WHAT YOU CAN DO - ASSESSING YOUR SITE 02

Understanding Your Demand Profile

Before deciding on whether you need to upgrade your existing electricity connection to accommodate the additional load requirements from electric vehicle charge points, you will need to establish how much electricity you are currently consuming on your site (i.e. your Maximum Demand) and at what times.

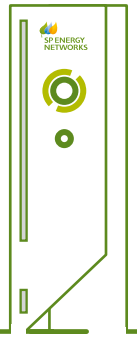
You should then check this against your Authorised Capacity for the site, as set out in your connection agreement (i.e. the capacity that you are authorised to use as part of your agreement with your DNO).

This will determine if you have available capacity to accommodate all, or part, of the additional load from your proposed EV charge points. While the provision of a single EV charger to support one or two vehicles may not be an issue, connecting multiple commercial vehicles will normally require an assessment of the electricity network. You should therefore contact your DNO to discuss whether an increase in your Authorised Capacity can be accommodated on the existing network or if the supporting electrical infrastructure needs upgrading to meet your requirements.

Optimising your Network Connection

Assessing your overall site requirements, rather than just looking at EV charging, may identify easy wins that can reduce your power requirements significantly. Reduction in your overall demand by achieving energy efficiencies and the introduction of demand side management technologies could also minimise, or in certain cases avoid, the need for reinforcement of the electricity network.

As an example, improving the energy efficiency of your depot/office buildings by reducing the amount of power used in heating, lighting, and other processes can help deliver additional capacity. Modifying how much and when you consume power on your site is also important in freeing up capacity at certain times for EV charging. This is particularly relevant where overnight charging is a requirement.



WHAT YOU CAN DO - ASSESSING YOUR SITE

02

Calculating your Fleet Charging Requirements

To calculate your EV charging requirements you will need to consider the following:

- The distance the individual vehicles needs to cover each day and over what timescale.
- When will your fleet need to be charged? - (throughout the day, overnight, when vehicles return, etc.)
- Where will your fleet charge? - (at home, en-route, at a destination or in depot)
- The number of vehicles that you will need to charge at any one time, both now and in the future.
- What duration does your fleet need to be charged? – (e.g. 40 mins, 2-4 hours, throughout the day or overnight)
- The likely charging patterns - (e.g. from 80% state of charge to 100% or do you expect your fleet to be recharging from almost 0% on every occasion?).

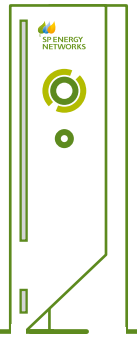
EV charger models have varying capabilities and power. If you want shorter charging times you will need higher powered chargers, which typically cost more and will increase your power requirements. A charge point installer should be able to assist you in identifying the appropriate EV charger specification, the number of charge points and power rating to meet your operational needs.

Do you have Sufficient Capacity?

Once you know how much demand you are using, when this is occurring and the spare capacity you have available, you can determine whether your maximum peak demand, including the EV charging requirements, is likely to be below your existing Authorised Capacity.

If your maximum demand is within your Authorised Capacity and total EV demand is less than 30% of your total site demand, then it may simply be a case of notifying your DNO of your plans, which you can ask your charge point installer to do on your behalf.

If your EV charging requirements take you above your Authorised Capacity or your total EV demand is more than 30% of your total site demand, then you will either need to take steps to reduce your maximum demand, as highlighted previously, or ask your DNO to provide more power to the site before your charge point installer undertakes the installation.



OPTIONS TO CONSIDER

04

Load Management

Load management systems offer a solution for multiple charge points to be operated without exceeding the maximum power capacity of a site.

Load management can be achieved through dynamic power management to charge points, reducing the speed of charge as necessary to moderate total electrical demand, striking a balance between the number and the speed of charge points.

