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Electric Vehicles and Charging Infrastructure

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Rob Broom (associate) and Paul Brennan (consultant), both from our Energy & Natural Resources Practice, Ray O'Connor (partner), from our Construction & Engineering team, and Alex Weatherall (senior associate) from our Real Estate Practice, take a look at the challenges for electric vehicle (EV) market growth in the UK and some of the current regulations and acts in place governing its supporting infrastructure.

What Are EVs and Their Types?

Electric vehicles (EVs, sometimes referred to as ultra-low emission vehicles or ULEVs[1]) use electric motors to drive their wheels and run on electricity some or all the time. There are three main types of EVs, classed by the degree to which electricity is used as their energy source:

- **Battery electric vehicles (BEVs)** – More frequently called EVs, where the battery is the only power source, i.e. the car is fully electric. BEVs store electricity on-board in high-capacity battery packs. This electricity is then used to run the electric motor, as well as the on-board electronics. Most current (non-luxury) models have a quoted range of 80-120 miles (130-190km). In practice, range varies according to driving style, terrain and the use of auxiliary equipment such as heating/air conditioning.
- **Plug-in hybrids (PHEVs)** – These are vehicles powered by both battery power and an internal combustion engine, which can switch between running on electricity or fossil fuels. They typically have a smaller battery, and, therefore, a lower battery-powered range of between 10 and 40 miles (15-60km). However, their maximum range is equivalent to a petrol car. They can be recharged by being plugged in or being filled with diesel/petrol.
- **Hybrids (HEVs)[2]** – These combine an internal combustion engine with an electric propulsion system (hence, hybrid) to provide a higher fuel economy than a conventional vehicle. HEVs do not plug in and have a much smaller battery, which is recharged while driving. This is called "regenerative braking", a process where the electric motor helps to slow the vehicle and uses some of the energy normally wasted as heat when braking[3]. HEVs can drive in electric mode for a few miles.
- **Fuel cell vehicles (FCEV)** – These are a type of EVs that use a fuel cell[4] instead of a battery, or in combination with a battery or supercapacitor, to power its on-board electric motor. FCEVs generate their own electricity on-board from a fuel such as hydrogen, and do not need to plug into the electricity grid to recharge. Re-fueling is similar to a petrol car.[5]

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1 ULEVs is a collective term for a group of vehicles that produce emissions of less than 75 grams per kilogramme (g/km) of carbon dioxide (CO2) for every kilometre (km) travelled.

2 EVgo website, "types of electric vehicles: BEV, PHEV and HEV", available at: https://www.evgo.com/why-evs/types-of-electric-vehicles/, accessed 19 February 2020.

3 Ibid 2.

4 A fuel cell is an electrochemical cell that converts the chemical energy of a fuel (often hydrogen) and an oxidizing agent (often oxygen)

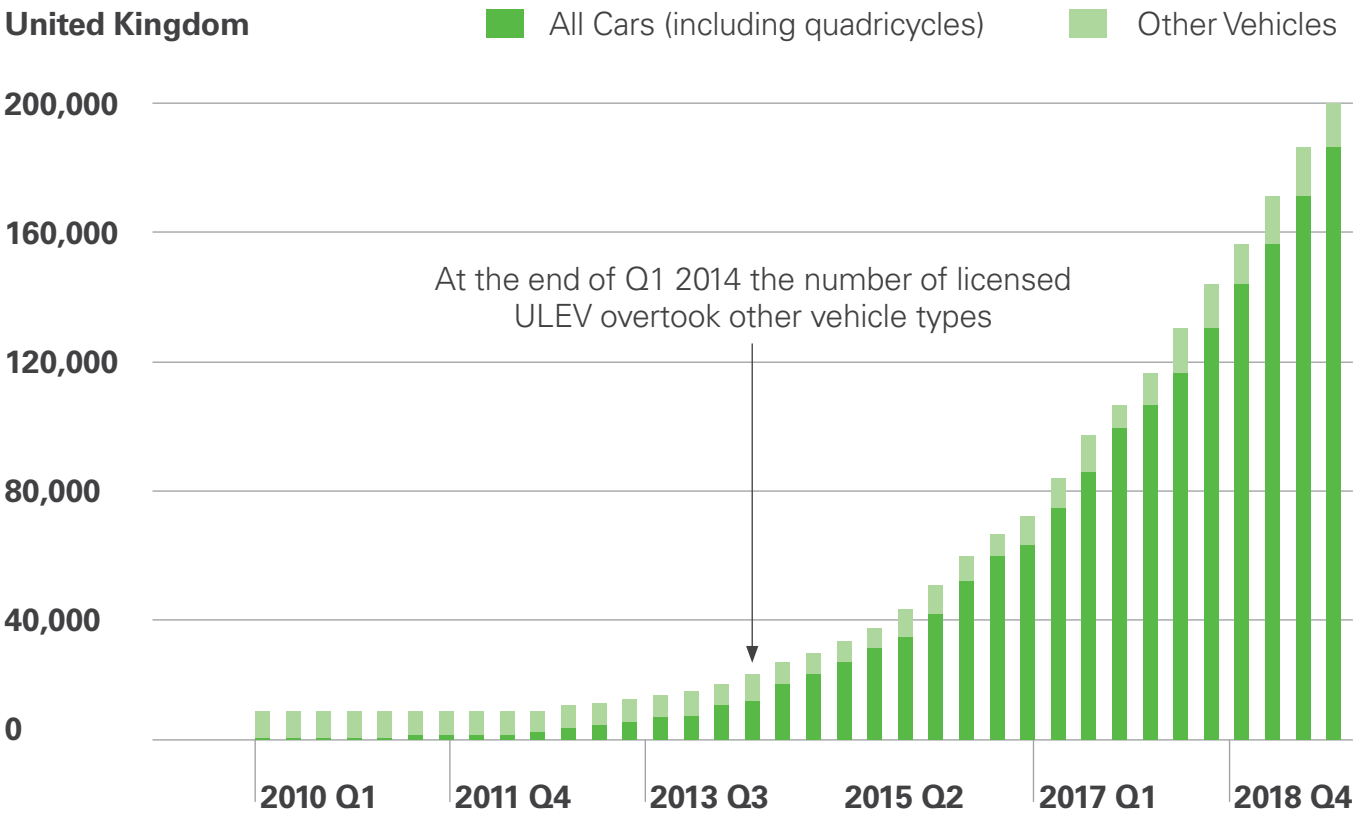
5 Hydrogen Europe website, "Refueling Station", available at: https://hydrogeneurope.eu/refueling-stations, accessed 4 March 2020.

