

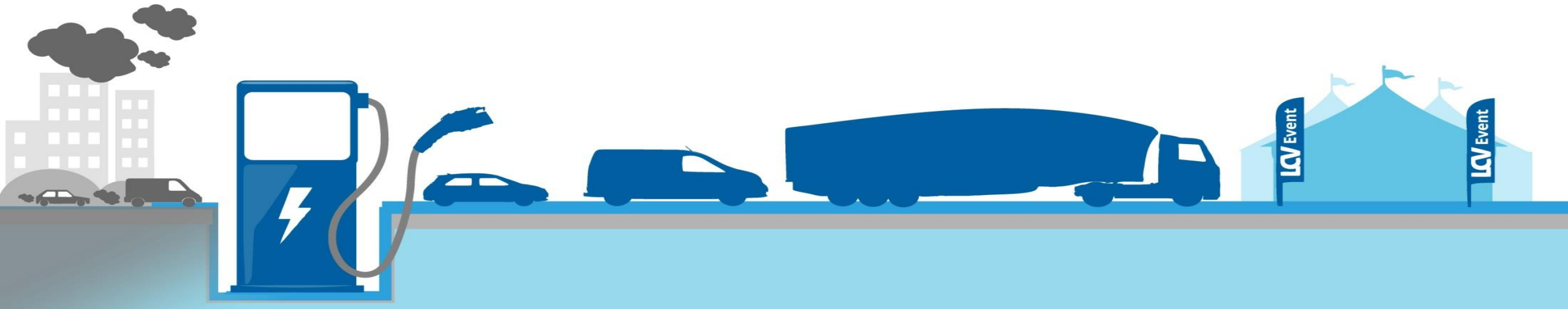
# Ultra Low Emission Vehicle Charging Infrastructure

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# Agenda

- Electric Vehicle Charging Infrastructure
- Charge Point Types and Charging Speeds
- Other Fuelling Infrastructures



# How do I charge an EV?

Connection types, charging speeds and modes



# Vehicle Charging Use Cases

## Conductive



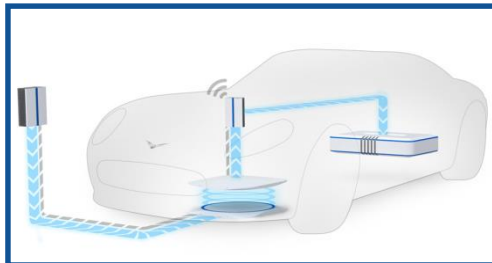
Case A

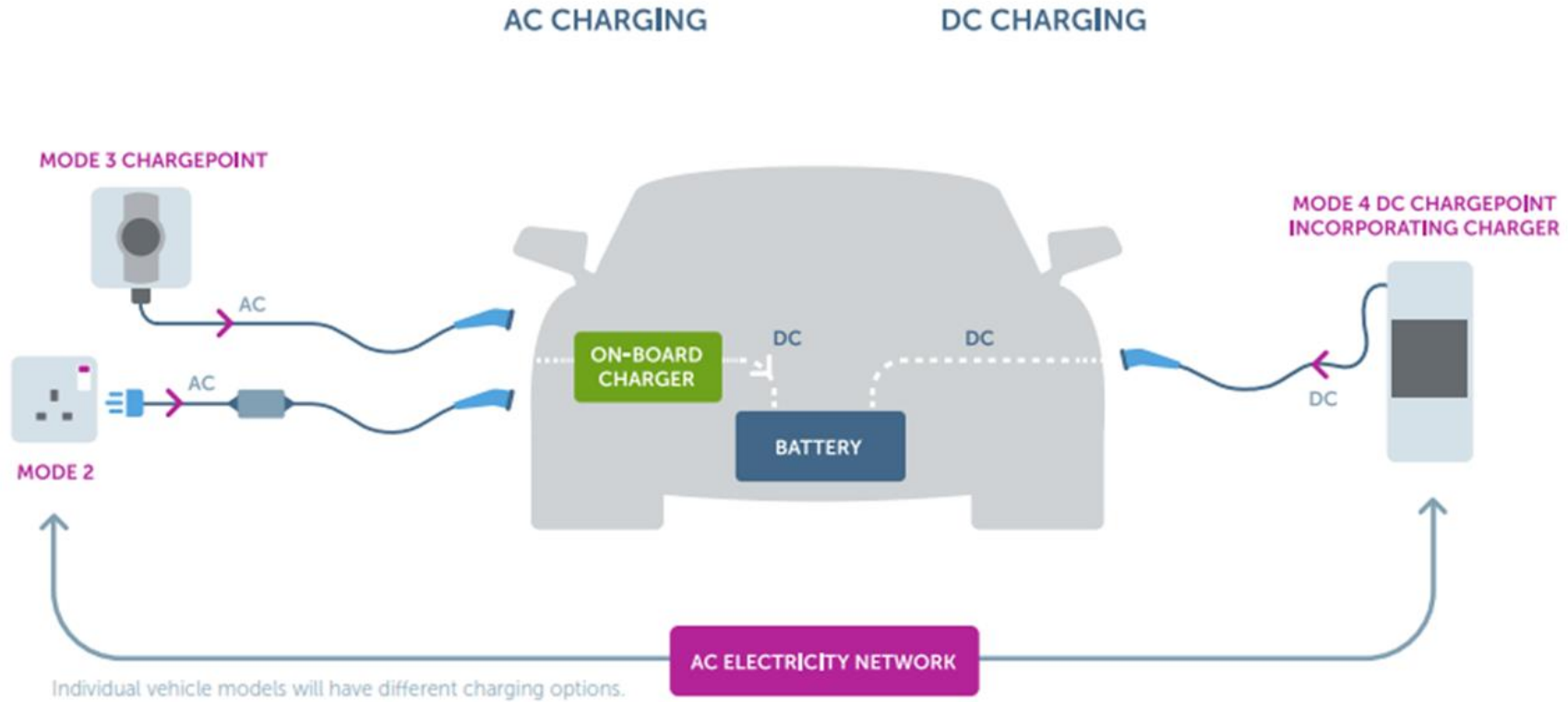
Case B










Case C

## Inductive





## Vehicle Charging

Charger Type	Charge Time	Power (kW)	Connection Type
<b>Slow</b>	0-100% in 10-12 hours	Home Workplace	
<b>Fast</b>	0-100% in 4-6 hours	Long stay car park Publicly accessible locations	 
<b>Semi-Rapid</b>	0-100% in 1-2 hours	Workplace	
<b>Rapid</b>	0-80% in 20-30 mins	Depots Service station Tesla Supercharger station	 
<b>Vehicle-to-Grid</b>	0-100% in 6 hours	Pre-commercial at Universities	