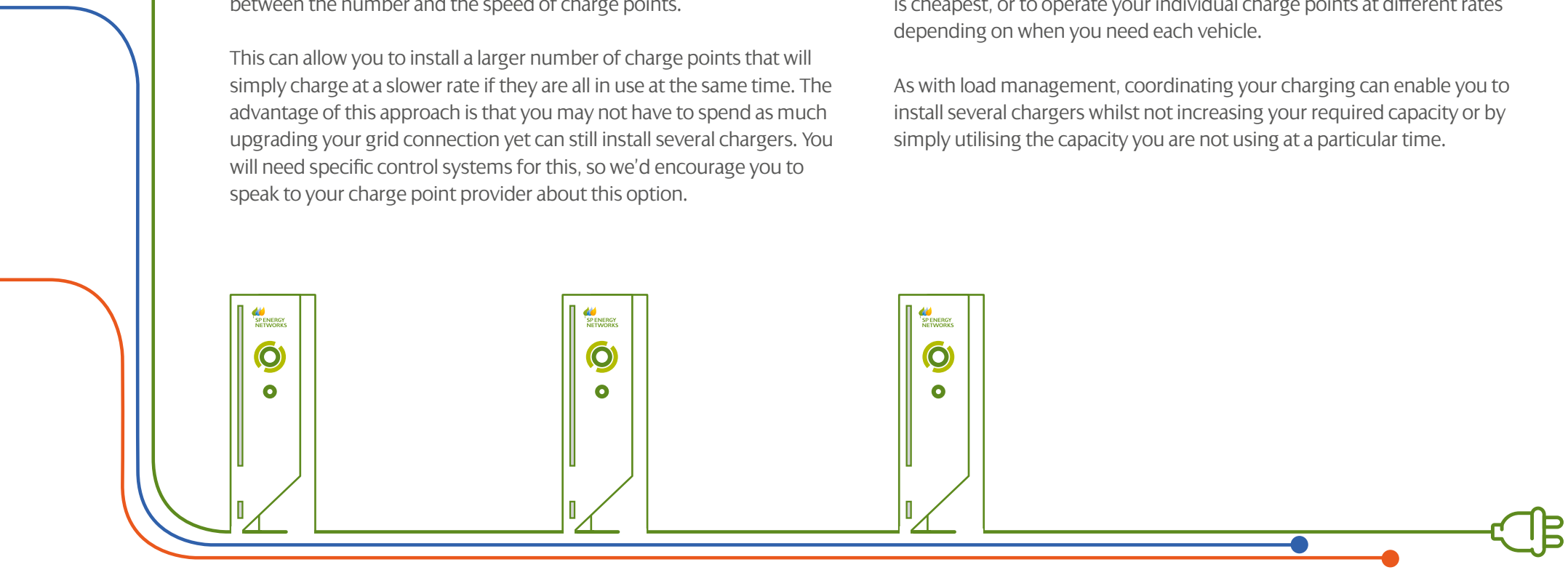
This can allow you to install a larger number of charge points that will simply charge at a slower rate if they are all in use at the same time. The advantage of this approach is that you may not have to spend as much upgrading your grid connection yet can still install several chargers. You will need specific control systems for this, so we'd encourage you to speak to your charge point provider about this option.

Smart Charging

Smart charging refers to different intelligent functionalities that help you recharge your vehicles in an efficient and flexible way in response to an external signal.

Smart charging includes load management but goes beyond that, allowing you to manage your EV charging in a more sophisticated manner. For instance, smart chargers enable you to automatically charge when power is cheapest, or to operate your individual charge points at different rates depending on when you need each vehicle.

As with load management, coordinating your charging can enable you to install several chargers whilst not increasing your required capacity or by simply utilising the capacity you are not using at a particular time.



OPTIONS TO CONSIDER

04

On-site Generation and Energy Storage

On-site generation and energy storage – combined with smart charging – can also enable you to reduce the size of your grid connection by levelling out your power demand.

