Project PACE

DNO led efficiencies in site selection for community EV charging hubs

A study funded by the SP Energy Networks Green Economy Fund

Project PACE Site Selection Study

Contents

1. Executive Summary

The widespread rollout of public Electric Vehicle (EV) charging infrastructure is essential to meeting the Scottish and UK Governments' Net Zero and carbon reduction targets. The availability of publicly available EV charging infrastructure in communities will encourage car users to switch to low emission vehicles with greater confidence.

Project PACE helps to achieve these goals by delivering a strategic network of public EV chargers, across North and South Lanarkshire, whilst piloting an innovative electricity Distribution Network Operator (DNO) led delivery model.

The EV Strategic Partnership was launched in August 2019 and the stated objectives of Project PACE at that time were to work in collaboration with Transport Scotland and Local Authorities to:

- Deliver 180[1] new public chargers at more than 40 community hubs across Lanarkshire;
- Significantly increase the number of available public EV chargers in the trial area, particularly the number of fast (22kW) and rapid (50kW) chargers, allowing drivers to charge more quickly; and
- Understand customer and societal benefits, in terms of cost and pace of delivery, from a DNO led delivery model.

The first step taken in Project PACE was the completion of an optioneering study, funded by SP Energy Networks' (SPEN) Green Economy Fund (GEF). This study employed a unique approach to site selection, combining SPEN's extensive knowledge of its network and operating environment, with inputs from key stakeholders enabling a collaborative approach to identify optimal locations to install EV charging infrastructure.

The investment of £500k from the GEF has enabled Project PACE to identify potential savings of £30k-£60k per site, in connections costs alone. This is a total of up to £2.6million (incl. VAT) across the circa 44 sites planned for delivery, and represents a saving of between approximately 50% and 65% of the connections costs to be funded by Government and taxpayers[2].

By carrying out the optioneering project phase, optimum sites were identified; problematic sites were eliminated; and planning or land rights were agreed in principle, upfront. It is expected this will enable the project to benefit from significant time savings in the end-to-end delivery of the EV charging hubs. The DNO-led element of the project has developed a new framework that could be replicated across the UK, allowing future EV infrastructure projects to be carried out more efficiently and effectively.

[1] The delivery phase of Project PACE is targeting delivery of up to 180 EV chargers. The optioneering study has identified future capacity for an additional 37 chargers across the 44 hubs selected for delivery

[2] Note that the network connections designs for sites excluded by Phase 1 were not developed so the potentially significantly higher costs of sites >500m from the existing electricity network or with complex delivery challenges (e.g. environmental/ conservation restrictions) are not included in the cost savings quoted.

Ofgem's regulatory policy in relation to the role of DNOs in EV charging infrastructure is still evolving. The role of a DNO could range from strategic support for stakeholders on site selection, through to delivering a Price Controlled ownership model where market provisions fail to meet stakeholder and community needs. This is a significant gap which will need to be filled in the RIIO-ED2 price control period for DNOs, which will run from 2023-2028.

As negotiations with Ofgem continue for the RIIO-ED2 framework, the role of DNOs in identifying, facilitating and delivering EV infrastructure will be a key area of focus and discussion. SPEN are already engaging with BEIS, Ofgem and the Scottish Government on this important issue, following on from our experience and knowledge in delivering Project PACE.

The benefits identified by the Project PACE optioneering study highlights the importance of enabling DNOs to play a key strategic role in the roll-out of EV infrastructure, both as part of the post-COVID Green Recovery and the longer-term transition to Net Zero.

The optioneering study documented in this report specifically focuses on the potential benefits of more effective site selection to enable a more cost-effective deployment of public EV charging infrastructure across all communities. Additional benefits of quicker delivery and other potential efficiencies that are expected to be demonstrated in the delivery phase of Project PACE, enabled by this optioneering study and the programme approach, will be subject to a comprehensive review by SPEN and Transport Scotland after the completion of the agreed EV charging hub delivery.

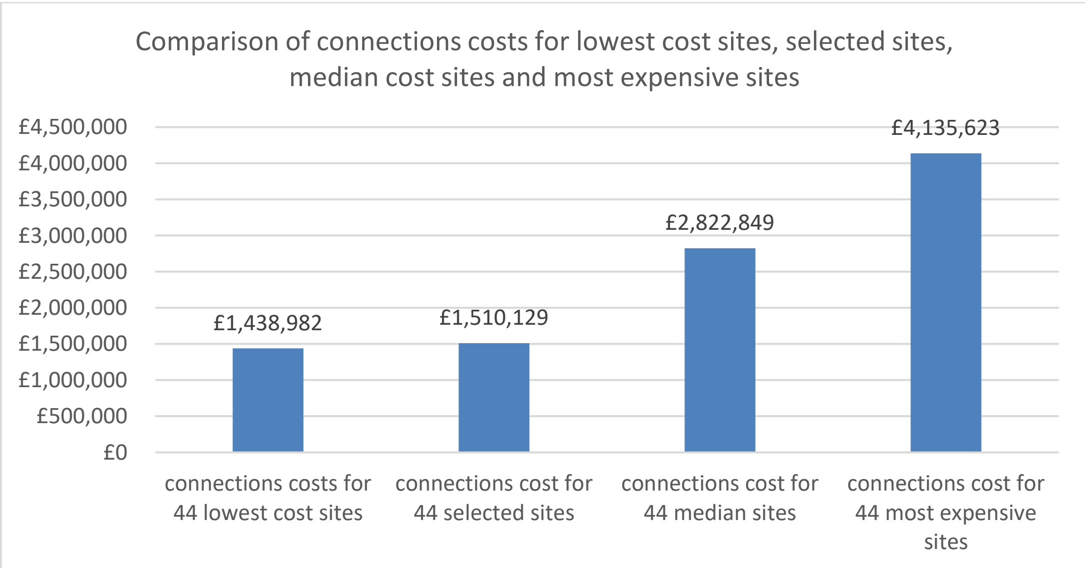

Figure 1: Comparison of connections costs

The optioneering study will enable a saving of £30,000 to £60,000 in connections cost per site, a total saving of £1.3m to £2.6m across 44 sites

Project PACE considers less than 10% of the publicly available chargers expected to be required by communities by 2050 (in the pilot area)

Scaling the Project PACE optioneering study across Scotland could result in connections savings of up to £26m for only 10% of the publicly available chargers required by 2050

Scaling the Project PACE optioneering study across UK could result in connections savings of over £310m for only 10% of the publicly available chargers required by 2050

The outputs of the optioneering study will enable Project PACE to deliver the following in the delivery phase:

- A potential increase of over **200%** in the number of ChargePlace Scotland EV chargers in Lanarkshire,
- A potential increase of **90%** more 7kW standard chargers, **400%** more 22kW fast chargers and **500%** more 50kW rapid chargers in Lanarkshire[3]
- A potential increase in installed capacity of around **10MW**, an increase of **360%**, that is expected to accommodate the charging of **5000** more EVs across Lanarkshire
- A resulting potential carbon reduction of over **6,200 tonnes CO_2/year**
- Time savings in the delivery phase as this approach allows common problems known to cause significant delays in the delivery of EV charging hubs (including land rights, required consents, planning permissions and scheduling road openings on major roads) to be avoided.
- By investing the expected saving in connections costs in the delivery of additional chargers, the project will potentially deliver up to 70% additional EV charging capacity than would have otherwise been possible within the fixed project funding

[3] The increase in charger numbers is compared to the number of chargers installed on the ChargePlace Scotland Network at December 2019 as detailed in Tables 13.11 and 13.12 of the Scottish Transport Statistics 2019 (https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition/chapter-13-environment-and-emissions/) and does not take into account chargers installed in 2020 via other programmes. The number of EV chargers in Scotland at August 2020 when the first Project PACE hub went live was around 1400.

