Energy Networks, UK Power Networks, Northern Powergrid and Scottish & Southern Electricity Networks and managed by the Energy Innovation Centre (EIC).
This project aims to assess the performance of environmentally friendly alternatives to creosote for wood pole preservation. Creosote is currently the pre-treatment preservative of choice for UK overhead line (OHL) wood poles and provides poles with a service life of 45-55 years. It is expected that the outcome of this project will influence UK DNO policies for the replacement of wooden poles.

Progress

The primary objective of the project was to evaluate whether the alternatives to Creosote (RVP and/or Tanasote) provide a preservative effect efficacious enough to allow either or both to serve as a possible replacement for creosote for the treatment of overhead line wood poles. At this stage of the project, this outcome is looking very positive. Although the preserved timbers were beginning to lose effectiveness after 48 months exposure, this was almost identical across all the preservative types, including Creosote, with no preservative type outperforming any other at that stage. At 60 months exposure, indications are that Creosote is showing an advantage over RVP and Tanasote, however none of the new preservative types appear prone to a sudden loss of protective effectiveness.

Next steps

The treated stakes will remain in the test bed for a further 12 months. In addition, round timbers have been added to the trial and they will shortly be reported on.

Significant learning

To give a better and much more accurate idea of a pole's Residual Strength Value (RSV) based on the stake results at this 30-35 years stage (of decay acceleration) the stake test results have been comparatively assessed in terms of depth of decay to the treated timber surface only (i.e. ignoring the Modulus of Rupture (MOR) strength results entirely). This depth of decay has then been applied to poles of different diameters and then an RSV calculated. The depth of decay was not measured precisely on any of the stakes but it is clear that it was never deeper than 5mm for any treatment. Using this information the RSV calculation/prediction gives the following results for all the treatments after 30-35 years in the field:

Pole Diameter (mm)	Residual Strength Value (RSV)
200	88.72%
250	91%
300	94%

The foregoing Residual Strength Values for Tanasote and RVP treated poles are mainly predictive because there is no body of field data available for these pole types over a service life of 30-35 years. This is not the case for creosoted poles. Based on field evaluations of 1,000s of such poles, the RSV results given above are entirely in keeping with values found for creosoted poles after 30-35 years' service life. Using the creosote results as a guide, the comparative performances of the treated stakes at this stage of the trial would indicate that the predictive values for Tanasote and RVP poles are likely fairly accurate.

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0029	£1,000,000	November 2017	March 2024	Live	https://smarter.energynetworks.org/projects/NIA_SPEN_0029

Digitalisation Projects

Secondary Telecommunications Phase 3 – Trial of Hybrid Telecoms

Investigating Broadband over Power Lines (BPL) for high speed communication over electrical lines.

Overview

Secondary Telecommunications Phase 3 is trialling a hybrid innovative communication solution, previously identified within the Secondary Communications Phase 2 project. The project is trialling a Broadband over Power Lines (BPL) solution which can enable high speed data communication over SP Energy Networks electrical lines. This will allow the reuse of utility assets and provide a private network to achieve control, reliability, and quality of service that affordable commercial alternatives cannot offer.
Project aims:

- To validate and confirm the technologies can support smart grids
- To demonstrate to what extent third party solutions from mobile operators can be relied upon in terms of coverage and performance
- To build upon output of previous innovation projects such as WPD's Falcon & Nexus and UKPN's 'Flexible plug and play' which focussed on a single technology solution or were desktop only exercises
- To satisfy Ofcom's requirements to justify access to an additional 400 MHz allocation as part of the spectrum release programme

Progress

BPL fits naturally into the concept of Smart Grid due to its unique combination of telecommunication capabilities with the primary and secondary networks. Being a Layer 1 Ethernet technology increases the interoperability of the solution with other technologies and makes it very easy to be deployed.

The BPL tests have demonstrated the solution is well-suited to an urban environment, where the density of equipment is high. To date, the electrical and telecommunication tests have been performed under supervised conditions on a test network.

The tests have indicated that latency criteria are met and that it is suitable for real time control of distributed assets, subject to qualification by further deployments and use with ground mounted control assets.