## Vehicle Charging “Modes”

### Mode 1:

- Typically domestic dumb socket with RCD protection
- No communication between EV and socket

### Mode 2

- Typically domestic dumb socket with RCD protection in the plug or in-line “control box”
- Communication between EV and in-line “control box” (Control Pilot)

### Mode 3

- Typically Type 2 cable with no in-line “control box”
- Communication between EV and Charge Point (Control Pilot)
- On-board charger

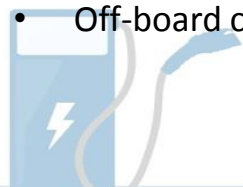
### Mode 4

- Typically tethered plug cable with no in-line “control box”
- Communication between EV and Charge Point (Control Pilot)
- Off-board charger

### Mode 2 Cable



### Mode 3 Cable

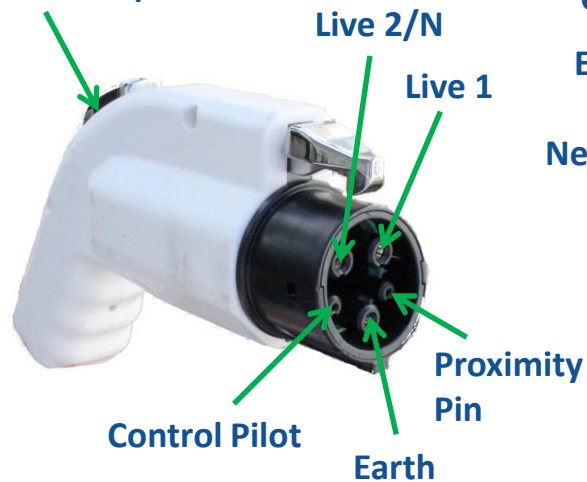


## AC Connecting Technology

### Vehicle Connector Types – AC Charging Cable

#### SAE J1772 Type 1

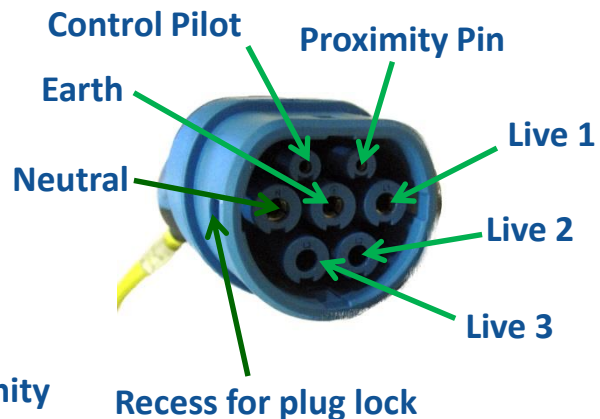
Release Button and hole for padlock



Nissan Leaf socket



#### EN62196-2 Type 2 Female

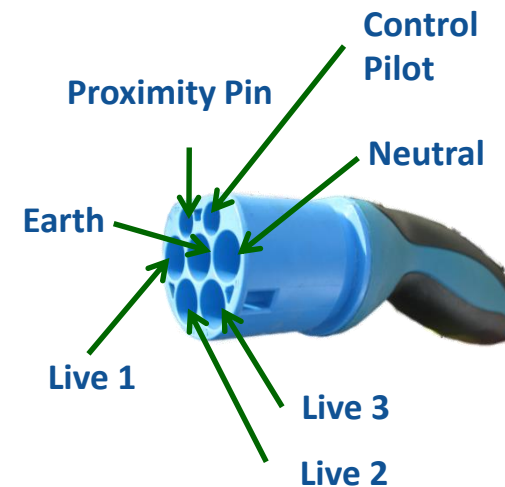


Renault Zoe socket



### Charge Point Side of Cable

#### EN62196-2 Type 2 Male



Tesla Model S socket





## DC Connecting Technology

CCS Combo 2



Control Pilot and Proximity Pins  
Earth  
DC +/-pins

BMW i3 socket



CHAdEMO JARI JEVS/G105



DC +/-pins

Nissan Leaf socket



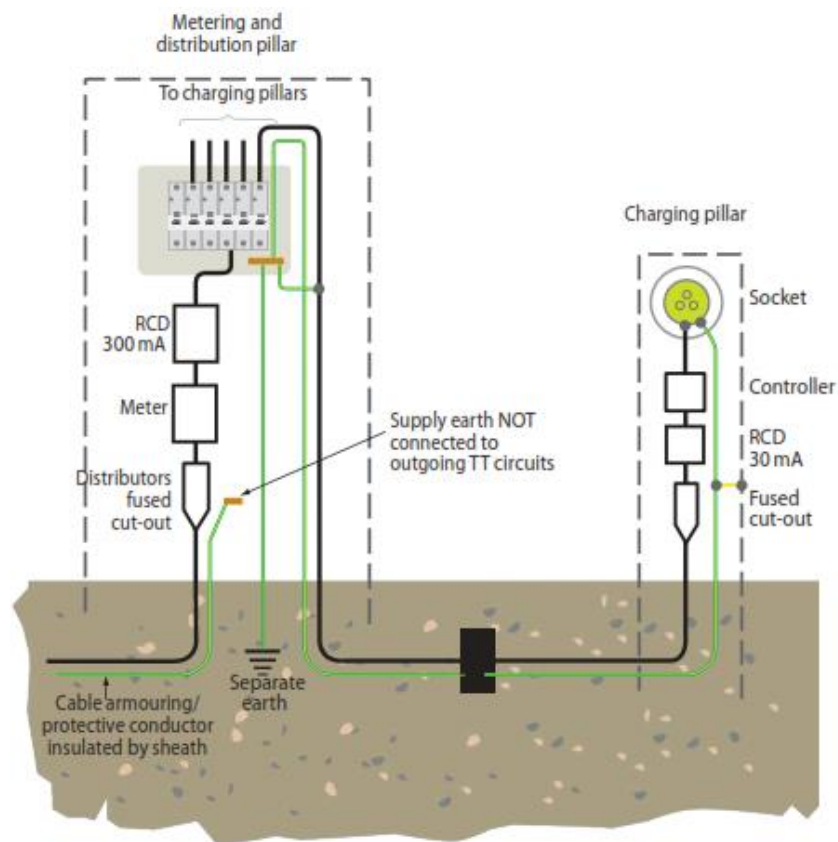
# What does a Charge Point installation look like?