2. Introduction

2.1 Purpose of the document

The purpose of this report is to give an overview of the Project PACE optioneering study that was used to select optimum locations and configurations for EV charging hubs across North and South Lanarkshire and to quantify some potential benefits of this approach compared to the local authority led model that has been used widely in Scotland to date.

The optioneering study was funded by the SPEN Green Economy Fund (GEF). This fund supports initiatives that will benefit the people of Scotland and support Scotland's ambitious green energy plans and local economic growth.

The Project PACE optioneering study fulfils the objectives of the GEF as it helps maximise the number of EV charging points that can be delivered from fixed Transport Scotland funding available and reduce delivery lead times, therefore accelerating progress towards the Scottish Government's low carbon targets. The project is also delivering community EV charging hubs which will be essential in enabling wider societal access to the transition to electric vehicles.

2.2 Strategic Partnership

A strategic partnership between the Scottish Government, Transport Scotland, SP Energy Networks and Scottish and Southern Energy Networks was established in 2019 with the aim of coordinating the decarbonisation of transport with the strategic development of the electricity networks. This is critical to ensuring both a common understanding of the challenges and to enable the achievement of the Scottish Government's ambition.

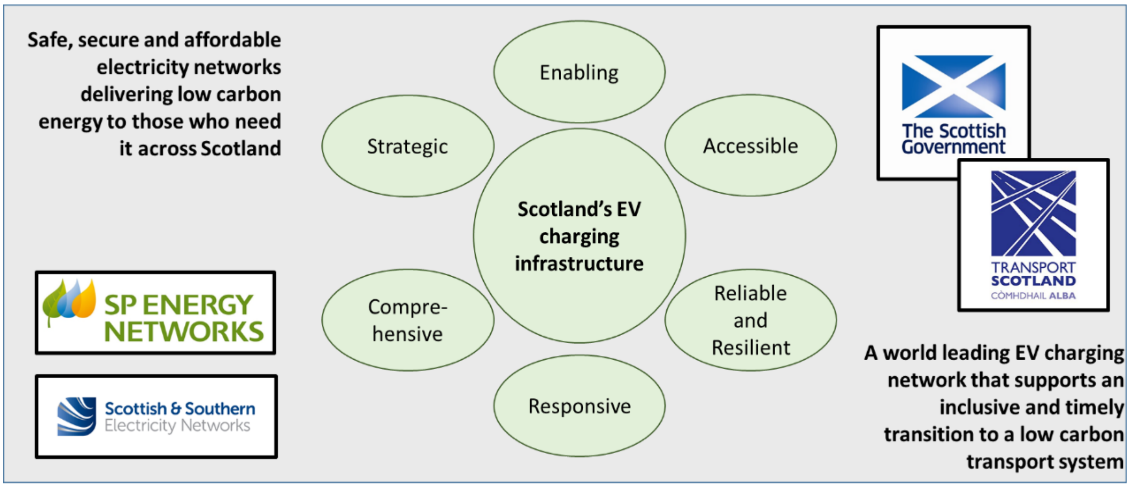

Figure 2: Strategic Partnership for the Decarbonisation of Transport Goals

Figure 3: Launch of Strategic Partnership for the Decarbonisation of Transport with First Minister Nicola Sturgeon in August 2019

2.3 Project PACE

Project PACE is the first major project delivered by SP Energy Networks on behalf of the Strategic Partnership. The project explores the roles a DNO can play in the process of planning and delivering a public EV charging network for areas of high electricity and transport energy demand. It will pilot a new model for delivering both EV charging and electricity network infrastructure which can more effectively satisfy Scotland's ambitions, including delivering inclusive universal access to the benefits of the decarbonisation of transport.

2.4 Project Objectives

The high-level outputs targeted by Project PACE are:

Efficiency

- Optimised locations to minimise connections costs
- Priming the market by creating a critical mass of EV chargers to encourage customer uptake of EVs and provision of additional EV chargers by other providers

Pace / Scalability (vs December 2019 baseline)

- Increase the number of public chargers in Lanarkshire by over **200%** in 6-9 months[4]
- Delivering around **14%** increase in public chargers in Scotland within a 12-month period [5]

Enable Universal strategic access to EV charging

- Supporting a 'Just Transition' in the decarbonisation of transport, ensuring no one is left behind
    - Case studies in rural, suburban and urban corridor locations
    - Delivering solutions where commercial market will not deliver
    - supporting local community transport groups in the transition to electric vehicles

[4] The increase in charger numbers is compared to the number of chargers installed on the ChargePlace Scotland Network at December 2019 as detailed in Table 13.11 of the Scottish Transport Statistics 2019 (https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition/chapter-13-environment-and-emissions/).

[5] The increase in charger numbers is compared to the number of chargers installed on the ChargePlace Scotland Network at December 2019 as detailed in Tables 13.11 of the Scottish Transport Statistics 2019 (https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition/chapter-13-environment-and-emissions/) and does not take into account chargers installed in 2020 via other programmes. The number of EV chargers in Scotland at August 2020 when the first Project PACE hub went live was around 1400.

2.5 Project Schedule

The key phases of Project PACE are illustrated in Figure 4 below:

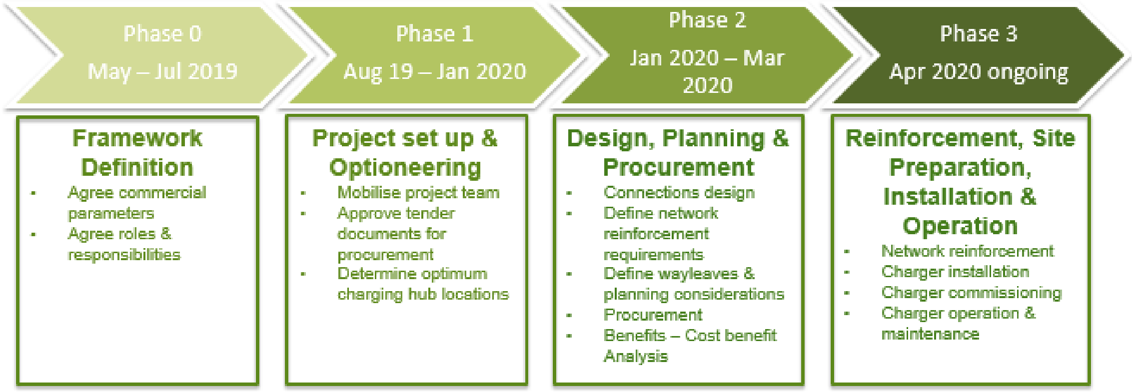

Figure 4: Project PACE key phases

The optioneering study in Phase 1 was 100% funded by SPEN's Green Economy Fund and is the focus of this report.

3. Electric Vehicle Charging Infrastructure Delivery in Scotland

This section gives an overview of Scotland's pioneering ChargePlace Scotland EV charging network and compares the EV charging site selection approach taken in Project PACE and how this differs from the local authority led approach.

3.1 Transport Scotland's ChargePlace Scotland Network

ChargePlace Scotland
electric vehicle charging

ChargePlace Scotland[6] is a national network of EV charge points available across Scotland. The vast majority of publicly available EV chargers in Scotland are currently connected to the ChargePlace Scotland network.

The ChargePlace Scotland network has been developed by the Scottish Government through grant funding of Local Authorities and other organisations to host publicly available charge points.

[6] More information about the ChargePlace Scotland network can be found at https://chargeplacescotland.org/

The EV chargers installed by Project PACE will be added to the ChargePlace Scotland network. The project is targeting an increase of **14%** in the number of chargers connected to ChargePlace Scotland (as ad December 2019).

