Charging Up

Policy Exchange

Policies to deliver a comprehensive network of public EV chargepoints.

Ed Birkett and William Nicolle

Foreword by Simon Clarke MP

Edited by Benedict McAleenan

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About the Author

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Acknowledgements

Policy Exchange would like to thank the European Climate Foundation and CIFF for their generous support for this project.

The author would like to thank the many companies and stakeholders who provided input and views to this report, including Ben Allen, Daniel Bentham, Daniel Brown, Josh Buckland, Zewditu Gebreyohannes, Sam Hall, Alistair McGirr, James McKemey, National Grid, Mike Nicholas, Natasha Patel, as well as those who wished to remain anonymous.

This report was produced by Policy Exchange and the views and the recommendations in the report are those of Policy Exchange.

Published by
Policy Exchange, 8 – 10 Great George Street, Westminster, London SW1P 3AE

www.policyexchange.org.uk

ISBN: 978-1-913459-54-3

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Foreword

By Simon Clarke MP

The UK has set itself a generation-defining challenge. To meet our 'Net Zero' target – one that I led calls for in Parliament in 2018 – we must recalibrate our entire economy to run on sustainable technologies and fuels, reinventing ourselves for this century and beyond.

We are also doing so in front of the world: as the host of the UN climate summit COP26 later this year, the UK will be expected to lead negotiations from a position of moral and competent authority. We need to show that we are 'walking the talk'.

And yet the most important scrutiny will come not from the eyes of history nor on the global stage, but from our own voters here at home. The process of retooling presents massive challenges, but also huge opportunities. The Prime Minister, in his 'Ten Point Plan for a Green Industrial Revolution', rightly put jobs at the heart of this agenda. The transition to clean technologies means that British engineers, scientists and workers with specialist skills in a host of industries can once again lead the world in an industrial boom – led, of course, by the North East.

The opportunity and the question of fairness aren't just about jobs, but about a broadening out of Britain's economic base. Addressing our well-documented regional disparities by 'levelling up' means ensuring that every part of the UK – every nation and every region – has equal access to first-class, modern infrastructure. That should be a central principle of the transition to a green economy: as we upgrade to renewable and zero-carbon technologies, every part of the UK should benefit. This principle is absolutely central to the levelling up agenda, but also to the future of our union.

Nowhere is this issue more central than in the UK's network of chargepoints for Electric Vehicles (EVs). Whereas a driver of a petrol car can travel confidently from Land's End to John O'Groats, knowing that they can refill the tank every few miles, that is not yet the case for EVs. Some areas have naturally built up impressive coverage, such as central London, but vast swathes of the country have not. As I travel between my constituency of Middlesbrough South and East Cleveland, and my work in Westminster, there is a stark contrast. My constituency has a handful of chargepoints, while whole neighbourhoods of London are already saturated. As with the enduring problems of broadband roll-out which leave blackspots even today, the market misses out large parts of the UK, especially smaller towns and rural areas.

If the UK is to meet our ambitious target of a 2030 phase-out of new

petrol and diesel cars, then this has to change. The target is appropriate, as transport is the largest carbon emitting sector, but it will depend on the decisions of car owners. Drivers will only buy cars that they can drive with confidence. As the authors of this excellent report point out, the target is to make driving an EV as easy and affordable as driving a traditional car. This was recognised in the Conservative Party's 2019 manifesto, which promised a rapid chargepoint within 30 miles for everyone in the UK.

This important report sets out a way to meet the challenge. It calls on the Government to target investment in public EV chargepoints in areas like my constituency, which are underserved. It proposes a system that ensures a driver in the most rural parts of our four nations will have the same confidence as one driving across London. Importantly, it includes incentives for chargepoint operators to maintain their chargers, ensuring a high-quality network as well as a comprehensive one.

The report also keeps an important factor front and centre: cost. After the ravages of the coronavirus, Britain must spend money more wisely than ever before. The authors' recommendations would mobilise the private sector, bringing innovation and cost savings along the way. In their proposed system of competitive procurement, they take lessons from the UK's successful support for offshore wind, in which costs have plummeted while the technology has become more efficient and (literally) reached new heights. These are approaches that will help to cut the costs of the transition to Net Zero.

Finally, I welcome the report's recommendations to ensure that chargepoints are as convenient as possible for drivers. I regularly hear stories from constituents about how some chargepoints are out of service for too long, and difficulties signing up to different chargepoint networks. Operators are working hard to improve the charging experience, but we can go further and faster.

The transition to electric and other zero-emissions vehicles is a big challenge for the Government and for industry. But it's also an opportunity to create new jobs in the car manufacturing sector, as we've seen in Nissan's decision to bring more battery manufacturing to the North East. If we get this right, the transition to clean transport can underpin a green industrial revolution, clean up our air, and take us a step further towards Net Zero. It will also help us to knit our country together with infrastructure fit for the 21st century.

Simon Clarke is the Member of Parliament for Middlesbrough South and East Cleveland, and a former Minister for Regional Growth and Local Government.

Glossary of Terms

Term	Definition
Alternating Current (AC)	Type of electricity supplied from the national electricity grid to UK homes and businesses. Used by slow/overnight EV chargepoints. EVs have 'on-board chargers' to convert AC electricity to DC electricity, which is used to charge the battery.
Battery Electric Vehicle (BEV)	A vehicle propelled by electric motors that are powered solely by an on-board battery.
Chargepoint	Device that supplies the electricity used to charge an EV. The charging speed varies between chargepoints. In this report, we classify chargepoint as 'slow/overnight', 'rapid', or 'high-powered' based on maximum charging rate.
Chargepoint operator (CPO)	Company that operates chargepoints for electric vehicles. CPOs in the UK include bp Chargemaster, Tesla Superchargers, Ubitricity, Pod Point and others.
Climate Change Committee (CCC)	Independent statutory body advising the UK and devolved governments on emissions targets and preparing progress reports to Parliament.
Contracts for Difference (CfD)	Main support scheme for renewable energy generators in Great Britain. Generators receive a fixed price for their electricity, with payments based on the difference between the wholesale price and a fixed 'Strike Price'.
Department for Business, Energy & Industrial Strategy (BEIS)	UK Government department responsible for business, energy and industrial strategy.
Department for Transport (DfT)	UK Government department responsible for transport policy.
Direct Current (DC)	Type of electricity used to charge a battery. Rapid and high-powered chargepoints provide DC electricity directly to the battery. Slow/overnight chargepoints provide AC electricity to the EV, which is converted to DC electricity to charge the battery.
Electric Vehicle (EV)	Definition typically includes BEVs and PHEVs, which can be charged using electricity, but not FCEVs, which are refuelled with hydrogen.
Fuel Cell Electric Vehicle (FCEV)	A vehicle propelled by an electric motor that uses an on-board hydrogen fuel cell as a source of electricity, rather than a battery.
High-powered chargepoint (100 kW+)	The fastest class of chargepoints and also the most expensive to install. A typical high-powered chargepoint that delivers 150 kW can charge a typical EV (75 kWh) to 50% in 15 minutes if the car can accept the maximum charging speed.
Hydrogen	A clear, odourless gas which is highly flammable; the most common element in the universe which can be used as a low-emission alternative fuel for power, heating and transport.
Kilowatt (kW)	Measure of battery charging rate. 1 kW = 1000 Watts.
Kilowatt hour (kWh)	Measure of energy. For example, if a car consumes 1 kW of electricity for one hour then it consumes 1 kWh of energy.
Net Zero	A target of zero overall greenhouse gas emissions across an economy or for a company. For example, the UK Government has committed to Net Zero emissions across the UK by 2050. The "Net" in Net Zero refers to a balance between positive emissions (e.g. from burning fossil fuels) and negative emissions (e.g. from planting trees or capturing carbon dioxide from the air).

Office for Zero Emission Vehicles (OZEV)	Team working across the UK Government to support the market for ZEVs. OZEV is part of DfT and BEIS. Formerly known as the Office for Low Emission Vehicles (OLEV).
Ofgem	The Office for Gas and Electricity Markets (Ofgem) is the regulator for gas and electricity in Great Britain.
On-street parking	The parking of cars on the street, usually because the owner does not have 'off-street parking'. These cars can be charged using 'on-street chargepoints', including chargepoints connected to lampposts.
On-street Residential Chargepoint Scheme (ORCS)	The UK's Government main support scheme for chargepoints on streets in residential areas. ORCS offers grants to Local Authorities that can be used to fund up to 75% of the cost of installing EV chargepoints.
Off-street parking	The parking of cars off the street overnight, for example in a private driveway or a garage. Also includes parking in communal garages in blocks of flats. These 'off-street households' are more likely to charge at home.
Plug-in Hybrid Electric Vehicle (PHEV)	A vehicle powered by a combination of a battery and a petrol or diesel engine. The battery can be charged at an EV chargepoint.
Public EV Chargepoint	Our definition of 'public EV chargepoints' includes all chargepoints except those in private homes and workplaces, as well as those on proprietary networks, such as Tesla Superchargers. Note: The *Alternative Fuels Infrastructure Regulations 2017* uses a different definition, which excludes on-street chargepoints in residents' parking bays. The term 'public EV chargepoints' does not imply public/state ownership.
Rapid chargepoint (23 - 99 kW)	A typical rapid chargepoint (50 kW) can charge a typical EV (75 kWh) to 50% in 40 minutes.
Slow/overnight chargepoint (3 - 22 kW)	The slowest class of chargepoints and the cheapest to install. Typically installed in homes and workplaces. Often used for overnight charging. A typical slow/overnight chargepoint (7kW) can charge a typical EV (75 kWh) to 50% in around 5 hours.
Zero-Emission Vehicle (ZEV)	ZEVs include BEVs, PHEVs and FCEVs. ZEVs have zero exhaust emissions, i.e. no carbon dioxide or nitrogen oxide (NO_x) emissions from the exhaust. However, ZEVs still contribute to local air pollution through non-exhaust emissions, including from brake and tyre wear.
ZEV mandate	Regulation that requires car manufacturers to sell an increasing proportion of ZEVs each year, or to buy credits from other manufacturers. California has operated a ZEV mandate since the 1990s.

Executive Summary

The UK's commitment to phase out new petrol and diesel cars and vans by 2030 was at the heart of the Prime Minister's recent 'Ten Point Plan for a Green Industrial Revolution'.[1] This commitment reflects both sharp reductions in the cost of electric vehicles (EVs) and the urgent need to clean up the transport sector, which is now the UK's largest source of greenhouse gas emissions. The phase-out of petrol and diesel vehicles will only be delivered if drivers are confident that they will have access to a comprehensive network of EV chargepoints, allaying fears of 'range anxiety'. The majority of EV charging is expected to take place at home; however, **there is a critical role for public chargepoints, which are the focus of this report.**[2]

Our analysis shows that, in the 2020s, the UK needs to install public chargepoints five times faster than the current rate.[3] We estimate this could cost between £5bn and £10bn by 2030; to put the cost into context, this is between 25% and 50% of the estimated construction budget for the Hinkley Point C nuclear power station.[4] Chargepoint operators (CPOs) will have to grapple with expensive connections to the electricity grid, particularly for high-powered chargepoints (100 kW+). Without Government intervention, there is a risk that the UK will not develop a comprehensive network of EV chargepoints. Therefore, **in areas that are underserved, the Government should procure chargepoints through regular tenders that offer long-term contracts for EV chargepoints,** based on the Government's successful auctions for offshore wind farms.

In the 2020s, chargepoint operators must install chargepoint five times faster than today.

Today, the UK has around 35,000 public EV chargepoints and CPOs are installing around 7,000 new ones each year. By 2030, the UK is likely to need around 400,000 public chargepoints, including around 6,000 high-powered chargepoints. This means that, during the 2020s, CPOs need to install chargepoints 5 times faster than the current rate.[5]

For high-powered chargepoints, CPOs are broadly on track to deliver the 6,000 chargepoints required by 2030. However, there are likely to be issues installing chargepoints at key locations including motorway service areas, which may require expensive new connections to the electricity grid. There is also a risk that CPOs will build too few chargepoints in rural areas, which could put at risk the Government's manifesto commitment to ensure that everyone is within 30 miles of a rapid EV chargepoint.[6]

The Government's commitment to invest £1.3bn of public money in

1. 10 Downing Street (November 2020). *PM outlines his Ten Point Plan for a Green Industrial Revolution for 250,000 jobs.* Link
2. Our definition of 'public EV chargepoints' includes all chargepoints except those in private homes and workplaces, as well as those on proprietary networks, such as Tesla Superchargers. Note: The *Alternative Fuels Infrastructure Regulations 2017* uses a different definition, which excludes on-street chargepoints in residents' parking bays. 'Public EV chargepoints' does not imply public/state ownership.
3. Current rate calculated as the average installations per year over the last three years.
4. F. De Beaupuy (2019). *Cost rise again for UK Hinkley Point Nuclear Project.* Link; N. Thomas (2021). *Hinkley Point C nuclear power station cost rises by £500m.* Link; Note: Hinkley Point C's construction costs are estimated to be between £22bn - £23bn.
5. 35,000 per year during the 2020s versus around 7,000 per year over the last three years.
6. Conservative Party (undated). *Conservative Manifesto 2019.* Link. Page 29.

EV charging infrastructure is welcome.[7] However, our analysis shows that, by 2030, CPOs will need to invest between £5bn and £10bn in EV chargepoints and associated grid connection upgrades. This will require significant investment from private sector, alongside the Government's investment.

The Government's current programme of grants is unlikely to deliver the required increase in installations, in part because the grants do not give CPOs any additional certainty over their annual revenue, which is a major barrier to investment in chargepoints. For high-powered chargepoints, the Government is expected to release the details of the Rapid Charging Fund later in 2021.

Without further Government intervention, there's a significant risk that a lack of chargepoints will become a major barrier to delivering the petrol and diesel phase-out. In 2019, a survey of UK motorists found that two-thirds of drivers who are hesitant to switch to an EV are worried about a lack of charging infrastructure.[8]

In areas that are underserved, the Government should procure chargepoints through tenders that offer long-term contracts.

To deliver a comprehensive network of EV chargepoints, the Government should replace existing grant schemes with long-term contracts for CPOs, procured through regular, competitive tenders. These long-term contracts for EV chargepoints will build on the Government's success in the renewable energy sector, where competitive procurement and long-term contracts have helped to reduce the cost of offshore wind projects by two-thirds in just five years.[9] The Government should also use competitive tendering to determine where larger 'strategic grid connections' are needed, and to work out the most cost-effective way to deliver them.

For residential areas, the Government should provide time-limited support for Local Authorities to employ dedicated "Chargepoint Teams". These Chargepoint Teams should facilitate the rollout of chargepoints in their area by coordinating resources across teams within the Local Authority and by removing the bottlenecks faced by CPOs, such as changes to parking restrictions and alterations to highways. This funding could be allocated by the Department for Transport, similar to the existing roads funding process in England.[10]

To ensure fairness, the Government should regulate the maximum price charged by EV chargepoints that receive Government support; this price cap should be implemented through the tendering process. The price cap will help to ensure fair pricing, even where a CPO has a local monopoly, for example because one CPO has won a contract to provide hundreds of chargepoints in one Local Authority area.

Similarly, the Government should use the tendering process to improve the EV charging experience, which should be better than the experience of refuelling a petrol or diesel vehicle; all chargepoints that receive Government support should be required to offer 'roaming', which would allow drivers to find a chargepoint and to pay through an app of

7. UK Gov (2020). *Spending Review 2020*. Link; Note: this includes some Government support for home and workplace chargepoints.
8. Venson (August 2019). *Range anxiety remains the biggest turn-off for switching to an EV, reports Venson*. Link.
9. KPMG (September 2019). *Blown away: CfD Round 3 delivers record low prices for offshore wind*. Link
10. DfT (updated June 2020). *Roads funding information pack*. Link

their choice. The Government should also consider the potential for 'car-authorised payments', similar to how owners of Tesla vehicles can pay to use a Tesla Supercharger automatically without presenting a bank card or using an app.

Government intervention should complement private sector investment, not crowd it out.

Our recommendations form a significant intervention in the market for EV chargepoints, recognising the key role of chargepoints in enabling the transition to EVs and the risks from uncoordinated investment, including local monopolies and underprovision in rural areas. If this intervention is done badly, there is a risk that the Government could crowd out investment from the private sector rather than encourage it.

We have designed our recommendations to complement investment from the private sector. Specifically, by offering a minimum annual revenue guarantee, the long-term contracts will still encourage investors to maximise their profits by making their chargepoints as attractive to drivers as possible. In addition, we recommend that Government funding is focused in areas that would otherwise be underserved by the private sector; this will draw additional private investment into these areas. Taken together, these recommendations will help to minimise the cost to taxpayers and drivers of deploying EV chargepoints.

In the longer term, the market for privately-funded chargepoints will continue to grow, allowing the Government to intervene less in the market. If the Government follows our recommendations, it could increasingly focus the tenders only on areas that remain underserved, which will shrink over time. This offers the Government a pathway to comprehensive provision of chargepoints without a major long-term role for the Government, similarly to the market for petrol stations.

The phase-out of petrol and diesel cars and vans is a huge public policy challenge, but it is also an opportunity; an opportunity to show that the UK can lead on global climate action, to show that domestic offshore wind can power the UK's transport sector; and to show that a green industrial revolution is possible. Policy Exchange has previously argued for a California-style Zero-Emission Vehicle mandate ('ZEV mandate') to deliver the phase-out, complemented by investment in EV chargepoints.[11] This report provides a strategy to deliver a comprehensive network of EV chargepoints, which, alongside a ZEV mandate, is crucial to making EVs work for drivers across the whole of the UK.

The need for EV charging in the UK

Transport is the largest contributor to the UK's greenhouse gas emissions, generating over a quarter of domestic greenhouse gas emissions in 2018. Within transport, cars and vans account for around two-thirds of emissions.

In November 2020, the UK Government announced that it would bring forward the phase-out of new petrol and diesel cars and vans to

11. Policy Exchange (July 2020). *Route '35*. Link

2030, with the sale of some new hybrid vehicles permitted until 2035. To deliver the phase-out, the Government will need to convince drivers that Battery Electric Vehicles (BEVs) are cost-effective, and that there will be enough EV chargepoints across the UK.

Most EV charging is expected to take place at home or at work. **This report focuses on public chargepoints**, which will be used by those making longer journeys and those without access to off-street parking at home.

In a recent report, *Route '35*, Policy Exchange recommended that the Government introduce a California-style Zero-Emission Vehicle mandate ('ZEV mandate') as the primary policy to deliver the phase-out of petrol and diesel cars and vans. We also argued that the Government should phase-out purchase subsidies for ZEVs and instead spend more money on supporting the development of a comprehensive network of EV chargepoints.