This means in addition to your charge points, you would also install a stationary battery that would charge up gradually over the course of the day, or whenever you're not using a large volume of energy. You can then use that stored electricity to help charge your EV fleet and reduce, or even remove, the power needed from the grid.

If you also have solar PV installed, your solar panels will generate electricity during the day to charge up your batteries. Where that energy is not needed, you can store it for use later or sell it to your supplier and be rewarded for helping to maintain security of the network.

Timed Profile Connections

A timed profile connection agreement with your DNO allows you to vary the amount of power that you can use based on the time of the day, subject to a pre-agreed schedule.

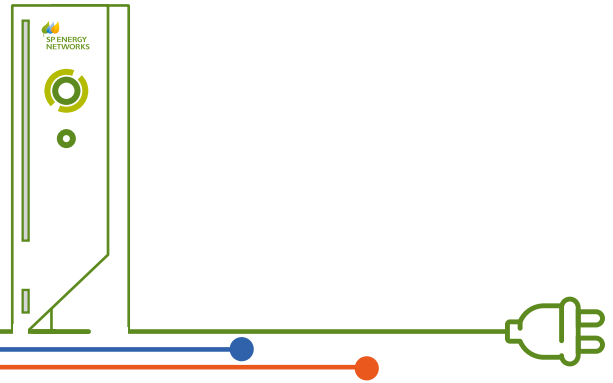
If, for instance, your maximum power requirements are out with peak times due to you charging your EVs overnight, this can be an effective solution as it allows you to agree different load capacities based on your usage patterns.

As an example, you may wish to use up to 2.5MW of power overnight and then reduce this to 0.5MW during the daytime to meet your operational needs. This approach avoids having to upgrade the electricity network to provide the 2.5MW of capacity 24 hours a day – the cost of which could be substantial and may take some time to implement.

Using a Different Part of the Electricity Network

Where you have a large site and have some flexibility over where to install charge points it is worth exploring whether you have access to another part of the network.

We will be able to help you assess any such option, which may result in a lower connection cost if it means an alternative substation faces less of a constraint.