Figure 5: ChargePlace Scotland Electric Vehicle Charger

3.2 Current Local Authority Led Delivery Model

One element of the delivery model for Transport Scotland funded EV chargers involves Transport Scotland allocating funding for EV chargers to each of Scotland's 32 local authorities via the Local Authority Implementation Programme (LAIP). Each local authority carries out their own procurement process for a small number of EV chargers, ancillary equipment and associated installation works.

In this model the local authority selects a site then applies to the DNO for a connection to the electricity network, following the standard connections process. The DNO will quote for the specific connection requested by the customer.

If this quote is more expensive than the local authority has estimated, they can seek additional grant funding. If additional grant funding is not agreed, the local authority will pick another site and request another connection. This process is repeated until a site is found with a suitable connection cost. Where requested, SP Energy Networks can provide a customer funded feasibility study prior to a formal connections application being made. These feasibility studies are normally limited to technical assessments of pre-chosen sites.

This process is illustrated in Figure 6 below.

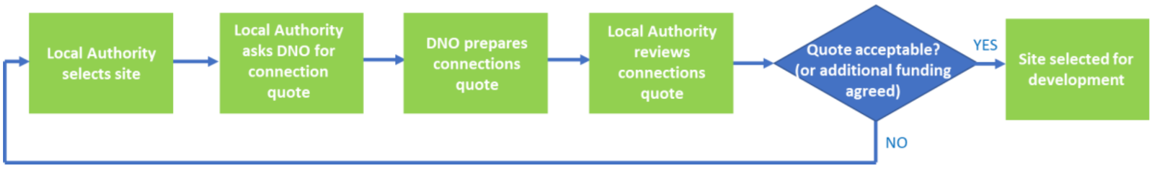

Figure 6: Local Authority led process for site selection

The existing Transport Scotland funded Local Authority Implementation Programme (LAIP) relies on resources and coordination within each local authority to spend the grant funding and deliver EV charging infrastructure. This can lead to differences in approach and deployment of EV chargers.

3.3 Project PACE Innovative DNO Led Delivery Model

In comparison to the LAIP, where site selection is led by the local authority, the innovative Project PACE site selection process is led by the DNO. SP Energy Networks have used their unique knowledge of the electricity network and worked collaboratively with key stakeholders to determine the optimum locations for community EV charging hubs.

The pilot DNO led delivery model includes the following steps carried out by the DNO:

- Develop a long list of potential sites with the local authorities
- Carry out an initial screening of the sites based on practical factors including availability of space, land ownership and environmental restrictions
- Agree general terms and conditions for all sites with the local authorities up front
- Specify equipment that can be installed under permitted development to avoid lengthy planning applications
- For the list of sites that remains, carry out network analysis to ensure chargers can be installed at that location for a reasonable cost
- For each site with suitable access to the electricity network, determine the optimum number of EV chargers
- Compare sites in close proximity to each other, and refine the list to develop a short list
- Review and agree short list of sites with local authorities
- Process connections applications for agreed sites for local authorities in batches

Figure 7: DNO led process for site selection

4. Trial Location Selection

The area selected for the trial covers both South and North Lanarkshire, which represents a diverse geographic and demographic challenge representative of many other areas of Scotland. The combined council population is the largest in Scotland and represents a unique opportunity to deliver national infrastructure across a diverse economic and geographic area, which will provide scalable learning across Scotland (& UK).

4.1 South Lanarkshire

- This region has a large and varied geographical territory and takes in rural and upland areas, market towns such as Lanark, Strathaven and Carluke, the urban burghs of Rutherglen and Cambuslang, and the new town of East Kilbride.
- South Lanarkshire is representative of much of Scotland as it includes urban and semi-urban areas, commuter towns and rural locations.
- SPEN has previously completed initial EV adoption modelling for East Kilbride, which provides greater understanding of the impact of EV charging on the network in this area.

Figure 8: South Lanarkshire trial area

4.2 North Lanarkshire

- Represents a similarly diverse geographic area and is positioned in a strategic location on the north east of the City of Glasgow, containing many of Glasgow's suburbs and commuter towns. It also borders East Dunbartonshire, Falkirk, Stirling, South Lanarkshire and West Lothian.

Figure 9: North Lanarkshire trial area

5. Multidisciplinary Optioneering Team

In order to carry out the sophisticated site selection exercise, a dedicated multidisciplinary team within SP Energy Networks was established.

An overview of the roles and responsibilities is given in Table 1 below:

Table 1: Optioneering team roles & responsibilities

Role	Responsibilities
Project Management & stakeholder engagement	Development of project strategy, liaising with Transport Scotland and local authority project leads, coordination of disciplines and activities, project reporting & governance, cost control, benchmarking against existing EV charging infrastructure project and review of common challenges.
Land Rights Officers	Confirmation of council ownership of each site (via council records or direct from land registry), checked each site for environmental planning restrictions such as protected woodland, flood plain or areas of sensitivity (e.g. conservation areas), arranged detailed environmental survey of each shortlisted HV site to confirm no environmental restrictions. Also checking for existing planning applications for commercial EV charging hubs in the area and checking that there are no commercial chargers suitable for all types of EV within 2 miles.
Electrical Design Engineers	Determination of distance to nearest suitable point of connection to the network, analysis of local HV and LV network capacity, determination of optimum EV charger configuration to make most efficient use of available capacity, review of planned reinforcement works to find synergies with proposed EV charging hubs, development of connections quotes, review of earthing requirements and requirement to move any existing street furniture such as lampposts.
Delivery Engineers	Confirmation of space and access requirements for equipment installation and maintenance and confirmation of requirements for vehicular access and egress from the EV chargers.

Alongside the optioneering study, additional activities (part GEF funded) were carried out to prepare for the delivery phase of Project PACE and to create a framework for a repeatable delivery model that can be used to accelerate progress on future similar projects. These included preparation of equipment specifications, development of a collaboration agreement with the local authorities and development of an agreed approach to planning applications with the local authorities.

Additional roles and responsibilities for these activities are given in Table 2 below:

Table 2: Repeatable delivery framework roles & responsibilities

Role	Responsibilities
Specification Development Engineers	Reviewing existing specifications and standards, liaising with manufacturers to understand best practice, development of equipment specifications
Planning Engineer	Liaising with local authority planning officers to agree an effective approach to planning for the delivery phase that involved making use of permitted development wherever possible, liaising with design and specification development engineers to confirm planning requirements.
Solicitors	Liaising with local authority solicitors, Legal drafting of overarching collaboration agreements with local authorities supported by style lease, license and wayleave documents.

6. Optioneering Study Methodology

This section details the steps taken by SP Energy Networks, working closely with key stakeholders, to refine a long list of potential sites to a short list of viable sites with optimum EV charger configurations and to provide examples of unviable sites eliminated at each stage. An overview of the optioneering process is given in Figure 10:

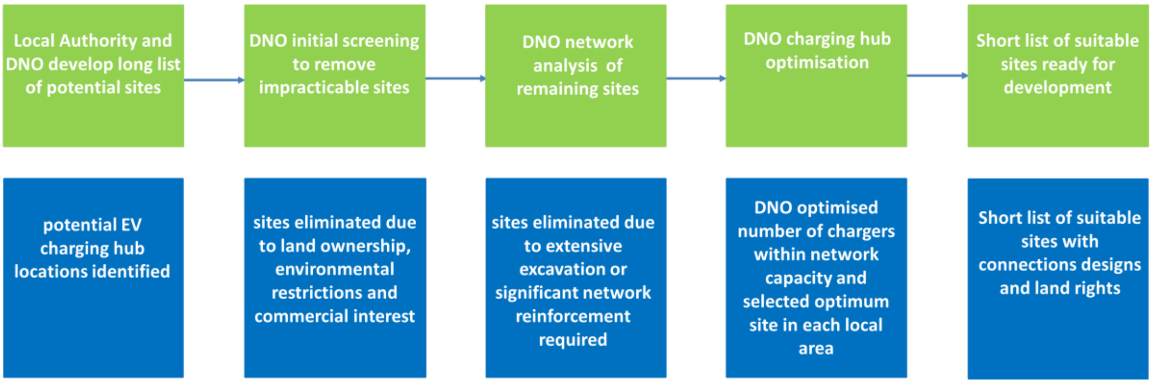

Figure 10: Optioneering Process

6.1 Longlist Identification

At the beginning of the project, a long list of 110 possible sites for EV charging hubs was generated by SP Energy Networks, North Lanarkshire Council and South Lanarkshire Council. All sites identified were locations where EV chargers would provide benefit to local communities such as parks, leisure facilities and local high street car parks in areas where commercial EV chargers were not available or known to be planned. This long list took account of many factors including local area knowledge, extensive electricity network knowledge and local authority development plans.