By supporting investment in EV chargepoints, the Government will help to increase sales of EVs by addressing fears of range anxiety. This 'indirect network effect' has been documented in Norway and the United States.[12,13] Studies conducted in both countries found that investment in EV chargepoints increased EV sales twice as much as purchase subsidies for EVs; however, this differential weakens as more chargepoints are built, suggesting that Government support for EV chargepoints should be targeted at underserved areas and reviewed regularly.

The Government has the power to regulate EV chargepoints through two recent pieces of legislation: *The Alternative Fuels Infrastructure Regulations 2017* and *The Electric and Automated and Electric Vehicles Act 2018*. Through this legislation, the Government can mandate how EV chargepoints operate, including smart charging capability, data sharing, and payment methods. The Government also has the power to require petrol stations and motorway service areas to build and operate public EV chargepoints.

To date, the Government has preferred to use voluntary measures to improve the EV charging experience. For example, it has said that it expects all new rapid and high-powered chargepoints to accept payments via credit and debit cards without requiring a subscription. The Government has also said that it expects industry to develop a roaming solution across the charging network that would allow EV drivers to use public chargepoints through a single method, for example an app. [14] The Government has said that "if the market is too slow to deliver improvements", then it is prepared to intervene through regulation.

Where should the Government intervene?

Today, chargepoint operators (CPOs) are installing a range of EV chargepoints across the UK, many of which are fully funded by the private sector. However, without further Government intervention in the short term, there is a risk that the market will fail to deliver a truly comprehensive network of EV chargepoints. In the longer term, it's possible that an efficient market will develop for EV chargepoints across the UK, similar to

12. Li et al. (2017). *The Market for EVs: Indirect network effects and policy design.* Link
13. Springer, K. (August 2020). *Network externality and subsidy structure in two-sided markets: Evidence from EV subsidies.* Link
14. DfT and OLEV (July 2019). *News story: All new rapid chargepoints should offer card payment by 2020.* Link.

the existing market for petrol stations. Therefore, the Government should keep any interventions under regular review.

As part of our research, we interviewed stakeholders in the UK's EV charging industry. Stakeholder feedback came in five main areas (Table 1).

Table 1: Feedback from stakeholders in the UK's EV charging industry.

#	Category	Description
1.	Underprovision in some areas.	The market may fail to deliver enough EV chargepoints in rural areas, or in poorer areas where there may be fewer early adopters.
2.	Lack of resources in Local Authorities.	Local Authorities, and especially Highway Authorities,[15] have a key role in enabling the delivery of EV chargepoints, particularly slow/overnight chargepoints. Today, many don't have dedicated staff working to enable the rollout of EV chargepoints.
3.	Need for strategic investment in new grid connections.	Rapid and high-powered chargepoints draw large amounts of electricity from the grid, so grid upgrades are often needed. In some places it will be cheaper to invest in a large grid upgrade now, rather than in lots of small upgrades as demand increases.
4.	Interoperability and reliability.	EV drivers often complain about difficulties using EV chargepoints, either because they have to sign up to a new app for each network or because some chargepoints are out of service.
5.	Risk of local monopolies and excessive pricing.	In some areas, once EV chargepoints are built, a CPO may have a local monopoly. This could allow chargepoint operators to charge excessively high prices.

Key principles

To accelerate the transition to electric vehicles, the Government must ensure that **driving an EV is as affordable and as convenient as possible.** This goal leads to five key principles for EV charging.

Driving an EV should be affordable, therefore:

1. Government support for EV chargepoints should be open to innovative solutions that could reduce the cost of installing chargepoints.
2. The Government should use competition between private sector chargepoint operators to drive down costs.
3. Drivers should be protected from excessively high prices, especially at chargepoints that have received Government support.

15. Highway Authorities own and operate roads in their area. In England, the Highways Authority is typically the County Council, Metropolitan Borough, London Borough or Unitary Authority. District Councils are generally not responsible for highways

Driving an EV should be convenient, therefore:

4. EV drivers should feel confident driving anywhere in the UK.
5. The experience of charging an EV should be better than refuelling a conventional petrol or diesel vehicle.

Policy recommendations

This report makes five specific policy recommendations for the UK Government (Table 2). These recommendations are designed to address the key principles that we have identified (Table 3). If the Government implements these recommendations, then the roles and responsibilities for EV chargepoints will be as per Table 4.

Table 2: Specific policy recommendations for EV chargepoints in the UK.

Policy Recommendations	
1.	In areas that are underserved, the Government should procure chargepoints through competitive tenders. The tenders should offer long-term contracts (10-15 years' long) that give chargepoint operators a guaranteed minimum annual revenue.
2.	The Government should fund dedicated 'Chargepoint Teams' in Local Authorities to facilitate the rollout of EV chargepoints.
3.	At motorway service areas and other key locations, the Government should tender for high-powered chargepoints and associated 'strategic grid connections'.
4.	Where chargepoints receive public support, the Government should regulate the maximum price charged.
5.	To improve the customer experience, chargepoints that receive Government support should be required to provide full interoperability and high levels of reliability.

Table 3: Mapping recommendations to key principles.

Recommendations	Principles				
	Innovation	Competition	No excessive prices	Give EV drivers confidence	Good charging experience
#1: Competitive tenders	✓	✓	-	✓	-
#2: Chargepoint Teams	✓	✓	-	✓	-
#3: Upgrades to the electricity grid	✓	✓	✓	✓	-
#4: Price cap	-	-	✓	-	-
#5: Interoperability & reliability	-	-	-	✓	✓

Table 4: Roles and responsibilities for delivering EV chargepoints and strategic grid connections.[16]

Asset type:	**Chargepoints in towns and cities (all speeds)**	**High-powered chargepoints on strategic routes***	**Strategic grid connections (for high-powered chargepoints)**
Description:	Mainly focused on slow/overnight chargepoints, but also some rapid and high-powered chargepoints*	Chargepoints with speed of 100kW+. Focused on motorway service areas and strategic routes	Large grid connections that can accommodate long-term demand for chargepoints in that location
Procured by:	Combined Authorities, Devolved Administrations and regional groups of Local Authorities	UK Government and Devolved Administrations	UK Government and Devolved Administrations
Asset Ownership:	Chargepoint operator (CPO)	Chargepoint operator (CPO)	Private company (DNO/TO, IDNO, other)**
Counterparty to long-term contracts:	Low Carbon Contracts Company (LCCC)***	Low Carbon Contracts Company (LCCC)***	Low Carbon Contracts Company (LCCC)***

Recommended policy timeline

The main recommendation in this report is to procure chargepoints in underserved areas through competitive tenders. These tenders will offer long-term contracts to chargepoint operators. Subject to passing any necessary legislation, the first competitive tenders could be held in mid-2022 (Figure 1). This would allow the first chargepoints to be delivered at the start of 2023, in line with the Government's aim to have at least six high-powered chargepoints at every motorway service area in England by 2023.

Until long-term contracts are in place, the Government should continue to support slow/overnight chargepoints through the ORCS scheme. We recommend that the Government should fund dedicated Chargepoint Teams in Local Authorities for four years, starting in April 2021 (Financial Year 2021/22).

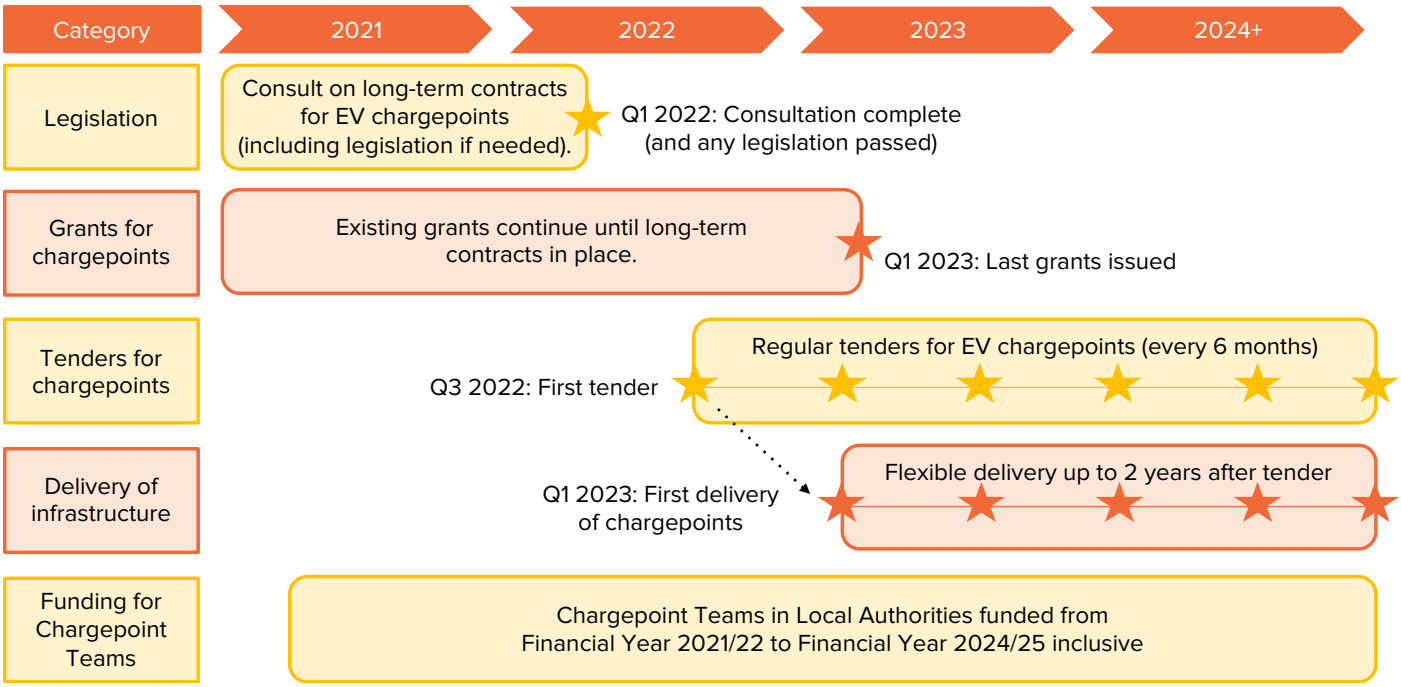
Over time, the Government should increasingly focus its support on areas that remain underserved. This will help to ensure that the Government does not 'crowd out' investment from CPOs who do not require public support.

16. *Slow/overnight chargepoints = 3-22 kW, Rapid chargepoints = 23-99 kW, High-powered chargepoints = 100 kW+.

**DNO = Distribution Network Operator, TO = Transmission Owner, IDNO = Independent DNO.

***Note: LCCC is currently funded through a levy on electricity bills. For EV chargepoints, we propose a new funding mechanism that would recover costs from drivers, not electricity users.

Figure 1: Recommended policy timeline.



1. What is EV charging?

Charging an Electric Vehicle

The three most important characteristics of an EV's battery are:

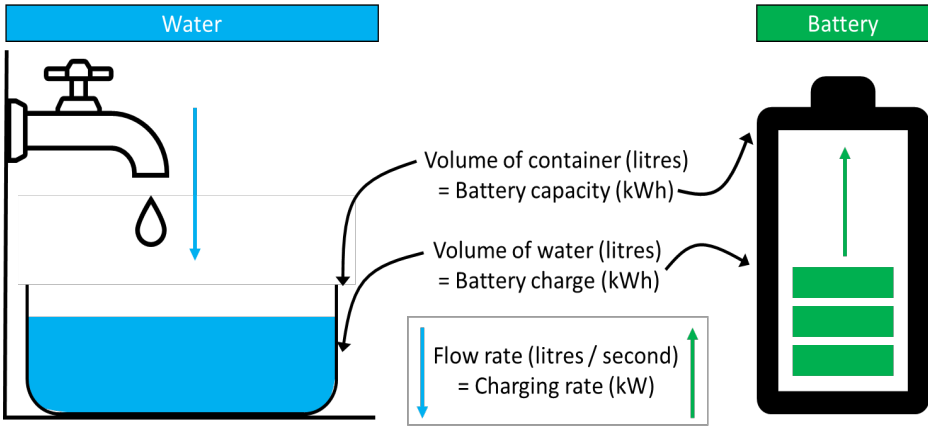
- **Battery capacity:** Measured in kilowatt hours (kWh).
- **Battery charge:** Measured in kWh.
- **Maximum charging rate:** Measured in kilowatts (kW).

The battery charge level can be between zero (empty) and the maximum capacity (full). A battery that charges at a rate of 1 kW for one hour will gain 1 kWh of charge, as per the following formula:

Battery charge (kWh) = Charging rate (kW) * Time (hours)

It may be helpful to consider an analogy between a battery and a container of water, where the charging rate of the battery is analogous to the rate of water flowing into the container (Figure 2).

Figure 2: Analogy between a water tank and a battery.



A battery degrades over time, which reduces the capacity of the battery. The rate of degradation depends on several factors including the number of fast charges, changes in battery temperature, and average state of charge.[17] Batteries that are often left at a high state of charge will degrade more quickly. Some manufacturers recommend that the battery is charged up to 80% for day-to-day use, and only charged to 100% for occasional longer journeys.

Data from Tesla owners shows average battery capacity degradation

17. A battery that is fully charged is at 100% state of charge and an empty battery is at 0% state of charge.

of 5% after 50,000 km (31,000 miles) and around 10% after 250,000 km (155,000 miles).[18] In England, cars are driven an average of 7,400 miles per year, which means that the average driver would experience around 10% battery degradation after 20 years.[19] This suggests that battery degradation is unlikely to be a major concern for most EV owners.[20]

Electric Vehicles can be charged with AC or DC electricity.

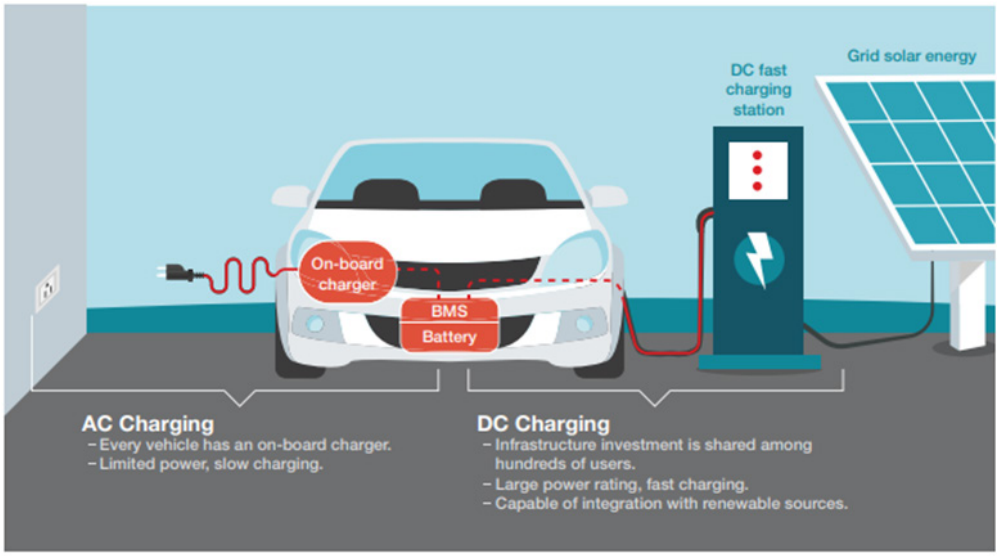
An EV is charged using either Alternating Current (AC) or Direct Current (DC) electricity (Figure 3). The battery can only charge up using DC electricity. If an EV is charged using AC electricity, then the car converts this to DC electricity using an onboard charger.[21] AC charging is typically slower; a domestic UK 3-pin plug socket delivers AC electricity at up to around 3 kW. The AC charging rate for most EVs is 7 kW using a single-phase AC supply (maximum typical home supply), and between 10 kW and 22 kW using a three-phase AC supply. DC charging is typically much faster; The Porsche Taycan can charge using a DC chargepoint at up to 270 kW,[22] and the Tesla Model 3 can charge using a DC chargepoint at up to 250 kW.[23]

The maximum charging speed of an EV depends on the battery charge level, also known as the State of Charge (%) (Figure 4). At a higher state of charge, EVs charge more slowly to protect the battery. At a charging rate of 150 kW, a 15-minute charge will add around 150 miles of range for a typical EV, which should be sufficient for most drivers. Longer-term, charging rates could improve significantly if new battery technologies are developed, including solid-state batteries.

The Government classifies chargepoints based on the type of electricity supplied (AC or DC) and the maximum charging rate (Table 5). These classifications can be confusing, as a 'fast' chargepoint can be as slow as 7 kW, which would take around 10 hours to fully charge a typical EV. Even a 'rapid' chargepoint can take over an hour to fully charge a typical EV. In this report, we classify chargepoints as 'slow/overnight', 'rapid' or 'high-powered'.

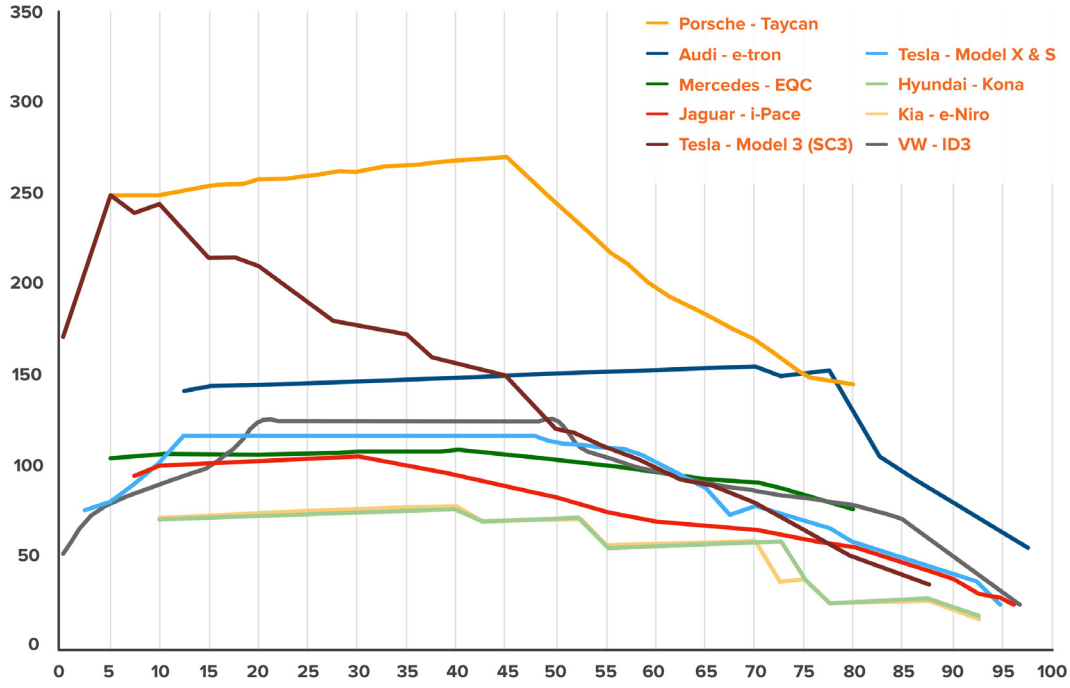
18. Lambert, F. Electrek. (April 2018). *Tesla battery degradation at less than 10% after over 160,000 miles, according to latest data.* Link
19. DfT (Updated August 2020). *Vehicle mileage and occupancy. Table NTS0901.* Link
20. Some drivers will drive much further each year, particularly those with Company Cars. Also, some earlier EVs suffered from much higher degradation.
21. The technical name for the AC to DC converter is a 'rectifier'.
22. Porsche newsroom (undated). *The charging process.* Link
23. Howard, B. Extreme Tech (March 2019). *Tesla's quarter-MW Supercharger enables fast Model 3 pit stops.* Link

Figure 3: AC and DC charging.



