SP Electricity North West

NIA ENWL040

Smart Street Rural

Progress Report

June 2026

SP Electricity North West

Version History

Version	Date	Author	Status	Comments
0.1	11 06 2026	CG	Draft	
0.2	16 06 2026	CG	Final	

Review

Name	Role	Signature
A Howard	Innovation Programme Mgr.	A J Howard
G Paterson	Innovation PMO Manager	G Paterson

Approval

Name	Role	Signature & Date
R Moulton	Head of Innovation	R Moulton – 29th July 2026

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Glossary of terms

Acronym	Description
CAPEX	Capital Expenditure
CLASS	Customer Load Active System Services – voltage control at primary substations using the primary substation on load tap changer
CVR	Conservation Voltage Reduction – the application of intentionally lowering supply voltage to reduce demand
EPRI	Electrical Power and Research Institute
HV	High Voltage
LV	Low Voltage
NPV	Net Present Value – used to calculate the value of the project outputs in the future
OLTC	On Load Tap Changer
OPEX	Operational Expenditure
p.u.	Per Unit
PMT	Pole Mounted Transformer
STATCOM	Static Synchronous Compensator

Project fundamentals

Project title	Smart Street Rural
Project reference	NIA_ENWL040
Funding licensee(s)	Electricity North West Limited
Project start date	Nov 2024
Project duration	0 years and 10 months Updated in March 2026 to 2 years and 2 months
Nominated project contact(s)	Chris Greenfield

1. Project background

Until recently, voltage regulation technology was not mature for pole mounted distribution transformers meaning that customers connected to them could not take advantage of the benefits of Conservative Voltage Reduction (CVR) as proven on ground mounted transformers as part of the Second-Tier project, Smart Street.

Pole mounted voltage regulation technology has now matured and this project will conduct desktop analysis to determine whether the application of CVR is cost beneficial for overhead networks including an assessment of the available voltage regulation equipment. If benefits can be realised, Smart Street Rural will scope a testing methodology for a small-scale network trial to be carried out in a potential future project.

2. Project scope

A modelling analysis will be undertaken by the Electric Power Research Institute (EPRI) on several representative overhead assets within the SP ENW Low Voltage (LV) network. The results from which will then be extrapolated across the wider network.

Using load flow analysis combined with time series historical demand data, substations will have voltage regulating capabilities applied to reduce demand and determine a potential cost saving on any potential reinforcement, along with potential energy savings to consumers.

Conversely, analysis will be carried to determine whether voltage regulating capabilities can be applied to increase the voltage and assist the resilience of circuits with long lengths of overhead line.

The project will also assess available voltage regulation equipment and scope a testing methodology for a small-scale live network trial to be carried out in a potential future project.

The project is split into two tasks:

Task 1: Modelling

- *Create a model of the SP ENW LV overhead network including substations, cables, and consumer point loads on several representative circuits.*
- *Apply historical time series demand data and determine overload and reinforcement requirements.*
- *Determine the net benefits of applying CVR to substations.*

Task 2: Equipment and Trials

- *Determine the feasibility and benefit of installing a chosen voltage regulation device onto the LV overhead network.*
- *Select an area of the SP ENW LV network to carry out a small demonstrator trial as part of a potential future project.*

3. Objectives

The objectives are:

- *Perform a detailed network study on several representative LV overhead circuits to determine the expected benefits from deploying assets to enable or enhance CVR.*
- *Determine the cost and benefits in deploying CVR on overhead LV distribution systems.*
- *Extrapolate the results to the wider network determining the costs and benefits of scaling the solution across the SP ENW.*
- *Select a voltage regulation device to use and plan for deployment as part of a potential future project.*

4. Success criteria

A technical report that summarises the costs and benefits to deploy a CVR system on the SP ENW overhead network along with a plan for a small-scale demonstration of the solution.

5. Performance compared to the original project aims, objectives and success criteria

Significant progress has been made on this project since mobilisation.

The modelling approach has focused initially on a preliminary subset of three primary substation models to ensure a robust method of analysis prior to wider extrapolation. Asset and time series historical data for these models were provided by SP ENW to EPRI for use on their OpenDSS modelling software.

The models were iterated, reviewed and adjusted where necessary until the outputs provided a solid foundation to meet the objectives.

Five different CVR cases including a base case were analysed. The base case is a system-as-is case with a fixed primary source voltage of 1 p.u. and no other CVR technologies. This enabled a view of the voltage profile across each HV and LV feeder on the substation and any potential headroom of voltage reduction available.

At this stage, no voltage excursions were identified and there appeared to be sufficient headroom for CVR reduction without any need for reinforcement.