Under the existing local authority led model, all 110 sites could potentially have, over many years, been deemed viable and been delivered, in some cases, at high cost to Transport Scotland. SP Energy Networks' extensive network insight allowed the prohibitively expensive sites to be excluded for delivery by Project PACE, enabling more effective use of public funding in the short to medium term.

6.2 Phase 1 – Initial Screening

Methodology

The long list was reduced in a systematic and repeatable manner using the following steps:

- Establish land ownership, high level assessment of proximity of electricity network and land rights and environmental concerns such as protected sites and conservation areas. This approach was two-fold and involved, where possible, the local authority supplying any deeds and boundary records that they had, as well as SPEN conducting an independent land registry check
- Further to confirming land ownership, the remaining sites then underwent assessments to establish any environmental or planning concerns. Checks were made for protected woodlands, areas of sensitivity and flood plains
- Proximity to commercial charging locations. All locations within 2 miles commercial charging locations were removed[7].
- Desk top review of potential location – identify space restrictions to install key electrical infrastructure or for vehicular access and egress from the charger stations.
- Site visit to confirm car park surface is in good repair and sufficient space and access is available to install key electrical infrastructure or for vehicular access and egress from the charger stations.

Established site screening criteria

In order to progress from Phase 1 to Phase 2, sites had to meet the following criteria:

[7] Note, this does not include commercial Tesla chargers as these are not suitable for charging all types of electric vehicles.

Table 3: Site screening criteria

Category	Criteria
Land ownership	• Land must be owned by the local authority
Environmental concerns	• Land must not be subject to environmental restrictions such as protected woodland, flood plain or area of sensitivity (e.g. site of special scientific or architectural interest)
Planning concerns	• Land where planning permission is highly unlikely to be granted (e.g. conservation areas) is to be avoided
Proximity to existing or planned commercial EV chargers	• Locations where there are existing (or known to be planned) commercial EV chargers within 2 miles are to be avoided
Proximity to electricity network (high level screening)	• Land must have a potential connection to the electricity network within 500m with a likelihood of spare capacity
Car park condition, access & space availability	• Sufficient space for installation and maintenance of electrical equipment and EV chargers • Sufficient space for vehicle access and egress to EV chargers • Sufficient space to create at least one accessible charging bay • Car park surface in acceptable state of repair • 24-hour access to EV chargers (or in exceptional cases approved by Transport Scotland and the Local Authorities where gates are closed overnight, alternative 24-hour charging facilities are available within 2 miles)

This phase resulted in 110 sites being refined to 83 sites. The 83 sites remaining were reviewed further in Phase 2. The Phase 1 initial screening process is illustrated in Figure 11 below.

Note that the network connections designs for sites excluded by phase 1 were not developed so the probable significantly higher costs of sites >500m from the electricity network are not included in the cost savings quoted.

Number of sites identified at the start of Phase 1	110
Sites ruled out due to insufficient space for equipment and vehicular access to chargers	14
Sites ruled out due to land ownership	7
Sites ruled out due to environmental restrictions	3
Sites ruled out due to commercial interest	3
Number of sites remaining at the end of Phase 1	**83**

Figure 11: Overview of Phase 1 – Initial Screening

Examples

An example of a site that was removed from progressing into the shortlist is the Emma Jay Road car park in Bellshill. Whilst the network surrounding the site is extensive, SPEN's initial land ownership checks indicated that this land may not be owned by North Lanarkshire Council, this was subsequently confirmed by the local authority.

Another example of a site that was removed from process by this screening phase, is the Carey Gardens Car Park, which services both the local library and community facility. There are a limited number of spaces at this location for these community services, and any charging infrastructure sited here would impact negatively on the community by removing a large proportion of the spaces.

6.3 Phase 2 – Electricity Network Analysis

Methodology

SPEN design engineers carried out network capacity checks for the 83 sites that made it through the Phase 1 selection process. This involved identifying Low Voltage (LV) and High Voltage (HV) network infrastructure close to the proposed charger location. The optimal point of connection to the existing network, was selected and capacity checks undertaken.

At this point in the local authority led model, the DNO is required to provide a connections quote for the requested site. In the Project PACE optioneering study, the design engineers defined three outcomes as follows:

- **Sufficient Network Capacity** – the existing network has unutilised capacity which would support the demand that the new charging location would place on the network.
- **Insufficient Network Capacity**- the existing network had insufficient capacity to support the demand that the new charging location would place on the network, and to increase this capacity would involve major reinforcement works that are expensive and can present additional delivery challenges.
- **Distance to Point of Connection** – Our design engineers identified that the safest and most appropriate point of connection for the proposed charging location was unjustifiably far from the charging location itself resulting in excessive digging lengths and increased associated connection costs.

This stage was a key step in delivering efficiencies. From their extensive knowledge and experience of the electricity network, the SPEN design engineers were able to eliminate sites that would be prohibitively expensive as a result of the requirement for network reinforcement due to insufficient capacity or extensive excavation due to the distance to the point of connection.

This phase of site refinement saw a reduction of sites from 83 to 53 sites as detailed in Figure 12 below:

Number of sites at the start of Phase 2	**83**
Sites ruled out due to insufficient network capacity	17
Sites ruled out due to long distance to nearest available point of connection	13
Number of sites remaining at the end of Phase 2	**53**

Figure 12: Overview of Phase 2 – Electricity Network Analysis

Examples

Whilst discounted from Phase 3, SPEN design engineers prepared connections quotes for the 30 sites that were removed in Phase 2. Two examples are set out below: one example where there was insufficient network capacity and one example where there was an unreasonable distance to the point of connection.

The schematic (below) depicts Salsburgh Community Hall, which would have required a 568m dig and cable track to its nearest point of connection. The indicative connections quote for this site was £118,000 (excl. VAT), much higher than the average connections cost of the sites selected for development (<£30,000 (excl. VAT)). The green markings denote the proposed cable route.