Source: Texas Instruments.[24]

Figure 4: Charging Power (kW) versus State of Charge (%) for selected vehicles when DC charging.



Source: Fastned and P3 Automotive.[25]

24. Gong, X. and Rangaraju, J. Texas Instruments (undated). *Taking charge of electric vehicles – both in the vehicle and on the grid.* Link

25. Electrive (March 2020). *P3 Charging index: Which electric car charges best on long-distance trips.* Link

Table 5: UK Government classification of chargepoints by speed.[26]

Chargepoint classification (UK Government)	AC/DC	Charging rate (kW)	Classification used in this report
Slow AC	AC (single-phase)	<3.5 kW	N/A
Standard AC	AC (single-phase)	3.5 kW – 7 kW	Slow/overnight
Fast AC	AC (single- or three-phase)	7 kW – 23 kW	Slow/overnight
Fast DC	DC	3.5 kW – 22 kW	Slow/overnight
Semi-Rapid AC	AC (three-phase)	23 kW – 43 kW	Rapid
Rapid AC	AC (three-phase)	43 kW – 44 kW	Rapid
Semi-Rapid DC	DC	23 kW – 50 kW	Rapid
Rapid DC	DC	50 kW – 62.5 kW	Rapid
High-Powered Chargers.[27]	DC	100 kW – 350 kW	High-powered.[28]

Different EVs use different chargepoint connectors, which can be confusing.

For DC charging, EVs typically use one of two connector types:

1. CCS (Combined Charging Standard)
2. CHAdeMO

Newer EV models typically use the CCS charging standard, which can deliver charging speeds of up to 350 kW (Figure 5). There are a large number of 50 kW DC chargepoints across the UK, most of which have both CCS and CHAdeMO connectors. For earlier models, Tesla used its own 'Tesla Type 2' DC charging standard (Model S and Model X), although newer models use the CCS standard (Model 3 and Model Y). Tesla offers a CCS retrofit option for Model S and Model X vehicles.[29]

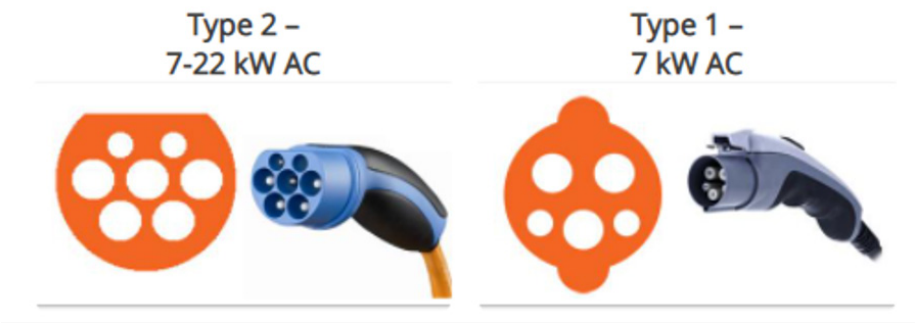
For AC charging, EVs typically use one of two connector types: Type 1 or Type 2 (Figure 6). Newer EVs typically use the Type 2 standard, in part because it is compatible with the CCS standard for DC charging. Adapters are available for owners of EVs that use a less common charging standard.

Figure 5: Types of DC chargers available in the UK.

Source: Zap Map.[30]

26. OZEV (updated March 2020). *Workplace Charging Scheme: minimum technical specification (Charging outlets).* Link
29. Lambert, F. Electrik (August 2020). *Tesla slashes price of CCS retrofit for Model S and Model X.* Link
30. Zap Map (undated). *EV connector types.* Link
27. BEIS, DfT, OZEV (May 2020). *Government vision for the rapid chargepoint network in England.* Link
28. In this report we are using 100 kW as the threshold for high-powered chargers. The Government uses 150 kW as the threshold. There are very few chargepoints with a speed between 100 kW and 150 kW.

Figure 6: Types of AC chargers available in the UK.



Source: Zap Map.[31]

Most EV charging currently takes place at home.

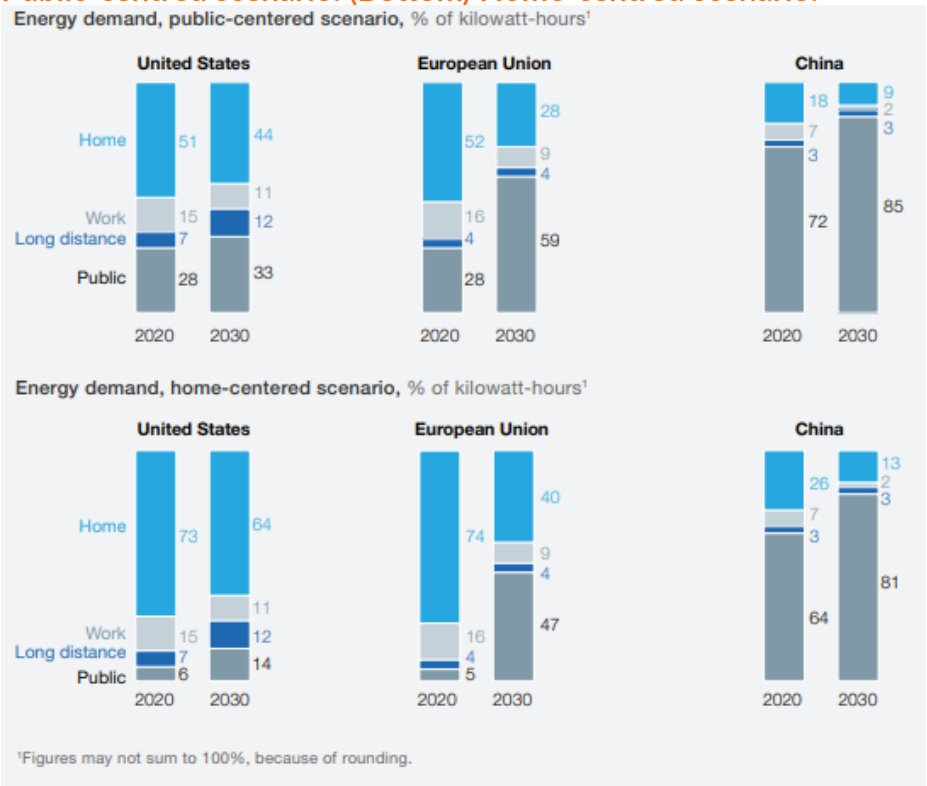
EV drivers will have multiple options to charge their vehicle. In 2018, around 75% of vehicles in England were parked on private property ('off-street households').[32] These off-street households are likely to be able to install a chargepoint and are therefore more likely to charge their EV at home most of the time. However, this may be more difficult in blocks of flats with communal garages.

Households without access to off-street parking ('on-street households') will have to rely on public charging infrastructure on residential streets or local car parks if they want to charge their vehicles overnight.[33] Alternatively, these households could charge at work or at 'destination chargers' hosted by supermarkets, gyms and others. For longer journeys, EV drivers will have the option of rapid and high-powered chargepoints, which fulfil a similar role to petrol stations for petrol and diesel vehicles.

Analysis from McKinsey & Company show that EV drivers in Europe currently charge at home most of the time. By 2030, the proportion of energy from home charging is expected to decrease in all jurisdictions (Figure 7). This trend is driven by widespread adoption of EVs, including from households with no access to off-street charging. These 'on-street households' are expected to drive increasing demand for public chargepoints on streets in residential areas.[34]

31. Zap Map (undated). *EV connector types.* Link
32. DfT (Updated August 2019). *Vehicle mileage and occupancy (parking).* Link
33. Our definition of 'public EV chargepoints' includes all chargepoints except those in private homes and workplaces, as well as those on proprietary networks, such as Tesla Superchargers. Note: The *Alternative Fuels Infrastructure Regulations 2017* uses a different definition, which excludes on-street chargepoints in residents' parking bays. 'Public EV chargepoints' does not imply public/state ownership.
34. Baringa (January 2021). *Enabling the roll-out of on-street charging infrastructure.* Link. Page 6.

Figure 7: Energy demand for EV charging by location type. (Top) Public-centred scenario. (Bottom) Home-centred scenario.



Source: McKinsey & Company.[35]

Best-selling BEVs in the UK (2020).

In 2020, the Tesla Model 3 was the most popular battery electric vehicles (BEVs) in the UK, with around 1,000 sold each month (Table 6). Different EVs have different battery capacity (kWh), range (miles) and price. In general, EVs are more expensive to buy than the equivalent petrol or diesel car, although the gap is narrowing and EVs generally have lower running costs.[36]

The features and performance of the Tesla Model 3 and Jaguar i-Pace are comparable to many of their petrol and diesel equivalents. The MG ZS EV is an example of a cheaper EV that has a shorter range and slower charging capabilities compared to more premium EVs. BEVs are increasingly popular amongst Private Hire drivers in cities, as BEVs are exempt from some local air quality charging schemes, such as London's Ultra-Low Emission Zone (ULEZ).[37] Some cities have also implemented emissions standards for private hire vehicles. From January 2023, all new Private Hire Vehicles registered in London must be ZEVs (including PHEVs).[38]

35. McKinsey & Company (October 2018). *Charging Ahead: EV Infrastructure Demand.* Link
36. Bullard, N. Bloomberg (April 2019). *Electric car price tag shrinks along with battery cost.* Link
37. Transport for London (undated). *Ultra Low Emission Zone (ULEZ).* Link
38. Transport for London (undated). *Emissions standards for PHVs [Private Hire Vehicles].* Link

Table 6: Selected best-selling BEVs in the UK (Jan-Sep 2020.)[39]

Make and model.[40]	Sales (Q1-Q3 2020)	Purchase Price (£).[41]	Battery Capacity (kWh)	WLTP Range	Efficiency (Wh/km)	Max AC Charge Rate (kW)	Max DC Charge Rate (kW)
Tesla Model 3 (Long Range AWD)	9,000	£47,000	75 kWh	360 miles (580 km)	130 Wh/ km	11 kW	250 kW
Nissan Leaf (E+ N-TEC)	3,000	£33,300	62 kWh	239 miles (380 km)	163 Wh/ km	6.6 kW	50 kW
MG ZS EV	2,100	£25,500	44.5 kWh	163 miles (260 km)	171 Wh/ km	7 kW	50 kW
Jaguar I-Pace	2,000	£65,000	90 kWh	290 miles (465 km)	194 Wh/ km	11 kW	104 kW

How do EV chargepoints make money?

In general, chargepoint operators make money by selling electricity to EV drivers. However, there are a range of other business models including: selling subscriptions to the network; increasing vehicle sales by offering a dedicated charging network; and attracting customers to visit a destination such as a supermarket, a hotel or a gym (Table 7).

39. Next Green Car (accessed November 2020). *Electric var market statistics.* Link.

40. In all cases the table shows the lowest-trim model that has the highest available range.

41. Includes UK Plug-in Car Grant of £3,000 where eligible.

Table 7: Business models for EV chargepoints.

#	Business Model	Description
#1.	Pay as you go	Chargepoint operators charge customers per kilowatt (kWh) of electricity used to charge their vehicle. This is very similar to refuelling at a petrol station, which charge customers per gallon or litre of petrol dispensed.
#2.	Subscription	Some chargepoint networks sell monthly or annual subscriptions in return for cheaper or free charging. This model is similar to a Netflix or Amazon subscription. For example, the *bp pulse* network offers reduced charging rates in return for a subscription fee of £7.85 per month.[42]
#3.	Increased vehicle sales	Tesla has built a network of 'Superchargers' that can only be used by Tesla drivers. This helps to sell more vehicles because it makes it easier to take a Tesla on a long road-trip compared to other vehicles.[43] In 2017, a consortium of car manufacturers started to build the Ionity network of high-powered chargers in Europe.[44] This network is open to all drivers but offers significant discounts to drivers of some brands of EV. For example, VW offers its drivers a range of pricing options on the Ionity network, in return for a monthly subscription fee, similar to point #2 above.[45]
#4.	Destination charging	Some destinations offer very cheap or even free EV charging as a way to attract customers to their destination. Examples include the supermarket Tesco, which offers free 7 kW charging at many of its stores.[46] With free destination charging, the business owner aims to offset the cost of building and running the chargepoint with additional customers and therefore additional revenue. Some destination chargepoints are not free, including 50 kW rapid chargers at Tesco stores. The supermarket Lidl has also committed to installing chargepoints. Lidl plans to install 50 kW chargepoints at 300 of its UK stores by 2020 at an estimated cost of £25m.[47]

Chargepoint operators face significant uncertainty over revenue.

As described above, most CPOs only make money when drivers charge at their chargepoints. This creates two significant risks for chargepoint owners:

1. **Lower overall take-up of EVs:** If take-up of EVs is slower than expected, then chargepoint operators will make less money than they expected. The UK Government's commitment to phase-out new petrol and diesel car sales by 2030 increases certainty for

42. bp Chargemaster (December 2020). *Introducing bp pulse*. Link
43. Tesla (undated). *Supercharger*. Link
44. Ionity (undated). *About*. Link
45. VW (accessed January 2020). *We Charge*. Link
46. Pod Point (undated). *Tesco Volkswagen EV Charging | UK National Rollout*. Link
47. Lidl (October 2019). *Lidl commits to installing rapid EV chargepoints at all new stores*. Link

chargepoint operators that the demand for EV charging will grow over time.[48] However, there is still significant uncertainty over how the ban will be delivered and how quickly demand for EVs will increase in different parts of the UK.

2. **Lower utilisation of individual chargepoints:** As well as uncertainty over the market-wide outlook for EVs, chargepoint owners face significant uncertainty over revenue at individual sites.
    - For chargepoints in residential areas, revenue will depend on individual households buying EVs and charging them on the street rather than at work or at other local chargepoints.
    - For rapid and high-powered chargepoints, owners need to make a substantial upfront investment, which can take many years to pay back. If another rapid or high-powered charging hub is built nearby then chargepoint owners might make significantly less revenue than expected.

Investments in EV charging networks are therefore typically seen as relatively high risk. However, this has not stopped significant investment in UK chargepoint networks by bp Chargemaster, Tesla, Pod Point, Ubitricity, Ionity, InstaVolt and others.

48. UK Government (2020). *News story: Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030.* Link

2. The need for EV charging in the UK

Why are EVs and other Zero-Emission Vehicles (ZEVs) needed for Net Zero?

Transport is now the largest contributor to greenhouse gas (GHG) emissions in the UK, generating over a quarter of domestic greenhouse gas emissions (Figure 8). Cars account for over half of transport emissions and around 15% of total UK emissions. Since 1990, UK greenhouse gas emissions have fallen by 40%; however, emissions from the transport sector have barely changed (Figure 9). Between 2013 and 2018, emissions from surface transport (which includes cars) actually increased by 5%. This lack of progress in the transport sector is in stark contrast to the electricity ('power') sector, where emissions have fallen by over 50% in the same period.

The UK's Net Zero target will only be achieved if the transport sector is decarbonised. Policy Exchange's recent report, *Route '35*, explains in detail why decarbonising transport is so important and recommends a California-style Zero-Emission Vehicle mandate ('ZEV mandate') to deliver the petrol and diesel phase-out.[49] *Route '35* also recommended that the Government invest more in EV charging infrastructure to complement a ZEV mandate.

49. Policy Exchange (July 2020). *Route '35*. Link

Figure 8: Total UK greenhouse gas emissions by sector (2018).[50]

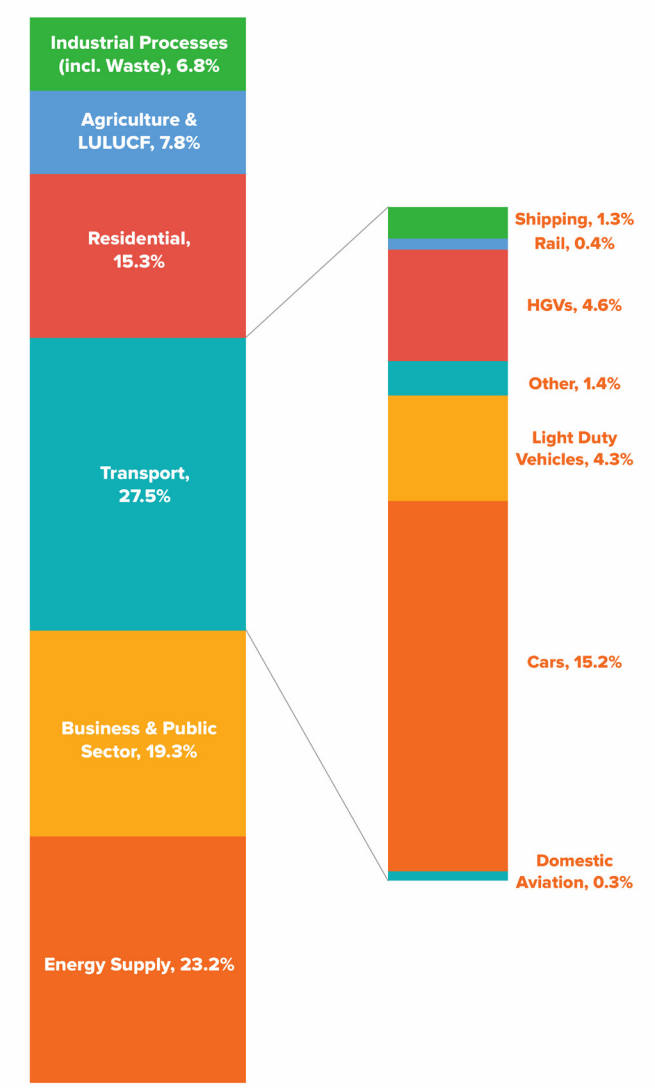
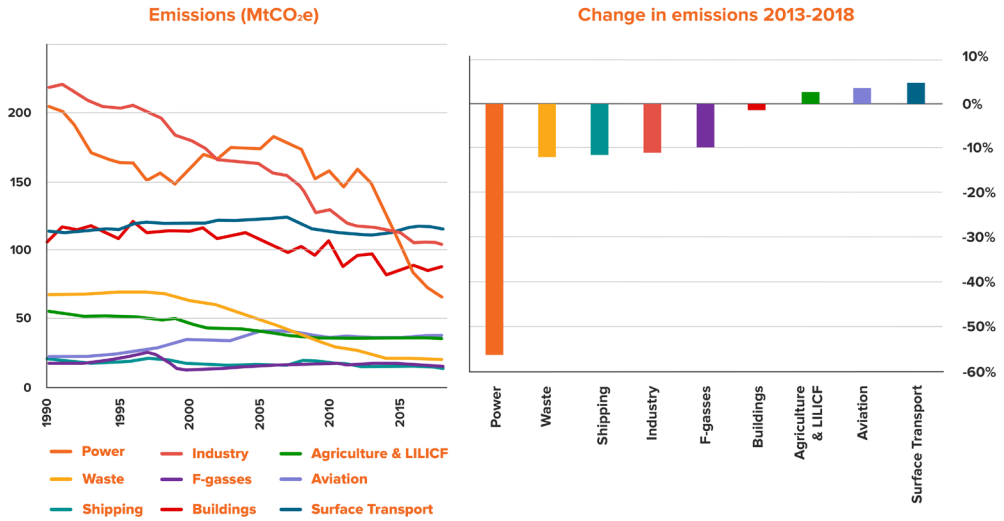


Figure 9: UK greenhouse gas emissions by sector, 1990-2018.[51]



50. BEIS (March 2020). *Final UK greenhouse gas emissions national statistics (Annex: 1990-2018 final emissions by end user and fuel type).* Link

51. CCC (July 2019). *Reducing UK emissions: 2019 Progress Report to Parliament.* Link

There are three main types of ZEV (Table 8).