CASE STUDY

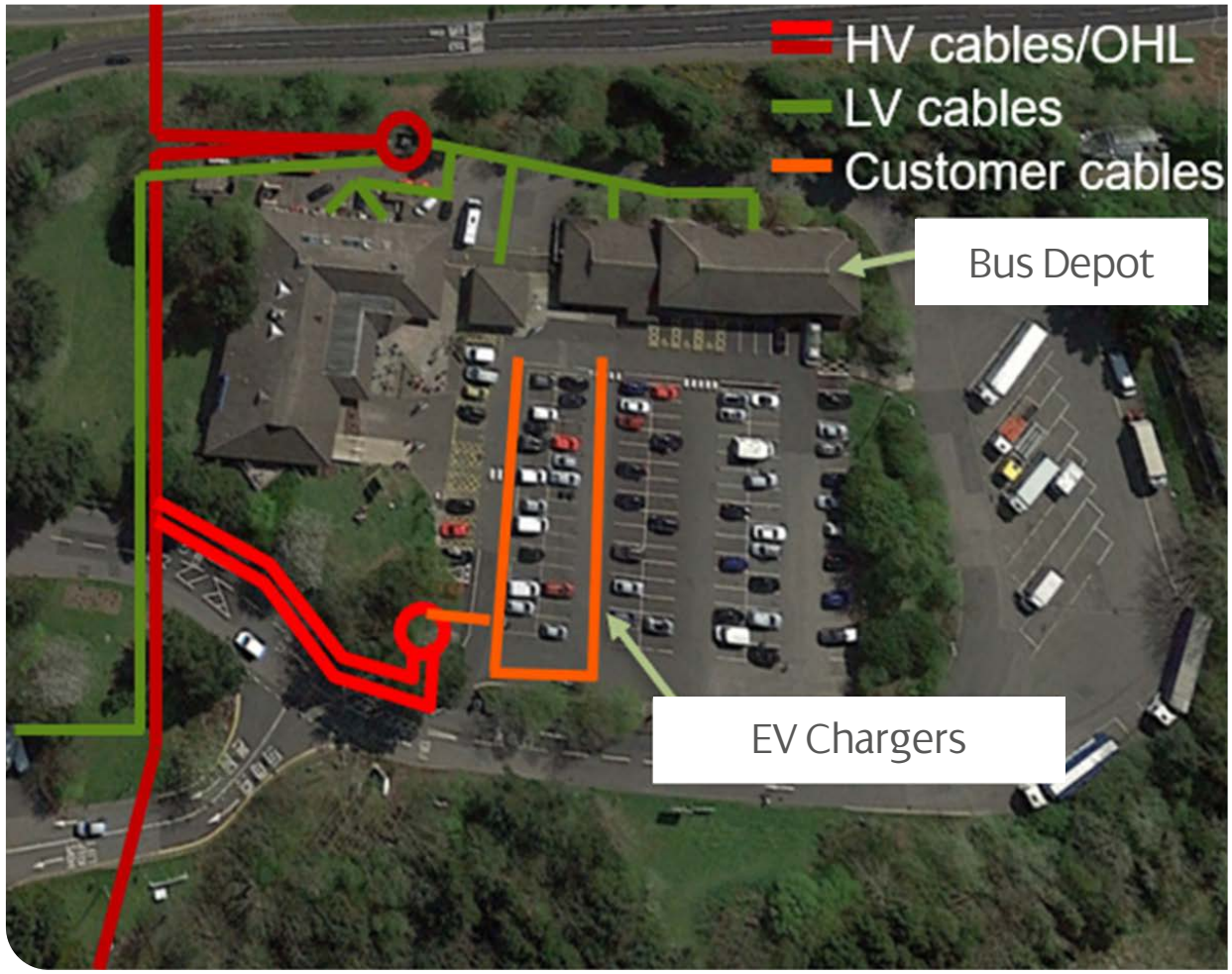
Example 1 - Small Connection

The following example demonstrates the work required to facilitate a small EV operating centre in a standard location, including the costs associated, the build time and an example cable route.

To enable a required load of 500kVA demanded by 10 chargers of 50kW capacity each, a dedicated HV substation would be built and connected to the DNOs 11kV network. LV customer cabling would then be laid and would energise the chargers in the layout as shown. There would be no constraints applied in this example and the chargers could utilise their agreed maximum capacity of 500kVA at any time of the day.

The estimated cost for this work is £70,000 - £100,000.

The estimated time to complete this work from project inception is **three to six months.** It is assumed in this example that there is sufficient headroom on the 11kV network to facilitate this connection. The customer should first ascertain through engagement with the DNO if indeed there is sufficient headroom preventing the costs outlined above from potentially increasing further.