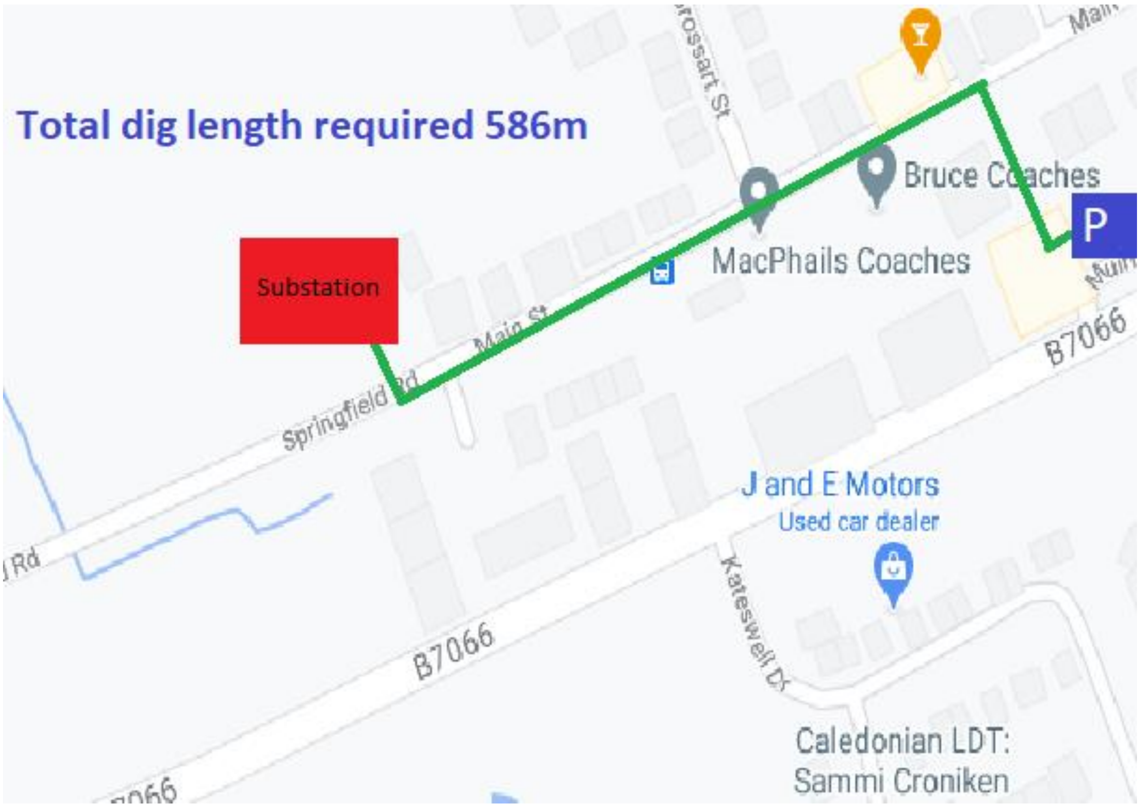

Figure 13: Salsburgh Community Hall

Another example of a site ruled out in Phase 2, in this instance due to poor network capacity, was Garnqueen Loch, which, inclusive of a new substation, would cost an indicative £111,000 (excl. VAT) to connect to the network. There is no HV infrastructure in the area and the existing LV cabling is already at full capacity. Not only would this site require a new substation to be installed, it would also require extensive excavation to connect this substation to the HV network.

Figure 14: Garnqueen Loch

6.4 Phase 3 – Site Optimisation

The remaining 53 sites were deemed viable based on the stringent process carried out during Phases 1 & 2. However, further optioneering was carried out to develop a confirmed list of site locations and ensure the project delivered maximum efficacy.

Methodology

- **EV-Uptake Modelling (EV-Up)[8] –** This is another SPEN commissioned project aimed at better understanding customers' ability to transition to electrified transport by combining households' ability to park off street with key socio-demographic information such as age profile and economic activity. Combining this information will enable SPEN to have greater understanding of the probability of specific areas transitioning to EVs, greatly improving future demand profiling for domestic customers and understanding of what network reinforcement solutions could be adopted. Furthermore, the project identified communities most likely to be early adopters of EVs, as well as areas where customers owning an EV face problems, including housing with off-street parking. Areas with housing with a lack of off-street parking will need greater deployment of publicly available EV charging infrastructure to support the transition to EV ownership. Shortlisted sites were reviewed in the EV-Up model to determine the relative EV adoption rate in the short to medium term including a consideration of areas where building type will be a barrier to EV adoption.

- **Destination Type** – The social or community-based activities that the hub location car park services. Car Parks that support multiple services ensure that a greater number of users are benefitting from any EV infrastructure. Distance to facilities such as catering was also considered.

- **Local Authority Input** - Both local authorities provided details of existing community transport groups, which enabled SPEN to liaise with these groups to facilitate a future transition into EVs.

- **Geographical Spread** - When an area had multiple viable sites, the best suited site taking the above into consideration alongside cost was selected. SPEN had coverage maps produced to ensure that as many communities as possible were serviced as a result of this project.

[8] SPEN innovation project funded via the Ofgem Network Innovation Allowance. More information can be found here https://www.smarternetworks.org/project/nia_spen_0037

In Phase 3, 53 viable sites were further reduced to 44 sites as detailed in Figure 15 below:

EV-Up	Destination type	Catering facilities available	Synergy with community transport group	Commercial EV chargers within 2 miles
• High proportion of early adopters • Low levels of off-street parking	• Is the hub in a popular destination such as a park, leisure centre or town centre?	• Are there facilities for drivers to use whilst car is charging?	• Is this charging hub likely to be used by a community transport group?	• Are there other EV charging facilities in the vicinity?

Number of sites at the start of Phase 3	**53**
Too close to better proposed sites	7
Significant amount of tree removal required	2
Number of sites remaining at the end of Phase 3	**44**

Figure 15: Overview of Phase 3 – Site Optimisation

Example

The below diagram shows 4 viable sites within Motherwell Town Centre. Using site optimisation, 4 sites were narrowed down to 1 site.

Site 2 and 3 - Both sites had scheduled investment works by the council which didn't fit with project timescales. These sites were ruled out at this phase.

Site 4 - Better value for money would be delivered in a large town centre area by having 1 large hub rather than multiple small hubs. This site wouldn't have allowed a large sized hub, and so was ruled out at this phase.

Site 1 – This car park services a leisure centre with swimming, skating and gym facilities. The car park is extensive and currently underutilised with space for a HV solution, meaning a large hub can be installed. This car park is also within walking distance to the local train station and town centre. Using the criteria defined in this phase, this was chosen as the optimal site for the area.

Figure 16: Motherwell Town Centre site optimisation

6.5 Phase 4 – Independent verification of site suitability for community

To validate the selected sites likely adoption by the local community, SPEN engaged a specialist consultant with experience of working with local authorities on community engagement for new EV charging hub installations[9].

Methodology

The consultant provided independent validation of the shortlisted locations, using their experience of the community adoption of existing EV charging hubs. Leveraging their experience of community perspectives from other projects, the contractor assessed the environment around the identified locations based on community based factors such as employment, deprivation, travel times to key services and dwelling type.

[9] Urban Foresight are an industry consultant with significant experience in the field of EV charging infrastructure and associated community engagement. They have wide experience in supporting EV charging infrastructure projects with local authorities across Scotland.

The independent review concluded that the EV charging hubs at all sites shortlisted by SPEN and the local authorities were likely to be successfully adopted by the local community.

6.6 Phase 5 – Optimum Site Configuration

Methodology

Using knowledge of the electricity network constraints and local knowledge of the communities under review, SPEN design engineers were able to determine an optimum EV charging hub configuration for each site. This hub configuration took into account the available electricity network capacity and the predicted driver behaviours at each site such as the length of time drivers would be likely to leave their cars at the EV charging hub. They used this information to determine the optimum number and split of EV chargers (between 7kW, 22kW and 50kW chargers) at each location that could be delivered without incurring unnecessary network upgrade costs.

Example

Regent Drive in Rutherglen is an example of a site which demonstrates maximum utilisation of current capacity, avoiding costly HV upgrade works. As illustrated in the schematic below, the car park has available points of connection to both the HV and LV networks nearby.

The available capacity within the LV network at that location accommodates 2 x rapid 50kW chargers, 2 x 22kW chargers and 1 x 7kW charger. A hub with this configuration can service 10 cars at any one given time. This configuration allows different user types to benefit from these chargers depending on their charging requirements. If the hub were to be designed with more chargers than proposed, a new substation may be required, and the connection cost would then be £76,000 (excl. VAT) compared to £20,280 (incl. VAT) for the proposed connection design.