BEVs and PHEVs are by far the most common type of ZEV sold globally, with over two million sold in 2019.[52] By contrast, hydrogen-powered vehicles (FCEVs) are currently extremely rare, with only 7,500 FCEVs sold globally in 2019.[53] PHEVs have a relatively small battery, which means that they only reduce emissions if they are charged regularly and are driven relatively short distances between charges. This makes PHEVs controversial. In a recent report, the non-profit *Transport & Environment* claimed that PHEVs are a "con" and that they emit two-and-a-half times more CO_2 than official tests show.[54]

Table 8: Types of Zero-Emission Vehicles (ZEVs).

Type	Plug-in Hybrid Electric Vehicle (PHEV)	Battery Electric Vehicle (BEV)	Fuel Cell Electric Vehicle (FCEV)
Description	A vehicle with a small battery that also has a conventional engine and fuel tank.	A vehicle driven only by motors, which are powered by a battery.	A vehicle driven by motors, which are powered by an on-board hydrogen fuel cell. May also have a small battery.
Examples	LEVC TX Electric Taxi.[55] Mitsubishi Outlander PHEV.[56]	Nissan Leaf.[57] Mini Electric.[58] Tesla Model 3.[59]	Hyundai Nexo.[60] Toyota Mirai.[61]
Recharging / refuelling	Battery: EV chargepoint Fuel tank: petrol station	EV chargepoint	Hydrogen refuelling station
Typical battery size	10 – 30 kWh	40 – 100 kWh	0 – 5 kWh
Typical battery-powered range	20 – 50 miles	150 – 350 miles	0 – 10 miles
Typical total range	500 – 1,000 miles	150 – 350 miles	300 – 500 miles

Sales of Zero-Emission Vehicles (ZEVs) in the UK.

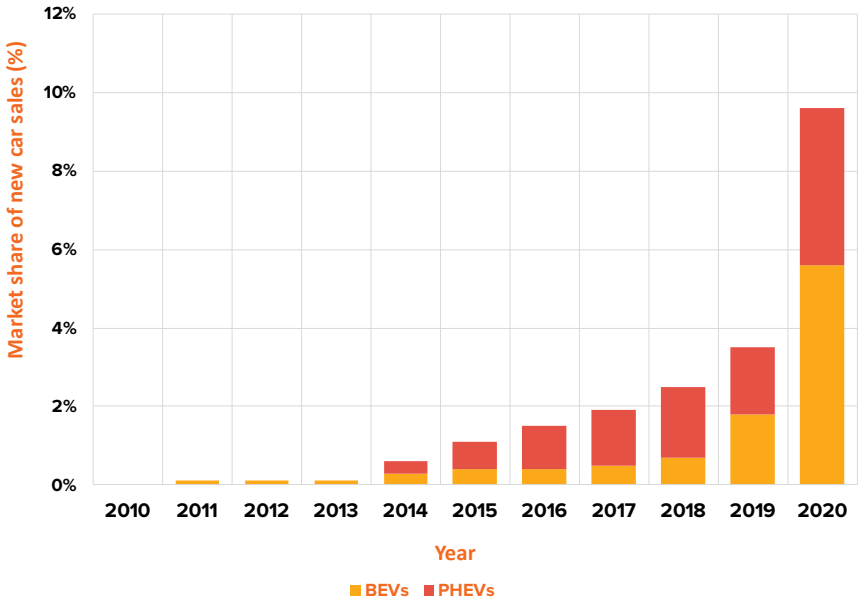
ZEVs comprised nearly 10% of new car sales in the UK in 2020 (Figure 10). The market share of ZEVs has risen sharply since 2019, when only 3.5% of new car sales were ZEVs. This rising market share is in part due to more ZEV sales, particularly BEVs, and in part due to sharp reductions in sales of petrol, diesel and hybrid vehicles during the coronavirus pandemic.

In November 2020, the Government announced that the ban on the sale of new pure petrol and diesel cars and vans will be brought forward to 2030.[62] Manufacturers will still be able to sell hybrids such as PHEVs until

52. Irle, R. EV-volumes.com (undated). *Global BEV & PHEV Sales for 2019*. Link
53. Kane, M. Inside EVs (February 2020). *Hydrogen Fuel Cell Car Sales in 2019 improved to 7,500 globally*. Link
54. Bannon, E. (Transport & Environment) (September 2020). *UK briefing: The plug-in hybrid con*. Link
62. BEIS and 10 Downing Street (November 2020). *The Ten Point Plan for a green industrial revolution*. Link
55. LEVC (undated). *TX Electric Taxi*. Link
56. Misubishi Motors (undated). *Mitsubishi Outlander PHEV*. Link
57. Nissan (undated). *Nissan Leaf*. Link
58. Mini (undated). *MINI ELECTRIC*. Link
59. Tesla (undated). *Model 3*. Link
60. Hyundai (undated). *All-New NEXO*. Link
61. Toyota (undated). *Hydrogen-powered Mirai*. Link

2035, providing they *"can drive a significant distance with no carbon coming out of the tailpipe"*. The Government has not yet defined "significant distance". In 2021, the Government will publish a Green Paper on delivering the petrol and diesel phase-out dates.[63] We recommend that, in the Green Paper, the Government should commit to a California-style ZEV mandate.

Figure 10: Annual share of new car sales in the UK that are BEVs and PHEVs (2010-2020).[64]



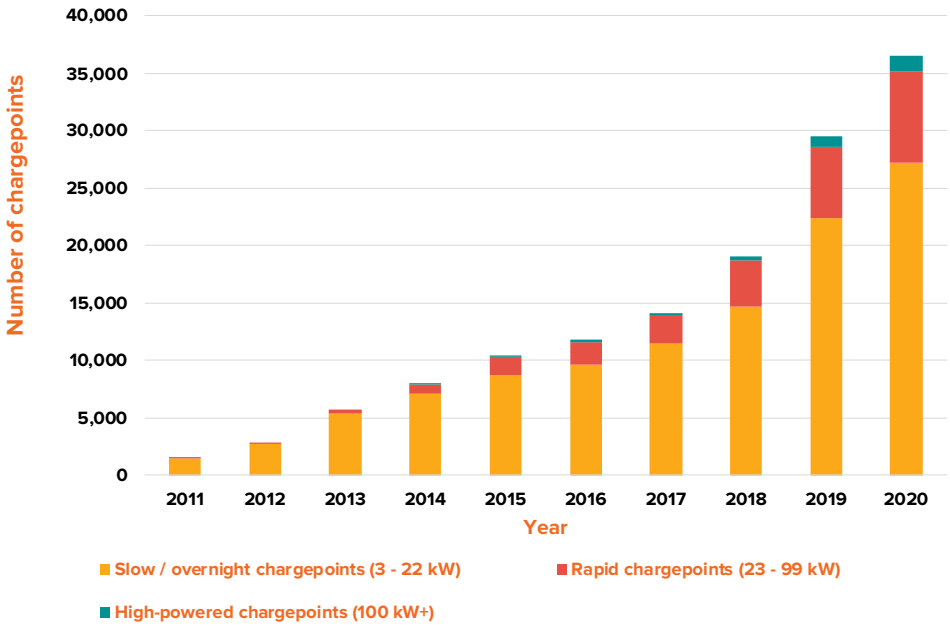
Existing EV charging infrastructure

The UK's public EV charging network has grown from around 1,500 chargepoints in 2011 to over 36,000 chargepoints today (Figure 11). The network is dominated by slow/overnight chargepoints (3-22 kW), which make up 75% of the existing network. Rapid chargepoints (2399 kW) make up a further 22% of the public network. High-powered chargepoints (100 kW+) are a small proportion of the overall public network, comprising just 3% of all public chargepoints (~1,200 high-powered chargepoints).

63. UK Government (2020). *Ten Point Plan*. Link. Page 15

64. European Alternative Fuels Observatory (EAFO). *Alternative Fuel Market Share New Registrations M1 (2020)*. Link. Note: Includes data up to November 2020.

Figure 11: Cumulative installed public chargepoints by speed (2011-2020).



Source: Zap Map.[65]

The growth in EV ownership has outpaced the growth of the public charging network over the last decade (Figure 12). Despite the number of public chargepoints increasing 24 times from 2011 to 2020, the number of EVs grew faster. In 2014, there were roughly two EVs per public chargepoint, compared to around twelve EVs per public chargepoint in 2020.

The increasing numbers of EVs per public chargepoint doesn't necessarily show that the UK lacks chargepoints. In fact, the number of EVs per public chargepoint in the UK is similar to comparable European countries such as Belgium and Ireland, both of which have ten EVs per public chargepoint. The Netherlands has a particularly low ratio of four EVs per public chargepoint.[66] This is partly explained by the fact that more EV drivers in the Netherlands rely on public rather than private charging, which increases the need for public chargepoints.

The Government should track this metric, amongst others, to ensure that the UK's network of public EV chargepoints keeps up with the growing number of EVs on the road. There is currently significant uncertainty over the number of EVs that each public chargepoint can support. In their advice for the Sixth Carbon Budget, the CCC modelled approximately 50 EVs per public chargepoint in 2030, significantly higher than today.[67] By contrast, the ICCT models approximately 15 EVs per public chargepoint, which is similar to today's level.[68] This difference is in part because the CCC assumes a much higher market share of rapid and high-powered chargepoints (45%) compared to the ICCT (4%). This shows the importance of tracking both the number of EVs per public chargepoint, and the speed of those chargepoints.

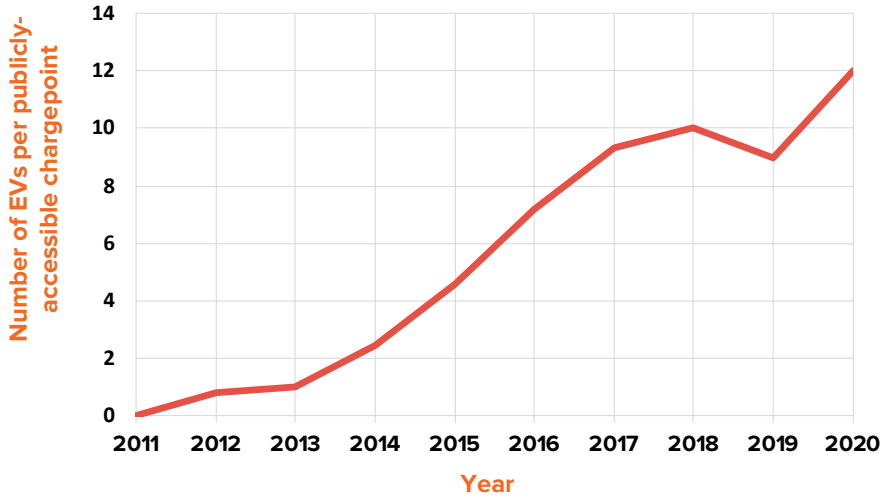
65. Zap Map (2021). *EV charging stats 2020*. Link [accessed 28/01/21]; Note: Zap Map data includes chargepoints on proprietary networks, such as Tesla Superchargers. Data is for the number of "connectors", which is higher than the number of "devices". Some devices have multiple connectors, which may or may not be able to be used simultaneously

66. Transport and Environment (2020). *Recharge EU: how many chargepoints will Europe and its Member States need in the 2020s*, page 54, Figure A1. Link.

67. CCC (December 2020). *The Sixth Carbon Budget: The UK's path to Net Zero*. Link. Page 98 and supporting dataset.

68. ICCT (August 2020). *Quantifying the EV charging infrastructure gap in the UK*. Link. Page 21 (Table A.2).

Figure 12: Number of EVs per public chargepoint in the UK (2011-2020).



Source: Zap Map.[69]

There are significant regional differences in access to public EV chargepoints.

EV drivers in some regions of the UK have significantly more access to chargepoints than others (Figure 13). London's public charging network is far ahead of other regions in the UK, with over 100 public chargepoints per 100,000 people; almost three times the amount in the North West of England, Yorkshire and Northern Ireland. The differential can be partly explained by the lack of off-street parking in cities like London, which creates higher demand for public chargepoints; however, this is unlikely to fully explain the regional differences.[70]

The Government's main support scheme for public EV chargepoints, the On-street Residential Chargepoint Scheme (ORCS, described below) is open to all Local Authorities in the UK. However, the projects supported by ORCS are not evenly distributed. ORCS mainly supports projects in England and has not yet supported any projects in Northern Ireland (Figure 14).[71] This contributes to the regional disparities in the number of public chargepoints per head in different UK regions.

Analysis from the consultancy *Field Dynamics* suggests that rural areas are particularly underserved compared to urban areas.[72] Their analysis finds that EV drivers without off-street parking in cities such as Brighton, Cardiff, Exeter, London, Manchester, Oxford and Portsmouth have more access to on-street EV chargepoints than drivers without off-street parking in the surrounding areas.

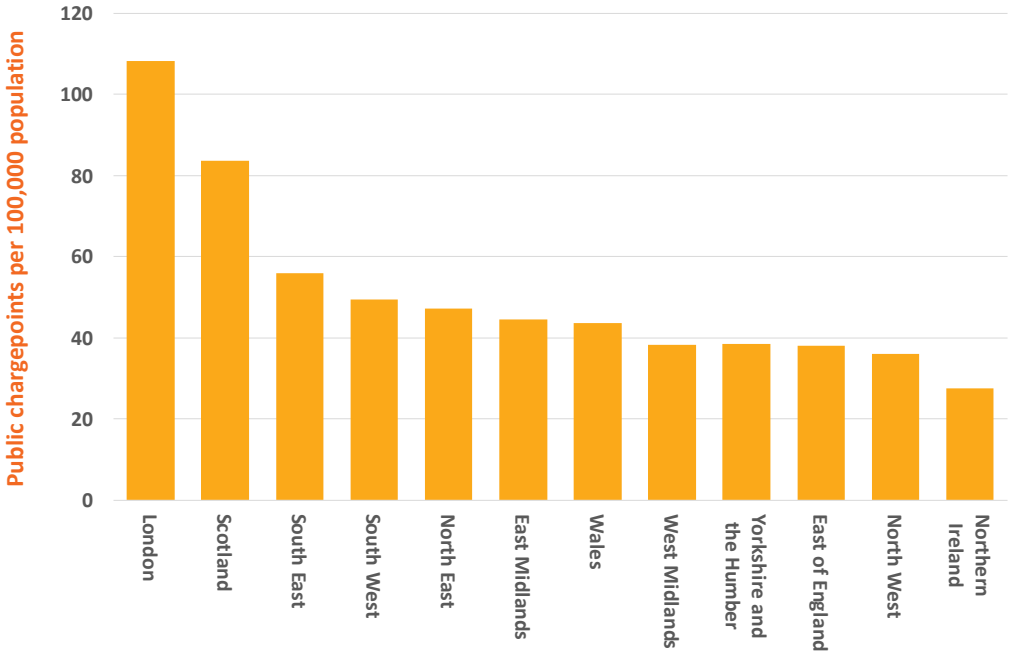
69. Zap Map. Link.

70. See analysis by Field Dynamics, referenced below, which focuses on households without access to off-street parking. This analysis shows that, even correcting for access to off-street parking, drivers in rural areas have fewer public chargepoints nearby.

71. We understand that, until recently, electricity supply regulations have held back the development of public chargepoints in Northern Ireland.

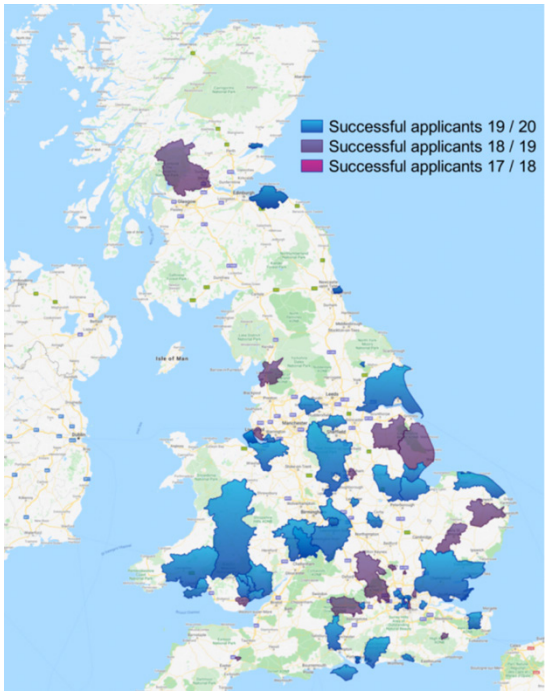
72. Field Dynamics (undated). *National Ranking of EV Charge Point Coverage (interactive map).* Link

Figure 13: Number of public chargepoints per 100,000 population in different UK regions (Jan 2021).



Source: Zap Map, DfT, Policy Exchange analysis.[73]

Figure 14: Projects supported by the On-street Residential Chargepoint Scheme (ORCS) (Up to 31st March 2020).



Source: Energy Saving Trust.[74]

73. Zap Map (2021). *EV Charging stats 2020.* Link. (accessed 28/01/2021) (number of chargepoints by region); DfT (2020). *Electric vehicle charging device statistics: October 2020.* Link. (regional population estimates); Policy Exchange analysis.