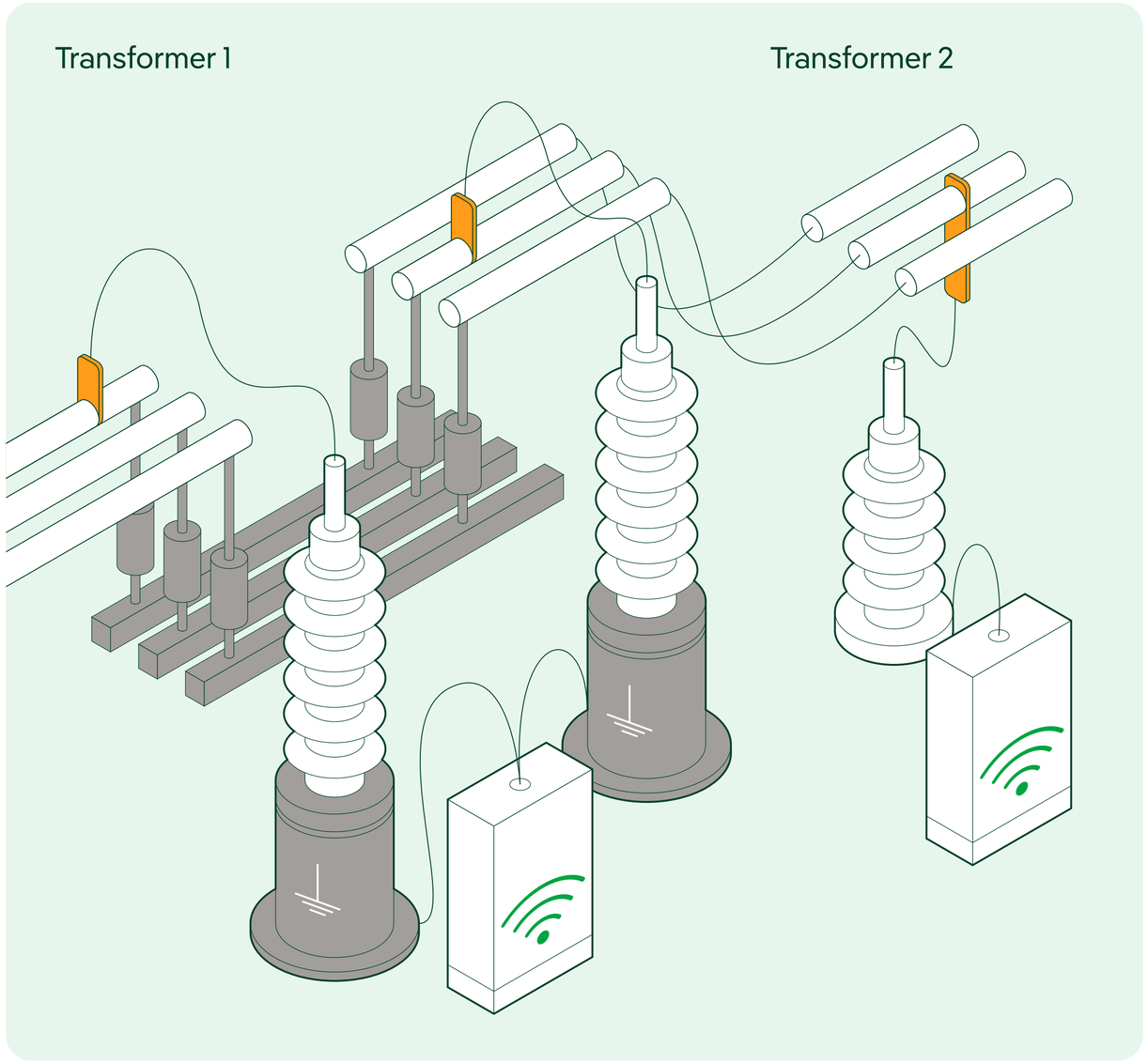
Secure 4G mobile solution has now achieved TRL 9 within SPEN, being integrated and deployed as a BaU solution.

Next steps

Following the successful BPL trials within a test environment, the next stage for the project is to conduct BPL tests within SPEN's live network infrastructure and validate the reliability during loss of mains events.
Once long-term deployment of BPL has been achieved across SPEN's network, new performance tests will measure the response these types of situations.

Significant learning

A key objective of the project is to build upon output of previous innovation projects. The trial has explored issues raised in the Nexus project gathering experience of "build versus buy", applying for segments of UK spectrum and applying standard end to end encryption to the 4G trial solution.



BPL leverages existing infrastructure to provide high speed communications across our network

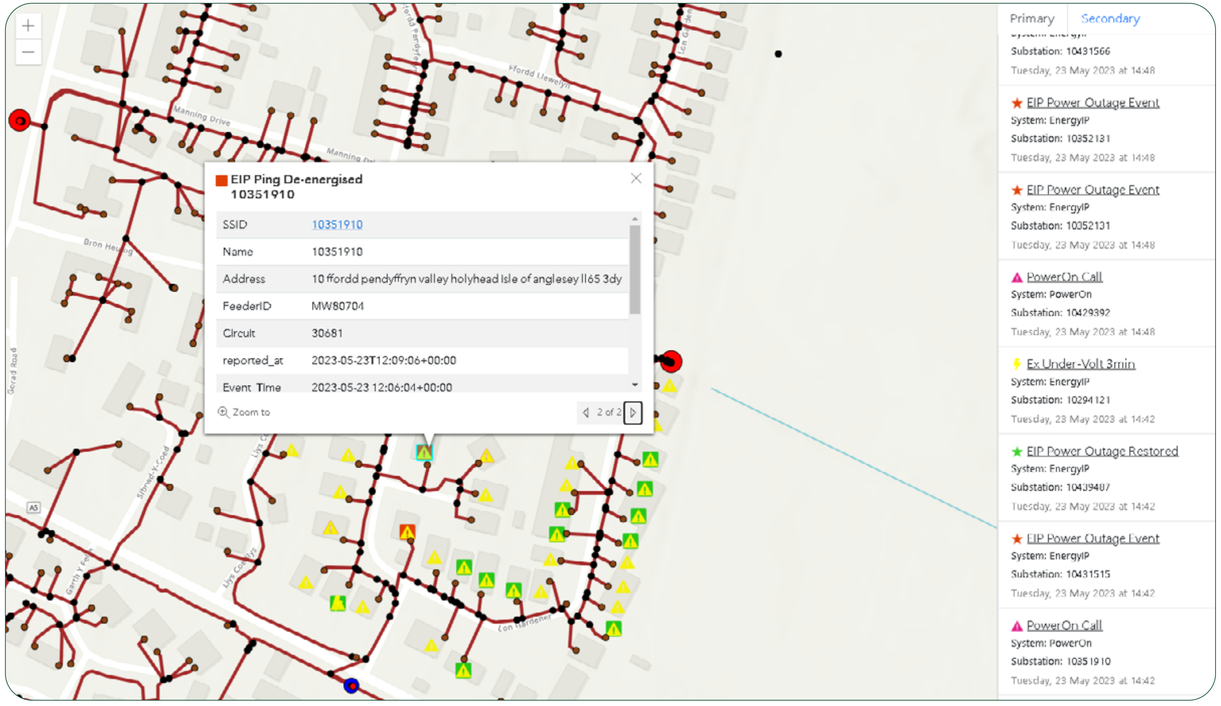
Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0034	£1,050,000	October 2018	December 2023	Live	https://smarter.energynetworks.org/projects/nia_spen_034

