Electricity Distribution

LGA Annual Conference and Exhibition – Powering Up

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nationalgrid

National Grid business units

nationalgrid

One of the World's largest investor owned energy companies. We play a vital role connecting millions of people to the energy they use safely, reliably and affordably. Our networks are among the safest and most reliable in the world. We employ over 29,000 people worldwide with our main operations are in the UK (electricity) and Northeast US (electricity and gas). National Grid are investing in the future and using transformational engineering to support the transition to net zero.

Electricity System Operator	Electricity Distribution	Electricity Transmission	Strategic Infrastructure	New York	New England	National Grid Ventures
Operates the electricity system for Great Britain, balancing supply and demand every second of every day.	Owns and operate the electricity distribution networks serving 8 millions customers across the Midlands and South West of England and South Wales.	Owns and operate the high-voltage electricity transmission network in England and Wales.	Responsible for delivering major strategic UK electricity transmission projects. Plays a vital part in achieving the UK Government's ambition of connecting 50GW of clean, low carbon offshore wind power by 2030	Owns and operates electricity transmission facilities and distribution networks across upstate New York, and gas distribution networks across upstate New York, in New York City and on Long Island.	Owns and operates electricity transmission facilities and distribution networks across Massachusetts, New Hampshire and Vermont, and gas distribution networks across Massachusetts.	Operates in competitive markets across the UK and US, including electricity interconnectors and large-scale renewable generation. Also operates liquefied natural gas (LNG) storage, conventional generation (in the US) and competitive transmission.