74. Energy Saving Trust (2020). *On-street residential chargepoint scheme.* Link. A full list of successful applicants, including 2020/21, is available on EST's website. Link

The UK's EV charging 'infrastructure gap'

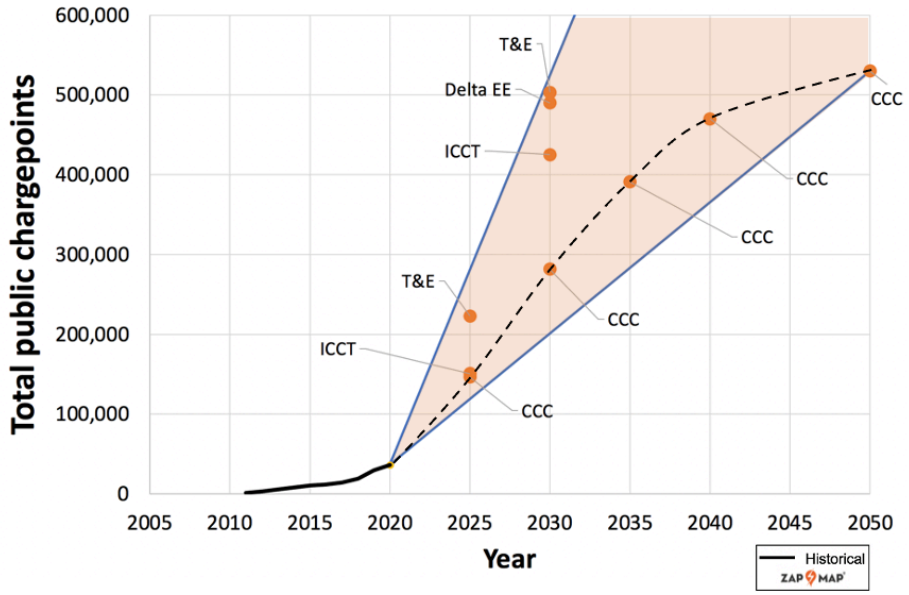
The Government has committed to phase out the sale of new petrol and diesel cars and vans by 2030, after which car manufacturers will only be able to sell BEVs, PHEVs and FCEVs. Post-2035, only BEVs and FCEVs can be sold. This means that a growing proportion of the vehicles on the UK's roads will be electric. According to the UK's Climate Change Committee, there could be 15.9 million BEVs and PHEVs on the road by 2030, compared to 340,000 in 2020.[75]

By 2030, the UK will need around 400,000 public EV chargepoints (all speeds).

By 2030, the UK will need a total of between 300,000 and 500,000 EV chargepoints, according to various forecasts including those from the CCC and Transport and Environment (T&E), an international NGO (Figure 15). Today, the UK has around 35,000 public EV chargepoints.

Assuming that the UK will need a total of 400,000 EV chargepoints by 2030, the midpoint of various estimates, CPOs will need to install around 35,000 chargepoints per year. Over the last 3 years, CPOs have installed an average of around 7,000 public EV chargepoints per year. Therefore, the UK needs to install chargepoints five times faster than the current rate to hit the 2030 infrastructure requirement for the total number of public EV chargepoints.

Figure 15: Total public EV chargepoints required (2020-2050).



Source (historical): Zap Map.[76]

Source (forecasts): CCC, T&E, ICCT, Delta EE.[77], [78], [79]

75. CCC (2020). *The sixth carbon budget: The UK's path to Net Zero*. Link. Page 98, Figure 3.1.b.

76. Zap Map (2021). *EV Charging stats 2020*. Link. (accessed 28/01/2021); Note: Zap Map data includes chargepoints on proprietary networks, such as Tesla Superchargers.

77. Nicholas, M. and Lutsey, N. ICCT (2020). *Quantifying the electric vehicle charging gap in the United Kingdom*. Link; CCC (2020). *The sixth carbon budget: The UK's path to Net Zero*. Link; Transport and Environment (2020). *Recharge EU: how many chargepoints will Europe and its Member States need in the 2020s*. Link; Delta EE (2020). *Whitepaper: European EV Chargepoint Forecasts*. Link.

78. Note: Each forecast is based on different assumptions, such as the number of EVs that will be on the road. Figure 15 is intended to show the spread of estimates, rather than comparing them on a like-for-like basis.

79. Thanks to Mike Nicholas of the ICCT for his advice on the use of their paper within our analysis.

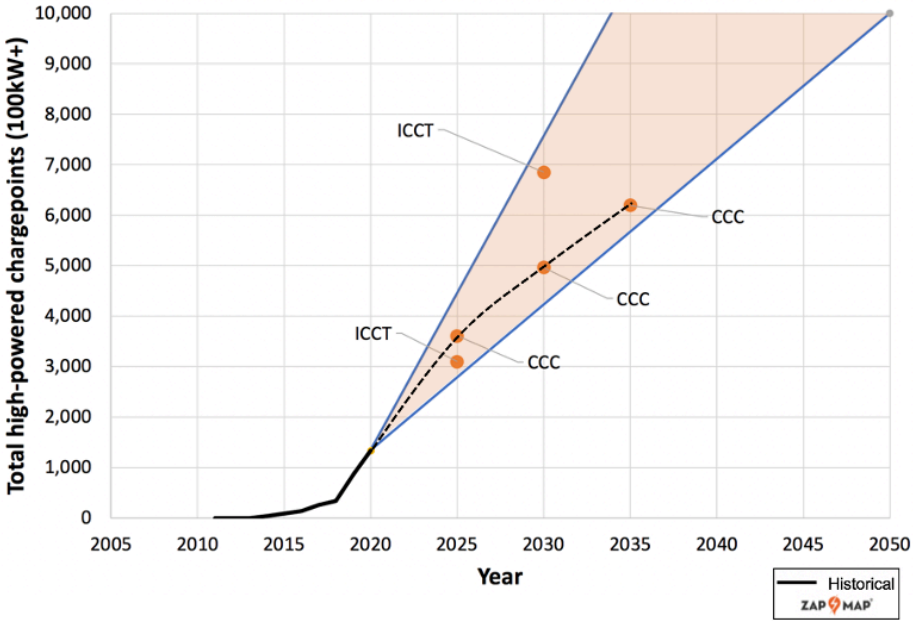
By 2030, the UK will need around 6,000 high-powered EV chargepoints (100 kW+).

By 2030, the UK will need between 5,000 and 7,000 high-powered EV chargepoints (Figure 16). Taking a midpoint of these estimates (6,000), CPOs will need to install around 500 high-powered chargepoints each year. This is only a modest increase, in absolute terms, compared to the current rate of around 300 high-powered chargepoints per year.[80] The Government is aiming for 2,500 rapid chargepoints along England's Strategic Road Network by 2030, increasing to 6,000 by 2035.[81]

However, the rollout of high-powered EV chargepoints may still present challenges, particularly at certain locations where expensive grid connection upgrades are required. The Government will also need to ensure that high-powered chargepoints are distributed across the whole country, both on strategic routes and in rural areas.

The Government will also want to incentivise ultra-high-powered chargepoints for buses and Heavy Goods Vehicles, which could each require over 1 MW (1,000 kW) of power. There are likely to be opportunities for large grid connection upgrades that could supply electricity to chargepoints for both cars and HGVs at the same sites, which should reduce the overall cost of decarbonising road transport. These high-powered grid connections could also be used to power hydrogen electrolysers, which would produce hydrogen for hydrogen-powered HGVs.

Figure 16: High-powered chargepoints required (2020-2050).



Source (historical): Zap Map.[82]

Source (forecasts): ICCT, CCC.[83,84]

80. Average of the last 3 years (2017-2020).

81. BEIS, DfT, OLEV and OZEV (2020). *Government vision for the rapid chargepoint network in England*. Link.

82. Zap Map. Link. Note: Zap Map data includes chargepoints on proprietary networks, such as Tesla Superchargers.

83. Nicholas, M. and Lutsey, N. ICCT (2020). *Quantifying the electric vehicle charging gap in the United Kingdom*. Link; CCC (2020). *The sixth carbon budget: The UK's path to Net Zero*. Link.

84. Note: Each forecast uses different assumptions, such as the number of EVs that will be on the road in the future. Figure 16 is intended to show the spread of estimates, rather than comparing them on a like-for-like basis.

Current policy and legislation

To date, the UK Government has provided grants to operators of public EV chargepoints. In the 2020 Spending Review, the Government announced increased funding for EV charging, although it is not yet clear exactly how this funding will be allocated among existing schemes (Table 9). The Government also provides grants for home and workplace chargepoints, which are outside the scope of this report.[85]

Table 9: The UK Government's main incentives and schemes for EV chargepoints.

Name	Overview	Details
On-street Residential Chargepoint Scheme (ORCS)	ORCS provides grant funding to Local Authorities for up to 75% of the capital cost of procuring and installing slow/overnight chargepoints on streets in residential areas (up to 23kW). Chargepoints must be installed in areas that lack off-street parking.[86] ORCS is administered by the Energy Saving Trust on behalf of the Office for Zero Emission Vehicles (OZEV).	£20 million available for 2020 – 2021. The Government estimates that this will support the installation of up to 7,200 chargepoints.[87] Up to £6,500 per chargepoint is available, up to £100,000 per project. As of March 2020, the ORCS had supported the installation of over 2,000 chargepoints in over 60 Local Authorities since 2017.[88] In the 2020 Spending Review, the Government announced extra funding for EV charging. This included extending existing grants for workplaces, homes and on-street locations by £275 million, as well as £90 million to fund local on-street and rapid EV charging infrastructure in England for larger schemes outside the scope of ORCS.

85. The WorkPlace Charging Scheme (WCS) is a voucher-based scheme that provides support for the up-front purchase and installation costs of workplace chargepoints, up to 40 charging sockets per application. The Electric Vehicle Homecharge Scheme (EVHS) provides grant funding for up to 75% of the installation costs for residential chargepoints. Both schemes offer a maximum grant of £350 per chargepoint socket.

86. 'Off-street parking' includes parking on driveways and in garages, including communal car parks and garages attached to blocks of flats.

87. HM Gov (2020). *The Government's response to the Committee on Climate Change's 2020 progress report to Parliament*, page 102. Link.

88. DfT, OZEV and OLEV (2020). *Update on the infrastructure grant schemes.* Link.

Rapid Charging Fund ('Project Rapid')	The Rapid Charging Fund consists of £950 million earmarked for investment in electricity networks to prepare them for the rollout of high-powered chargepoints. The design of Project Rapid has not yet been finalised. The Rapid Charging Fund will provide funding for grid infrastructure upgrades in 'strategic locations' where the costs of the project make the project 'not commercially viable'.[89]	Aims to provide between 6 and 12 "high-powered" chargepoints (150 kW+) at all motorway service areas in England by 2023, with a longer-term target of 6,000 along the entire Strategic Road Network in England by 2030.
Charging Infrastructure Investment Fund (CIIF)	Announced in the Budget 2017, CIIF is a public-private £400 million investment fund focused on charging infrastructure. All of the funds must support investment in public charging infrastructure.[90] Through the CIIF, the Government hopes to encourage more private-sector investment in EV chargepoints. The Government initially agreed to invest £200m in the fund, with the other half funded by private investors.[91] The CIIF is expecting to raise the full £200 million from the private sector in early 2021.[92]	The fund is managed by Zouk Capital, and the first tranche of funding was invested in the CPO InstaVolt in November 2019. InstaVolt is using the money to expand its national network of rapid and high-powered DC chargepoints.[93]

The Government has powers to regulate the EV charging sector.

On top of existing grants for public EV chargepoints, the Government also has various powers to regulate the EV charging sector. The *Alternative Fuel Infrastructure Regulations 2017* sets technical standards and consumer experience requirements for public EV chargepoints; these regulations also apply to hydrogen refuelling infrastructure.[94] In 2018, the Government legislated to take more powers to regulate EV chargepoints through the *Automated and Electric Vehicles Act*. This Act gives the Government various regulatory powers, including the power to:

- Require chargepoints operators to offer roaming and to accept card payments;
- Require new chargepoints to be 'smart' compatible; and
- Require operators of motorway service areas and owners of petrol stations to install EV chargepoints.[95]

94. Gov.uk (undated)*The Alternative Fuels Infrastructure Regulations 2017*, Link; Our definition of 'public EV chargepoints' includes all chargepoints except those in private homes and workplaces, as well as those on proprietary networks, such as Tesla Superchargers. Note: The *Alternative Fuels Infrastructure Regulations 2017* uses a different definition, which excludes on-street chargepoints in residents' parking bays.

95. Gov.uk (undated). *The Automated and Electric Vehicles Act 2018*. Link

89. BEIS, DfT, OLEV and OZEV (2020). *Government vision for the rapid chargepoint network in England*. Link.

90. UK Gov (September 2019). *Details of the operation of the Charging Infrastructure Investment Fund*, p1. Link.

91. Infrastructure and Projects Authority and HM Treasury (2019). *Policy paper: Charging Infrastructure Investment Fund*. Link.

92. A. Grundy (January 2021). *Charging Infrastructure Investment Fund nears on £400m target after third close*. Link.

93. Zouk Capital (2020). *Zouk Capital announces £80 million second close in Charging Infrastructure Investment Fund*. Link.

The Government has said that it wants all new rapid and high-powered chargepoints to offer credit and debit card payments. The Government also wants industry to develop ways for drivers to pay for EV charging through an industry-wide 'roaming solution', replacing the current patchwork of smartphone apps and membership cards that EV drivers currently need to charge their vehicle on chargepoints that are operated by different networks.[96] In July 2019, the Government made it clear that "if the market does not deliver [these] improvements across the entire network, it is prepared to intervene" by introducing more regulation.

Some areas of EV charging policy and legislation are devolved.

Transport policy is partly devolved in Scotland, Wales and Northern Ireland.[97,98] Scotland has its own public network of chargepoints, *ChargePlace Scotland*, which consists of 1,400 public chargepoints. The network is funded by a public grant in partnership with Local Authorities and other organisations, amounting to £30 million since 2011. The network is also operated by a private sector CPO through a commercial agreement with the Scottish Government.[99]

The Welsh Government has its own EV charging strategy currently out for consultation, but its approach is expected to be broadly similar to that taken by the UK Government.[100] In Northern Ireland, the Department for Economy is developing an Energy Strategy, which will be published by the end of 2021 and will include policies to facilitate EV charging.[101]

96. HM Gov (2019). *News story: All new rapid chargepoints should offer card payment by 2020*. Link.
97. Butcher, L. House of Commons Library (June 2017). *Transport in Scotland, Wales & Northern Ireland*. Link
98. Note: There is a single regulatory framework for electricity networks across Great Britain, managed by Ofgem. Northern Ireland has a separate framework for regulating electricity networks, which is regulated by the Utility Regulator (Link).
99. See Scottish Government (2019). *More electric vehicle charging points*. Link; ChargePlace Scotland (2020). *About us*. Link
100. Welsh Government (2020). *Consultation Document: Electric Vehicle (EV) charging strategy for Wales*. Link
101. Department for the Economy (2020). *Northern Ireland Energy Strategy 2050*. Link

3. Where should the Government intervene?

In the UK, CPOs are installing large networks of rapid and high-powered chargepoints across the country, often fully funded by the private sector. However, there is evidence to suggest that the market is failing to deliver sufficient EV chargepoints in certain areas of the UK. Without additional Government intervention in the short term, there is a significant risk that a lack of chargepoints could delay the take-up of Electric Vehicles (EVs).

In the longer term, it's possible that an efficient market for public EV chargepoints will develop that will serve EV drivers across the whole of the UK. This would allow the Government to intervene less in the market for EV charging, similar to the Government's approach to petrol stations. Therefore, the Government should keep any interventions under regular review.

As part of this project, we interviewed stakeholders from chargepoint operators, car manufacturers, Government (including Local Government), policymakers and more. We found concerns over possible market failures in the following five categories.

#1: Risk of underprovision in some areas

In some areas, there are likely to be fewer EV drivers, either because the area is more sparsely populated or because there are fewer early adopters. In these areas, the market may fail to deliver sufficient EV chargepoints to meet the needs of drivers. Our stakeholders suggested that this risk is particularly high in rural areas, and in poorer areas of towns and cities.

Today, the UK suffers from an uneven distribution of chargepoints across the UK, with three times more chargepoints per person in London compared to areas like the North West of England, Yorkshire and Northern Ireland (Figure 13). Analysis from the consultancy *Field Dynamics* shows how the uneven distribution of chargepoints impacts households without off-street parking ('on-street households'). Field Dynamics found that, outside London, 90% of on-street households are more than five minutes' walk from their nearest public chargepoint.[102]

The provision of chargepoints can vary significantly between Local Authorities. For example, in the London Borough of Hackney, 56% of on-street households are within five minutes' walk from their nearest chargepoint; a figure that falls to just 11% in the neighbouring London Borough of Newham. *Field Dynamics* finds similar results in Brighton, Cardiff, Exeter, Liverpool, Oxford, and Portsmouth.[103]

102. Field Dynamics (undated). *Public charger catchment research.* Link

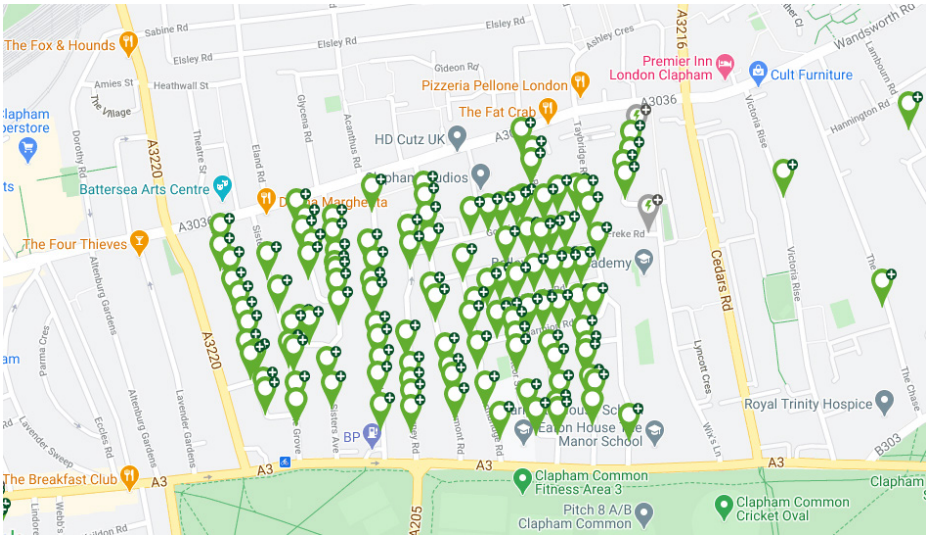
103. Field Dynamics (undated). *National Ranking of EV Charge Point Coverage (map).* Link

This analysis demonstrates a significant lack of provision for households who have to park their cars on the street ('on-street households'), which, if unaddressed, will become a major barrier to delivering the phase-out of new petrol and diesel cars and vans by 2030. It also represents evidence of 'unjust transition', whereby climate policies leave certain demographic groups behind. Unless the Government addresses this issue, poorer households will struggle to access new technologies such as EVs, which could weaken the democratic case for Net Zero. There is a clear case for more Government intervention to ensure a comprehensive network of EV chargepoints across the UK, in line with the Government's manifesto commitment to ensure that everyone is within 30 miles of a rapid EV chargepoint.[104]

#2: Lack of resources within Local Authorities

Local Authorities have a key role in enabling the delivery of EV chargepoints, particularly for slow/overnight chargepoints in residential areas. Local Authorities are responsible for granting permissions for chargepoints, including alterations to highways and street furniture, and for changes to parking restrictions including residents' parking bays. Many slow/overnight chargepoints are installed on existing lampposts, which are usually owned by Local Authorities. One neighbourhood in Wandsworth, London, now has access to over 50 slow/overnight chargepoints on lampposts as part of a deal between the Wandsworth Borough Council, Siemens and Ubitricity (Figure 17).