Digitalisation Projects

NCEWS2 – Network Constraint Early Warning Systems (Phase 2)

Developing a platform to provide visibility of our network - unifying multiple data sources and adding new capabilities.

NCEWS2 has developed a unified interface for accessing LV network data from a variety of systems and monitors



Overview

As Smart Meters (SMs) are rolled out across the UK, it is expected that this greater visibility of the LV network will provide sufficient intelligence to trigger Smart Grid dynamic network control, which in turn will release more capacity on the network for increased levels of LCTs.

As part of the NIA funded innovation project NCEWS (Network Constraint Early Warning System), we developed an LV Connectivity Model which will allow us to annotate Smart Meter, EV, and other internal/external data sets in order to allow users to better understand the operation of SPEN's LV Network via the NAVI (Network Analyse and View) Platform and associated data exports. Our ambition is for this to become our central data management tool.

Benefits

- Enhanced visibility of network data for improved decision making
- Faster fault identification and resolution
- Reducing Customer interruptions (CI) and Customer Minutes Lost (CML)
- Identifying network issues and targeting planned maintenance before they develop into faults

Progress

Progress in this reporting period has focussed on development of the LView platform – a lightweight, real-time complement to the NAVI data model. The LView trial platform provides, for the first time, a single system where users can access the existing NAVI LV data model alongside real-time data from 3rd party platforms including LV Substation monitors, PowerON and half-hourly smart meter voltage data. Work is ongoing to provide connectivity to additional 3rd party monitors.

We have worked closely with our LV Support Room teams in both our licence areas, SP Manweb and SP Distribution, to enhance the tools ability to analyse the network. Through our collaboration we have continued to extend the LView functionality and have added new features such as:

- **Trace Down** – quickly calculate the number of downstream customers on a network line or node. Useful for calculating CI/CML impacts of a particular fault.
- **Voltage Charts** – graphical view of voltage levels from within the LView platform.

LView has been designed to be lightweight and provides users with access to our data model even in areas with poor connectivity. In February 2023, we launched a trial of our LView platform with field engineers in the Wirral (SPM) and Glasgow (SPD) Districts, giving our team access to near real-time monitor data and the NAVI LV model in the field for the first time.

Next steps

If the trials are successful, we will look to incorporate additional functionality requested by the LV control room team.

Both the NAVI and LView platforms are outputs of NCEWS2 and are transitioning into business as usual (BaU). Pending a successful field trial, LView for field operatives will also become part of our BaU and a wider rollout.

Significant learning

Undertaking this project has allowed SPEN to develop two significant platforms, NAVI and LView, which will be incorporated into our BaU practices pending the successful conclusion of trials currently underway.

The NAVI platform provides SPEN with the ability to automatically create a connected network model from GIS data, including backfilling of missing asset information.

The LView platform consolidates the view of all potential low voltage (LV) alarms/data into a single view, including smart meters, PowerOn incidents/calls, and LV substation monitors, etc for near-real-time visualising of their LV alarms. This has allowed SPEN to internally manage this data and move away from several third-party platforms and display 'our own' data via a single platform.

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0049	£1,000,000	February 2020	March 2024	Live	https://smarter.energynetworks.org/projects/NIA_SPEN_0049