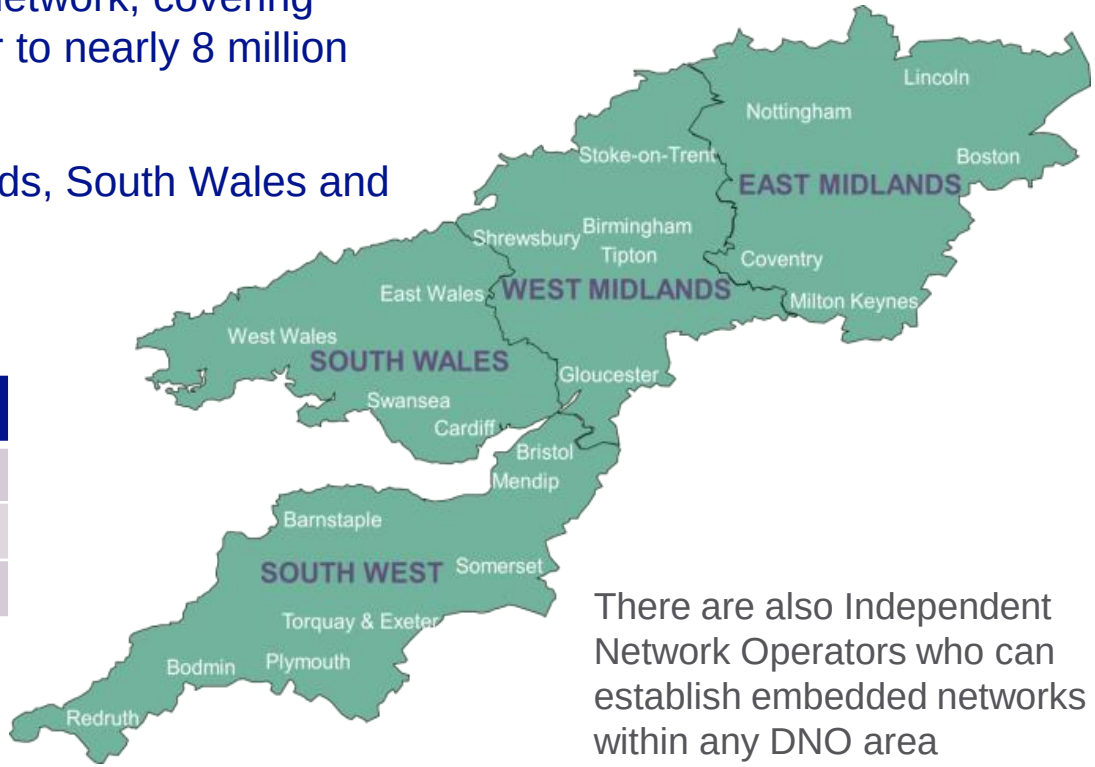
National Grid - ESO

- NG Recognise connection timelines are too long for many of our customers. In England and Wales, the pipeline currently stands at 220GW and is continuing to grow at an accelerated rate.
- Important to first consider the causes. There is an unconstrained market which is not acting in a rationale way combined with low barriers to entry and loose contractual obligations which is subsequently driving a need to build more connections and network than we require, under credible energy scenarios - all of which are causing delays.
- Immediate and critical tactical change is underway, i.e., how transmission and distribution networks coordinate; how we treat storage and our modelling assumptions all of which potentially delivers 40GW of capacity [equivalent to 12 Hinkley Point C's and nearly 20% of the current pipeline].
- But further and long-term reform is needed, to decouple investment from individual customers applications, ensuring we have the connections and network in place for the future and adopting a "connect or move" policy to allocate the capacity that the connections and network provide to customers who are ready to connect.

Who NGED are.

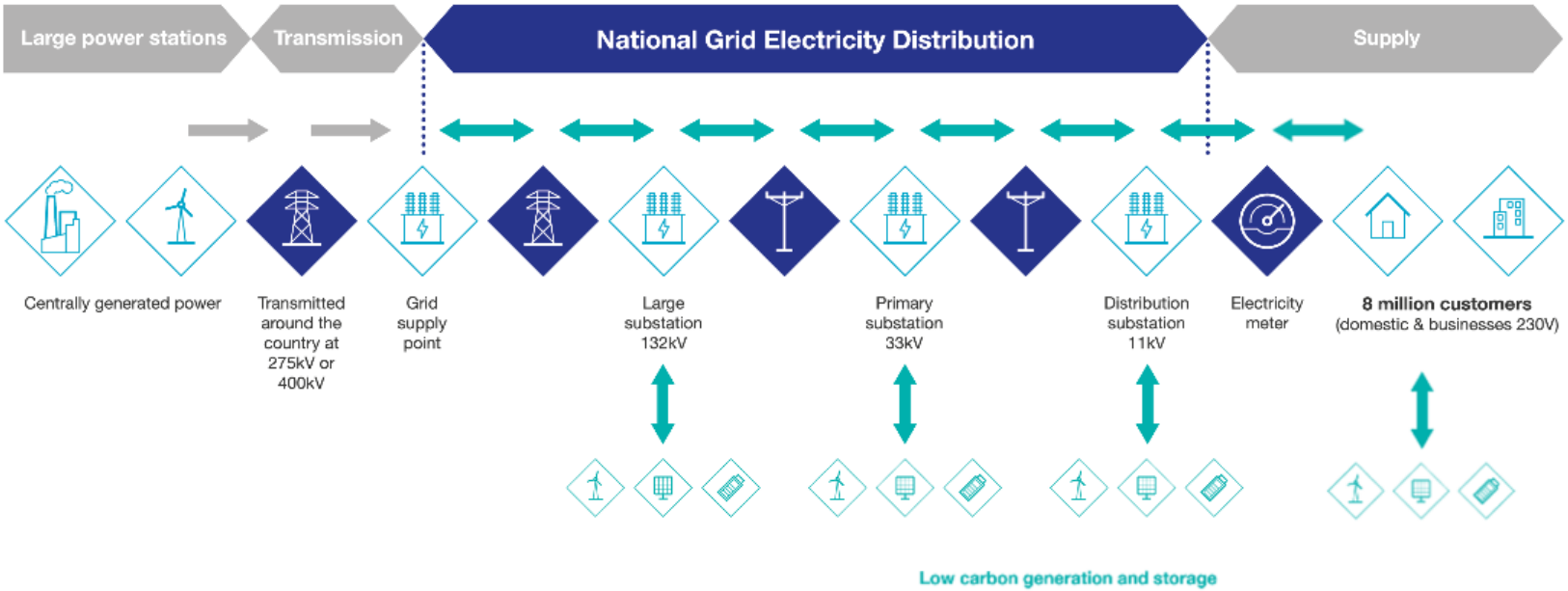
- NGED operate the local electricity network, covering some 55,000km², distributing power to nearly 8 million homes & businesses;
- Covering the East and West Midlands, South Wales and South West England

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



There are also Independent Network Operators who can establish embedded networks within any DNO area

Being a Distribution System Operator



Setting the scene.