CASE STUDY

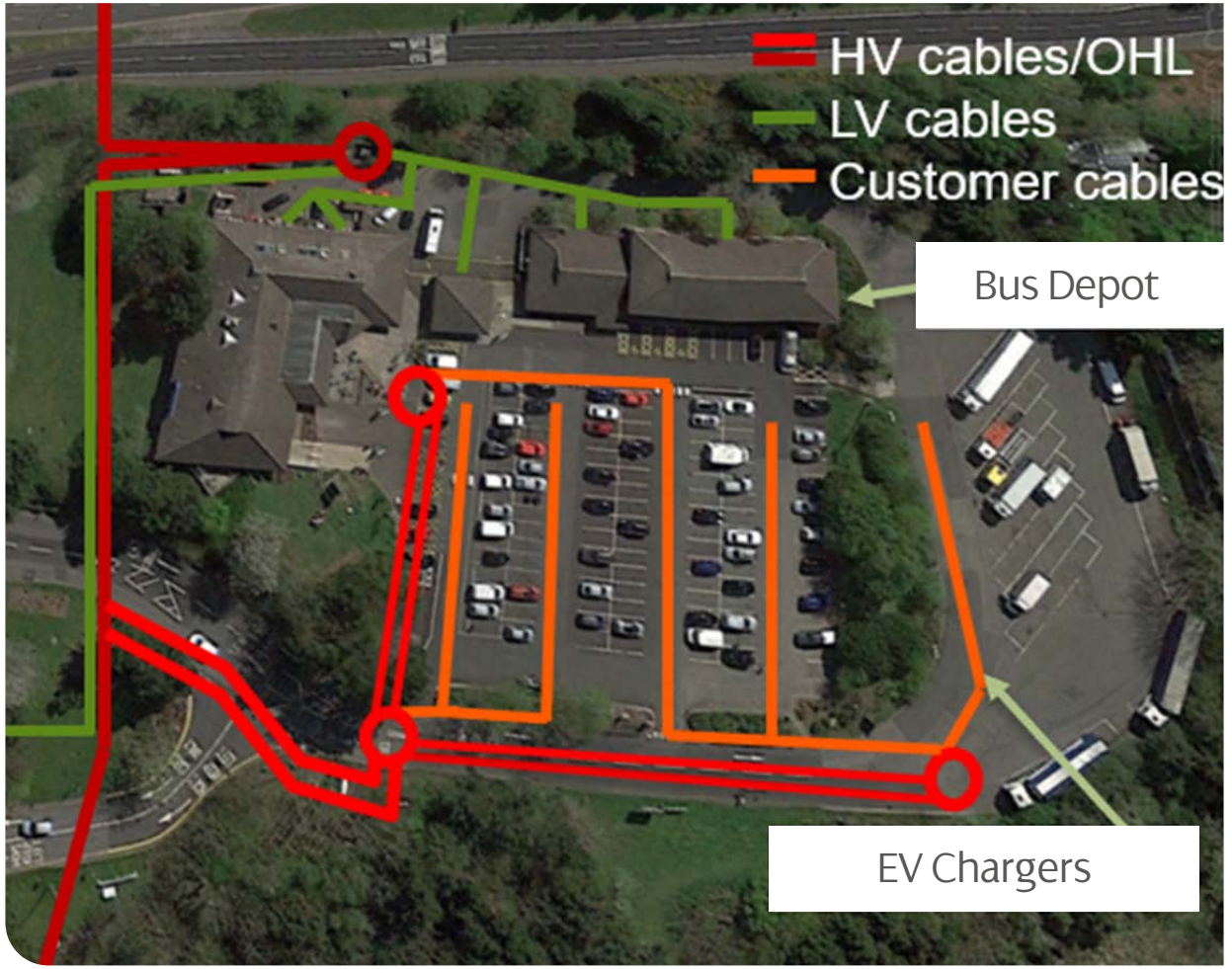
Example 2 - Large non-firm/flexible connection

A method of reducing the costs for the customer is to pursue a non-firm/flexible connection. An example of this is outlined on the right.

To enable the required 2.5MVA flexible load, three dedicated HV/LV substations would need be built and connected to the DNO 11kV network as shown. The agreement between the fleet operator and DNO would be for 0.5MVA at any time and 2.5MVA during the off-peak hours of 23:00-06:00. Each of the 50 vehicles would still be connected to a charger after returning to base however could only all begin charging simultaneously between 23:00-06:00. Outside of these hours only ten of the chargers could be utilised or any combination of charging that totals a maximum of 0.5MVA.

The estimated cost for this work is £200,000- £500,000

The estimated time to complete this work from project inception is **three to seven months**.