From the base case, CVR technologies were applied as follows:

- *Case 2: Adjusted primary substation tap changer.*
- *Case 3: HV line voltage regulators.*
- *Case 4: Pole Mounted Transformer (PMT) on load tap changers (OLTC)s.*
- *Case 5: LV STATCOMs.*

The variation in cases enabled the team to test different options that could potentially be used in the small demonstrator trial.

Case 2 and 3 were tested on one substation only to determine the high-level feasibility of taking these options forward. Case 3 applied voltage regulators on three out of the four HV feeders from the primary substation.

The outstanding issue with case 2 is that a reliable modelling result alongside the simultaneous operation of the CLASS system on the SP ENW network would be difficult to achieve. For case 3, the available equipment that could be used during the trial was deemed unsuitable at this time for installation on the network.

It was anticipated then that for this project the LV technologies would take precedence as these are suitable for installation and are in line with the original Smart Street project.

Due to the uncertainties of the load characteristics, each case was modelled with a CVR factor of 1, 0.75 and 0.5. This provided an optimistic and pessimistic view of what potential overall reduction in demand could be available. The 0.75 factor was considered most reasonable.

The main sensitivity for the LV technologies was determining how many distribution substations the CVR technologies would be applied to. A full deployment was considered but deemed unrealistic due to resource constraints involved with significant installations.

The model then considered deployment at 1/3 of substations, either those with the highest loaded transformers, or those transformers that are more constrained. Overall, it was found that deployment on the highest loaded transformers delivered the most meaningful and realistic voltage reduction.

The aggregated results per substation for full deployment show that the effectiveness of the CVR technology varies significantly between the different cases.

Cases 2 and 3 were only applied at Substation 1, where they achieved median load voltage reductions of 1.4% and 2.8% respectively, resulting in total energy reductions of 2.6% and 3.1%.

Case 4 delivered the greatest impact across all three substations, producing median voltage reductions of 7.1%, 6.2% and 7.7%, which translated into energy savings of 5.1%, 4.6% and 5.4% respectively.

By comparison, Case 5 achieved more modest reductions, with voltage decreases ranging from 0.3% to 2.1% and corresponding energy reductions between 0.3% and 1.3%.

The PMT OLTCs provided the most effective and consistent CVR performance, achieving energy reductions across all three primary substations. Additionally, the PMT OLTCs had the largest reduction in loses on the network providing additional benefits when considering both customer energy savings and network efficiency.

Translating the energy reduction results into a Net Present Value (NPV) required certain assumptions:

- *The value up to 2050 was considered to avoid uncertainties in the far future.*
- *Value of carbon reduction was based on DESNZ carbon values per kWh.*
- *Discount rate of 3% applied.*

The Capex cost is the difference in capital expenditure of the CVR technology and any associated reinforcement compared to the base case. The Opex cost is the ongoing operational expenditure associated with installing and maintaining the equipment.

Each installation carries a carbon footprint and the tonnes of CO2e are monetised to determine the environmental benefit. There is also a further saving in carbon through reduced network losses associated with the demand reduction from the CVR technology.

The Cost Benefit Analysis (CBA) for the SP ENW region when considering a CVR factor of 0.75 and deployment of LV OLTCs at 1/3 of the highest loaded transformers indicates that the NPV of the project remains positive throughout the assessment period up to 2050, suggesting that the benefits consistently outweigh the costs.

These results are based on a simple extrapolation of the three modelled substations modelled as part of work package 1.

The NPV increases steadily from approximately £5m 2026 to a peak of around £16m in the late 2030s, before falling to approximately £8m by 2050.

Overall, the analysis demonstrates a strong economic case for the investment, with the highest value being realised during the middle of the asset life and positive returns maintained throughout the assessment period.

During the next reporting period, the results will be extrapolated across the SP ENW network in greater detail and further over the wider GB area. Work has commenced on the trial selection of sites for the demonstrator project and the selection will be finalised following additional checks from the relevant policy and operational teams.

Additionally, the procurement team has also been notified of the intention to purchase the equipment necessary to carry out the trials.

6. Required modifications to the planned approach during the course of the project

Agreement of terms and conditions took longer than expected due to different governing law between the US and UK. This resulted in the project having a later start date than what was stated when the project was registered. The new end date is now December 2026.

There have been no modifications to the tasks in the project plan or workstream deliverables since commencement of the project.

The project expects to fully achieve the original aims, objectives and success criteria.

7. Lessons learned for future projects

Consider potential delays on contracts for partners from countries outside GB due to different governing law.

8. Data access & quality details.

There is no data available associated with this project at this stage.

Anonymised data can be made available in line with our innovation data sharing policy, which can be found on our website.

9. Foreground IPR

There is no foreground IPR associated with this project at this stage.

10. Standards documents

Not applicable.