Figure 17: EV chargepoints on lampposts in Wandsworth, London.



Source: Ubitricity.[105]

Local Authorities often own significant land and property, including local car parks and other buildings. These locations have the potential to host chargepoints of all speeds, depending on what grid connection upgrades are needed. Despite the importance of Local Authorities, many don't have

104. Conservative Party (undated). *Conservative Manifesto 2019*. Link. Page 29.

105. Ubitricity (undated). *Residential Charging (map)*. Link

dedicated teams responsible for facilitating the rollout of EV chargepoints. This means that EV charging often falls between teams responsible for planning, roads and transport, parking, the environment, climate change, and others.

Local Authorities have wide-ranging statutory responsibilities including bins and recycling, social care, highways, education, and housing. In this context, it is understandable that many Local Authorities do not yet have dedicated teams to facilitate the rollout of EV charging infrastructure in their area. However, given their critical role, it is increasingly important to have dedicated resources within Local Authorities to work on EV charging. Many of the stakeholders we spoke to suggested that more dedicated resources in Local Authorities would make it easier for CPOs to roll out EV chargepoints more quickly.

Through ORCS, Local Authorities are currently heavily involved in the rollout of on-street chargepoints in residential areas. However, some stakeholders suggested that EV chargepoints could be delivered more effectively by allowing the private sector, rather than Local Authorities, to take the lead.[106]

#3: Need for strategic investment in grid connections

Rapid and high-powered EV chargepoints draw large amounts of electricity from the grid. Overall, the existing electricity grid is likely to be able to accommodate the transition to EVs, so long as drivers use smart charging where possible. Smart charging will encourage EV drivers to charge their vehicles at off-peak hours, for example overnight.[107] However, there are still likely to be significant local bottlenecks that will require grid upgrades, particularly for hubs of rapid and high-powered chargepoints. This raises questions about how grid connections should be paid for, including whether changes are needed to the UK's regulatory framework for electricity networks.[108]

In the future, some EV charging hubs could have several dozen high-powered chargepoints, requiring a grid connection of 10 megawatts (MW) or more. If electric lorries take off, then grid connections will need even more power, perhaps as much as 50 MW in some locations. These locations are likely to require significant new electricity infrastructure to connect them to the grid, which could cost up to £25m at some motorway service areas.[109] Larger grid connections could also be used by hydrogen electrolysers, which would use electricity to make hydrogen for hydrogen-powered HGVs.[110]

Chargepoint operators (CPOs) could pay to upgrade the grid connection at each site incrementally over time, in line with increasing demand for EV charging. However, in many cases it will be cheaper overall to build a single big grid connection at each site, rather than multiple small upgrades. This creates a need for 'strategic investment' in grid connections at some sites, with CPOs and/or the Government investing before demand increases.

The Government recognises the need for strategic investment in grid

106. ORCS does permit applications from public-private partnerships and private ownership of chargepoints. However, applications must come from the Local Authority because they are the landowner. Other Government support schemes, including the CfD scheme for renewables, allow applications from private sector providers, so long as they can demonstrate a suitably long lease (or an option-to-lease) over the land where the projects will be installed.

107. Hull, R. This Is Money. (November 2020). *National Grid confident it is 'suitably robust to cope' with increase EV demand from 2030 when new petrol and diesel cars will be banned.* Link

108. Energy Systems Catapult (July 2018). *Preparing UK electricity networks for electric vehicles.* Link

109. National Grid (January 2019). *Supporting the growth of electric vehicles.* Link. Page 9.

110. Element Energy for the CCC (12 December 2020). *Analysis to provide cost, efficiencies and roll-out trajectories for zero-emission HGVs, buses and coaches.* Link. (Page 26); This study estimates that sites on the strategic road network will require 5-10 refuelling spaces for zero-emission HGVs.

connections at key locations and has announced a £950m Rapid Charging Fund that will pay for grid upgrades.[111] However, the Government has not yet released many details. The Office for Zero Emission Vehicles (OZEV) is currently undertaking a comprehensive review of EV charging infrastructure and is analysing options for how the Rapid Charging Fund should be spent.[112] Grid connection upgrades are also likely to be needed for hubs of rapid and high-powered chargepoints in urban areas.

#4: Interoperability between chargepoint networks and variable levels of reliability

EV drivers often complain about difficulties using different chargepoint networks. Some networks require drivers to sign up to an app, whereas others allow payments using credit and debit cards, RFID cards or QR codes. EV drivers often report struggling to sign up for new networks, which can delay their charging session or may prevent them charging altogether. There are also reports of poor reliability on some networks and variable levels of customer service. This fragmented system leads to occasional negative experiences, such as a couple from Kent who reported taking nine hours to travel 130 miles in their new EV.[113]

These negative experiences are uncommon and will become less frequent as more chargepoints are rolled out and as EV drivers become more familiar with the process of charging an EV. The market may also consolidate and/or coalesce around common interoperability standards that will improve the experience for drivers. However, these stories have a negative impact on potential EV drivers and contribute to range anxiety.

In 2019, the Government said that all new rapid and high-powered chargepoints *"should offer card payments by 2020"*.[114] The UK Government also says that it *"expects industry to develop a roaming solution across the charging network, allowing electric vehicle drivers to use any public chargepoint through a single payment method without needing multiple smartphone apps or membership cards"*.

If CPOs do not implement card payments and improved roaming solutions, then the Government has powers under the Electric and Autonomous Vehicles Act to require chargepoint operators to offer contactless payment and roaming solutions. Chargepoint operators have developed a number of roaming solutions, including Zap-Pay,[115] NewMotion,[116] and the Octopus Electric Juice Network.[117] However, there is currently no option for drivers to pay for charging at all of the UK's chargepoints through a single interface.

During our research, we found a range of views on interoperability. We found that chargepoint operators are generally keen to retain an element of control over how customers use their network, in part because this encourages drivers to join their network rather than others. Also, CPOs can make money from their customers through in-app adverts and premium features or potentially by monetising customer data in other ways. We also found tension over who 'owns' customer data, particularly between CPOs and car manufacturers.

111. UK Gov (2020). *Spending Review 2020*. Link.
112. UK Parliament (Hansard) (4th December 2020). *Written question 120900*. Link.
113. Brignall, M. (November 2020). *"Why did it take nine hours to go 130 miles in our new electric Porsche?"* Link
114. DfT and OZEV (July 2019). *All new rapid chargepoints should offer card payment by 2020*. Link
115. Zap Map (undated). *What is Zap-Pay?* Link
116. New Motion (undated). *EV Charge Card*. Link
117. Octopus Energy (undated). *Introducing the Electric Juice Network*. Link

On the other hand, there is significant demand from customers for roaming solutions that would allow them to charge across multiple networks through a single platform. Ultimately, drivers want a seamless charging experience, including secure data and high standards.

#5: Risk of local monopolies and excessive pricing

Many EV chargepoints, particularly on-street chargepoints in residential areas, have some of the characteristics of monopolies. For example, once a company (or a Local Authority) has installed chargepoints on a street, it's very unlikely that another company would then install a competing set of chargepoints on the same street. This is in part because the first set of chargepoints is likely to have used the available electrical connections to the grid, and in part because there would be insufficient demand to justify two sets of chargepoints.

There are similar risks for high-powered chargepoints, where grid connections are a barrier to entry. Once a CPO has installed high-powered chargepoints, for example at a motorway service station, it's likely to be more expensive for a rival CPO to install a competing set of chargepoints.

Therefore, for both slow/overnight and high-powered chargepoints there is a risk of local monopolies, which could allow CPOs to charge excessively high prices. To date, this risk is largely theoretical, in part because Local Authorities either own slow/overnight chargepoints or have imposed pricing requirements through commercial agreements with CPOs. However, many of the stakeholders we spoke to acknowledge a growing risk of local monopolies and excessive pricing.

Despite some concerns over excessive pricing, the market for EV charging in the UK is, on the whole, highly competitive. For example, many of the UK's supermarkets have installed chargepoints and some offer free charging to their customers. Similarly, many of the UK's largest petrol station operators are installing rapid and high-powered chargepoints in their forecourts, including BP and Shell. These types of chargepoints are less susceptible to local monopolies, keeping prices low for customers. As the Government tries to address the risk of excessive pricing, it must avoid 'crowding out' private sector investment in these types of EV chargepoints.

In December 2020, the Competition and Markets Authority (CMA) launched a 'market study' into EV charging.[118] This study is considering how to incentivise competition between CPOs whilst continuing to attract private investment, as well as how to improve the experience for drivers. The CMA's final report is due to be published by December 2021. We recommend that this market study explores the potential for local monopolies, as highlighted above.

118. CMA (December 2020). *Electric vehicle charging market study*. Link

4. Key principles

To decarbonise road transport, the Government's must support a smooth transition from internal combustion engines (ICEs) to Zero-Emission Vehicles (ZEVs), especially EVs. Investment in EV chargepoints will help to increase sales of EVs through indirect network effects, as described earlier in this report. This makes EV chargepoints crucial to delivering the 2030 phase-out of new ICE cars and vans.

As set out in previous sections, there are good arguments for the Government increasing its support for the rollout of public EV chargepoints across the UK. At every stage, Ministers should put the driver at the heart of policy. The Government's mission should be to make it as affordable and as convenient as possible to own and drive an EV; to achieve this, we recommend five key principles, set out below.

Driving an EV should be as affordable as possible, therefore:

Principle 1: Government support for EV chargepoints should be open to innovative solutions that could reduce the cost of installing chargepoints.

High-powered chargepoints require powerful connections to the electricity grid, which are often expensive. In some locations, the cost of the grid connection may prevent CPOs from installing high-powered chargepoints. To address this, the Government has pledged support for high-powered chargepoints where *"upgrading connections to meet future demand for high-powered chargepoints is prohibitively expensive and uncommercial"*.[119]

Grid connections are often a major cost for high-powered chargepoints. However, if the Government focuses too much on grid connection costs then it risks rejecting support for other projects that have a lower overall cost. Consider the three examples below:

Example 1: Using an existing grid connection.

- A chargepoint operator (CPO) may be able to secure a grid connection from a nearby industrial site, an existing solar farm, or an existing battery storage project. These connection options may be significantly cheaper than building a new connection.
- However, the CPO may have to pay rent to the owner of the existing grid connection in return for installing equipment on their land and may have to compensate them for a reduction in their access to electricity.
- This project would have lower grid connection costs but higher rent costs.

119.UK Government: *Vision for rapid chargepoint network in England*. Link

Example 2: Using a battery in combination with a smaller grid connection.

- Consider a CPO that is developing a site with 6 x 150 kW high-powered chargepoints. The maximum electricity demand required by these chargepoints is 900 kW. To provide a capacity of 900 kW, the CPO may need to pay for an expensive grid connection upgrade.
- Instead, it may be possible for the CPO to secure a 500 kW grid connection relatively cheaply because fewer grid upgrades are required.
- To accommodate 6 x 150 kW chargepoints, the CPO could use a cheaper 500 kW grid connection, plus a battery that would help to supply the chargepoints at peak times.
- This project would have lower grid connection costs but would incur additional costs for the battery.

Example 3: A cheap grid connection, but expensive road upgrades.

- A CPO may identify a very cheap grid connection that is close to a motorway or A-road.
- However, to give vehicles access to the chargepoints from the main road, the CPO may need to build expensive modifications to roads, including new slip lanes.
- This project would have lower grid connection costs but higher access costs (road upgrades).

These examples demonstrate the complexity of deploying EV chargepoints and the multiple options available to reduce overall costs. The key point is that the Government should be open to innovative solutions that can reduce total costs rather than overly focusing on grid connection costs, even though grid costs are often significant. These examples also demonstrate the importance of harnessing private sector competition to find the lowest-cost option. Compared to the private sector, the Government is not well placed to work out the most cost-effective grid connection options for high-powered chargepoints.

Principle 2: The Government should use competition between private sector chargepoint operators to drive down costs.

Post-coronavirus, the UK Government will have limited public funds to invest in EV charging infrastructure; it is therefore vital that Government investment in EV chargepoints is as cost-effective as possible.

We believe that EV charging infrastructure warrants public investment, based on similar arguments to those for the Government's planned £5bn investment in gigabit broadband.[120] Public sector investment in chargepoints is likely to have a bigger impact on sales of Zero-Emission Vehicles (ZEVs) than purchase subsidies such as the Plug-In Car Grant, which should be replaced by a California-style 'ZEV mandate' for manufacturers.[121] However, the Government should leverage private sector investment wherever possible to drive down costs.

120. Department for Digital, Culture, Media & Sport (December 2020). *Next steps in Government's £5 billion gigabit broadband plan.* Link

121. Policy Exchange (July 2020). *Route '35.* Link

There is significant private capital lining up to invest in infrastructure projects in the UK, as demonstrated by the UK's growing fleet of offshore wind farms, which are financed by the private sector. As with offshore wind farms, the Government should bring forward measures that will draw private capital into the UK's EV charging sector.

Our analysis shows that the UK's chargepoint network needs between £5bn and £10bn of investment by 2030, far more than the Government's planned investment of £1.3bn in EV charging.[122] If the Government replaces the Plug-in Car Grant (PiCG) with a ZEV mandate, then it will free up the approximately £135m per year that the Government currently spends on the PiCG.[123] However, the Government should still expect the private sector to provide the vast majority of funding for new EV chargepoints in the UK.

Principle 3: Drivers should be protected from excessive prices, especially at chargepoints that have received Government support.

Across the UK, CPOs are building privately-funded EV chargepoints in supermarket car parks, at petrol station forecourts and at motorway service stations. In general, these CPOs are charging a fair price for EV charging, because otherwise motorists will use another network. However, for some types of chargepoints, there is still a risk of local monopolies and excessively high prices.

Consider a neighbourhood where all of the lampposts have been retrofitted with slow/overnight EV chargepoints by a single company. These chargepoints are now a natural monopoly for slow/overnight charging in the local area. They are the only convenient choice for overnight charging in the neighbourhood and there is no opportunity for a rival company to install cheaper chargepoints using existing lamppost connections.

Today, most of the UK's slow/overnight chargepoints are either owned by Local Authorities or operated under a long-term commercial agreement that puts conditions on pricing. In future, the Government plans to provide support to many more CPOs, both for on-street residential chargepoints and for rapid chargepoints. Without appropriate safeguards, there is an increasing risk of excessive prices.

The Government could mandate 'fair pricing' whenever there is a local monopoly for EV charging infrastructure. However, it is often hard for the Government or regulators to assess whether a project has a monopoly. Instead, the Government should ensure that, where chargepoints receive Government support, they cannot charge excessive prices. The definition of any price cap will be contentious; we recommend one definition later in this report.

Longer term, it's possible that competitive markets for EV charging will develop in all locations, including for slow/overnight chargepoints. If this happens, fair pricing would emerge through market competition, allowing the Government to intervene less in the market.

122. UK Gov (2020). *Spending Review 2020*. Link; Note: this includes some Government support for home and workplace chargepoints.

123. OZEV, DfT (March 2020). *Update on plug-in vehicle grants following today's budget*. Link. As of the Budget 2020 (March 2020), the Government expected to spend £403m on the PiCG until March 2023, equivalent to £135m per year.

Driving an EV should be convenient, therefore:

In addition to the affordability principles set out above, Ministers should also aim to make driving an EV as convenient as possible. This includes addressing the challenges left by gaps in geographical coverage and interoperability.

Principle 4: EV drivers should feel confident driving anywhere in the UK.

The Government will only be able to deliver the phase-out of new petrol and diesel cars and vans by 2030 if the vast majority of the public feels confident that they will be able to drive their EV anywhere in the UK. Statistics show that most car journeys are very short, so most people will be able to charge at home or at work most of the time.[124] However, surveys show that range anxiety is a concern for many potential EV owners.[125] As described above, chargepoints are unevenly distributed across the different regions of the UK, which suggests that this concern is not unreasonable.

Policy Exchange has argued extensively for the central role of infrastructure in supporting the Union.[126] An EV driver should feel as confident driving in the Scottish Highlands or in Belfast as they do in London. If the regional disparities in the provision of EV chargepoints remain, they could contribute to weakening the concept of a united kingdom. Therefore, the Government should see a comprehensive network of EV chargepoints as an investment in the Union alongside the other transport infrastructure considered by the Union Connectivity Review.[127]

The Government needs a clear strategy to give confidence to all types of drivers that there will be enough chargepoints for them to make their journey. This strategy needs to accommodate the full range of drivers in the UK, including taxi and private hire drivers who may need a full charge once per day, van drivers who park on the street overnight, drivers in rural areas who regularly make longer journeys, and those making holiday trips across the UK.

Principle 5: The experience of charging an EV should be better than refuelling a conventional petrol or diesel vehicle.

The refuelling experience for petrol and diesel cars has remained relatively stable for decades: you turn up; you fill up using a mechanical pump; then you pay either at the pump or in store. Today, the experience of charging an EV can be significantly more complicated. You may need to download and sign up for a mobile phone app, which will be difficult if you have no phone signal or if your phone has run out of battery. You may also have to download a different app for each chargepoint network. This complicated charging experience could put off potential EV owners, particularly if they read or hear negative stories from existing EV owners.

The Government has said that it wants the EV charging experience to be as smooth as possible and is taking steps to improve the experience. In

124. DfT (Updated August 2020). *National Travel Survey 2019 [NTS0308: Average number of trips by trip length and main mode]*. Link; The National Travel Survey shows that, in 2019, over 90% of car journeys in England were less than 25 miles.

125. AA (September 2020). *Almost half of drivers thinking of buying an Electric Vehicle*. Link; Polling showed that among the most common reasons for not wanting an EV were "lack of public charging points" (69%) and "range anxiety" (66%).

126. Policy Exchange (August 2019). *Modernising the United Kingdom*. Link

127. DfT (Updated November 2020). *Union connectivity review: terms of reference*. Link

July 2019, the Government said that all new high-powered chargepoints should offer 'pay as you go' debit or credit card payment options.[128] This will bring EV chargepoints in line with petrol stations, which offer card payments. However, the Government should consider steps to make the experience of charging an EV better than refuelling a conventional petrol or diesel vehicle. Any changes should still allow the private sector to develop innovative solutions in this area.