- In the UK, Transport according to BEIS creates some 27% of the UKs CO_2 emissions.
- Urban freight is responsible for approx. one – quarter of urban transport emissions in most advanced economies.
- In the UK HGVs cover 5% of total mileage but produce 19% of GHGs.
- E-commerce has increased freight volume in cities and shifted logistics vehicles to local streets and A roads. As the EV market grows, electrification of logistics vehicles can play a significant role in reducing air pollution in cities.
- Ultra Low Emission Zones and Clean Air Zones will also drive adoption of ZEV's.
- Mature EV cities in the EU now operate a procurement system so that municipal fleets buy BEV's in all but exceptional circumstances.

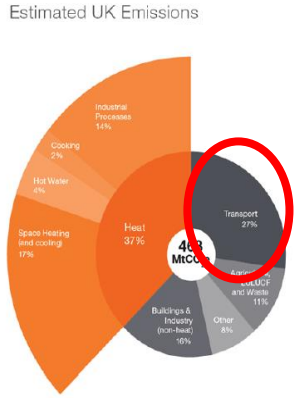
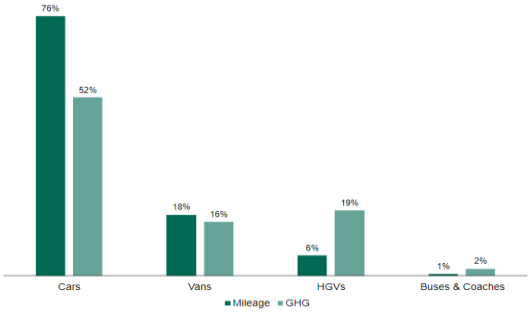


Figure 5: Emissions and Mileage for Cars, Vans, HGVs and Buses in 2020 (tables ENV0201 and TRA0101)



Where BE LCVs & cars can charge.

- **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, charging will typically be carried out in four locations: -**
  1) At Home; 2) At Work; 3) At Destination; 4) On-route charging.
- **Home EV chargers are single phase 7.4kW or three phase 22kW fast chargers.**
- **Typically Work and Destination chargers are usually 7.4kW or 22kW fast chargers, as work staff are normally at work for about 8 hours. There are some Destination locations where 50 or 100kW rapid chargers are installed.**
- **On-route charging at motorway service areas (MSAs) and CPO charging hubs are usually where Rapid and ultra rapid EV charging takes place, this could see CCS rapid chargers of 350kW in size. Project Rapid has standardised at 150kW.**

Background to HGV Charging.

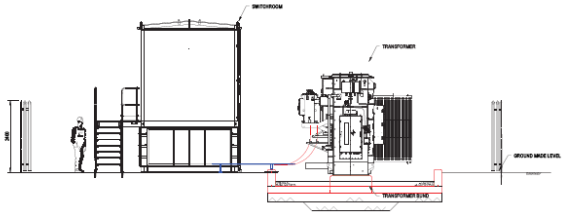
- There is a variety of truck use cases and these differ significantly with respect to trip characteristics, vehicle types, their payload, and daily routines.
- Annual conventional ICE sales amounted to roughly 375,000 medium and heavy-duty trucks in 2018 in the EU and nearby relevant markets i.e. UK, Switzerland and Norway. Heavy-duty trucks make up the majority of the market, with the remaining portion comprising 12,000 light-duty trucks and 44,000 medium-duty trucks. The UK purchase about 35,000 brand new HGV's per year.
- The majority of vehicles are idle for over 9 hours per day, presenting a clear opportunity for vehicle charging at lower power levels. So understanding where and how many is critical. Typically Depot chargers would be circa 150kW chargers.
- Depot charging is the key charging scenario for all use cases, although Long-haul will need reliable public charging as well. Installing a EV Charger network of currently up to 350kW CCS 2 chargers and provision of the new MCS charging system across UK Motorway Service Areas (MSAs) would allow more and more use cases to switch to electric HGVs. Understanding the two use cases for HGVs in MSAs is critical.