The Slow Growth of EVs in the UK

Uptake of EVs has seen the support of past and current governments, as they can contribute to a wide range of transport policy goals, for example, noise pollution reduction and improving air quality (road transport is responsible for 26% of the UK's GHG emissions[6]). According to the Department for Transport (DFT), the number of ULEVs in the UK has increased from around 9,500 at the end of Q1 2010 to 200,000 at the end of Q4 2018 (please see Chart 1), which represents an increase of 1,732%. At the end of Q1 2014, the number of licensed ULEV cars overtook the number of ULEVs of other types. Currently, cars account for around 93% of all licensed ULEVs. Other ULEVs include vans, scooters, HGVs, etc.[7]

Chart 1: Licenced Ultra-low Emission Vehicles

The number of licensed ultra low emission vehicles (ULEVs) at the end of the quarter.



Source: Department for Transport, Vehicle licensing statistics: Table VEH0130

Whilst the findings of the DFT may at first glance seem highly impressive, the Committee on Climate Change (**CCC**), an independent statutory body established under the Climate Change Act 2008 to advise the UK government on emissions targets, found that the rate of uptake is insufficient if the UK is to have any chance of meeting its new net zero emissions target by 2050. In May 2019, the CCC released a report titled, "Net Zero – The UK's contribution to stopping global warning",[8] recommending that by 2035 at the latest (and ideally by 2030), EVs should make up 100% of the new vehicles market. Whilst noting that the transition to EVs is already underway, the CCC pointed out that progress is slower than in many other countries, with EV sales making up just 2% of new car sales in the 12 months up to September 2018.

[6] Sean O'Grady, "How will Britain's drivers go electric?", *Independent*, 21 June 2019, available at: https://www.independent.co.uk/life-style/motoring/britain-drivers-electric-cars-motoring-emissions-carbon-footprint-a8968536.html, accessed 19 February 2020.

[7] David Hirst, House of Commons Library Briefing Paper, "Electric Vehicles and Infrastructure", 31 January 2020.

[8] Committee on Climate Change Report, "Net Zero – The UK's contribution to stopping global warning", May 2019, available at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf, accessed 10 February 2020.