Charge Point installation components,  
considerations and examples



## Charge Point Installation Components

A typical on-street or car park Fast Charge Point installation



EN62196-2 Type 2  
Female socket



Status lights

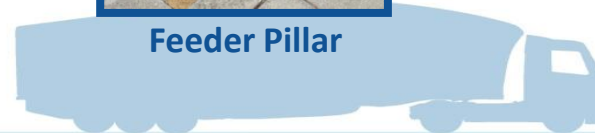


Feeder Pillar

Display and  
RFID card  
reader



Crash Barrier



## Charge Point Installation Components

A typical workplace Fast Charge Point facility



Company  
branded  
signage

Fast Charger  
with Type 2  
socket(s)

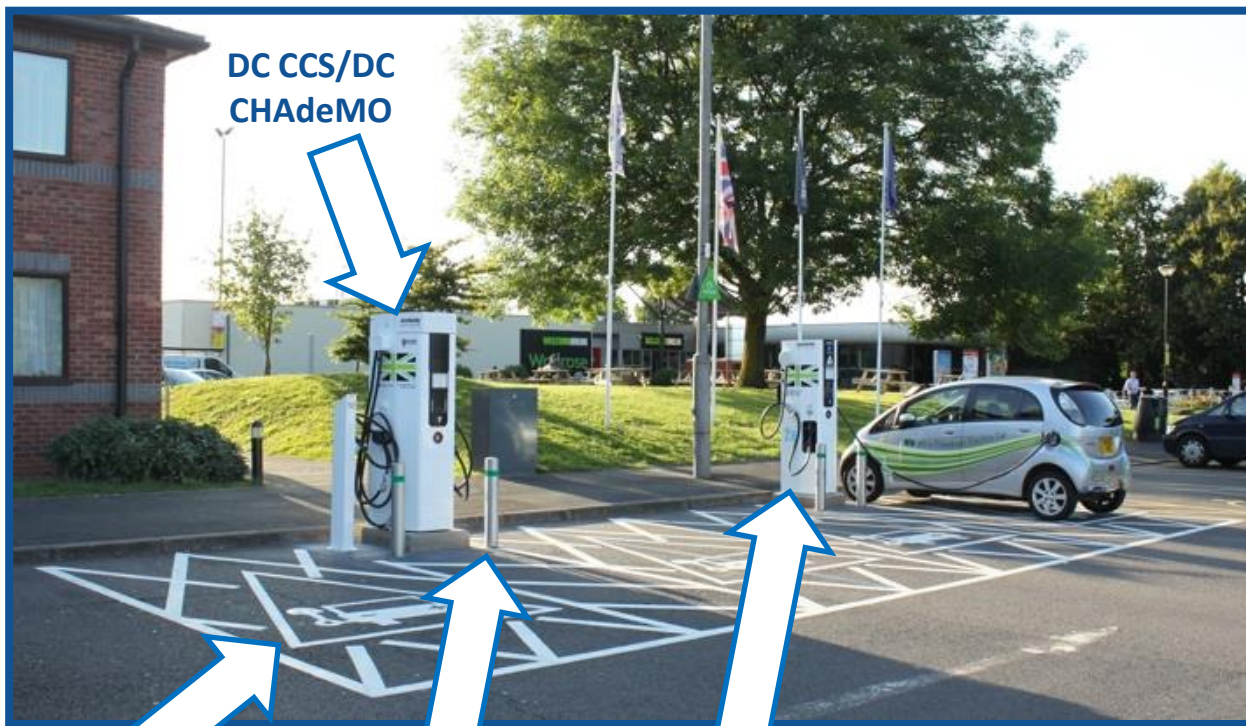
- Privately owned and monitored site
- Clear bay markings and signage
- Policed by own staff
- RFID card accessed Charge Point (but not always needed)

Company branded EV



## Rapid Charge Point Installation

A typical UK Motorway services rapid charger facility (private site)



Network or investor branding



EV-specific bay markings

Crash Barrier

DC CHAdeMO/  
AC Type 2

DfT approved signage  
(P660x9 and S65)



## Council On-street Charge Point Installation

### A typical on-street fast Charge Point facility

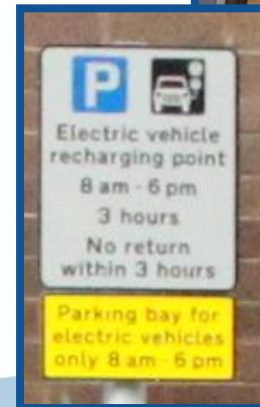


DfT approved sign  
(P660x9)

Fast Charger with 2  
Type 2 sockets

DfT approved  
bay markings

- Council owned/monitored sites
- Clear bay markings and signage
- Traffic Regulation Order in place (contravention code 14, 71 for car parks)
- RFID card accessed Charge Point



Traffic Signs Manual  
Chapter 3

Web Search on  
P660x9 or S65 for  
working drawings



# Charge Point Installation Recommendations

## Company

- Usually a simpler and quicker process.
- Consult with expert with extensive knowledge of charge points.
- 3+ companies to provide a quote.
- Purchase maintenance package and review the details.
- Know your business model (i.e., PAYG).
- Certified electricians are required and comply with latest standards.

## Rapid

- New electricity supply to support rapid chargers.
- Contact Distribution Network Operator (DNO) for power assessment.
- Location as close to Low Voltage substation as possible.
- Planning permission may be required.
- Charge Point suppliers' lead time should be short.