Digitalisation Projects

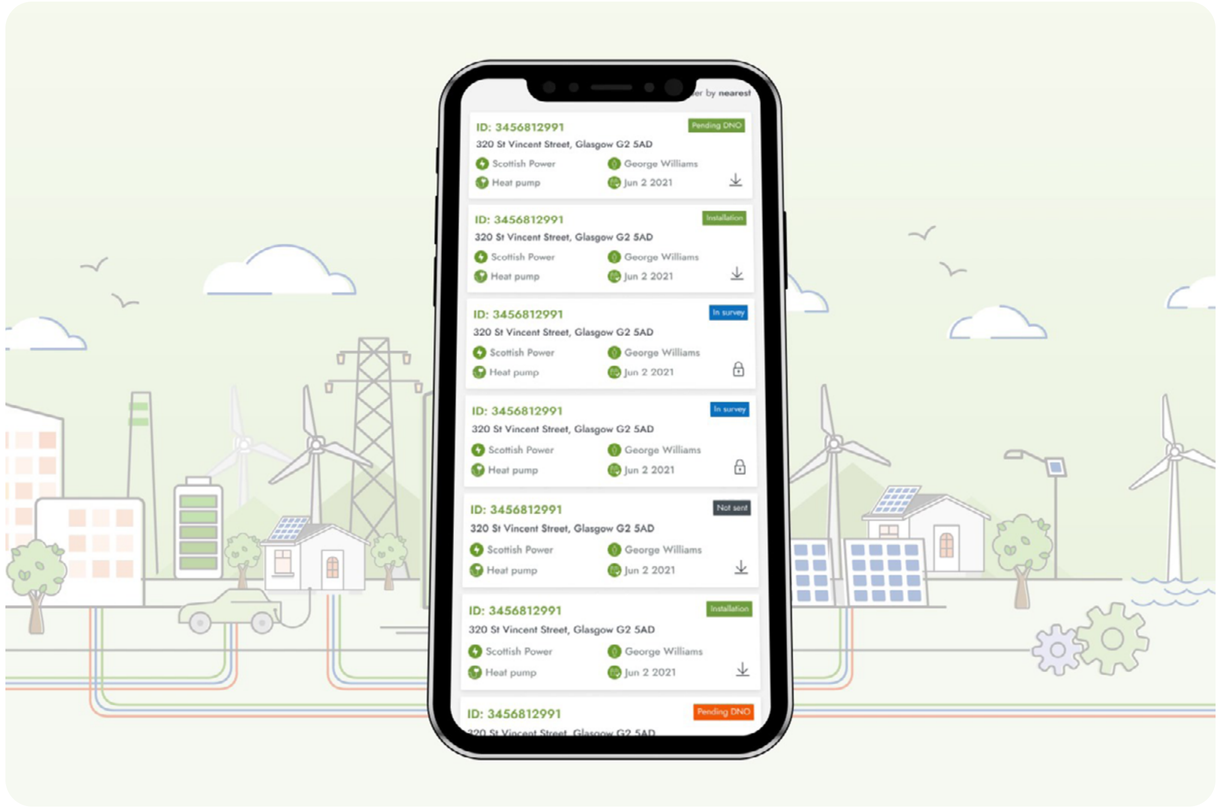
iDentify

Streamlining the installation of LCT assets through AI-assisted asset identification and replacement of paper forms with digital workflows - all in one app.

Overview

iDentify will address issues with fault reporting related to customer cut-outs. It aims to: Replace the ENA Electric Vehicle Charge Point (EVCP), Heat Pump (HP) and Small Generation (G98) paper forms to enable installers to provide information digitally.

iDentify will develop an app which utilises artificial intelligence (AI) and augmented reality (AR) to identify assets it is trained on and provide useful asset data or problem-solving guidance to the user.



Installers of Low Carbon Technologies (LCT) can easily share install details with us via the app

Benefits

The iDentify app will include a fuse size calculator, an AI-assisted visual check on the cut-out and rule-based decision making to instantly inform an installer whether they can continue with an installation (Connect and Notify), or if SP Energy Networks need to intervene (Apply to Connect).

The app allows installers to register on the app and submit the data collected at a property directly to SPEN. A proximity check ensures that the cut-out was surveyed in the vicinity of the correct property. A key benefit of this app, once rolled out to installers, will be the replacement of paper forms with a digital system that shall more efficiently capture the necessary information required by SPEN to undertake any required assessments. The app will allow installers to obtain an answer from SPEN immediately rather than enduring the delays inherent to the current environmentally unfriendly paper-based system, with the information captured by the app to be fed directly into the ESRI GIS system. Use of the iDentify app can also help prioritise areas of the network for reinforcement more quickly if necessary.

At present, the app is being targeted for use by installers only; however, subsequent releases of the app are intended to extend the benefits of this technology to other parties including local authorities, customers, and field personnel. This future rollout would allow customers to send information directly to installers such that they can undertake their own assessment on-site or at their own offices instead of SPEN having to become involved.

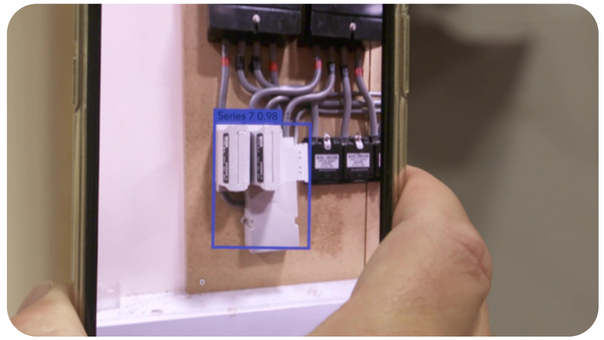
Progress & Next steps

The iDentify project went live with a selection of installers in May 2023. These installers are currently trialling the app on site and shall provide feedback from a customer perspective to complement the in-house testing already completed by SPEN. A key next step is to expand the trial to a greater number of installers and gather feedback on its usefulness and likely incorporation into installers' future plans.

The roll out of the iDentify app will be facilitated by a four-phase media strategy which shall include activities such as engagement with target installers and other industry audiences, a social media campaign and publication of a promotional video. The app will be available at the 'go live' date (currently targeted for Q3 2023) for download via a shared QR code.