Since the CCC's May 2019 report, the uptake in EVs has gathered some pace amongst consumers and service delivery companies alike. According to the Society of Motor Manufacturers and Traders (SMMT), sales of EVs rose from 1,334 in January 2019 to 4,054 in January 2020, growing to 2.7% of the new car market, although the overall market fell 7% to 149,000 (see Table 1). However, customer behaviour is still largely being dictated by concerns over basic elements such as:

- **Driving range** – Currently, most current (non-luxury) models have a quoted range of 80-120 miles or so on a full charge[9]
- **Cost/price premium** – The price of an EV is fundamentally dictated by its battery capacity in kilowatt hours (kWh), which dictates its range and the power level of the motor; the initial price of an electric car can be higher than that of a combustion engine car of a similar class[10]
- **Lack of EV charging infrastructure** – While uptake of EVs has grown nearly 100% since 2012, the increase in the number of charge points over the same period is only 44%[11] (Please also see Part 4 "Charge Point Demand")
- **Charge time** – It can take as be as little as 30 minutes to charge an EV or more than 12 hours. This depends on the size of the battery and the speed of the charging point. A typical EV 60kWh battery takes just under eight hours to charge from empty-to-full with a 7kW charging point[12]
- **Safety concerns** – There is a growing concern about the safety of EVs, given the demonstrated tendency of the Lithium-ion battery, most promising for EV use because of its high energy density, to overheat, which could possibly leading to fire or explosion, in particular when the EV is damaged in a crash[13]

Table 1: Electric Vehicle and Alternatively Fueled Vehicle Registrations (2019 vs 2020 comparisons)

	YTD 2020	YTD 2019	% Change	Market share -20	Market share -19
Diesel	29,605	46,264	-36%	19.8%	28.7%
Petrol	91,836	101,444	-9.5%	61.5%	63%
BEV	4,054	1,334	203.9%	2.7%	0.8%
PHEV	4,788	2,268	111.1%	3.2%	1.4%
HEV	8,941	7,412	20.6%	6%	4.6%
MHEV diesel	4,591	559	721.3%	3.1%	0.3%
MHEV petrol	5,464	1,732	215.5%	3.7%	0.3%
Total	**149,279**	**161,013**	**-7.3%**		

BEV – Battery Electric Vehicle
HEV – Hybrid Electric Vehicle
PHEV – Plug-in Hybrid Electric Vehicle
MHEV – Mild Hybrid Electric Vehicle

Source: SMMT website[14]

[9] Net Zero Made Simple – How to Convert Your House to Low/No Carbon, available at: https://www.netzeromadesimple.com/elec-car/, accessed 22 February 2020.

[10] Groupe Renault, "The price of an electric car battery", 28 November 2019, available at: https://easyelectriclife.groupe.renault.com/en/day-to-day/charging/what-is-the-price-of-an-electric-car-battery/, accessed 23 February 2020.

[11] Kat Hall, "Electric vehicles won't help UK meet emissions targets: Time to get out and walk, warn MPs", available at: https://www.theregister.co.uk/2019/08/22/electric_vehicles_wont_help_carbon_emissions_target_say_mps/, accessed 22 February 2020.

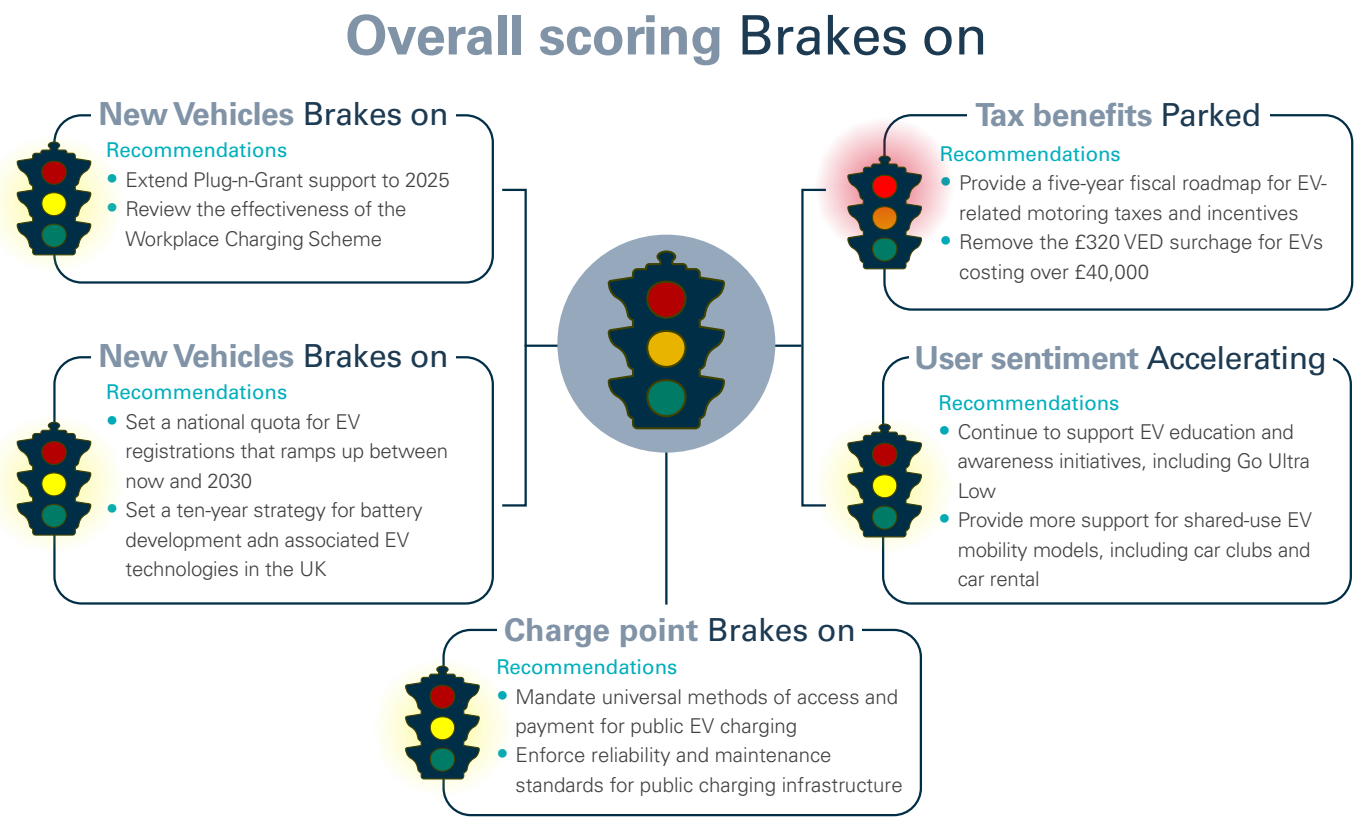
[12] PodPoint, "How Long Does It Take to Charge an Electric Car?" available at: https://pod-point.com/guides/driver/how-long-to-charge-an-electric-car, accessed 22 February 2020.