# Charge Point Installation Recommendations

## Council

### Considerations prior to the procurement

- All the points listed in the Company and Rapid.
- Collaborate with other Council departments.
- Site ownership.
- Existing vehicle charging facility.
- Timeline to install charge points.
- Access methods and restrictions.
- Parking space requirement.
- Electricity supply; availability and capacity.
- Traffic Regulation Order alteration requirements and timescales.
- Alternative sites.
- Operational model for the charge points installed.

### Project Timescale Allowance

Shortest timescale = a few weeks

Average timescale = 4-6 months

Longest timescale = 3 years

### Shortest

- Own site
- Everyone on-board
- Power supply available
- Equipment lead time short

### Longest

- Long approval chain
- Landlord needs convincing
- No metered power supply
- Planning permission needed
- TRO needed
- Council procedures too slow
- Long equipment lead time



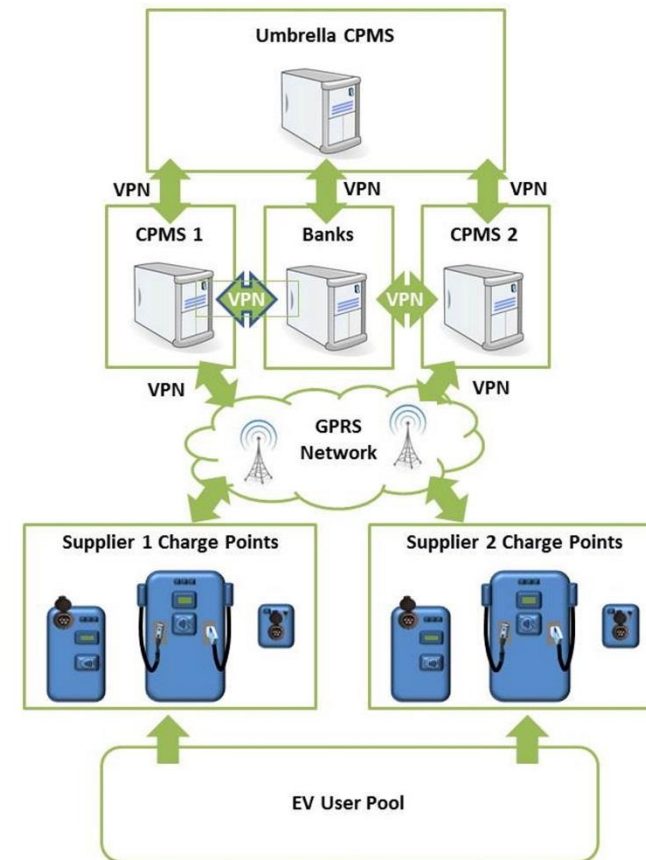
# What is a Charge Point Management System?

A brief explanation



## A word on Charge Point Management Systems

- CPMS is a Back Office function provided by a Charge Point supplier or Network Operator. It is hosted on a server that connects to Charge Points of the mobile telephone network
- The CPMS provides the following functions;
  - 1) A database of all the Charge Points on its network;
  - 2) A database of the network's authorised EV users;
  - 3) The ability to remotely diagnose and operate Charge Point functions;
  - 4) Collection of anonymised EV charging data for Gov't, host and EV user billing purposes;
  - 5) A user help line and website (with location map);
  - 6) Pay As You Go billing options for EV users;
- Common CPMSs in use in the UK include Charge Your Car, Chargemaster Chargevision and Charge Point Services Genie
- The CPMS may be determined by who you buy Charge Points from
- A CPMS connection is an ongoing cost that must be paid to keep the charging service running and for revenue generation
- Councils should buy connected equipment
- Businesses have the option to buy connected or non-connected equipment (lower cost option)



# Where do I find Charge Point location details?



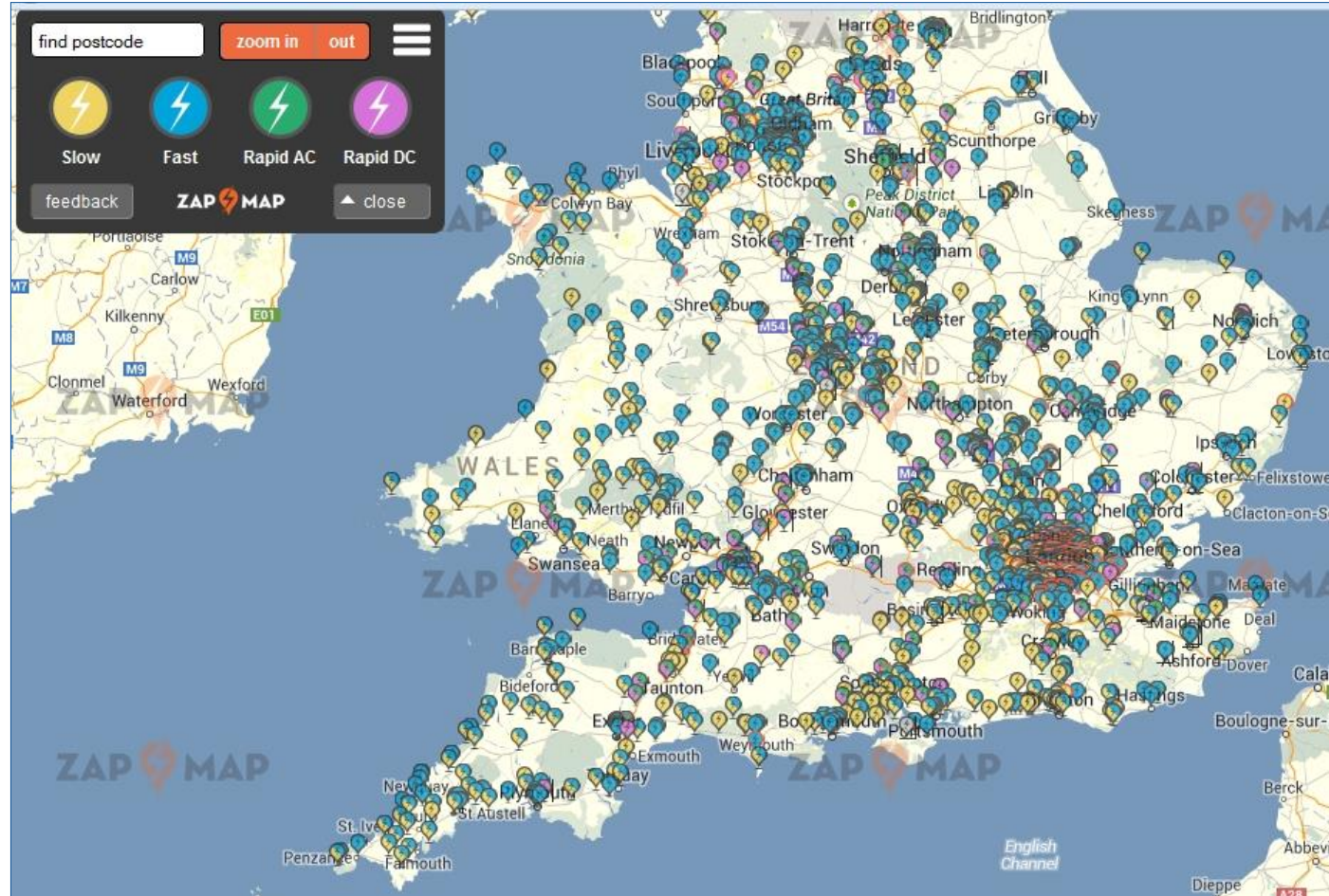
## Examples of Charge Point Maps Providers