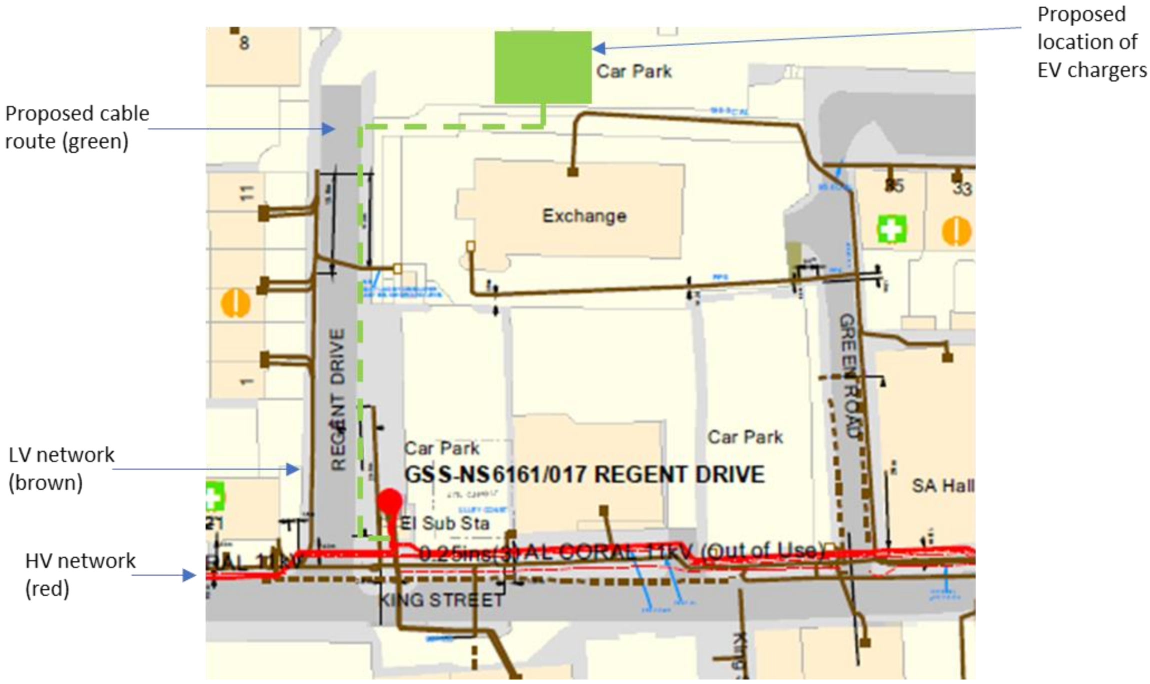

Figure 17: Regent Drive, Rutherglen

7. Benefits realised by Green Economy Funded Optioneering Study

The optioneering study will enable a potential saving of between £1.3m and £2.6m in connections costs (inclusive of VAT).

This is an estimated average saving of between £30k and £60k (50-65%) per site in connections costs.

7.1 Connections Costs

During the optioneering phase, connections quotes were prepared for 83 sites. 44 sites were selected for development in the delivery phase.

SPEN's connections costs are determined by published charging methodologies and statements and regulated processes that are governed by the industry regulator Ofgem. To calculate the benefits of the site selection study, SPEN has consistently used these methodologies and processes to estimate the connections cost for each site.

Had the DNO optioneering study not been carried out and the 44 most expensive sites had been selected for development, the total connections cost would have been £4,135,623.

Had the DNO optioneering study not been carried out and the 44 median cost sites been selected for development, the total connections cost would have been £2,882,849.

The total connections cost for the 44 sites selected based on the optioneering study is £1,510,129. The potential saving achieved in connections costs is £2.6m when the total connections cost of the 44 sites selected based on the optioneering study is compared with the 44 most expensive sites and £1.3m when compared with the total connections cost of the 44 median cost sites. This gives a range of potential savings between £1.3-£2.6m.

The total connections cost for the 44 selected sites, compared with the 44 lowest cost sites, the 44 most expensive sites and median 44 sites from the long list of 83 is shown in Figure 188 below:

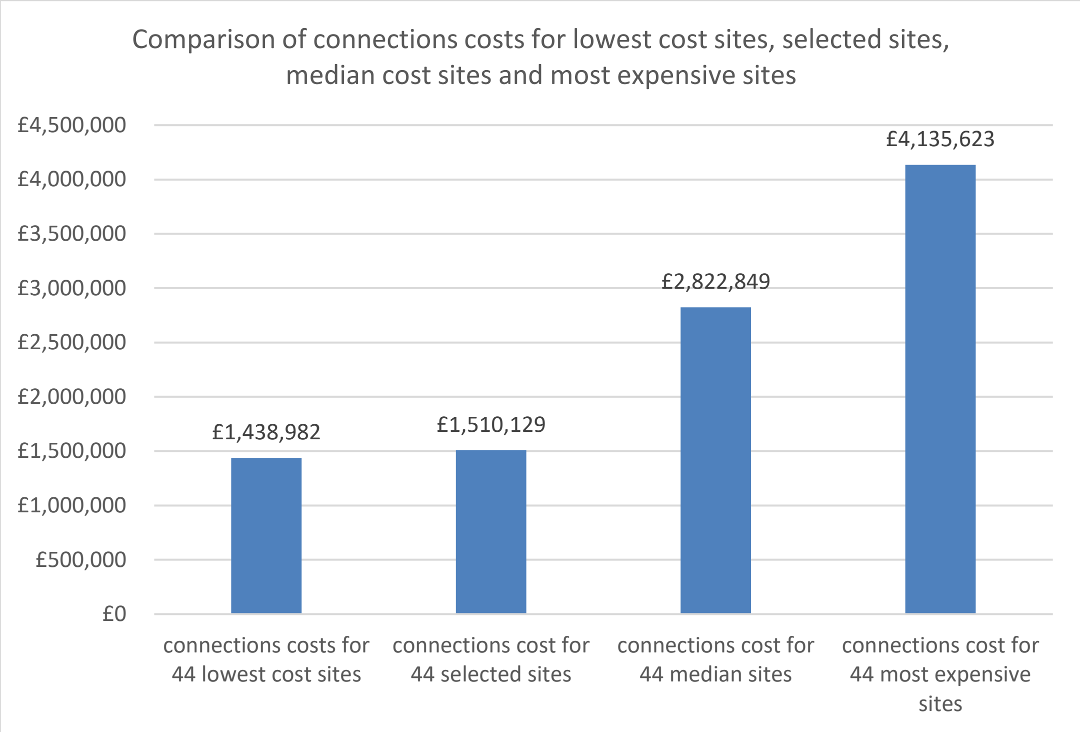

Figure 18: Comparison of connections costs

Analysing the costs in Figure 18 shows that Project PACE has achieved a saving of between £1.3m and £2.6m in connections costs. This equates to an average saving of between £30k and £60k per site. These figures are inclusive of VAT.

Note that the Project PACE optioneering team did not simply select the cheapest 44 sites. A range of factors were considered including the potential benefit of each site to the local community. In several cases, where it was agreed that a more expensive site would be of significantly greater benefit to the community than a cheaper site in the same area, the more expensive site was selected. An example of this is Broadwood Stadium, Cumbernauld. Broadwood stadium is at the heart of the community including a football stadium and a sports centre, and within easy walking distance of Broadwood Loch and a new retail park. A large hub consisting of 4 x 50kW chargers, 2 x 22kW chargers and 2 x 7kW chargers can be accommodated here allowing 16 EVs to be charged at the same time. The connections cost for Broadwood stadium is £72,094 (excl. VAT).