Significant learning

While the major learning from this project has been on the use of Artificial Intelligence and image recognition to identify what an asset is, engagement with installers has also helped understand their issues and complexity around completing paper forms. The app brings consistency to the process, regardless of the installer, which currently does not exist.



iDentify uses AI to identify assets and notify installers if they can proceed with their install or if SPEN involvement will be required

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0057	£1,985,213	June 2021	October 2024	Live	https://smarter.energynetworks.org/projects/NIA-SPEN-0057

Whole Energy System Projects

Re-Heat: Enabling Renewable Heat

The first DNO-led, large-scale trial of electrified heat, developing solutions to make heat demand flexible - reducing peak demand on the electricity network.

Overview

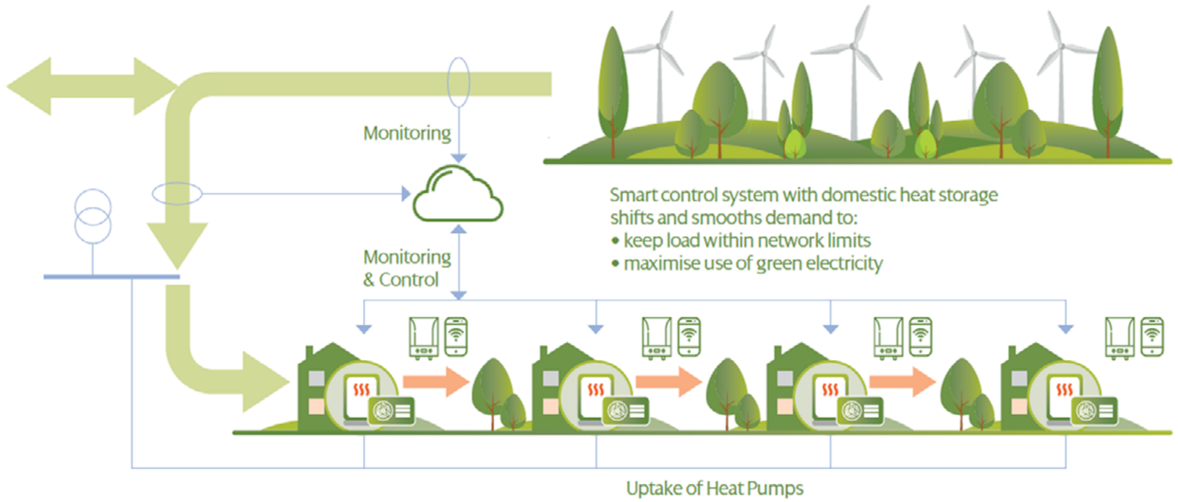
Re-Heat is a strategically significant project being the first of its kind to investigate the impact of full electrification using technology such as Air Source Heat Pumps (ASHPs) and thermal storage to maximise the usage of existing assets by deferring and optimising the conventional network reinforcement needs.

Re-Heat will demonstrate tools to enable an accelerated deployment of low carbon electrified heating at an efficient cost to customers and release the whole-system benefits of flexible heat, providing timely evidence to inform national policy and electricity networks' investment strategy.

Benefits

- Customers could benefit through lower socialised costs resulting from savings due to avoided network reinforcement.
- Carbon reduction across SPD.

Please note the benefits quantified on the ENA portal represent those anticipated at the time of project registration and have since been superseded by the latest estimates presented within this report.



Progress

A Direct Load Control (DLC) platform has been developed to the prototype stage and is ready to be trialled with the Home Energy Management System (HEMS) and installed heat systems.

Installation of the heat pumps and thermal batteries has commenced in a small number of pilot homes. E.On have continued to recruit customers and over 600 customers have expressed interest to date.

Derryherk have continued to develop the DNO network modelling capabilities on the NAVI platform and an API has been developed to facilitate monitoring and load control between the DNO and the DLC.

The individual components have been tested and developed on their own in preparation for full-scale trials.

Next steps

- Installation of DLC and HEMS systems alongside heat pump and heat battery systems to enable full system trials.
- Trial and monitoring of load control to test the solution against DNO requirements.
- Monitoring of home conditions through in-home monitoring equipment and supplementary customer surveys to determine if the solution meets customer requirements.

Significant learning

There is a high dropout rate during the customer journey from initial expression of interest through to signing of the final contract. Reasons can include eligibility for local authority funding and the suitability of the property, including requirements for additional storage space for heat batteries. The full range of reasons for this will be analysed and reported on further as part of the next phase of the project.

The challenges in installation across different property types led to an innovative combined HEMS and DLC interface, which is pre-wired, being developed to simplify the installation process and reduce installation time on site. It is anticipated that this solution will also increase system reliability.

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0060	£241,250	September 2021	September 2023	Completed	https://smarter.energynetworks.org/projects/NIA_SPEN_0060

Network Modernisation Projects

ADAPT-DC

Converting the network from LV AC to LV DC operation to support Electric Vehicle (EV) charger connections.

Overview

Building on the learning garnered from our previous NIA project “A Transition to LVDC Networks – Phase 2”, ADAPT-DC has investigated an alternative to traditional LVAC EV connections by converting areas of the LV AC network to LV DC operations.

At present, the best means of facilitating Rapid EV Hubs (500kW+) is to provide a connection to the existing mains where there is sufficient capacity or to build a purpose-built secondary substation and connect the EV charging hub to the network via a dedicated LV Mains feed. This can be costly and very disruptive to the local environment as substantial roadworks/excavation is required. Coupled with this is the requirement for an AC to DC conversion either within the charger or on the EV itself, this is costly and a complexity that can avoided with an LVDC solution.

