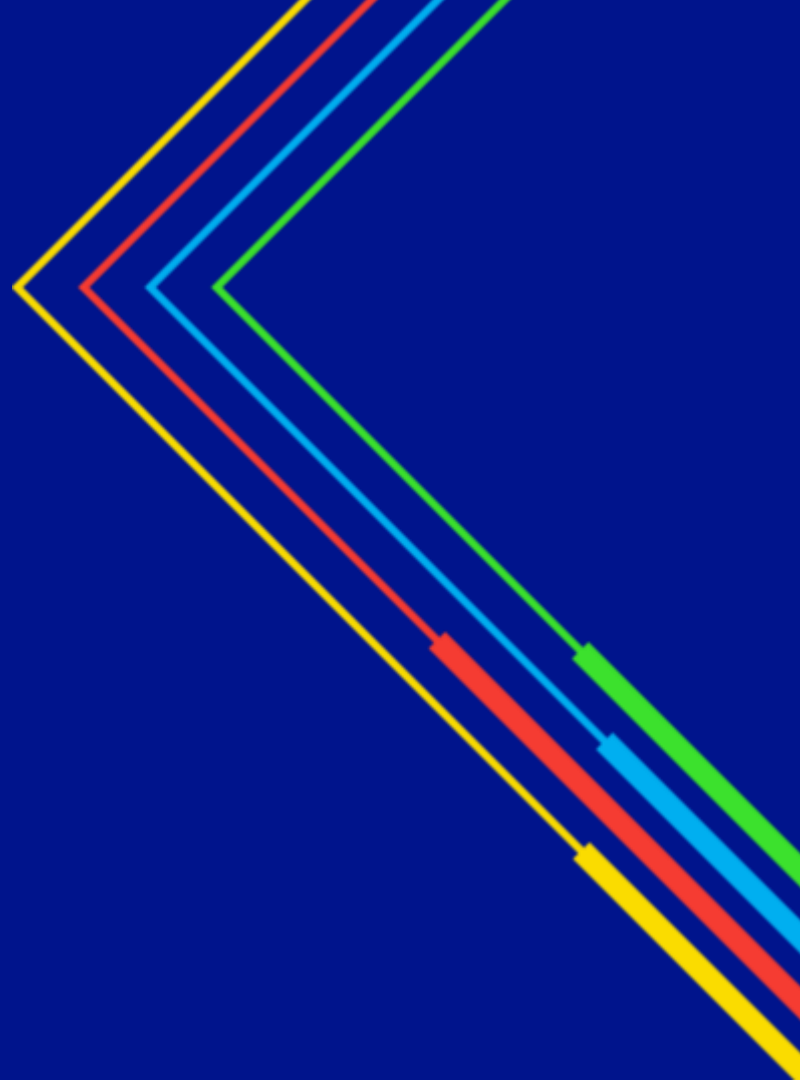


Impacts of increasing numbers of EVs on Distribution Networks

Peter White
17 October 22



Who NGED are

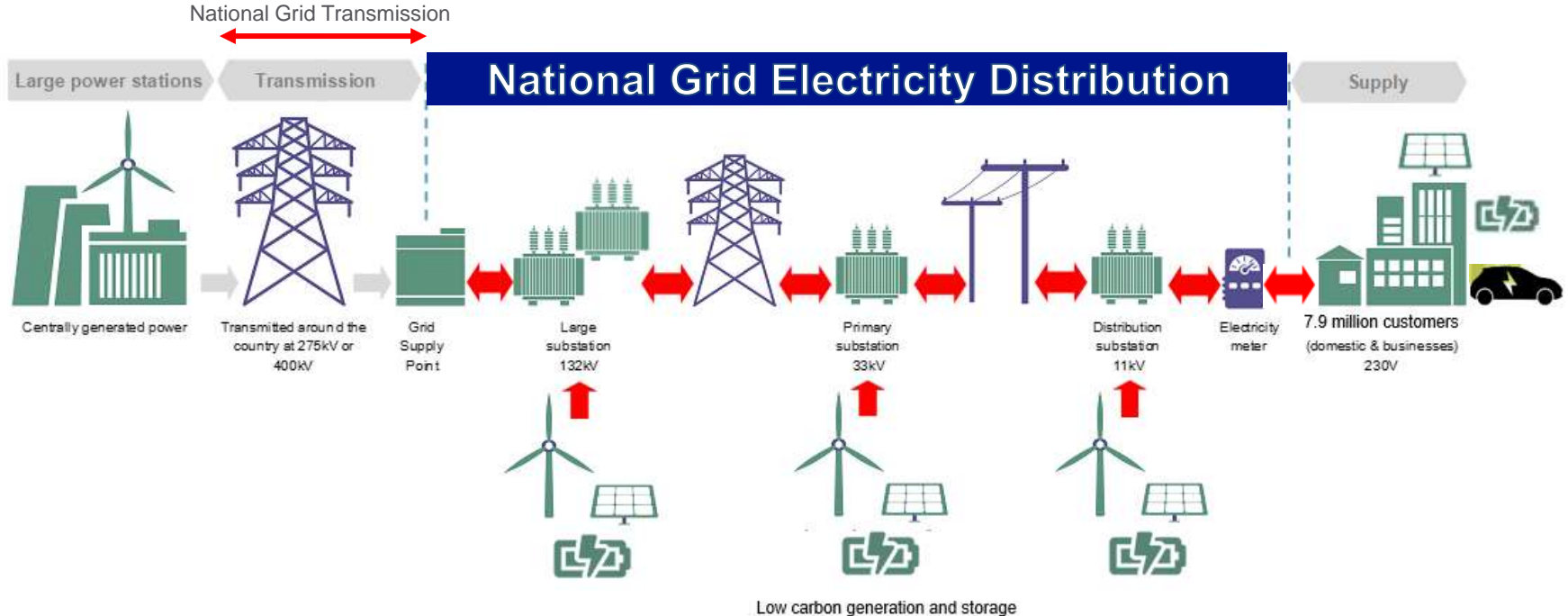
- NGED operate the local electricity network, distributing power to 7.9 million homes & businesses.
- Covering the East and West Midlands, South Wales and South West England.

Network assets	
Cables and overhead lines	225,000 km
Poles and towers	1,389,000
Transformers	188,000



Where NGED fit in, in the UK's Electricity system

A Distribution Network Operator (DNO) including a Distribution System Operator (DSO)

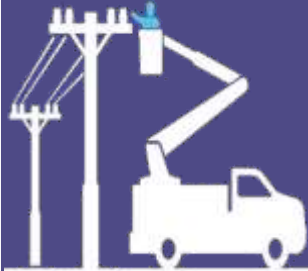


NGED typical work streams



Keep the lights on

by operating our network assets effectively



Maintain equipment

so that the network is in a condition to remain reliable



Fix the network

if equipment gets damaged or is faulty



Connect customers

by upgrading existing networks or building new ones



Operating a smart system

Managing two-way power flows and flexibility services

Safety

Context for Low Carbon Technologies

- Government ban on sale of ICE vehicles by 2030 will mean that all new vehicles require charge facility.
- This will create over 1 million domestic EV chargers per year.
- The Government Heat Pump target adds 600,000 per year.
- NGED operates in approximately 1/3rd of the UK.
- Our exposure would be roughly 500,000 low carbon connections per year.
-or 2,000 for each working day.



EV charging infrastructure installation.

- The DNO needs to be properly engaged and consulted to coordinate and facilitate the connection of charge points to the network.
- The DNO needs to know the size of the required connection characteristics to help ensure the local low voltage and medium voltage network have sufficient capacity and are designed to prevent issues for other local electricity users.
- Rapid EV chargers are pre-assessed to BS EN 61000 part 3-2, 3-3, 3-11 and 3-12 for Power Quality and Flicker by Threewood for the ENA and the information stored on a confidential database only visible to the ENA and DNOs. This allows a quicker service level agreement (SLA) response for the customer.

EVCP & HP Connections Form v3.4

Cover Page

Completing this form accurately will help DNOs process your application as quickly as possible. Please read the following information thoroughly before starting to ensure you have all information required to complete the relevant sections.