[13] Deloitte Report, "New markets. New entrants. New challenges. Battery Electric Vehicles" available at: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/manufacturing/deloitte-uk-battery-electric-vehicles.pdf, accessed 19 February 2020.

[14] SMMT website, Electric Vehicle and Alternatively Fuelled Vehicle Registrations, available at: https://www.smmt.co.uk/vehicle-data/evs-and-afvs-registrations/, accessed 10 February 2020.

A key factor preventing a higher rate of EV registrations identified by the British Vehicle Rental and Leasing Association (BVRLA) (which represents fleets that own or operate nearly five million cars and vans) in its "Road to Zero Report Card" analysis,[15] is the current poor charge point infrastructure, a view that has been echoed by National Grid, who reported in January 2019, that a network of ultra-rapid EV charge points will need to be delivered by the time at which vehicle cost parity is predicted to be reached, to ensure infrastructure is not the remaining barrier to consumer EV uptake.[16] Other factors cited by the BVRLA include taxation and supply chain constraints. The BVRLA analysis, which uses a scorecard system to provide a review of the Government's Road to Zero progress is currently marked as "Amber – Brakes on" (please see Chart 2).

Chart 2: BVRLA Analysis



Source: BVRLA's Road to Zero Report Card[17]

The UK government is now facing an even more exacting legal obligation as regards the reduction of greenhouse gas (GHG) emissions following the adoption of The Climate Change Act 2008 (2050 Target Amendment) Order 2019 in June last year in the last days of Theresa May's premiership. The order changed the UK's 2050 GHG reduction target enshrined in section 1 of the Climate Change Act 2008 (CCA 2008) from the original 80% to 100%, or net zero. If the government is to meet this legally binding target, EVs must become widely used and consumer EV concerns (some of which are outlined in Part 2) will need to be tackled. Enabling the transition to zero emission vehicles does not just require EVs to be available and affordable. Critically, an infrastructure network needs to be put in place that is easy for current and prospective drivers to locate and use, and is affordable, efficient and reliable.[18]

[15] BVRLA Road to Zero Report Card, 18 June 2019, available at: https://www.bvrla.co.uk/resource/bvrla-road-to-zero-report-card.html, accessed 19 February 2020.

[16] National Grid Report, "Supporting the growth of Electric Vehicles", January 2019, available at: https://www.nationalgrid.com/document/125116/download, accessed 19 February 2020.

[17] BVRLA's Road to Zero Report Card 18 June 2019, available at: https://www.bvrla.co.uk/resource/bvrla-road-to-zero-report-card.html, accessed 19 February 2020.

[18] Government Report, "The Road to Zero- Next steps towards cleaner road transport and delivering our Industrial Strategy", July 2018, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf, accessed 23 February 2020.

EV Charging

There are three main types of EV charging; rapid, fast, and slow. These represent the power outputs and, therefore, charging speeds, available to charge an EV.