The EV charging network



## Charge Point Maps



- On-line maps
- EV satnav

<https://www.zap-map.com/live>



# Hydrogen and Gas Fuelling Infrastructure

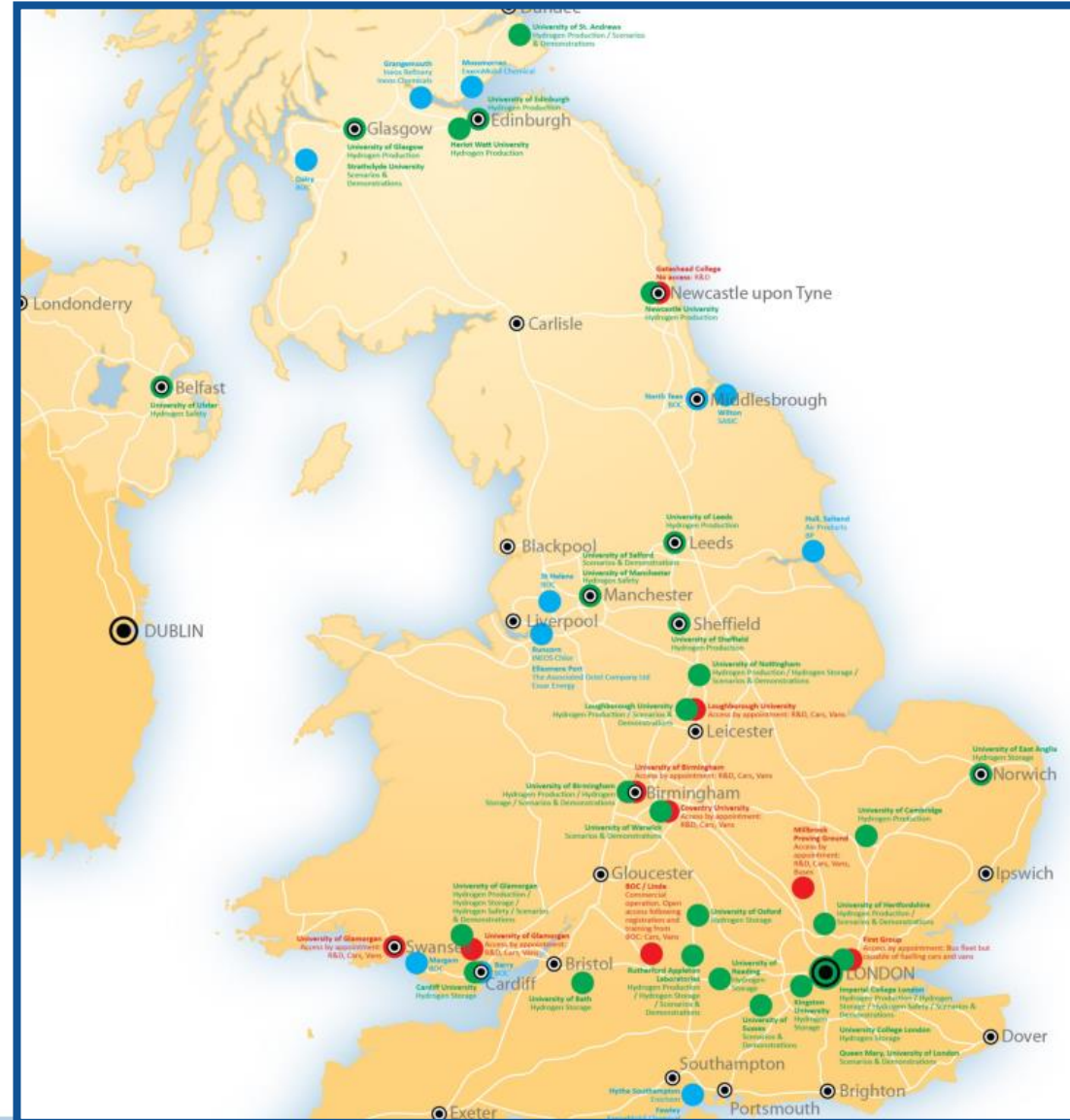


## Hydrogen Fuelling

- UK hydrogen infrastructure deployment only emerging
- Typically for research purposes or for specific fleets
- Dispensed at either 350 or 700 bar gas
- 350 bar provided by TK16 nozzle