Many EVs have similar functionality to smartphones, including mobile data connectivity and wireless software updates. This offers the potential for a significantly smoother charging experience. For example, owners of Tesla vehicles can access the following features when using the Tesla Supercharger network:

- **Live status of Superchargers:** Number in service, number in use, and charging speed.
- **Integrated navigation features:** Navigate from A to B with automatically planned charging stops.
- **The option to pre-heat the battery on the way to a Supercharger:** This prepares the battery to accept the highest rate of charge, minimising charging time.
- **Automated payments:** Tesla cars and Tesla Superchargers communicate with each other to take payments from the driver automatically, without the need to present a credit or debit card each time.

Some of these features are available to non-Tesla drivers through apps like Zap Map and through an EV's navigation system. However, some are not, particularly automated payments. This is mainly due to a lack of interoperability between chargepoints networks and some technical barriers. These features, if made widely available, would significantly improve the charging experience for EV drivers and would smooth the transition to EVs.

The Government could take further measures to improve the experience of charging an EV. It could use powers under the Automated and Electric Vehicles Act 2018, which gives it the power to mandate payment methods, cooperation between CPOs, and provision of live data on chargepoint status. Alternatively, the Government could consider imposing requirements on CPOs in return for receiving Government support, as described later in this report.

128. DfT, OLEV (July 2019). *All new rapid charge-points should offer card payment by 2020.* Link

5. Policy Options

This section summarises the policy options through which the UK Government can support investment in public chargepoints, based on international examples. Our research highlighted four main policy approaches for developing public EV charging infrastructure, although these are not mutually exclusive. These policy approaches are summarised below, and case studies are summarised in Table 10.

The Government has four main policy options to support EV chargepoints:

1. **Market-led policies:** These policies incentivise CPOs to install public chargepoints using financial incentives including taxes, subsidies and trading systems. A good example is California's *Low-Carbon Fuel Standard*.
2. **Regulation-led policies:** These policies require certain businesses to install chargepoints and/or supporting grid infrastructure, for example through a mandate. One example is the German Government's recent proposal to mandate public EV charging in every petrol station.
3. **Grant-based policies:** Government grants for EV chargepoints help CPOs to pay for the upfront capital cost of purchasing and installing chargepoints, including associated grid connection upgrades. These upfront costs are often cited as a barrier to rolling out EV chargepoints. The UK's Rapid Charging Fund is expected to focus on locations that require expensive grid connection upgrades. The UK Government operates a grant system for EV chargepoints, as does the French Government.
4. **Long-term contracts:** Instead of upfront capital grants, governments can procure EV chargepoints through competitive tenders for long-term contracts. In these tenders, the Government invites organisations to submit bids to build, own and operate EV chargepoints and associated grid connections. Governments can specify technical requirements as well as setting conditions on pricing. The Netherlands operates a comprehensive system of tenders for long-term contracts. The Dutch central Government supports different tiers of local government to run tenders for public EV chargepoints.

Table 10: International case studies of public support for EV chargepoints.

Policy Approach	Case study	Description
Market-led	California, USA: *Low Carbon Fuel Standard* (LCFS).[129]	The LCFS mandates a reduction in the carbon intensity of transport fuels. The LCFS provides significant flexibility in how this target is achieved and establishes a credit trading market within California. Any low-carbon fuel can generate credits if it meets certain conditions, including electricity used to charge EVs. In 2018, EV charging accounted for 15% of the credits generated in the LCFS. The LCFS incentivises organisations to install chargepoints, because they can generate LCFS credits, which they can then sell. EV chargepoints generate two types of LCFS credits: "Infrastructure Credits" and "Fuel Credits".[130] Infrastructure Credits are paid to chargepoint operators based on the installed capacity of chargepoints, rather than the amount of electricity supplied. The number of Infrastructure Credits decreases each year, meaning that chargepoint operators must increasingly rely on Fuel Credits, which are generated when an EV is charged. Infrastructure Credits help to support investment in EV chargepoints now, before the number of EVs on the road increases.
Regulation-led	Germany: Proposal to mandate public charging at petrol stations.[131]	As part of its coronavirus stimulus package in June 2020, the German Government stated its intention to mandate EV chargepoints in all German petrol stations. In October 2020, the German Government set out a series of targets to introduce fast charging in at least 25% of petrol stations by 2023; 50% by 2024; and 75% by 2026. The German Government has not yet introduced regulations that would to require petrol stations to install chargepoints, instead inviting the market to meet these targets voluntarily. If a voluntary solution is not found, the Government has said that it will consider introducing regulations that would require owners of petrol stations to install EV chargepoints through a new supply obligation.

129. Energy Systems Catapult (October 2018). *California Low Carbon Fuel Standard. Rethinking Decarbonisation Incentives – Policy Case Studies.* Link

130. California Air Resources Board (June 2018). *Workshop: LCFS* regulation. Link. Page 6.

131. Hampel, C. Electrive.com (November 2020). *Germany extends stimulus for EVs until 2025.* Link.

	New York State, USA: *EV Make-Ready Program.* [132]	New York State's '*EV Make-Ready Program*' is a $700m (£515m) programme of investment to deliver supporting infrastructure for EV charging, such as upgraded electricity distribution grids. The majority of the funding is reserved for regulated utility companies and is funded through a levy on consumer energy bills. By paying for the supporting infrastructure, the regulations aim to reduce the costs incurred by CPOs to install chargepoints. The chargepoints themselves are not eligible for funding through this regulatory programme. In July 2020, the utility companies submitted implementation plans. As part of the regulations, they will also need to incorporate the costs of upgrading infrastructure to facilitate EV charging in their annual projections of capital costs. The regulations encourage the utility companies to upgrade grid connections to facilitate chargepoints on public land. To ensure that the benefits of public EV chargepoints are spread evenly throughout the state, the utilities are also eligible for more support if they upgrade the electricity grid in areas with more 'Disadvantaged Communities'.[133]
	San Francisco, USA: Building codes / regulations.[134]	For home and workplace chargepoints, San Francisco requires all parking spaces in new or retrofitted apartments to have the supporting infrastructure in place for EV chargepoints. In the UK, the Government is consulting on changes to Building Regulations that would require EV chargepoints in both residential and non-residential buildings.[135] These regulations would mainly affect home and workplace charging rather than public chargepoints, which are the focus of this report.
Grant-based	France: *ADVENIR* programme. [136]	France has a range of generous subsidies for EV chargepoints, administered through the '*ADVENIR*' programme. The programme offers subsidies for public EV chargepoints, as well as smaller grants for home and workplace chargepoints. On-street public chargepoints attract subsidies of up to €3,000 (£2,700) per chargepoint, depending on the speed of the charger. Individuals can apply to a local or other competent authority, who will install a chargepoint within 500m of their home or in a preferred location on a specified list.

132. Alford, C. (August 2020). *New York's $701 million program for EV charging, by the numbers*. Advanced Energy Perspectives. Link.

133. ConEdison (September 2020). New York electric vehicle infrastructure Make-Ready Program participant guide. Link.

134. San Francisco Board of Supervisors (April 2017). San Francisco *Green Building and Environment Codes – Requirements for Installation of Electric Vehicle Chargers*. Ordinance No. 92-17. Link (page 12). Note: To be compliant, each parking space needs cabling in place to host a chargepoint and the relevant connection capacity so that 20% of the car parking spaces could be used for EV charging simultaneously.

135. DfT (Updated July 2019). *EV chargepoints in residential and non-residential buildings*. Link

136. ADVENIR (undated). *The ADVENIR program: Funding of chargepoints private or open to the public by the EWCs*. Link.

Long-term contracts	The Netherlands.[137]	Public procurement of EV chargepoints in the Netherlands is generally led by Local Governments, which run tenders for long-term public-private contracts. The tenders are generally for long-term contracts, under which private CPOs build, own and operate public chargepoints for a set period, generally at least 10 years. These tenders reduce demand risk for CPOs, in part by pooling demand risk across a large number of sites; this reduces the cost of financing investment in EV chargepoints. The tenders generally specify technical requirements, consumer protections such as public accessibility, data sharing and pricing terms, as well as commercial conditions like revenue sharing with the Local Government. The Dutch Government supports Local Governments tendering for EV chargepoints. As part of the 2020 National Charging Infrastructure Agenda, Local Governments have agreed to produce a "locally owned [...] vision on charging infrastructure" in their area and to update it at least every 2 years. [138] The Central Government provides different forms of support to help Local Governments produce and update their 'local vision' for EV charging. For instance, the Netherlands has a 'Knowledge Platform for Charging Infrastructure', which outlines clear guidelines for tendering. It also contains recommended terms and conditions for chargepoints which can act as reference documents for the tenders run by Local Government. [139] This knowledge platform aims to reduce the complexity of tendering documents and the cost and length of the overall tendering process, because Local Governments do not have to create their own standards.

Each of these policy options can deliver extensive EV charging infrastructure. However, some are likely to be more effective than others.

Pure market-based approaches like California's Low Carbon Fuel Standard (LCFS) are unlikely to address underprovision in rural areas and in poorer areas, because these chargepoints are likely to need more government support. However, the LCFS does provide an additional incentive for the private sector to invest in EV chargepoints. In the UK, the Government could consider adapting the Renewable Transport Fuel Obligation (RTFO) to include electricity used to charge EVs. However, even if the Government amended the RTFO to include EV charging, it would need to introduce complementary policies to ensure that EV chargepoints are built across the whole of the UK.

137. SPP Regions (Regional Networks for Sustainable Procurement) (March 2018). *Transport: Joint Procurement of Charging Points in Rotterdam*. Link.

138. RVO (Netherlands Enterprise Agency) (June 2020). *The National Charging Infrastructure Agenda (English version)*. Link

139. NKL Nederland (Netherlands Knowledge Platform for Charging Infrastructure) (undated). *Uniform Standards for Chargepoints*. Link

Regulation is a cost-effective way to phase out petrol and diesel car and vans, but not to roll out a comprehensive network of public EV chargepoints.

In our recent Policy Exchange report, *Route '35*, we argued for a regulatory approach to deliver the phase-out of petrol and diesel cars and vans, through a Zero-Emission Vehicle mandate ('ZEV mandate').[140] A ZEV mandate will work because the obligation is simple (sell more ZEVs each year) and can be easily targeted at car manufacturers. It is also relatively easy to establish a trading mechanism for ZEV credits, which harnesses market competition to reduce the cost of complying with the mandate.

The Government could also consider regulation to require petrol stations and other businesses to install chargepoints, using existing powers under the Automated and Electric Vehicles Act 2018.[141] However, this could raise the overall cost of installing chargepoints because it will be very expensive to install them in some locations due to expensive grid upgrades and the cost of acquiring the right to lay cables over adjoining land.

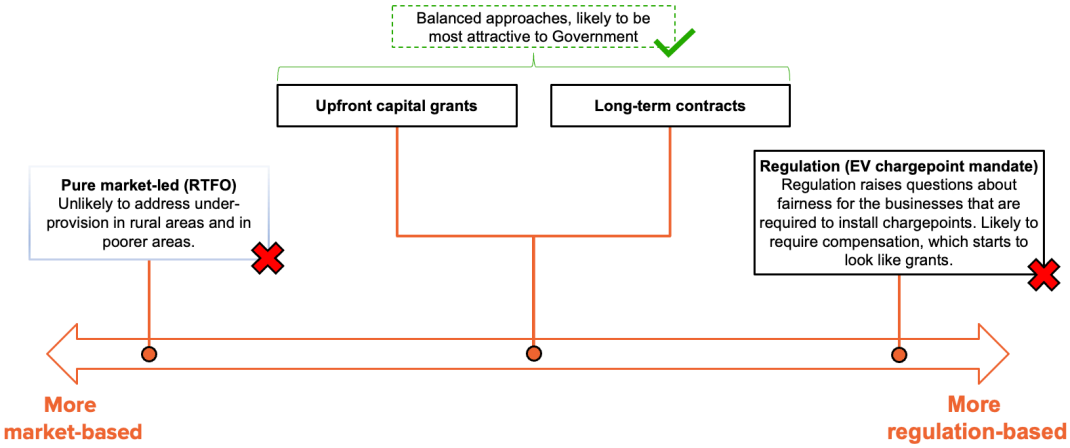
In addition, it would be much harder to establish a mandate for EV chargepoints, for the following reasons:

- An 'EV chargepoint mandate' would apply to a large number of organisations including Local Authorities, businesses, and petrol stations. This makes it harder to design and to apply a mandate.
- The speed of EV chargepoints varies and it is difficult to assess the relative value of different chargepoints.
- A chargepoint mandate would need to accommodate new offerings such as dedicated charging stations for EVs as an alternative to converting petrol stations to offer EV charging.[142]
- Some chargepoints will require much more public support than others, for example due to higher grid connection costs or lower utilisation in rural areas.

Given the challenges of market-led and regulation-led approaches to supporting EV chargepoints, the Government should instead consider upfront capital grants and long-term contracts, both of which offer a balanced approach (Figure 18).

140. Policy Exchange (July 2020). *Route '35*. Link
141. UK Government: *Automated and Electric Vehicles Act*. Link
142. Gridserve (December 2020). *Gridserve opens UK's first Electric Forecourt® to support mass market EV charging*. Link

Figure 18: Analysis of policy options: More 'market-based' versus more 'regulation-based'.



The Government currently offers capital grants for EV chargepoints through the On-street Residential Chargepoint Scheme (ORCS). As discussed in earlier sections, the Government now plans to extend grants to support high-powered chargepoints through the Rapid Charging Fund (RCF). The RCF will focus on grid connection upgrades for high-powered chargepoints.

Instead of grants, the Government could introduce long-term contracts for EV chargepoints, following the example of the Netherlands. There are advantages and disadvantages to both upfront capital grants and long-term contracts (Table 11).

Table 11: Analysis of upfront capital grants and long-term contracts.

	Upfront capital grants	Long-term contracts
Advantages	• Simple and fast to set up. • No ongoing Government liability. • Could be phased out over time.	• Harness competition to reduce costs and find innovative solutions. • Reduce demand risk and therefore reduce cost of finance.
Disadvantages	• Doesn't address demand risk, which keeps cost of finance quite high. • Often fail to fully harness market competition (e.g. current design of ORCS).	• Ongoing financial liability for Government. • Complicated because there are lots of factors (location, speed, etc.). • Arguably, could hook the private sector on Government support.

The main advantage of grants is that they are simple to administer and don't require an ongoing financial commitment from the Government. However, even with a grant, chargepoint operators' revenue remains uncertain (known as 'demand risk'). This demand risk means that the cost of financing chargepoints remains relatively high.

With long-term contracts, the Government can 'de-risk' private investment in EV chargepoints by offering increased revenue certainty.[143] The Government could offer CPOs fixed annual revenue, for example through a Contract for Difference (CfD), or a guaranteed minimum annual revenue. This de-risking would encourage more investment in EV chargepoints from low-risk/low-return investors such as pension funds. However, under long-term contracts, the Government would have to make payments to CPOs depending on the contract structure and how often the chargepoints are used. This creates an ongoing financial liability for the Government but is likely to lower the overall cost of rolling out EV chargepoints.

The Government could fund long-term contracts through a levy on certain users, similar to how it funds renewable energy subsidies through levies on electricity bills.[144] However, the cost of EV chargepoints should not fall on electricity bills. We propose a funding mechanism later in this report.

143. Baringa (October 2020). *Rapid Charging EV infrastructure: on the cusp of the investment opportunity.* Link

144. LCCC (undated). *CfD levy.* Link

6. Policy recommendations

This report focuses on the need for public EV chargepoints across the UK, ranging from slow/overnight chargepoints in residential areas to high-powered chargepoints on the Strategic Road Network. Our research highlighted five recommendations to guide the Government's approach to EV charging, in line with the five principles already identified.

Recommendation 1: In areas that are underserved, the Government should procure chargepoints through competitive tenders. The tenders should offer long-term contracts (10-15 years' long) that give chargepoint operators a guaranteed minimum annual revenue.

Principle:	Innovation	Competition	No excessive prices	Give EV drivers confidence	Good charging experience
Addressed?	✓	✓	-	✓	-

The Government's existing approach to EV chargepoints is based on upfront capital grants for Local Authorities and chargepoint operators (CPOs). The On-street Residential Chargepoint Scheme (ORCS) offers Local Authorities upfront capital grants to fund up to 75% of the cost of installing slow/overnight EV chargepoints in residential areas.[145]

ORCS has played a useful role in funding the first batch of chargepoints; however, there are several issues with the scheme, including the need to complete projects within a financial year. These barriers may deter some Local Authorities from applying to the scheme, which may contribute to the uneven deployment of slow/overnight chargepoints across the UK.

Our analysis shows that, in the 2020s, the UK must deploy EV chargepoints five times faster than over the last three years, and at a cost of £5bn to £10bn by 2030. This makes it even more important that the Government looks again at the design of incentives for EV chargepoints. In particular, the Government should introduce competitive tenders or competitive funding rounds, which will increase competition between CPOs and between areas.

The ORCS scheme awards funding to projects on a first-come, first-served basis.[146] This means that, despite a requirement to demonstrate value-for-money and to follow public sector procurement rules, the scheme does not fully harness competition to bring down the cost of EV chargepoints. Evidence from the UK's renewable energy sector shows

145. ORCS can fund chargepoints with a speed of up to 23kW. Link

146. Energy Saving Trust (undated). *On-street Residential Chargepoint Scheme – Information Pack (2020-2021)*. Link (pages 3-4)

that competition is the key to driving down the cost of publicly-procured infrastructure projects.[147] The Government could improve ORCS by moving to competitively-allocated grants. Under competitive allocation, Local Authorities and CPOs would compete in regular tenders or funding rounds to deliver EV chargepoints as cost-effectively as possible. Only the most cost-effective projects would receive public funding. in order to ensure a fair distribution of chargepoints, the Government should be prepared to pay more for chargepoints in areas with less existing provision.

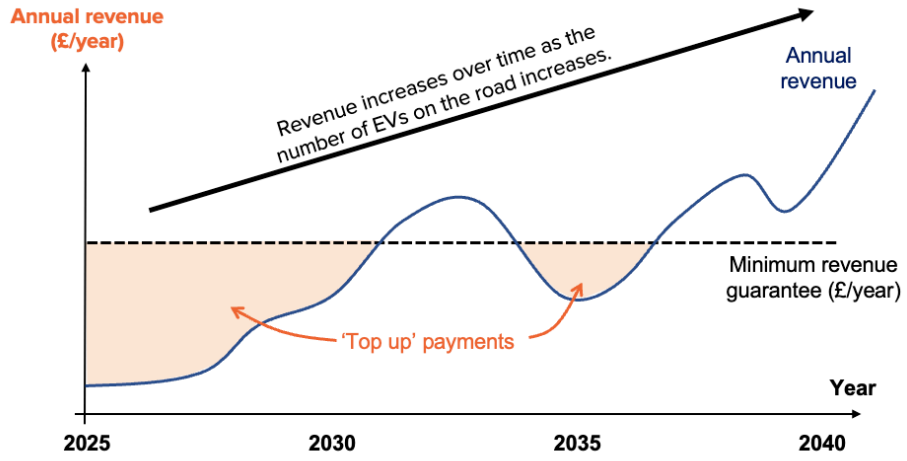
However, competitively-allocated grants would not address the 'demand risk' faced by CPOs, because the revenue generated by the chargepoints remains uncertain. This would keep the cost of financing EV chargepoints relatively high.