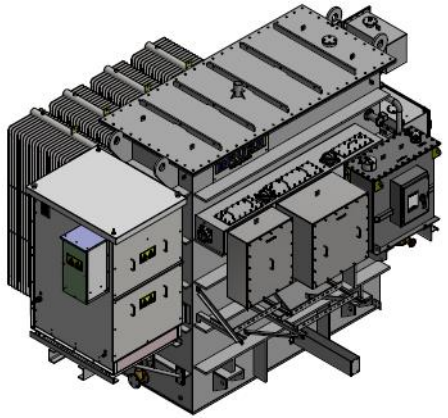
Where BE HGVs can charge.

- **Depot charging:** is likely to be the first focus of electrification efforts as early adopter logistics companies can easily install the exact chargers they need for their use case. Typically for HGVs these will be 100 or 150kW. Understanding the use case would help give insight for network design.
- **Destination or Opportunity charging:** In all logistics use cases, loading and unloading cargo is an important scheduling component next to driving and resting times. If these timeframes were used for charging the vehicle, the vehicle would be able to do multiple trips without returning to the depot. It is important to note that opportunity charging requires a close cooperation between a logistics supplier and their customer, e.g. grocery stores or industrial plants.
- **Public hub charging or On-Route charging:** When a scheduled trip exceeds the range of an electric truck, roughly 100-300km for early models, the dispatcher will have to schedule an additional stop for charging at a public fast charger. These will be a mixture of CCS2 and MCS

Solutions to aid fleet supplies.

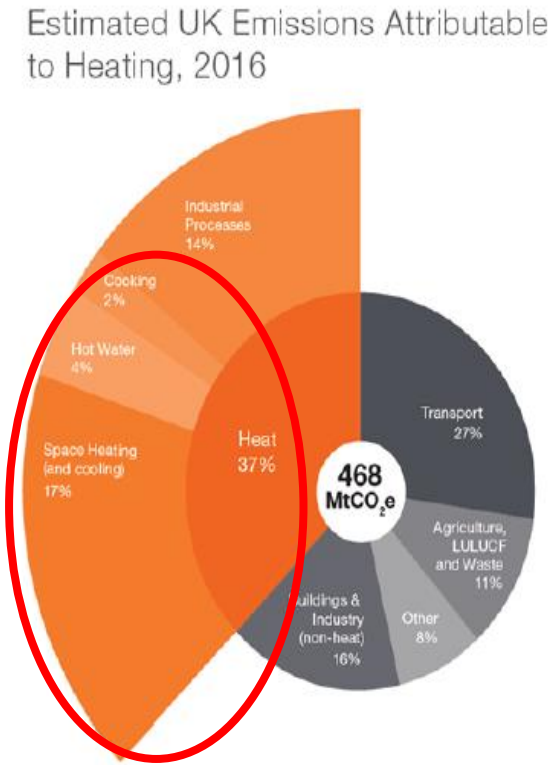
- Taking the Committee on Climate Change lead, we would plan to “touch once for 2050” when upgrading supplies at these locations.
- NGED have developed a hub charging solution typically to supply 12 to 15 off 150kW rapid BEV chargers to help the deployment of charging infrastructure in depots, car parks and other locations.
- Take Charge – Large power supply ≤ 12MVA.
- Project Rapid sees the average size of the 44 MSA WPD sites require at least 7MVA supply for BEV cars and LCV’s.
- HGV’s see the load increase at MSA’s, load is dependant numbers per 24hour period 400HGV’s about 24MVA.
- CharIN the consortium which produced CCS, are type testing MCS (megawatt charging system) scheduled for release in 2024, an MCS charger connects at MV and can require up to 4MVA per charger. This would put about 400kms of range back into the battery of an HGV in 45 minutes.