What is it for?	This form is for Electric Vehicle Charge Points (EVCP) and Heat Pumps (HP) being installed in a premises with an existing Expendable Network Connection (ENC) electricity connection. The form may also be used for the installation of Vehicle-to-Grid Electric Vehicle Charge Points (V2G EVCP) where the final aggregated capacity of generation/battery storage equipment is in excess of 50kW (please contact your DNO for more details). To apply for a new connection to the network, please contact your relevant DNO.
What to complete	This form should always be reviewed prior to installing any new EVCP or HP to determine whether the installation requires an application or whether it is eligible for the notification process.
When to submit	If the installation meets all the notification criteria (Section 5) the DNO must be notified within 20 days of installing the new equipment. If all the criteria in Section 5 cannot be met, you should submit an application to the DNO using this form before connecting the new equipment to ensure that the DNO can maintain safe and effective operation of the electricity network.
What to submit	Depending on the nature of the new equipment, the DNO may require additional information. For multiple pieces of equipment (including multiple pieces of equipment under one contract) or multiple premises, please use the multiple installations spreadsheet , after available on the ENA website.
Find out your DNO	For help identifying your DNO and their contact details please visit the EMA website .
Cost	Any costs (except those associated with the installation) may be charged to the customer.

Required Information

To complete this form, you will need information about the following:

Location to be installed	Details of EVCPs or HPs to be installed are required. Where equipment is not registered in the relevant CNA database , additional information will be required (Section 6). A link to the Heat Pump Database can be found on the Customer page on the ENA website. Type listed V2G EVCPs can be found in the CNA Type List (vehicle-to-grid Storage) .
Connection details at the premises	Details of an existing EVCPs, electric heating, battery storage, generation (e.g. solar PV), storage or other high load drawing devices.
Maximum demand (kW)	A load survey is required to calculate the Maximum Demand. This should consider the existing Maximum Demand of the whole premises and the new equipment to be installed as well as any impact on load limiting devices. Further guidance on such devices is available in the FAQ section of the Connections to the network page on the ENA website.
Supply Capacity (kW) and rating	If the cut-out rating is unknown or uncertain, it can be established by asking the DNO. This supply capacity MUST be confirmed with the DNO where the MD is greater than the cut-out rating of where the new MD is higher per phase (TT-DNA single phase) for residential or non-CT network premises.
Supply assessment	If the cut-out rating is unknown, a photograph can be provided to the DNO together with the application. Please note that you MUST NOT open the cut-out unless authorised to do so. Further guidance on cut-out safety is available on the ENA website.
Supply assessment	An assessment of supply assessment is required prior to installing a EVCP or HP. The DNO must be contacted at installation where there is an identified risk with electricity or a safety concern with the premises existing DNO usage agreement.

Timelines

Provided that this form is fully and correctly completed, the following timelines are applicable:

Notification	Provided the installation meets all the relevant notification criteria (i.e. all the applicable checkboxes in Section 5) that are relevant to the installation you can be notified, installers can contact the new EVCP or HP and notify the DNO using this form within 20 days of their installation.
Application (DNO - 10 days)	The DNO should assess the supply capacity and confirm if the new equipment can be connected within 10 working days of receiving the completed form.

[https://www.nationalgrid.com/uk/ena/connections/evcp-connection-form-v3.4](#)
[https://www.nationalgrid.com/uk/ena/connections/evcp-connection-form-v3.4](#)

Charging locations

- Transport according to BEIS creates some 27% of the UK's CO₂ emissions.
- There are 32.6m cars and light vans in the UK in 2022. About 40% of those vehicles do not have the luxury of Off Street parking, these vehicles need alternative locations to charge.
- Considering Cars and Light vans only there are typically four locations where Battery Electric Vehicle charging can take place.
- For those people with no off street parking this removes one of the primary sites to charge your vehicle.



Domestic Charging - Home

- Electric Nation showed that EV drivers do not charge every night.
- EV drivers will also react to price signals.
- We expect tariff structures to move most charging away from peak times.
- We have changed our network design models to reduce the overall impact of EV chargers.
- We have changed connection policy to allow all domestic (7.4kW) EV chargers to be accepted for connection, with any network upgrades being completed at a later date.



Work Charging

- Typically Work and Destination chargers are usually 7.4kW or 22kW fast chargers, as work staff are normally at work for about 8 hours this makes it a good location to charge.
- There are some Work / Destination locations where 50 or 100kW rapid chargers are installed.