CASE STUDY

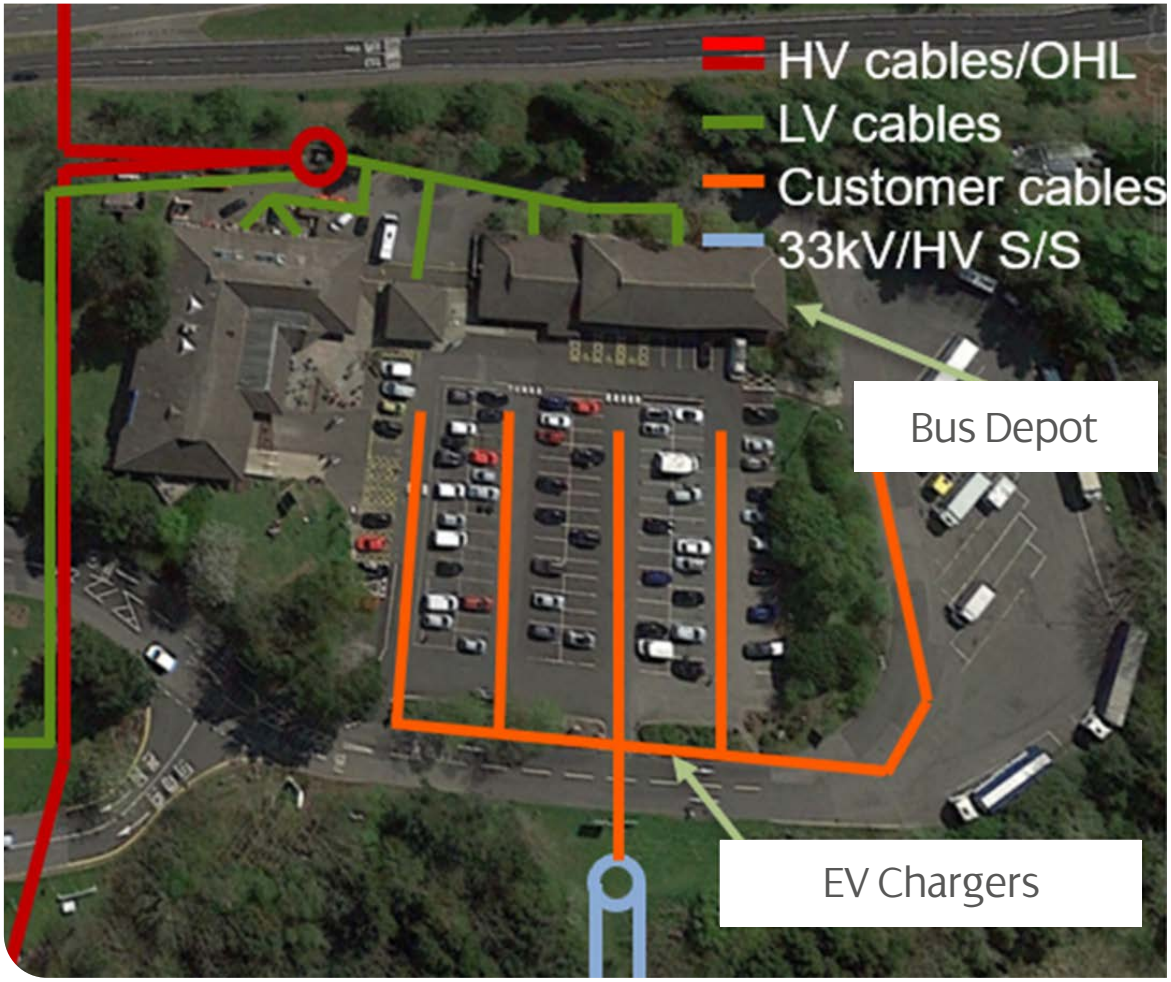
Example 3 - Large connection

The following example demonstrates the work required to facilitate a large EV fleet depot in a standard location, including the costs associated, the build time and an example cable route.

To enable the required load of 5MVA demanded by the 100 x 50KW or 50 chargers of 100kW capacity each, it is likely that a dedicated 33kV/ HV substation would need be built and connected to the DNOs' 33kV network. The size of the required capacity means an 11kV connection may no longer be appropriate and a feed to the primary substation at 33kV is required. LV customer cabling would then be laid and would energise the EV chargers in the layout as shown. There would be no constraints applied in this example and the chargers could utilise their agreed maximum capacity of 5MVA at any time of the day.