De-carbonisation of Heating

- Space heating (SH) and domestic hot water (DHW) according to BEIS creates some 24% of the UKs CO_2 emissions.
- The UK government are targeting growing the installation of electric heat pumps, from the current 30,000 per year to 600,000 per year by 2028.
- Energy efficiency is assessed by Energy Performance Certificate (EPC) rating, where ‘A’ represents the best performing homes and ‘G’ the ‘worst’. Homes with high EPC ratings will generally have high levels of insulation and efficient heating systems. The EPC system is floored the data used is based on 2012 data this is out of date.
- With heat pumps offering low grade heat compared to gas fired central heating it means the building housing the heat pump needs to have an EPC rating of C or above.
- The UK has the oldest building stock in Europe, this will impact on the de-carbonisation of heating, especially when retro fitting HPs.



Heat Pumps

- A heat pump is a device that uses a small amount of energy to move heat from one location to another.
- It is an energy efficient heating method, due to the coefficient of performance (COP) a heat pump has, depending on the time of year this could reach around 3.5, which means for 1kW of power in you get 3.5kW of heat out.
- Heat Pumps breakdown into basically two distinct types Ground / Water Source or Air Source.
- The primary function of heat pumps is space heating through radiators, underfloor heating systems, or warm air convectors, heat pumps can also be used to heat water for use in the home or business.
- For example a detached house of 200m² which was built in 2010 in accordance to the relevant Building Regulations Standards would have a space heating requirement of 11,000kWh per year.
- In addition to the space heating (SH), there is the domestic hot water (DHW) to account for, assume 4 people living in the house, would equate to an additional 4,000kWh per year.
- A typical condensing gas boiler performing at 85% efficiency would achieve this at around £1,005 per year, - £734 for SH and £271 for DHW. An oil-fired boiler with a similar efficiency would cost about £1,615 per year.
- These prices are volatile as they are based on world markets.

De-carbonisation

- When de-carbonising both transport and heating it is extremely important to engage at the earliest opportunity with your host DNO.
- NGED offer one on one connection surgeries where NGED will listen to your proposals and offer various solutions especially when looking at the de-carbonisation of transport.
- As a highly regulated industry we are required during the current RIIO ED2 period to charge for all connections.
- Ofgem our regulator has recently issued a “Significant Code Review” document where they are changes to the charging methodology, this comes in on 01/04/23.
- There will still be costs like the extension of assets costs and the capacity costs.
- But there are no upstream reinforcement costs to bear, which will make a big improvement. These changes will be from 01 April 2023. Unless
- For more information on SCR: -

  Access and Forward looking SCR

NGED – NIA EPIC project

- EPIC (Energy Planning Integrated with Councils) was a joint NIA project funded by NGED and Wales and West Utilities (WWU).
- EPIC explored how network companies and local authorities can work effectively together to create local energy plans and support the production of investment plans with an understanding of the costs and benefits from a whole system perspective.
- Energy modelling focussed on the impact of the key building blocks within the Distribution Future Energy Scenarios (DFES). DFES building blocks are different items that can impact demand e.g. items such as domestic PV, heat pumps (HPs) and Electric Vehicle (EV) chargers as well as new houses, new commercial customers etc.
- The number of units for these building blocks were set at a level to reflect the local authorities plans and ambitions in a local energy plan before using network modelling to determine where and when network issues were expected and to consider the options to resolve these. As the impact of DFES are already routinely considered on networks that are 33kV and above, EPIC focussed on the impacts on the High Voltage (HV) and Low Voltage (LV) networks for electricity and the equivalent areas for the gas network.
- The results of the analysis generally showed that the benefits of one option over another within each use case were relatively small with the exception of the investment strategies where the “Fit for the Future” option resulted in significant savings by avoiding repeated upgrades at the same sites.
- However, the current regulatory framework is not set up to capture very long term trade-offs that occur between price control periods that could be thirty or forty years apart.

EPIC continued.

- The project has uncovered a number of data quality issues which took considerable resources to resolve on a relatively small test area.
- Similarly there would need to be additional automation applied to the steps in the EPIC process to reduce the resource requirement to a point at which it could be practical to implement.
- However, the process could be used to provide insights on additional use cases to support local authority policy decisions.
- Similarly the process to create long term load forecasts at HV and LV could be used to inform LV and HV asset replacement decisions by showing the likelihood of future capacity related issues.

Electricity Distribution

Thank you for your time.

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