ADAPT-DC approaches this problem differently by switching the network from LVAC to LVDC. This unlocks significantly increased power transfer capability meaning the Rapid EV Charging hub demand of 500kW+ can be met by the infrastructure that is already in the ground.

Progress

We engaged with manufacturers and suppliers who would be able to deliver the ADAPT-DC equipment to gather expressions of interest and initial proposals. Our market engagement was conducted on an international level with leading EV charger manufacturers invited to participate.

Potential DC customers, in particular Glasgow City and Edinburgh City councils, were approached and a number of site allocation studies were conducted to map the opportunities where the ADAPT-DC solution could potentially be deployed. This was assessed based on two main criteria:

- Is it possible to convert the existing cable circuits for DC operation, whilst minimising the impact on existing customers?
- Are there any plans for new DC charger infrastructure in the vicinity of the cable circuits identified?

Finally, we engaged with suppliers of DC technology who could potentially join a collaboration to input into the overall solution.

Outcome

After further investigations, market engagement, site selection exercises and based on learnings gathered from similar projects, such as LV Engine, it was decided to pause this project.

We will look to review this project at a later date after completion of the LV Engine trial which is looking into LVDC technology.

Significant learning

- Emerging DC technology suppliers can presently offer products for factory production lines and commercial buildings. Yet, while there is transferable knowledge from these other sectors, significant changes are likely required to those existing products to make them suitable for network applications.
- We learned from our market engagement that LVDC protection remains the main project risk/challenge as the existing overcurrent protection solutions were not suitable for the ADAPT-DC project concept.
- The equipment required for ADAPT-DC solution is not commercially available on the market and the development of this kind of equipment (LVDC boards, LVDC pillars, LVDC protection and AC-DC converters) requires input from across multiple manufacturers. This creates extra risk regarding reliability of the solutions when multiple vendors are responsible for only part of an overall solution.
- Our LV Engine aims to trial the UK’s first substation supplying an LVDC network. Full technical and commercial learning will be available after this trial which we expect will inform the future of the ADAPT-DC project and enable a more efficient delivery with mitigated risks.

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0061	£200,000	September 2021	October 2023	Live	https://smarter.energynetworks.org/projects/NIA_SPEN_0061

Network Modernisation Projects

Innovative Replacement for Underground Substations

Investigating the feasibility of new and/or existing overground solutions to existing underground secondary substations.

Our project investigated sidewalk transformers as an alternative to underground transformers

Overview

The current methodology of removing and replacing an alternative overground site has a number of problems, including high capital costs, problematic land ownership issues, the need to install a large amount of HV cable in urban environments and the impact of voltage levels when moving LV substations further away from the point of demand.

The key objectives of the project are to:

- Investigate potential alternatives to the above mentioned current methodology;
- Compare the current methodology against solutions with both high and low Technology Readiness Level (TRL), providing feasibility studies and comparative supporting Cost Benefit Analysis (CBA); and
- Undertake the studies to understand the potential benefits of using Power Electronic Devices (PED) on the LV Distribution network.

Progress

The project progress over the reporting period includes:

- Market research was conducted to identify potential solutions that can either provide a replacement capacity fully or partially at the same location as underground substation or provide network support e.g. voltage control or capacity sharing.

- Identified solutions were further investigated by carrying out desktop system studies, technical specification assessments and operational risk analysis. Four solutions were shortlisted for further assessments:
  - A compact 200kVA to 315 KVA sidewalk transformer
  - Soft Open Point for sharing capacities
  - LV STATCOM to support voltage
  - Hybrid transformers with partially rated PEDs fitted
  - Like for like underground substation.

Outcome & Next Steps

We are currently drafting a close down report to reflect all the findings and learnings from this project.

Significant learning

The application of compact transformers (in their existing design) in close proximity to public paths may introduce safety risks to public as the HV terminals may be exposed to public as a result of vandalism or accidental damage. Also, there is possibility of transformer oil pressure overflow to public space. Providing these key safety issues are addressed (by redesigning, careful site selection or other protective measures) the concept of a sidewalk transformer with a small capacity can be promising to compensate the supply capacity lost when decommissioning an underground transformer.

LV STATCOMs can be an effective solution for overhead line circuits, however, our power system studies on the LV network and engagements with a number of potential suppliers suggested that STATCOMs may not be suitable for voltage regulations in cable LV circuits.

Considering the growing limitations for securing space for new substations, especially in city centres or close to built-up area where load is concentrated, we believe there is a value in developing a new underground substation/ transformer design. The new design needs to specifically address the impact of environment (humidity, etc.) and safe access for operation and maintenance. In that regard, we are currently working on market potential of an “improved” underground substation.

Registered id:	Budget:	Start date:	End date:	Status:	Link
NIA_SPEN_0076	£154,000	June 2022	March 2023	Complete	https://smarter.energynetworks.org/projects/NIA_SPEN_0076

Consumer Vulnerability Projects

Vulnerability in the Energy System Transition (VEST)

Heat mapping customer vulnerability in our licence area to better target our support.

Overview

SP Energy Networks (SPEN) have committed to address three areas in consumer vulnerability (supporting customer during power cuts, addressing fuel poverty, and ensuring that no customer is left behind in the energy system transition). One of the key challenges identified in addressing the three areas, has been measuring the risk of being left behind and determining which customers are more likely to be left behind.