- 700 bar provided by TK17 nozzle



## Natural Gas Fuelling

NGV2 200-250 bar



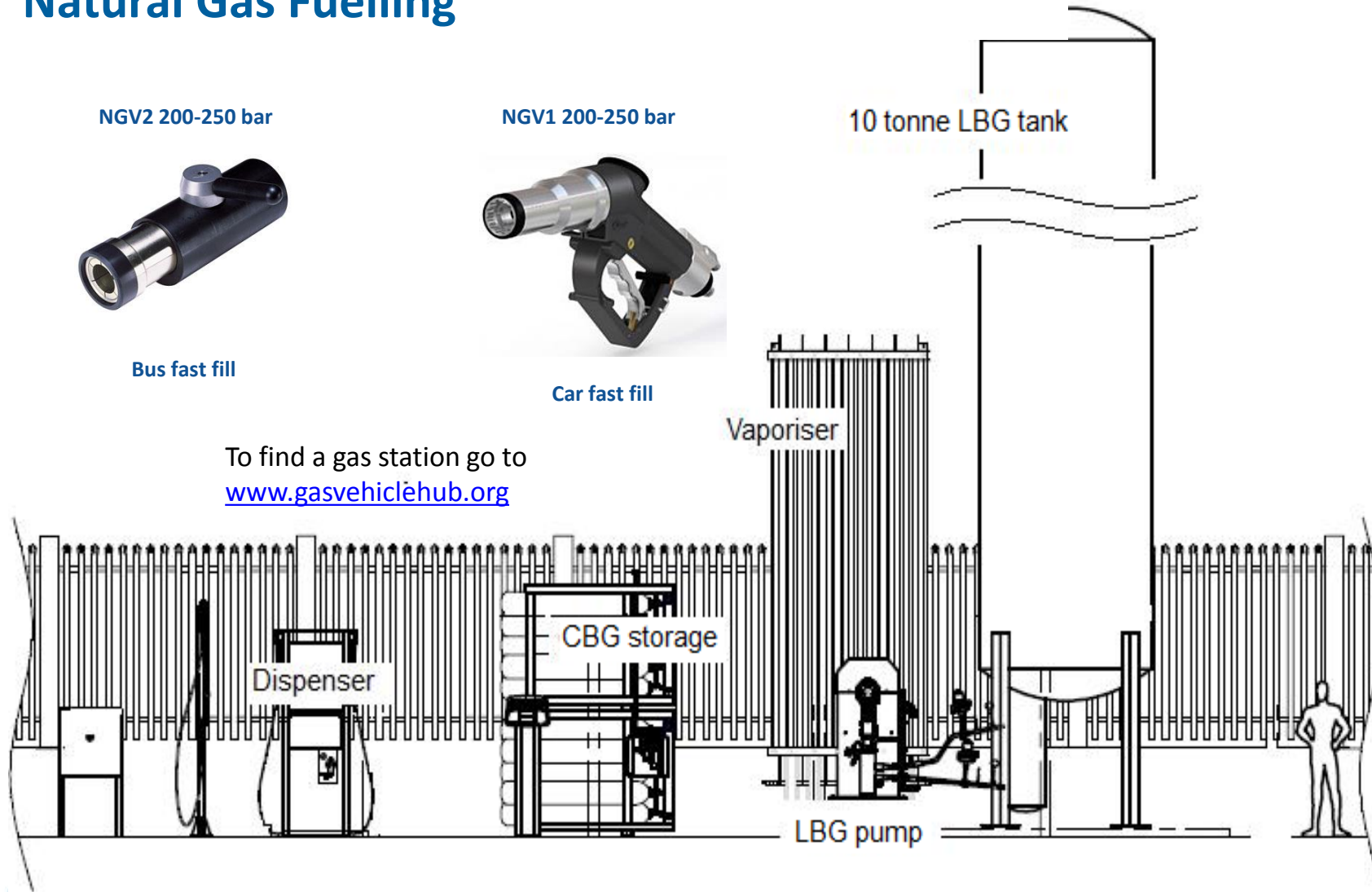
Bus fast fill

NGV1 200-250 bar



Car fast fill

To find a gas station go to  
[www.gasvehiclehub.org](http://www.gasvehiclehub.org)

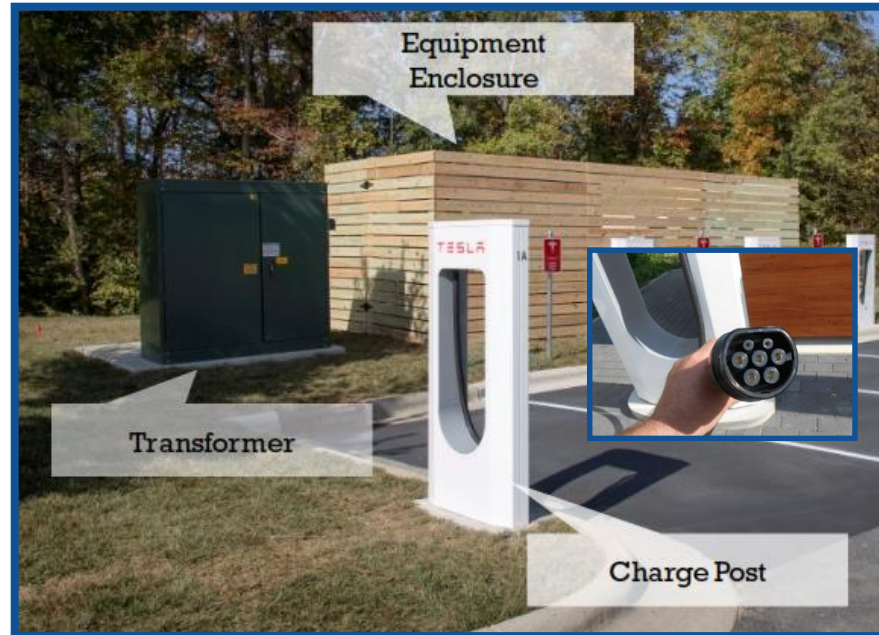




# Some Novel Charge Point Technology and Equipment

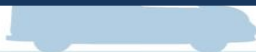
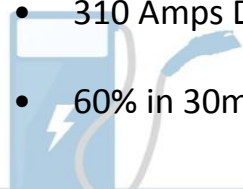


## Tesla Supercharger Facility



- DC Only using Type 2 tethered plug
- Only Tesla compatible
- Large energy requirement
- Free to use
- 14 sites

- Three phase AC input
- 192 Amps per phase
- 125kW
- 310 Amps DC output
- 60% in 30min (170 miles)