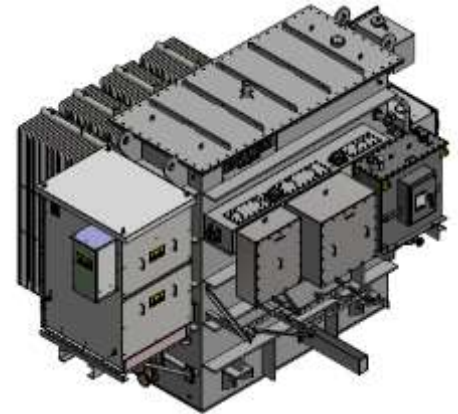
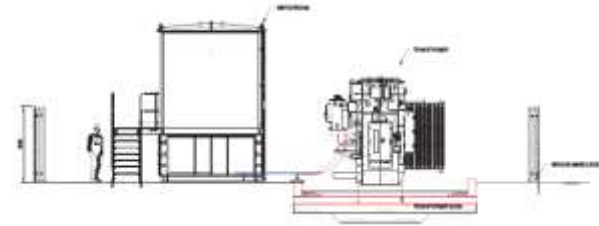
Town Centre Hub Solutions

- Early stakeholder engagement with Local Authorities showed they were more likely to offer car park based charging than on-street solutions.
- We are used to building substations to support housing demands.
- We have developed a version of our local substation which is specifically wired for EV charger connections.
- It will offer 1 to 1.6MVA of charge capacity at each location.
- It can be used at any car park and takes up two parking spaces.



Motorway Service Area (MSA) Charging

- The Government's Project Rapid predicts that Motorway Service Areas will require multiple Mega Watts of charge capacity.
- In many cases the demand will be the same as a small town.
- Our "Take Charge" innovation project has developed a solution to the problem.
- We have shrunk a version of our 33/11kV substation into two shipping containers for use at MSA's.
- Our trial site at Moto Exeter is now live and has 12MW of capacity on site, enough for 80 chargers.



LA Charge Point Placement

Street Side

- Electricity connections for street lights were designed for a demand of around 50 watts and ‘fast charging’ has a rating of up to 7360 watts (32A) single phase.
- Therefore, even though the cut-out may have an item rating of 5750 watts/25A single phase – the electrical infrastructure will most likely not permit the increased demand due to thermal overload of the ‘looped’ conductors and the voltage drop across the circuit.
- It is worth discussing requirements with the DNO perhaps a load sharing connection can be used for EV charging. In addition, street furniture connections most typically have a PME Earthing system and cannot be converted to a TT Earthing system without thought of the segregation requirements as detailed earlier.



LA Charge Point Placement

Car Parks

- Typically car parks have a low powered electricity connection to run a few lights and a parking ticket machine, therefore to provide multiple charge points of varying capacity a new electricity connection will be required.
- Currently NGED's largest distribution transformer is rated at 1000kVA and this substation could provide 135 vehicles with a 32A/7.36kW 'Fast' charge but would require the space of 3-4 parking bays for the WPD and customer apparatus.
- Depending on the battery size a 'Fast' charger will charge a typical electric vehicle within 8 hours and is therefore suitable for long stay car parks used by commuters.
- The same sized set up could provide power to 20 'Rapid' chargers with a maximum rating of 50kW each and these chargers are more suitable for short stay parking.



LA Charge Point Placement

Taxi Ranks and Similar Charging

- Due to the short waiting time of a taxi between fares, a 'Rapid' charge point would be most suitable to ensure that the vehicle range is maintained.
- The space requirement for a rapid charger will prohibit locations without off street parking and in addition the location will require a suitable electricity connection.
- The electricity network within congested city centres may already be at or around capacity and therefore the charge points may require a dedicated connection from the nearest substation and this substation may require a transformer upgrade.



NGED Process Changes

- We have changed connection policy to allow all domestic (7.4kW) EV chargers and most domestic heat pumps (12kW) to be accepted for connection. Some older Heat Pump models can affect the wider network so are excluded
- We need to know three things
 - Demand of the property
 - Type of main fuse cut-out assembly
 - Number of service cables
- We have centralised this activity in one team for speed and consistency. We respond on the same/next day.
- Any remedial works are carried out later, after the connection is made



Network Impacts

- Our low voltage networks are likely to require upgrades to support low carbon technologies
- We changed our design rules in 2015 to increase minimum network sizes, in 2019 we also made three phase service cable standard
- We will reinforce low voltage networks in retrospect for early adopters, but also work proactively where forecasts predict demand or high volumes are seen
- Our higher voltage networks have more interconnectivity so are less impacted. LCT forecasts to 2050 are built into our modelling



In Summary

- The drive to Net Zero is one of the biggest changes to electricity networks since rural electrification in the 1950's.
- NGED are already working to make future capacity available, both on existing networks and for newly installed networks.
- NGED want to make the process as simple as possible for all early adopters of EV's.
- NGED have options at all capacity sizes to support charger demands.



Thank you for listening.

national**grid**