Vulnerability in the Energy System Transition (VEST) has developed a tool that builds a complete picture of vulnerability dynamics across the areas served by SPEN. The tool provides an interactive map that integrates (i) the risk of being left behind in the energy system transition, (ii) the prevalence of PSR situations and (iii) the level of fuel poverty for each area.

The data provides a breakdown of which specific barriers are determining the likelihood of customers being left behind across geographical areas. This information will allow SPEN to provide bespoke advice and support to customers, addressing the identified challenges and barriers for specific communities.

Benefits

Through RIIO-ED2, SPEN have committed to supporting vulnerable consumers in the energy system transition. Utilising the VEST tool will allow users to visualise a range of vulnerability related information at the Local Authority (LA) and Lower Layer Support Output Area (LSOA) levels across the areas served by SPEN.

The tool will provide direct benefits to customers as the interactive map will allow SPEN to inform the development of new advice and support services tailored to address the challenges and obstacles of groups of customers facing the identified blockers.

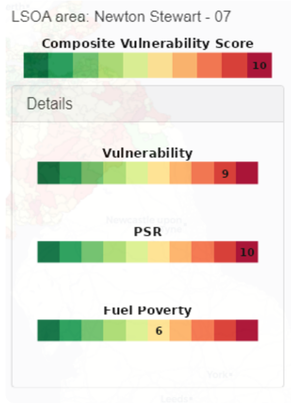
Progress

The project has successfully been complete, and the tool is accessible for to the public via the SP Energy Networks website.

Through the first three phases of the project, a measure of the 'risk of being left behind' was developed.

The risk score is derived by the likelihood that customers may adopt technologies (e.g., heat pumps) and behaviours (e.g., demand flexibility) that would allow them to benefit from the energy transition. The index was developed based on direct engagement with customers across the areas served by SPEN.

The fourth phase of the project has developed a unified view of vulnerability by joining together the core dimensions relevant to energy networks: PSR, Fuel Poverty and the newly developed 'risk of being left behind' measure created from this project.



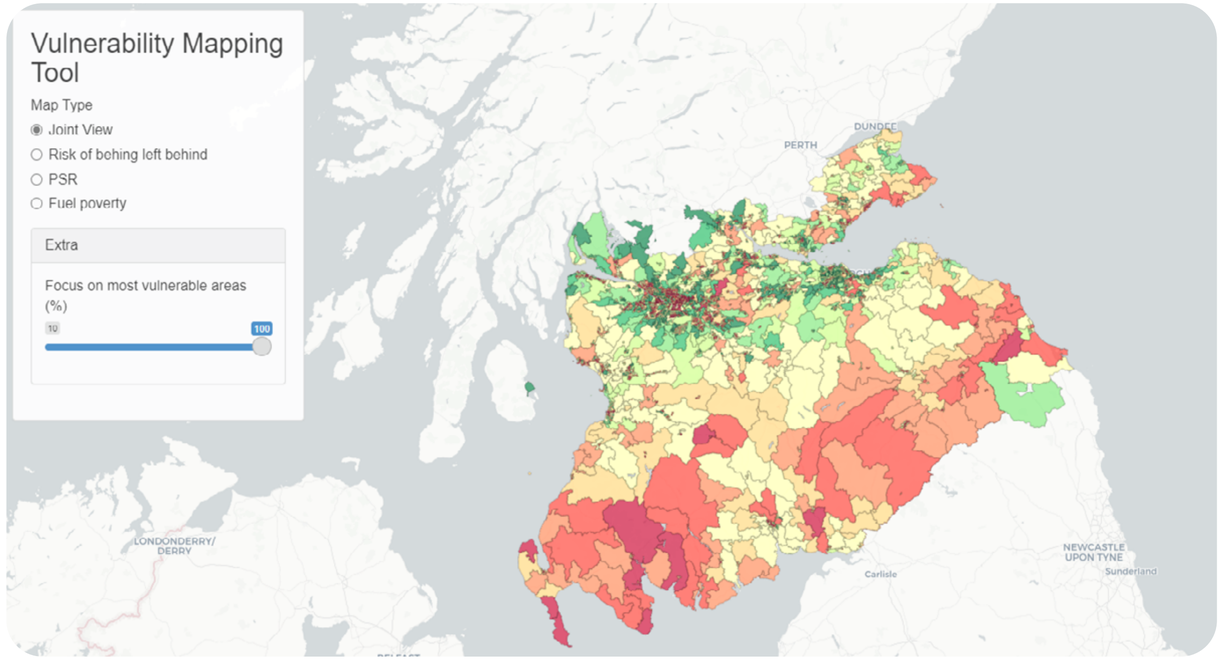
VEST is enabling heatmapping of customer vulnerability, allowing us to target our support

Next Steps

The tool has successfully been implemented into Business as Usual (BaU) and will be reviewed at the end of the year to review its effectiveness and to ensure it is being utilised to its full capability.

Significant learning

- Identification of regions in which customers are most at risk of being left behind in the energy system transition
- The 'Technical Capability' domain, one of the blockers considered in the project, is most related to the overall risk score across the areas studied. This may suggest that assessing a customer's technical capability could be a good proxy for their risk of being left behind.



VEST combines Vulnerability, PSR and Fuel Poverty indices to give an overall Vulnerability Score

Our NIA 2022-23 Portfolio

These tables summarise our full NIA activities for the 2022-2023 year. Learn more and stay updated about an individual project by clicking the link to the ENA Smarter Networks Portal.