- **Rapid chargers** are the fastest way to charge an EV, and predominantly cover Direct Current (DC) charging. This can be split into two categories – ultra-rapid and rapid. Ultra-rapid points can charge at 100+kW – often 150kW – and up to 350kW, and are DC only. Conventional rapid points make up the majority of the UK's rapid charging infrastructure and charge at 50kW DC, with 43kW AC rapid charging often also available.
- **Fast chargers** include those that provide power from 7kW to 22kW, which typically fully charge an EV in three to four hours. The most common public charge point found in the UK is a 7kW untethered Type 2 inlet, though tethered connectors are available too for both Type 1 and Type 2.
- **Slow units** (up to 3kW) are best used for overnight charging and usually take between six and 12 hours for a pure-EV, or two to four hours for a PHEV. EVs charge on slow devices using a cable that connects the vehicle to a three-pin or Type 2 socket.[19]

EV Chargepoint Demand

A key factor creating "range anxiety" – fears over the distance EVs can travel between charges – amongst prospective EV customers is the availability of charging points. Public charge points allow EV drivers to charge their cars on the road when they need to travel distances longer than their vehicle's single charge range. A CCC report published in January 2018, which envisages EVs accounting for 60% of new car and van sales by 2030, estimates that a total of 29,000 public chargers will be required to meet the EV charging needs of 2030. The majority of these chargers will need to be fast (22kW) or rapid (43+kW). The overall estimated costs is around £530 million, excluding grid connection costs. The network of public chargers continues to grow rapidly, with ZapMap reporting a total of 17,817 chargers, over 3,000 of them rapid, at 11,045 different locations at the time of writing (March 2020).[20]

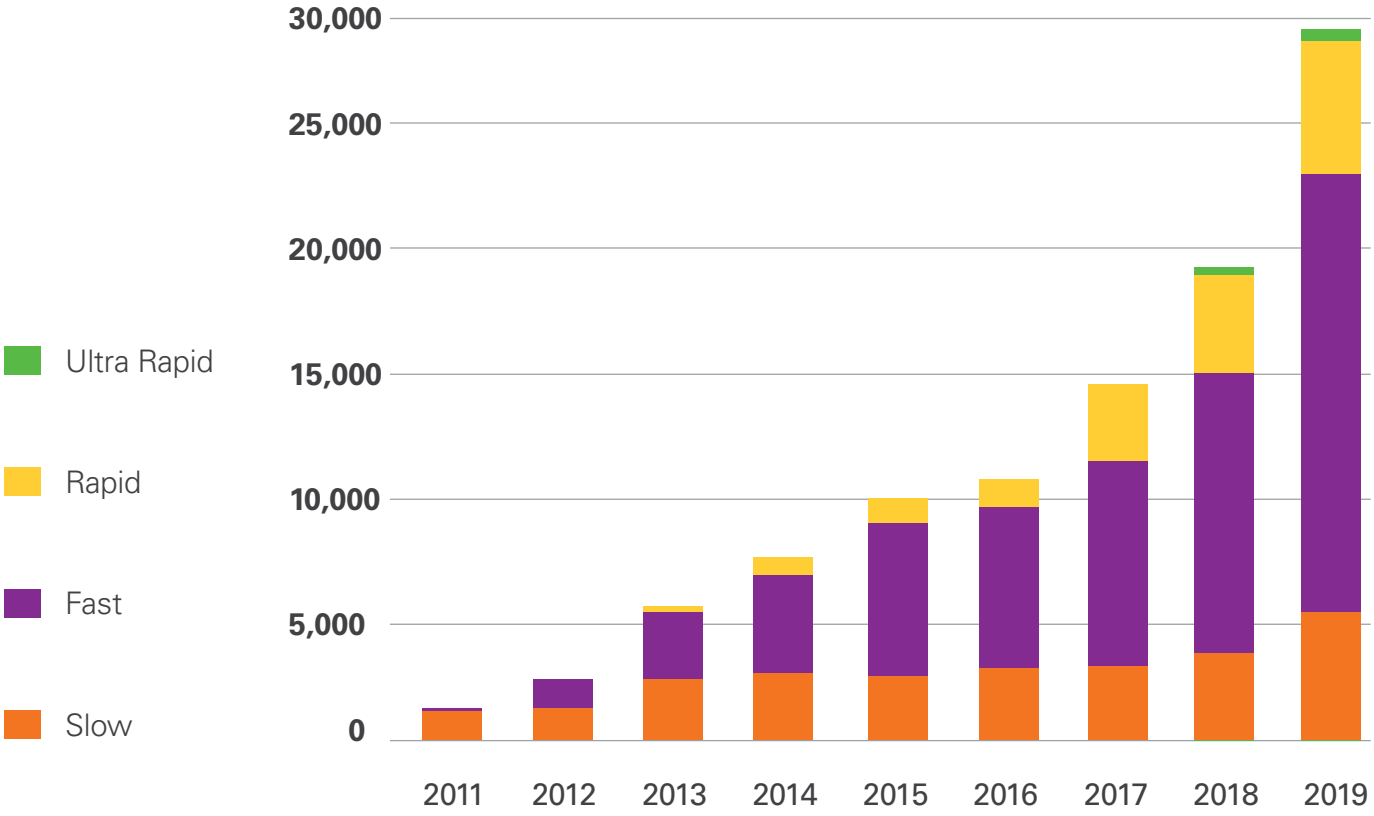
According to ZapMap, the majority of growth over the past few years has been in rapid chargers and fast chargers. This reflects the growing demand for higher charging rates as battery capacities increase and EVs are driven on longer journeys. Chart 3 shows the breakdown of connectors by slow (3-5kW), fast (7-22kW), rapid (25-99kW) and ultra-rapid (100kW+) type chargers between 2011 and 2019. As Chart 3 shows, from 2018 to 2019, there was also a significant increase in the number of slow chargers, which indicates the rapid expansion of the EV market in 2019.[21]