## Formula E



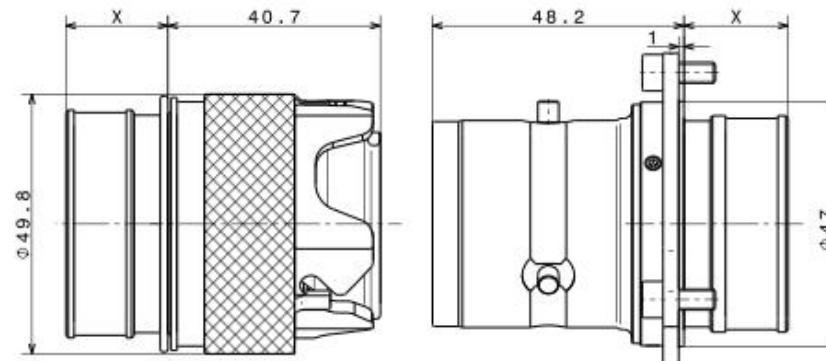
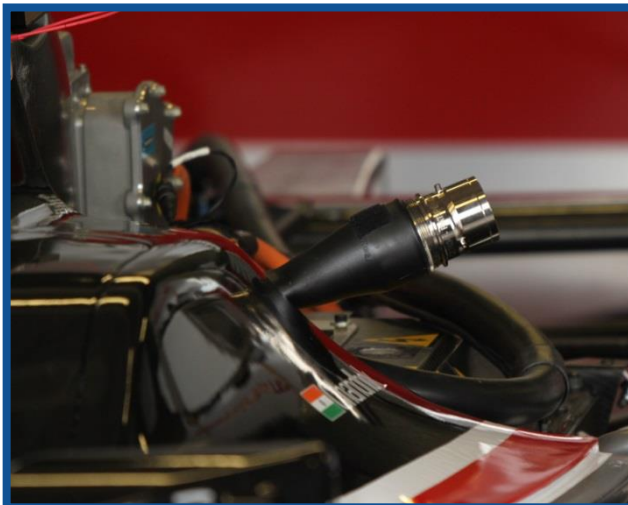
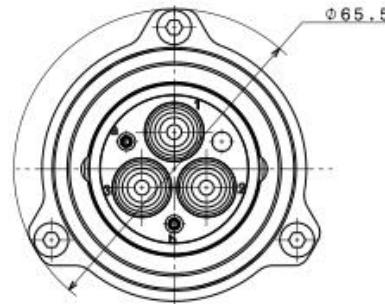
- Spark\_Renault SRT\_01E
- 180kW peak electric power
- 0-62 mph – 3 sec
- 5 speed paddle shift (fixed ratio)
- 888kg (inc. 320kg battery and 26kg electric motor)
- Carbon Fibre and Aluminium
- 32kWh (28kWh useable) Lithium-ion
- Charging 0-100% in 50 min
- Sound - 80dB (F1 car is ~140dB; normal car is 70dB)
- Charge lasts 30 min (race is 1h with one vehicle change)



## Formula E – Mobile DC Rapid Chargers



- 22 Mobile chargers
- Nominal 550-600 V DC charging
- 40 kW output
- Bespoke CER connector
- Meets EN61851-1 (general requirements for charging EVs)
- Developed by IES-Synergy for Williams battery