Figure 19: Map of Cumbernauld showing Broadwood and Palacerigg

Palacerigg Country Park was a site which, whilst viable, the existing network would not have been able to support a hub of the same size as Broadwood. Less than half the number of chargers would be able to be installed here. The connection cost for Palacerigg would be an indicative £65,698. Whilst over £6,000 cheaper than Broadwood, the hub itself would not support the same volume of cars as well as not having the same level of amenities nearby. Whilst there is a country park and golf course nearby, Broadwood has significantly more amenities within close proximity. Figure 19 above shows a lack of charging around Broadwood and the surrounding areas, whereas Palacerigg is closer to existing charging infrastructure. A key issue faced within Cumbernauld is that a lot of the town centre is not owned by the local authority, meaning that options are restricted, and several smaller hubs are harder to achieve than one larger hub. Also, whilst it can be undertaken, there would also be a significant amount of tree cutting required to facilitate the installation into Palacerigg. These weighted factors then allowed the project team to select the best location within Cumbernauld area.

This benefit has been achieved by taking a non-standard approach to site selection and EV charging hub design, employing SPEN's knowledge of the electricity network from the start of the project to identify optimum EV charging hub locations and configurations. Analysing the electricity network, SPEN design engineers have managed to both eliminate sites with high connections costs due to significant network upgrades or extensive excavation and to maximise synergies with planned electricity network upgrades.

SPEN, and other DNOs, have the capabilities to complete this enhanced optioneering activity under normal circumstances, however, the following points should be noted:

- As a regulated natural monopoly DNOs are not currently funded by customers for this activity via their current RIIO-ED1 price control framework, which is regulated by Ofgem.
- Third party customers therefore would need to pay the DNO directly for these extensive feasibility studies.

7.2 Synergies with planned network upgrades

Nine of the proposed EV charging hubs will be connected to the network via substations that were due to be upgraded as part of existing planned network works[10]. As a result, the project will only pay for a proportion of the network upgrade works. By working with planned network upgrade synergies, £421,716 savings could be realised, an average saving of 26% across the nine suitable sites.

Had these planned synergies not been achieved, for example if the proposed EV charging hubs had been developed at a different time to the planned network works, the project could have been eligible to pay the full cost of the upgrade works.

Working in alignment with planned network upgrades has saved over £10,000 on the average connection cost of the proposed 44 sites. With network synergies, the average connections cost of the 44 selected sites is £28,600. If synergies with planned network upgrades were not achieved, the average connections cost of the 44 sites would have been £38,200.

7.3 Optimised Site Configuration

By configuring the mix of EV chargers in the EV charging hub to maximise available network capacity, unnecessary network reinforcement can be avoided.

The main advantages of a DNO led approach is the insight into the network and available capacity within different locations that the DNO design engineers can bring. SPEN design engineers analysed the network, calculated the available capacity and used this to determine EV charging hub configurations that did not require additional HV works. This

[10] This would apply to any connecting party connecting to these upgraded substations

enabled 22 large EV charging hubs to be connected to the LV network, with site configuration tailored to the available capacity. The standard approach to connections would be that the local authority applies for a connection with a pre-determined site configuration and load demand. The DNO would quote for this connection cost, and if the demand exceeded the available capacity, then HV or reinforcements works would be necessary. Some examples of this are highlighted below.

Examples of site optimisation

The Wynd Car Park in Cumbernauld is a site that has been tailored to fit the available capacity. The designed hub model has 1 x rapid 50kW charger and 2 x 7kW chargers. That is all that the network in that area can support, and the installation of additional chargers would take the anticipated site cost from £42,948 to £92,878 due to reinforcement works. As well as incurring additional costs, installation of a new HV substation would involve additional time delays due to third party land being utilised, and disruption to local residents with access restrictions throughout the works.

The Ally McCoist Centre in East Kilbride is another example of available capacity being utilised fully. The designed hub model at that location has 1 x rapid charger, 1 x 22kW charger and 1 x 7kW charger. To increase the volume of chargers at this site would have required a new substation on the site, meaning that the anticipated cost of this site would have increased from £43,285 to £108,215.

8. Outputs targeted in delivery phase enabled by the Optioneering Phase

The outputs of the optioneering study will enable Project PACE to deliver the following in the delivery phase:

- A potential increase of over **200%** in the number of ChargePlace Scotland EV chargers in Lanarkshire,
- A potential increase of **90%** more 7kW standard chargers, **400%** more 22kW fast chargers and **500%** more 50kW rapid chargers in Lanarkshire[11]
- A potential increase in installed capacity of around **10MW**, an increase of **360%**, that is expected to accommodate the charging of **5000** more EVs across Lanarkshire
- A resulting potential carbon reduction of over **6,200 tonnes CO_2/year**
- Time savings in the delivery phase as this approach allows common problems known to cause significant delays in the delivery of EV charging hubs (including land rights, required consents, planning permissions and scheduling road openings on major roads) to be avoided.
- By investing the expected saving in connections costs in the delivery of additional chargers, the project will potentially deliver up to 70% additional EV charging capacity than would have otherwise been possible within the fixed project funding

9. Projected Scotland & UK Wide Benefits of Project PACE approach

The Committee on Climate Change report "*Net Zero: The UK's contribution to stopping global warming*" states that 210,000 public EV chargers are required across the UK by 2050[12].

Scaled on population, the Project PACE optioneering study has identified optimal locations and configurations for charging hubs to meet approximately 10% of this predicted public EV charger requirement for two of Scotland's local authorities in just

[11] The increase in charger numbers is compared to the number of chargers installed on the ChargePlace Scotland Network at December 2019 as detailed in Tables 13.11 and 13.12 of the Scottish Transport Statistics 2019 (https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition/chapter-13-environment-and-emissions/) and does not take into account chargers installed in 2020 via other programmes. The number of EV chargers in Scotland at August 2020 when the first Project PACE hub went live was around 1400.
[12] https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

one year with connections savings of £30,000 - £60,000 per hub, a total connections saving of £1.3m-£2.6m (incl. VAT).

If a similar optioneering study were to be rolled out more widely, significant savings could be made on connections for EV charging hubs.

SPEN owns and operates the electricity networks servicing 21 of Scotland's 32 local authorities, approximately 80% of the Scottish population. Carrying out an optioneering study similar to Project PACE across the rest of the SPEN area in Scotland would cost ca. £5m, to identify around 270 optimum EV charging hub locations containing around 1080 chargers and saving more than £16m in connections costs (estimated).

Scaling up this site selection activity to the whole of Scotland, including the SSEN network, would cost ca. £7.5m, to identify around 430 optimum EV charging hub locations containing around 1730 chargers and could save more £26m in estimated connections costs.

Carrying out this site selection activity across the whole of the GB would cost ca. £94m, identify around 5,200 optimum EV charging hub locations containing around 21,000 chargers and could save more than £310m in connections costs (estimated).

A summary of these figures is provided in Table 4 below.

Table 4: Scale up of Project PACE site selection

	Number of chargers	Number of EV charging hubs	Cost of optioneering study	Connections saving[13]
Project PACE	209	44	£0.5m	£1.3m - £2.6m
SPEN area (Scotland, excl NLC & SLC)	1080	270	£5.0m	£8m - £16m
Scotland wide (excl NLC & SLC)	1730	430	£7.5m	£13m - £26m
UK wide	21,000	5,200	£94m	£160m-£310m

NOTE: Scaling based on population and assuming equivalent savings

This study has demonstrated that there are significant financial savings and time savings (with both environmental and economic benefits) to be leveraged through early and effective engagement of DNOs in public EV charging hub site selection.

These benefits are delivered through completion of network feasibility studies and through working collaboratively with local authorities in the planning stage.