[19] ZapMap, "EV Charging" available at: https://www.zap-map.com/charge-points/, accessed 23 February 2020.

[20] ZapMap website, https://www.zap-map.com/ accessed 19 February 2020.

[21] ZapMap website, https://www.zap-map.com/statistics/, accessed 23 February 2020.

Chart 3: Increase of Number of Charging Points Across the UK



Source: ZapMap[22]

The government's 2018 Road to Zero Strategy outlines its long-term strategy to achieve a transition to zero emission road transport "effectively" by 2040, with an ambition for at least 50% – and as many as 70% – of new car sales, and up to 40% of new vans, to be ultra-low emission by 2030). The Road to Zero Strategy sets out the steps the government will take to enable a massive rollout of infrastructure to support the EV revolution, including:

- A push for charge points to be installed in new build homes, where appropriate, and new lampposts to include charging points
- Providing up to £500 for EV owners to put in a charge point in their homes through the EV homecharge scheme; and an increase in the value of grants available to workplaces to install charge points so cars can be charged at the workplace[23]
- Creating a new £40 million programme to develop and trial innovative, low cost wireless and on-street charging technology
- Launch of a £400 million public-private Charging Infrastructure Investment Fund, which aims to catalyse the rollout of V charging infrastructure that is required to support the electrification of vehicles by providing funding to new and existing companies that produce and install charge points[24]

[22] Alex Janiaud, Nilushi Karunaratne & Tom Dines, "is the UK really ready for electric cars?" 12 February 2020, available at: https://www.investorschronicle.co.uk/company-news/2020/02/12/is-the-uk-ready-for-electric-cars/, accessed 17 February 2020.

[23] Fleet News, "What is the Government's Road to Zero strategy?", available at: https://www.fleetnews.co.uk/fleet-faq/what-is-the-government-s-road-to-zero-strategy, accessed 23 February 2020.

[24] Gov.uk "Details of the operation of the Charging Infrastructure Investment Fund", September 2019, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834758/Details_of_the_operation_of_the_CIIF.pdf, accessed 23 February 2020, and Gov.uk "Government launches Road to Zero Strategy to lead the world in zero emission vehicle technology", 9 July 2018, available at: https://www.gov.uk/government/news/government-launches-road-to-zero-strategy-to-lead-the-world-in-zero-emission-vehicle-technology, accessed 23 February 2020.

Do EV Charge Point Operators Need a Supply Licence to Supply EVs?

The activities that need a supply licence (or exemption) are set out in the Electricity Act 1989 (**EA89**), which provides that (subject to certain exemptions) a supply licence is required for the supply of electricity to "premises", further defined as any "land, building or structure". In October 2019, the UK's gas and electricity markets regulator, Ofgem, published a guidance note focused on the retail elements of selling electricity to EV users setting out Ofgem's views on how the supply licensing regime under the EA89 applies to different forms of vehicle charging.[25]

The Ofgem guidance concludes that the supply of electricity to an EV at a public charge point is not a "supply to premises" under the EA89, although it did suggest that in future, there may be EV use cases that stretch this conclusion. Scenarios considered by Ofgem include:

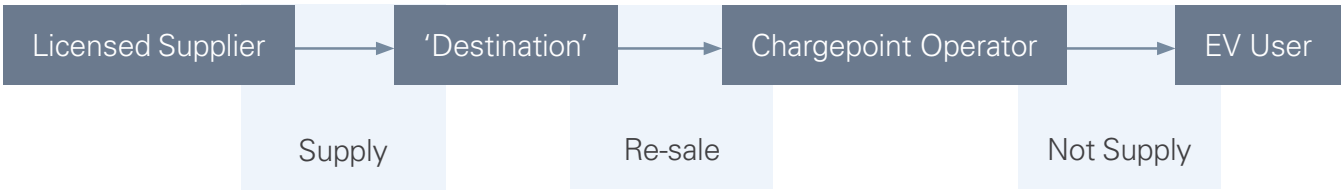
- **On street charging** – This is charging an EV at a public charge points on the road. These could be dedicated charge points or could use existing street infrastructure, such as lampposts. Charging in this way is likely to be particularly common in urban areas where EV owners lack their own off-street parking. Ofgem noted that in selling the electricity to EV users, these charge points are not likely to be bound by the regulatory regime governing electricity supply but, rather, broader consumer protection rules.
- **Destination charging** – This is charging at a location where an EV may be left for a period of time, such as a supermarket car park or workplace. A number of business models could exist here, such as the destination (e.g. a car park/supermarket) offering free charging, or renting out their parking to a third party who then sell electricity to the end EV user. Ofgem noted that the rules that apply here are similar to those for on-street public charging: the selling of electricity to the end EV user is not usually supply.

As the final sale of electricity to the EV is not a licensable supply, in theory, there is no limit on the price charged by the charge point operator to the EV user, though in the case of standard types of connectors, competitive forces will tend to produce prices that reflect prevailing market rates.

Resale of Electricity to Charge Point Operators

Although sale to the end user is unlikely to constitute a supply within the meaning of the EA89, the relationship between the host of charge point, for example, a supermarket, and the charge point operator can be more problematic. Ofgem considers any provision of electricity from the host to the charge point operator to be a supply on the basis that charge points are structures bringing the resale to the operator within the scope of the EA89 definition. However, the onward supply between landlord and tenant of electricity purchased by the landlord from a licensed supplier would typically be covered by an exemption under the Electricity (Class Exemptions from the Requirement for a Licence) Order 2001, in which event so the host would not need a supply licence.

Chart 4: Full Intermediary Supply Chain (Licensed Supplier-to-EV Users)



Source: Ofgem EV Charging Guidance

[25] Ofgem Guidance, available at: https://www.ofgem.gov.uk/system/files/docs/2019/10/what_you_need_to_know_about_selling_electricity_to_ev_users.pdf, accessed 13 February 2020. Please note the Guidance does not cover other regulatory considerations that apply to EVs, such as technical standards or network connection issues.

Should Supply to EV Charge Points Be Metered?

In general, supplies made by licensed suppliers to EV chargers should be metered,[26] certainly in the case of rapid and fast chargers. Circumstances in which an unmetered supply of electricity may be given are prescribed by the Electricity (Unmetered Supply) Regulations 2001 (SI 2001/3263) (**Unmetered Supply Regulations**) commonly used for supplies to street lighting, traffic signals and other street furniture, which meet the regulations' requirement that the electrical load is predictable.

The Department for Business, Energy & Industrial Strategy (BEIS) Guidance on the Unmetered Supply Regulations[27] indicates that supplies to EV charging points should generally be metered because of the size of the load and the inability to predict the usage of such points. However, it suggests that for slow ("trickle") charging points on residential streets, an unmetered supply may be agreed by the licensed supplier, distribution network operator (DNO) and the customer (which in this context, would be the operator of the charging device, rather than the end user), where the charge point:

- Is used in conjunction with an approved Measured Central Management System (MCMS) under the Balancing and Settlement Code (BSC) which utilises measured feedback, and
- Is not used for fast or rapid charging (e.g. they should have an individual power output that is typically not greater than 7.2kW- subject to the relevant DNO'S engineering standards)[28]

Where end users are being charged for the amount of electricity supplied to them, some form of measurement will obviously be required, though other charging models are possible. For instance, charges could be applied in whole of or in part by reference to the amount of time the vehicle occupies the charging space.

[26] Paragraph 1 (1) Schedule 7 to the EA89 provides that "where a customer of an electricity supplier is to be charged wholly or partly by reference to the quantity of electricity supplied, the supply shall be given through, and the quantity of electricity shall be ascertained by, an appropriate meter". Paragraph 1(1)(A) provides for exemptions.

[27] Business, Energy & Industrial Strategy (BEIS) Guidance on Unmetered Supply Regulations – the Electricity (Unmetered Supply) Regulations 2001 (SI 2001/3263) available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/704336/Unmetered_supplies_of_electricity_-_Guidance_to_the_UMS_Regulations__version_3.0.pdf, accessed 23 February 2020.

[28] Ibid 26.