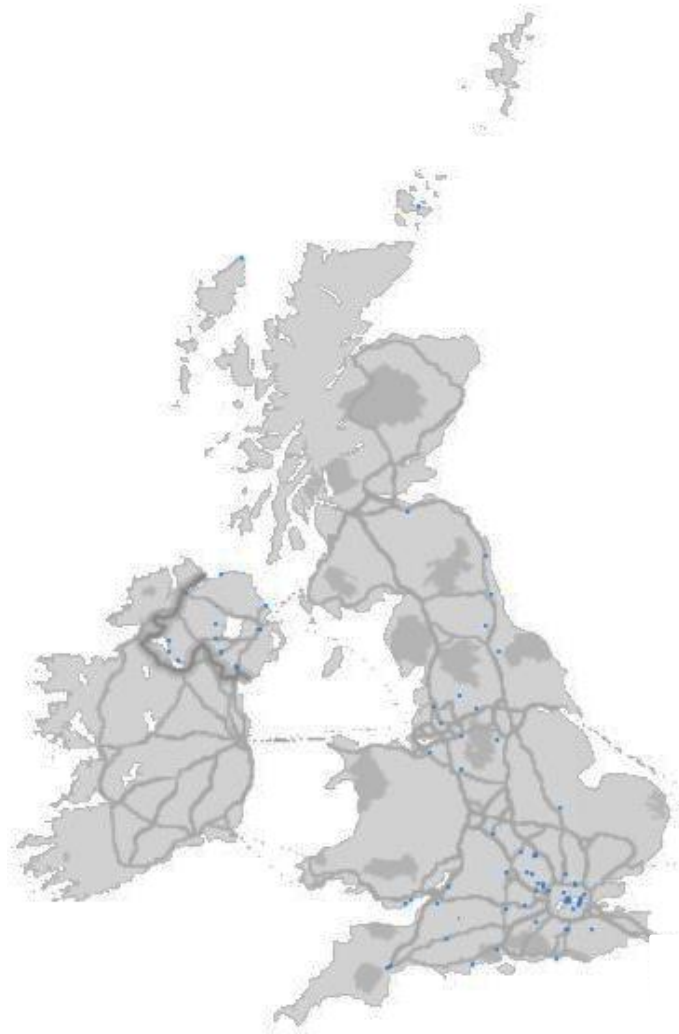


# Vehicle Charging Infrastructure Market Development Forecast

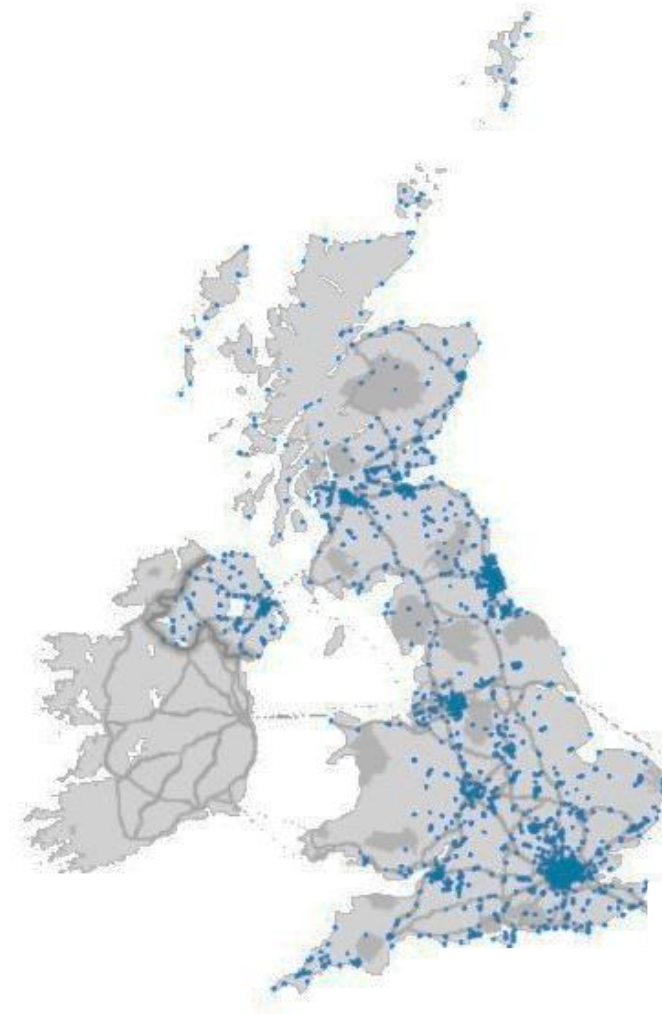


## EVSE Infrastructure Growth

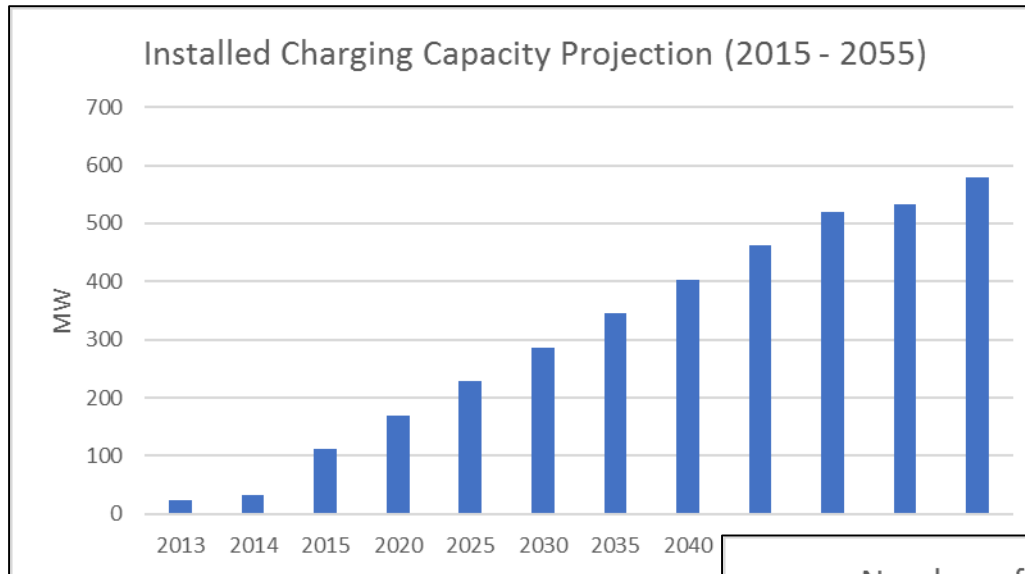
2012



2017

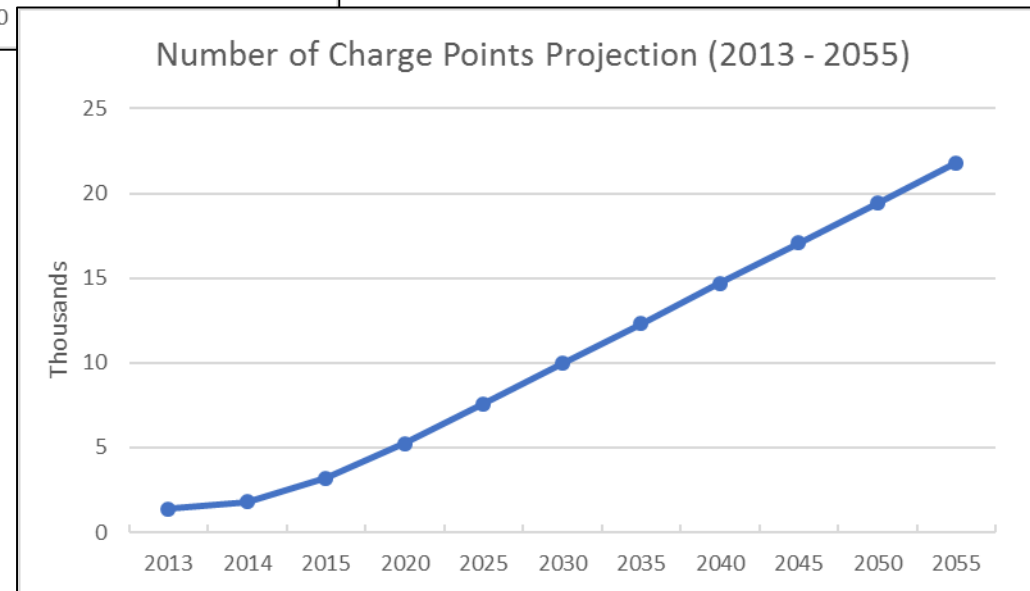


## EVSE Infrastructure Growth



- Rapid growth to support significant of plug-in electric vehicle uptake.
- Publicly accessible charge points: workplace, destination and retail.
- Private charge points: home chargers.

- By 2020, there would be more than 5,000 charge points installed in the UK.
- A charge point can have dual outlet and support two electric vehicles being charged simultaneously.



### Conclusions

- Electric vehicles are available for most transport uses, including passenger cars and vans.
- Plug-in electric vehicle can be pure battery based, extended-range or hybrid electric vehicles.
- UK electric vehicle charging infrastructure is growing rapidly.
- Hydrogen and gas fuelling stations are less deployed compared to electric vehicle charging stations.
- Dual fuel CNG vehicles are common as Heavy Goods Vehicles and Refuse Collection Vehicles.





**Are there any questions?**



# Discussion Activity

What infrastructure options could work for you?

Where could this infrastructure be installed?

What are the biggest barriers that you can see to implementing some, or all, of these technologies?