[13] Connections savings are inclusive of VAT

10.Appendices

11.1 Appendix 1: Sites considered and selected at each stage (including estimated connection costs)

Site Reference Number	Successfully Shortlisted Site (Y/N)	Reason for Exclusion (if applicable)	Indicative Connections Cost (£)
N12	N	Excluded Phase 1	N/A
N15	N	Excluded Phase 1	N/A
N17	N	Excluded Phase 1	N/A
N21	N	Excluded Phase 1	N/A
N23	N	Excluded Phase 1	N/A
N27	N	Excluded Phase 1	N/A
N3	N	Excluded Phase 1	N/A
N34	N	Excluded Phase 1	N/A
N35	N	Excluded Phase 1	N/A
N38	N	Excluded Phase 1	N/A
N39	N	Excluded Phase 1	N/A
N42	N	Excluded Phase 1	N/A
N45	N	Excluded Phase 1	N/A
N46	N	Excluded Phase 1	N/A
N47	N	Excluded Phase 1	N/A
N51	N	Excluded Phase 1	N/A
N54	N	Excluded Phase 1	N/A
N60	N	Excluded Phase 1	N/A
N9	N	Excluded Phase 1	N/A
S20	N	Excluded Phase 1	N/A
S29	N	Excluded Phase 1	N/A
S3	N	Excluded Phase 1	N/A
S30	N	Excluded Phase 1	N/A
S32	N	Excluded Phase 1	N/A
S4	N	Excluded Phase 1	N/A
S7	N	Excluded Phase 1	N/A
N16	N	Excluded Phase 1	N/A

N4	N	Excluded Phase 2	£59,523.86
S5	N	Excluded Phase 2	£68,582.11
J3	N	Excluded Phase 2	£65,522.62
N33	N	Excluded Phase 2	£111,482.95
N53	N	Excluded Phase 2	£118,205.82
N57	N	Excluded Phase 2	£74,580.29
S8	N	Excluded Phase 2	£84,901.45
S2	N	Excluded Phase 2	£109,443.88
N18	N	Excluded Phase 2	£66,052.72
N20	N	Excluded Phase 2	£65,028.08
N22	N	Excluded Phase 2	£61,925.16
S35	N	Excluded Phase 2	£74,133.27
N29	N	Excluded Phase 2	£121,688.78
N31	N	Excluded Phase 2	£69,694.88
N32	N	Excluded Phase 2	£76,276.80
N36	N	Excluded Phase 2	£109,803.00
N37	N	Excluded Phase 2	£94,469.09
N40	N	Excluded Phase 2	£124,366.58
N30	N	Excluded Phase 2	£71,091.59
N43	N	Excluded Phase 2	£75,069.35
N48	N	Excluded Phase 2	£74,021.61
N52	N	Excluded Phase 2	£89,420.79
N55	N	Excluded Phase 2	£73,614.24
N58	N	Excluded Phase 2	£90,546.91
N6	N	Excluded Phase 2	£72,018.94
N62	N	Excluded Phase 2	£87,872.66
N7	N	Excluded Phase 2	£59,764.92
N8	N	Excluded Phase 2	£73,997.38
S11	N	Excluded Phase 2	£75,900.38
S14	N	Excluded Phase 2	£71,501.56
S24	N	Excluded Phase 3	£74,256.25
S25	N	Excluded Phase 3	£73,574.74
S35	N	Excluded Phase 3	£74,133.27

S6	N	Excluded Phase 3	£72,009.17
N11	N	Excluded Phase 3	£79,029.44
N19	N	Excluded Phase 3	£51,976.70
N25	N	Excluded Phase 3	£57,057.86
N26	N	Excluded Phase 3	£65,697.37
S16	N	Excluded Phase 3	£85,657.98
J1	Y	N/A - Site Progressing	£50,263.00
J2	Y	N/A - Site Progressing	£13,467.00
N1	Y	N/A - Site Progressing	£53,575.00
N10	Y	N/A - Site Progressing	£56,677.00
N13	Y	N/A - Site Progressing	£28,308.00
N14	Y	N/A - Site Progressing	£25,784.00
N2	Y	N/A - Site Progressing	£5,875.00
N24	Y	N/A - Site Progressing	£72,094.00
N28	Y	N/A - Site Progressing	£9,287.00
N41	Y	N/A - Site Progressing	£13,910.00
N44	Y	N/A - Site Progressing	£16,636.00
N49	Y	N/A - Site Progressing	£4,093.00
N50	Y	N/A - Site Progressing	£15,351.00
N56	Y	N/A - Site Progressing	£16,418.00
N59	Y	N/A - Site Progressing	£49,030.00
N61	Y	N/A - Site Progressing	£7,530.00
N63	Y	N/A - Site Progressing	£44,516.00
N64	Y	N/A - Site Progressing	£59,406.00
N65	Y	N/A - Site Progressing	£12,725.00
N66	Y	N/A - Site Progressing	£20,580.00
S1	Y	N/A - Site Progressing	£34,520.00
S10	Y	N/A - Site Progressing	£25,101.00
S12	Y	N/A - Site Progressing	£19,158.00
S13	Y	N/A - Site Progressing	£6,443.00
S15	Y	N/A - Site Progressing	£30,196.00
S17	Y	N/A - Site Progressing	£12,580.00
S18	Y	N/A - Site Progressing	£29,713.00
S19	Y	N/A - Site Progressing	£18,194.00

S21	Y	N/A - Site Progressing	£25,189.00
S22	Y	N/A - Site Progressing	£64,271.00
S23	Y	N/A - Site Progressing	£37,832.00
S26	Y	N/A - Site Progressing	£37,333.00
S27	Y	N/A - Site Progressing	£91,483.00
S28	Y	N/A - Site Progressing	£50,386.00
S31	Y	N/A - Site Progressing	£16,900.00
S33	Y	N/A - Site Progressing	£50,789.00
S34	Y	N/A - Site Progressing	£12,455.00
S36	Y	N/A - Site Progressing	£47,813.00
S37	Y	N/A - Site Progressing	£9,718.00
S38	Y	N/A - Site Progressing	£10,852.00
S9	Y	N/A - Site Progressing	£21,990.00
N6754	Y	N/A - Site Progressing	£7850.00
N68	Y	N/A - Site Progressing	£11,430.00
N69	Y	N/A - Site Progressing	£10,720.00

11.2 Appendix 2: Site Selection Considerations

Category	Criteria
Community utilisation	• Land must be in a public car park with public amenities nearby such as town centre shopping, country parks, sports & leisure facilities, libraries or community centres
Land ownership	• Land must be owned by the local authority
Environmental concerns	• Land must not be subject to environmental restrictions such protected woodland, flood plain or area of sensitivity (e.g. site of special scientific or architectural interest)
Planning concerns	• Land where planning permission is highly unlikely to be granted (e.g. conservation areas) is to be avoided
Proximity to existing or planned commercial EV chargers	• Locations where there are existing (or planning applications registered for) commercial EV chargers within 2 miles are to be avoided

Proximity to electricity network (high level screening)	• Land must have a potential connection to the electricity network within 500m with a likelihood of spare capacity
Car park condition, access & space availability	• Sufficient space for installation and maintenance of electrical equipment and EV chargers • Sufficient space for vehicle access and egress to EV chargers • Sufficient space to create at least one accessible charging bay • Car park surface in acceptable state of repair • 24-hour access to EV chargers (or in exceptional cases approved by Transport Scotland and the Local Authorities where gates are closed overnight, alternative 24-hour charging facilities are available within 2 miles)
Distance to nearest suitable point of connection	• What is the distance to nearest suitable point of connection? (<200m is preferable) • Are there road crossings required? • What type of excavation is required? • Is the excavation likely to cause major disruption (e.g. crossing a major road)?
Network analysis	• Is there sufficient capacity in the network? • Will the connection be HV or LV? • Will network reinforcement be required? • Are there any planned upgrade works in this area where synergies can be achieved?
EV charging hub configuration	• Based on available network capacity, what is the total charging capacity that can be accommodated within the EV charging hub? • Based on how the EV charging hub is likely to be used by the public (e.g. typical length of stay) what mix of EV charger types would be most beneficial?