The estimated cost for this work is £3,000,000 - £5,000,000.

The estimated time to complete this work from project inception is **18-24 months**. It is assumed in this example that there is sufficient headroom on the primary network to facilitate this connection. The customer should first ascertain, through engagement with the DNO, if indeed there is sufficient headroom preventing the costs outlined above from potentially increasing further. The cost may vary further if the EV depot is in a more problematic area – for example, a remote rural location or embedded in a densely populated city centre where reinforcement work is more cumbersome and costlier.



GLOSSARY OF TERMS

Term	Definition
Authorised Capacity	Authorised Capacity is the capacity that the customer is authorised to use as part of their agreement with the DNO for the connection provided to their premises.
Connection Agreement	A Connection Agreement is an agreement between a customer and the DNO setting out the terms and conditions upon which the customer is connected to the Distribution System, specifying for instance the capacity being connected.
Demand-Side Management	The term Demand Side Management refers to a group of actions designed to manage and optimise a site's energy consumption and to cut costs, from grid charges to general system charges.
Distribution Network	Electricity distribution networks carry electricity from the high voltage transmission grid to industrial, commercial and domestic users. In Scotland this is the 33kV network and below.
Distribution Network Operator (DNO)	A Distribution Network Operator is a company licensed to distribute electricity in the UK. It owns and maintains the underground cables, overhead lines and substations that bring electricity downstream from the national transmission grid, to homes and businesses.
Electricity Supply Constraint	A supply constraint is when the network capacity is near its upper limit, meaning that it can't accommodate much additional demand (e.g. installing lots of EV charge points) without having to make upgrades.
Electricity System Operator	The responsibility for the day-to-day security of the electricity system and the real-time balancing of electricity generation with the demand required by industry, businesses and domestic customers rests with the Electricity System Operator (ESO). National Grid ESO carries out this role across the whole of GB, including Scotland.
Fast charger	Fast chargers are typically rated at either 7kW or 22kW. Charging speeds will vary with the vehicle but as a rough rule of thumb, a 7kW charger will recharge a compatible EV with a 40kWh battery from empty in four to six hours, and a 22kW charger in one to two hours.

Term	Definition
ICP	An ICP or Independent Connection Provider is an accredited company that can build electricity networks to agreed standards and quality required for them to be owned by either by a Distribution Network Operator (DNO) or an Independent Distribution Network Operator (IDNO). For an ICP to carry out some of the connection works they must be registered with National Electricity Registration Scheme (NERS) that is administered by Lloyds' Register.
IDNO	An IDNO or Independent Distribution Network Operator is a company licensed by Ofgem, to own and operate electricity networks. An IDNO network will be connected to the local power network, however, the IDNO will be responsible for managing and operating their local network, including all future maintenance and fault repairs.
kV	kV stands for kilo volt or 1,000 volts. The transmission network in Scotland operates at 400kV, 275kV and 132kV. The distribution network operates at 33kV and 11kV before transforming the voltage down to 400/230V to supply our homes and businesses.
kVA	A kVA is also a measure of Power, A kVA is a kilovolt-ampere, which is 1,000 volt-amperes.
kW and kWh	kW stands for kilowatt. A kilowatt is 1,000 watts, which is a measure of power. Watts are used to define the amount of power that runs through a given power supply. A kilowatt is not to be confused with a kilowatt hour (kWh) which is a measure of energy, rather than power. A kWh indicates how much energy is consumed in a given period. EV chargers are rated based on kilowatts (see power rating). For instance, a 50kW charge point will take one hour to deliver 50kWh of energy.
MW and MWh	MW stands for megawatt or 1,000kW. MWh or megawatt hour is the energy consumed over time.