Applicable Standards to Be Met by Charging Infrastructure Operators

The Alternative Fuels Infrastructure Regulations 2017 (**AFIR**) came into force on 9 October 2017, and ensures publicly accessible alternative fuel infrastructure for road transport comply with technical specification and customer experience standards, which enable a minimum level of access and information for consumers. Under the AFID, operators of charging infrastructure are to comply with a common set of standards for vehicle connectors and socket outlets (as well as for refuelling points supplying hydrogen). These standards are set out in Table 2.

Table 2. Charging Infrastructure Standards

Charging Infrastructure	Standard
Normal power recharging points for motor vehicles	(1) An alternating current normal power recharging point for EVs must be equipped for interoperability purposes with at least socket outlets or vehicle connectors of Type 2 as described in standard EN 62196-2. (2) While maintaining the Type 2 compatibility, those socket outlets may be equipped with features such as mechanical shutters.
High power recharging points for motor vehicles	(1) An alternating current high-power recharging point for EVs must be equipped for interoperability purposes with at least connectors of Type 2 as described in standard EN 62196-2. (2) A direct current high-power recharging point for EVs must be equipped for interoperability purposes with at least connectors of the combined charging system "Combo 2" as described in standard EN 62196-3.
Technical specification for refuelling points supplying hydrogen for motor vehicles	Connectors for motor vehicles for the refuelling of gaseous hydrogen must comply with the ISO 17268 gaseous hydrogen motor vehicle refuelling connection devices standard.

Source: Alternative Fuels Infrastructure Regulations 2017

Pursuant to the AFIR, customer experience standards are also required for:

- Geographic location data of recharging and refuelling points made available to the public
- Intelligent metering systems incorporated into recharging points[29]
- *Ad hoc* provision enabling consumers access to recharging points without entering into a pre-existing contract or membership[30]

[29] These are:

(1) The infrastructure operator must ensure that the intelligent metering system

(a) displays to the person using the recharging point the time of its use;

(b) is secure with regard to data sent from and to it.

(2) The infrastructure operator must ensure that information on the performance of the intelligent metering system is available to the person at the point of recharging.

[30] AFIR, Regulation 5.

Future Regulation of EV Charging Infrastructure

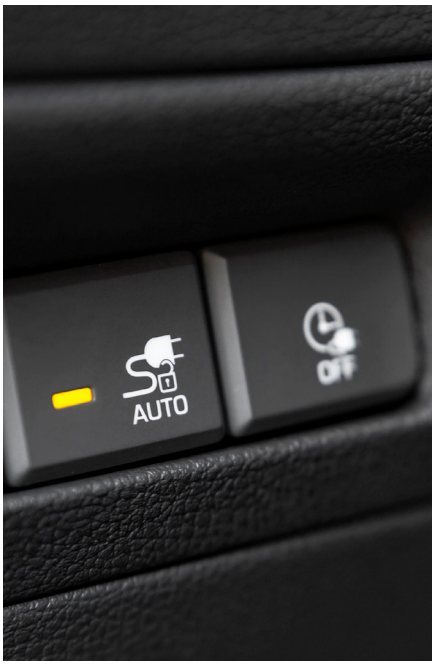
The powers in the Automated and Electric Vehicles Act 2018 (**AEVA**) allow the government to regulate the following areas, if necessary, in the coming years to improve consumer confidence in charging their vehicles:

- Making sure that public charge points are compatible with all vehicles
- Standardising how they are paid for
- Access to information about public charging points, including their performance, maintenance and availability
- Clarification as to who is responsible is responsible for providing public charging points – the AEVA envisages that this will concern large fuel retailers or service area operators, but these terms will be further defined in regulations
- Setting standards for reliability
- Technical specifications and abilities of the charging points, e.g. the ability to monitor and record energy consumption or comply with security requirements

However, the precise detail is left to be set out in secondary legislation. Until then, the AEVA resembles no more than a wish list. The AEVA requires the Secretary of State to consult prior to enacting the secondary legislation.

Authors' Conclusions

Range anxiety has been seen as one of the primary obstacles to the uptake of EVs, and the organic growth in the competitive market has already gone some considerable way toward addressing the issue. The initiatives set out in the government's Road to Zero Strategy will provide welcome support, though excessive reliance on the competitive market to provide chargers could mean there are likely to be gaps in the network in more remote parts of the country where the level of demand is insufficient to justify investment. The cost and potential delays in accessing grid capacity for rapid chargers also need to be addressed. The benefits offered to the electricity system by EVs, especially when fast or rapid charging is not required, also needs to be recognised – EVs could be used to provide services to the electricity suppliers and network operators, by varying their rate of charge or even exporting stored electricity to the grid. The transition to EVs involves far more than simply replicating the fuel supply chains for the internal combustion engine for a different energy source. If the government's targets for EV take up are to be achieved, commercial and regulatory innovation will be required so that EVs are fully integrated into the UK's electricity industry.



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