Collaboration projects

Collaboration is a core aspect of our innovation process and, as well as collaborating with partners on our own projects, we actively support other DNO-led projects that address key industry challenges. Across our Distribution NIA portfolio, we have 15 collaborative projects – of which we lead on nine and our partners lead on the remaining six. To learn more about these collaborative projects led by our partners, please refer to the lead DNO Annual Report or visit the Smarter Networks Portal using project links listed below.

Collaboration Projects	ENA Reference	Started
Net Zero Service Termination Project	NIA_SSEN_0055	Aug-21
Decarbonising Utility Transport using Whole System Thinking	NIA_SSEN_0057	Feb-22
CageCapture™ SF6 Paint Detection	NIA_SSEN_0059	Sep-22
Consumer Vulnerability Impact Assessment Tool	NIA_WWU_2_06	Sep-21
Step Up Transformer	NPG_NIA_043	Mar-23
Approach for Long-term Planning accounting for Carbon Assessment (ALPACA)	WPD_NIA_062	Jan-22

Closed Projects	ENA Reference	Started
Mini-Mole	NIA_SPEN0006	Apr-15
SINE Post	NIA_SPEN0012	Jan-17
Secondary Communications Phase 2 – Consultancy Engagement	NIA_SPEN0017	Jan-17
Instrument for the identification of Live and Not Live HV and LV cables	NIA_SPEN0020	May-17
Weather Normalised Demand Analytics (WANDA)	NIA_SPEN0022	Aug-17
Connected Worker Phase 1 – Field Data Automated Capture	NIA_SPEN0023	Oct-17
Endbox G38 Level Detection Phase 2	NIA_SPEN0024	Oct-17
Low Cost Fault Current Measurement of Wooden Poles	NIA_SPEN0025	Nov-17
Linkbox Monitoring using Narrow Band IoT	NIA_SPEN_0026	Dec-17
Zebedee Sectionaliser Device	NIA_SPEN_030	Mar-18
CALISTA – Cable Asset Life by Integrating Statistical Failure Models	NIA_SPEN_033	Sep-18
Electric Vehicle Uptake Modelling (EV-Up)	NIA_SPEN_0037	Feb-19
Improving Storm Resilience and Readiness through Data Analytics	NIA_SPEN_0040	Jun-19
Proof of concept Tarmac Reinstatement Tester	NIA_SPEN_0041	Jun-19
Enabling Monitoring and Control of Underground Assets	NIA_SPEN_0046	Jun-19
A Transition to LVDC – Phase 2	NIA_SPEN_0047	Nov-19
The Chatter Tool	NIA_SPEN_0048	Dec-19
A Substation of the Future	NIA_SPEN_0052	May-20
Flexible Tower Block	NIA_SPEN_0056	Feb-21
Virtual OHL Inspections: Combining Statutory Inspection & Condition Based Assessment (CBA)	NIA_SPEN_0063	Oct-21
Introduction of Process mining enabler into SP Energy Networks	NIA_SPEN_0065	Oct-21
On-Site Non-Intrusive Polychlorinated Biphenyls (PCB) Tester	NIA_SPEN_55	Oct-21
PSR Communication Review	NIA_SPEN_0079	Sep-22
EVOLUTION	NIA_SPEN0010	Dec-15
THOR Hammer	NIA_SPEN_0039	Jun-19
ADAPT-DC	NIA_SPEN_0060	Sep-21
Vulnerability in the Energy System Transition	NIA_SPEN_0076	Jun-22

Live Projects	ENA Reference	Started
APPEAL – Environmentally Acceptable Wood Pole Pre-treatment Alternatives to Creosote	NIA_SPEN0008	Mar-16
Active Fault Level Management (AFLM)	NIA_SPEN0014	Feb-17
Secondary Telecommunications Phase 3 – Trial of Hybrid Telecoms	NIA_SPEN_0029	Nov-17
NCEWS2 – Network Constraint Early Warning System (Phase 2)	NIA_SPEN_034	Oct-18
Bethesda Home Hub	NIA_SPEN_0043	Oct-19
iDentify	NIA_SPEN_0049	Feb-20
Real Time Fault Level Monitoring Stage 2	NIA_SPEN_0050 RTFLM Stage 2	May-20
Re-Heat: Enabling Renewable Heat	NIA SPEN 0057	Jun-21
Innovative Replacement for Underground Substations	NIA_SPEN_0061	Sep-21
Level-Up	SPEN 0066	Dec-21
Data Historian Replacement	NIA_SPEN_0080	May-22
Security of Supply for Vulnerable Consumers (SSVC)	NIA_SPEN_0078	Aug-22
Resilient and Flexible Railway Multi-Energy Hub Networks for Integrated Green Mobility (Hubs)	NIA_SPEN_0089	Feb-23
Switchgear Requirements for Future Networks	NIA_SPEN_0082	Mar-23
Open Innovation Phase 2	NIA_SPEN_0083	Apr-23
PSR Resilience System	NIA_SPEN_0086	Apr-23
LV De Mesh	NIA_SPEN_0087	Apr-23
XR Facilitating Training and Operations (X-FacTOR)	NIA_SPEN_0085	May-23

SP Energy Networks Distribution and Manweb

NIA Annual Summary

2022-23

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