Long-term contracts are likely to offer the best value for money.

To reduce costs further, the Government should implement competitive tenders that offer long-term contracts for public EV chargepoints (10-15 years' long), backed by the Government. This would mirror the Government's approach to supporting renewables such as offshore wind.

The long-term contracts should offer CPOs a minimal annual revenue guarantee (Figure 19); CPOs would bid for the level of the minimum revenue guarantee that they require. With the guarantee, CPOs can be more certain over their revenue, which will help them to raise cheaper finance. With competitive procurement, there will be pressure on CPOs to bid a lower minimum revenue guarantee to increase the chances of being awarded a contract; this increases the likelihood that CPOs will have to rely on higher revenues in later years, which will only materialise if the chargepoints are easy to use and in places where customers want to use them.

Figure 19: Schematic of a minimum annual revenue guarantee.



In the early years of the contracts, demand for EV charging is expected to be relatively low, so the revenue generated by many chargepoints won't exceed the guaranteed annual minimum. In later years, there will be more

147. KPMG (September 2019). *Blown away: CfD Round 3 delivers record low prices for offshore wind.* Link

EVs on the road, which means that the Government is less likely to have to make payments to CPOs. We recommend that the Government applies long-term contracts to both slow/overnight chargepoints and high-powered chargepoints, focusing on areas that are underserved.

In the later years of the contracts, demand for EV charging is likely to increase and some chargepoints could be extremely profitable. To ensure value for money for taxpayers, the contracts could include a revenue cap, beyond which the revenue would be returned to the Government. However, any cap is likely to increase the bids made by CPOs, as well as increasing complexity. We recommend a minimum revenue guarantee only, combined with a cap on the price charged by CPOs per kilowatt-hour (kWh) of electricity sold (see Recommendation 4).

For slow/overnight chargepoints, the revenue guarantee should apply across all of the chargepoints installed by each CPO in each local tender. For example, a CPO might secure a long-term contract for around a hundred slow/overnight chargepoints in one Local Authority area. The minimum annual revenue guarantee should apply to the average revenue generated by those chargepoints. Tendering for a large number of chargepoints in a single contract will reduce the number of contracts offered to CPOs, which will make them easier to administer. Larger contracts will also make investment in EV charging more attractive to institutional investors, who often require investments to have a minimum size.

For high-powered chargepoints, the revenue guarantee should apply to each hub of high-powered chargepoints. For example, a CPO might secure a long-term contract for six high-powered chargepoints at one motorway service area. In this case, the minimum annual revenue guarantee would apply to the average revenue generated by those six chargepoints.

The Government should use the tendering process to ensure geographical coverage.

If the Government decides to run tenders for EV chargepoints in areas that are underserved, then it will have significant control over where chargepoints are built and how they operate. To ensure geographical coverage across the UK, the Government should be prepared to pay more for chargepoints in areas that are particularly underserved. For example, some high-powered chargepoints at domestic holiday destinations might be needed mainly during the peak holiday periods. The Government is likely to need to pay more for these chargepoints than those in urban areas, which are likely to be used more consistently throughout the year.

As part of the tendering process, the Government will need to carefully define 'underserved areas'. Rural areas are often thought of as most likely to be underserved; however, many urban areas could also be affected. For instance, an urban area with hundreds of EVs and few driveways would be underserved if there are only a few on-street chargepoints in the local area. The definition of 'underserved areas' should include metrics such as the number of EVs served by each public chargepoint. The definition could also be based on the average walking distance from a home or business to

the nearest public chargepoint.

In the longer term, the number of EVs on the road may increase to the point that the Government no longer needs to intervene in the market to ensure geographical coverage. Therefore, the Government should keep its tendering strategy under regular review and should aim to reduce its involvement over time. If the minimum annual revenue guarantee offered by CPOs falls to low levels, this would suggest that there is sufficient interest from the private sector to install chargepoints in these areas without Government support. Also, to limit the Government's financial liability, the contracts for CPOs should be no longer than 15 years.

The Low Carbon Contracts Company (LCCC) is the natural counterparty for long-term contracts for EV chargepoints, but costs should not be recovered from electricity bills.

The long-term contracts for chargepoints should be structured as private law contracts between the CPO and a Government-owned company. The Government-owned company should be the Low Carbon Contracts Company (LCCC), which already administers contracts for renewable energy projects and nuclear energy projects.[148,149]

For energy projects, the LCCC collects money from energy suppliers and distributes it to low-carbon electricity generators in line with the CfD contracts. CfD contracts are funded by a dedicated levy on electricity bills, which varies quarterly. The LCCC is responsible for forecasting the value of the levy and for collecting it.[150]

For EV chargepoints, the LCCC would make payments to CPOs when their annual revenue falls below the guaranteed minimum in their long-term contract. Similar to energy projects, the Government should consider a dedicated revenue mechanism to fund payments to CPOs. However, this levy should not fall on electricity users, as environmental and social obligations already make up around 20% of the average electricity bill.[151]

In the early years of the scheme, payments to CPOs could be funded using the some of the £1.3bn that the Government announced for investment in EV charging infrastructure. In the longer term, the Government should consider a levy on road users to pay for public EV chargepoints. This could be through a dedicated levy on Vehicle Excise Duty or as part of a road pricing scheme. A dedicated funding mechanism will help the Government manage the liability created by these long-term contracts, which will be relatively difficult to forecast.

We note that the Government is considering changes to Vehicle Excise Duty and recently ran a Call for Evidence on the matter.[152] We also note recent media reports suggesting that the Treasury is considering a new national scheme of road pricing as an option to replace falling receipts from Fuel Duty.[153] Any dedicated funding stream for public EV chargepoints should be considered in conjunction with these reviews.

148. BEIS (Updated March 2020). *Policy paper: Contracts for Difference.* Link.
149. Low Carbon Contracts Company (undated). *Who we are.* Link.
150. LCCC (updated December 2020). *15-month forecast.* Link
151. Ofgem (undated). *Breakdown of an electricity bill.* Link
152. HM Treasury (Updated April 2020). *Vehicle Excise Duty: call for evidence.* Link
153. The Times (November 2020). *Charges for using roads to fill £40bn black hole.* Link

Government support should be open to applications from privately-owned CPOs.

Today, the ORCS offers grants to Local Authorities to install slow/overnight chargepoints. The design of the ORCS means that Local Authorities often own EV chargepoints, which are usually operated by private companies, for example under a commercial agreement. Some Local Authorities may want to own EV chargepoints because it gives them more control over how chargepoints operate. However, other Local Authorities will be happy for privately-owned CPOs to own and operate slow/overnight chargepoints in residential areas, similar to how private companies operate other local services like bins and recycling.

If private companies own slow/overnight chargepoints, then Local Authorities may find that they have more time and resources available to focus on the bottlenecks that only the Local Authority can resolve. For example, Local Authorities have sole responsibility for parking restrictions, adjustments to highways, and the lampposts that many slow/overnight chargepoints are connected to.

Private ownership of chargepoints could, in theory, allow more chargepoints to be installed at a lower cost; competitive procurement will show whether or not this is the case in practice. Therefore, the Government should ensure that privately-owned CPOs can access Government support for chargepoints directly, rather than having to go through the Local Authority as per the current design of the ORCS.[154]

Slow/overnight chargepoints should be procured by Combined Authorities, the Devolved Administrations, and regional groups of Local Authorities on behalf of the UK Government.

Today, the ORCS scheme for slow/overnight chargepoints is administered by the Energy Saving Trust (EST) on behalf of the Office for Zero Emission Vehicles (OZEV). This means that grants applications for many slow/overnight chargepoints are, in effect, evaluated at the national level. As the Government looks to support more chargepoints across the UK, it should look to devolve more of this decision-making to regional bodies.

We recommend that Combined Authorities and the Devolved Administrations should administer the tenders for slow/overnight chargepoints on behalf of the UK Government. In areas of England that fall outside of a Combined Authority, chargepoints tenders could be administered by regional groups of Local Authorities. Regional bodies will have a better understanding of their residents' needs for EV chargepoints. The Netherlands follows this approach, with local and regional bodies procuring EV chargepoints in their areas.[155]

The UK Government would be the counterparty for the long-term contracts, so it should still have the ultimate right to decide whether to approve the contracts. There are precedents for this type of funding arrangement between the UK Government and regional and local governments.

154. ORCS does permit applications from public-private partnerships and private ownership of chargepoints. However, applications must come from the Local Authority because they are the landowner. Other Government support schemes, including the CfD scheme for renewables, allow applications from private sector providers, so long as they can demonstrate a suitably long lease (or an option-to-lease) over the land where the projects will be installed.

155. RVO (Netherlands Enterprise Agency) (June 2020). *The National Charging Infrastructure Agenda (English version).* Link

In 2018, the Government agreed 'Housing Deals' with Local Authorities in Oxfordshire, Greater Manchester, the West Midlands, and the West of England.[156] Under these deals, Combined Authorities and collections of Local Authorities have agreed a funding mechanism under which the UK Government supports new housing projects in their areas. For EV chargepoints, the Government could use a similar framework to allow regional bodies to procure chargepoints on behalf of the Government.

The Government uses a similar model of regional procurement for the rollout of superfast and gigabit broadband, where Local Authorities and the Devolved Administrations procure broadband infrastructure on behalf of the UK Government.[157]

High-powered chargepoints on strategic routes should be procured by the UK Government and/or by the Devolved Administrations.

The UK Government aims to have at least six high-powered chargepoints at every motorway service area in England by 2023.[158] This aim recognises that high-powered chargepoints form part of the UK's national transport infrastructure. It is therefore right that the UK Government is responsible for ensuring national provision of high-powered chargepoints. We recommend that, in England, the UK Government procures these high-powered chargepoints.

In Scotland, Wales and Northern Ireland, there is a clear rationale for the UK Government to provide funding for high-powered chargepoints, not least to meet the Government's aim of improving connectivity across the whole of the United Kingdom.[159] High-powered chargepoints in devolved nations should be procured either by the UK Government directly, or by the Devolved Administrations on behalf of the UK Government. Regardless of who procures the chargepoints, the UK Government and the Devolved Administrations must coordinate to ensure that drivers can be confident driving their EV anywhere in the UK.

In urban areas, high-powered chargepoints should be procured by regional bodies because these chargepoints are more likely to be used by local drivers, particularly taxis and Private Hire Vehicles.

156. MHCLG (published March 2018). *Collection: Housing Deals*. Link
157. DCMS (December 2020). *Next steps in Government's £5 billion gigabit broadband plan*. Link
158. UK Government: *Vision for the rapid charge-point network in England*. Link
159. DfT (October 2020). *Union Connectivity Review*. Link

Recommendation 2: The Government should fund dedicated 'Chargepoint Teams' inside Local Authorities to facilitate the rollout of EV chargepoints.

Principle:	Innovation	Competition	No excessive prices	Give EV drivers confidence	Good charging experience
Addressed?	✓	✓	-	✓	-

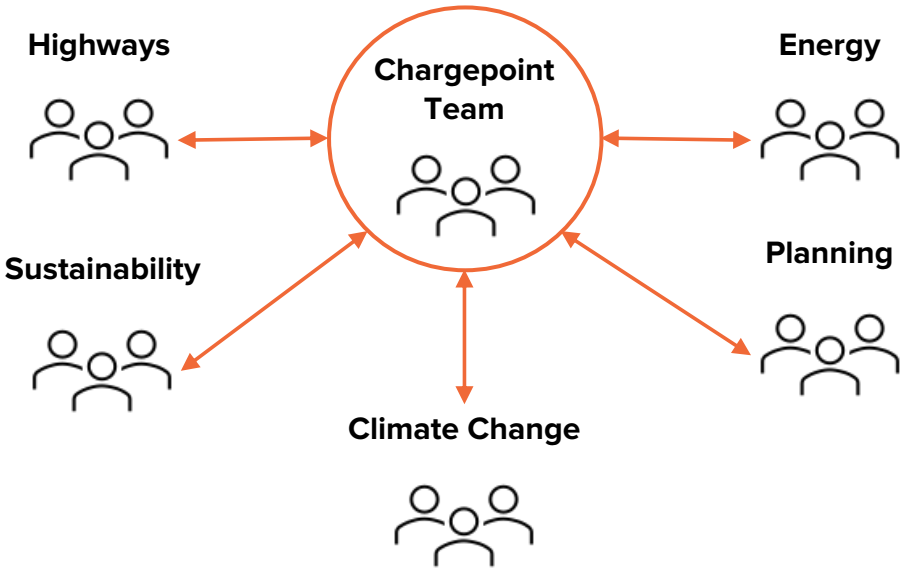
As discussed earlier in this report, Local Authorities are key stakeholders in enabling the installation of on-street chargepoints in residential areas, for example by amending highway regulations to create dedicated parking bays for EV charging and by allowing CPOs to connect slow/overnight chargepoint to lampposts owned by Local Authorities.

In many Local Authorities, responsibility for EV charging doesn't fit naturally into any existing teams, which means that it often falls between the cracks. Multiple stakeholders stressed the importance of dedicated staff within Local Authorities. Local Authorities that have a 'Chargepoint Team', or even just one individual dedicated to working on EV charging, have often successfully rolled out EV chargepoints in their local area. However, where no one takes responsibility for chargepoints, the rollout is often slow. This is one reason for the large variation in chargepoints between similar Local Authorities, as discussed earlier in this report. Over time, more Local Authorities are creating dedicated teams responsible for EV charging; however, there is still significant regional variation.

We recommend that the UK Government funds dedicated Chargepoint Teams in Local Authorities across the UK. In many cases, these Chargepoint Teams could be shared by multiple Local Authorities, for example between the County Council and the Districts Councils in an area. The primary responsibilities of the Chargepoint Team should include:

- Coordinating resources across different teams within a Local Authority (Figure 20);
- Coordinating resources across neighbouring Local Authorities, including between District Councils and County Councils;
- Liaising with potential CPOs;
- Identifying potential sites, including on streets and in car parks;
- Identifying potential bottlenecks, including necessary adjustments to highways and parking bays;
- Helping to negotiate lease agreements between CPOs and the Local Authority, including for land and connection points, for example lampposts and parking spaces in car parks;
- Liaising with the local Distribution Network Operator (DNO) to identify available grid connection capacity; and
- Liaising with the relevant body operating tenders for chargepoints in their area, which could be a Combined Authority, Devolved Administration, or a regional group of Local Authorities.

Figure 20: Role of a 'Chargepoint Team' in a Local Authority.



The Government should fund Chargepoint Teams until 2024/25. This will cost around £16m per year, or £64m over four years (Box 1). We believe that this is proportionate to the scale of the challenge and is a relatively small commitment compared to the £1.3bn of support that the Government has already announced for EV chargepoints and associated grid upgrades, and the £5bn-£10bn of investment required by 2030. This funding could be distributed by DfT through the existing roads funding process in England, and through equivalent mechanisms in the devolved nations.[160]

At the end of 2024/25, Local Authorities should be expected to fund staff to work on EV charging as part of the Local Authorities' day-to-day activities. Local Authorities are likely to receive payments from CPOs that lease land and/or connections to lampposts, which could be used to support the Chargepoint Team. For example, as part of the Go Ultra Low Nottingham scheme, led by Nottingham City Council, the Local Authority receives a guaranteed minimum payment from BP Chargemaster for each chargepoint installed. This minimum payment helps to pay for a dedicated EV project manager.[161]

Chargepoint Teams could also contribute to the development of Local Area Energy Plans (LAEPs), which would help to coordinate the development of electricity and heating networks at a local and regional level.[162] The CCC highlighted the role for LAEPs in their recent report on the Sixth Carbon Budget.[163]

160. DfT (updated June 2020). *Roads funding information pack.* Link
161. Energy Saving Trust (September 2019). *Procuring electric vehicle charging infrastructure as a local authority: A report by the Energy Saving Trust.* Link. Page 16.
162. Energy Systems Catapult (July 2020). *Local Area Energy Planning: The Method.* Link
163. CCC (December2020). *The Sixth Carbon Budget – The UK's path to Net Zero.* Link

Box 1: Estimating the cost of funding dedicated Chargepoint Teams in UK Local Authorities.

There are approximately 400 Local Authorities in the UK, comprised of:

- 343 Local Authorities in England, including some with overlapping responsibilities;[164]
- 32 Unitary Authorities in Scotland;[165]
- 22 Principal Local Authorities in Wales;[166]
- 11 District Council Areas in Northern Ireland;[167]

Around half of these are District Councils in England, which are typically not responsible for highways but may have other relevant responsibilities including car parks and planning applications. Therefore, there are around 200 Local Authorities in the UK with direct responsibility for highways, known as 'Highway Authorities'.

We estimated the annual cost of Chargepoint Teams using the following high-level assumptions:

- 400 full-time staff employed in Chargepoint Teams across the UK's 200 Local Authorities with responsibilities for highways (i.e. an average of 2 full-time staff per Highway Authority). In many cases, County Councils could share resources with the District Councils in their areas.
- Average employment costs for employees in the Chargepoint Teams of around £40,000, including salary and non-employment costs such as Employer's National Insurance and pension contributions.

This results in an annual average cost of £16m per year, or £64m over 4 years.

The Government should consider new ways to share best practice with Local Authorities.

In addition to funding dedicated Chargepoint Teams, the Government can help Local Authorities to roll out EV chargepoints by providing information and sharing best practice. This should include providing estimates of the number of EVs currently registered in each region of the UK, as well as guidance and case studies showcasing best practice for EV chargepoints. The Netherlands operates a 'Knowledge Platform for Charging Infrastructure', which could act as a guide for a similar platform in the UK.[168]

168. NKL Nederland (Netherlands Knowledge Platform for Charging Infrastructure) (undated). *Uniform Standards for Chargepoints.* Link
164. MHCLG (update April 2019). *Local government structure and elections.* Link
165. Scottish Government (undated). *Policy: Local government*. Link
166. GOV.UK Registers (updated September 2018). *Principal local authorities in Wales register.* Link
167. NI Direct (undated). *Local councils in Northern Ireland.* Link

Recommendation 3: At motorway service areas and other key locations, the Government should tender for high-powered chargepoints and associated 'strategic grid connections'.

Principle:	Innovation	Competition	No excessive prices	Give EV drivers confidence	Good charging experience
Addressed?	✓	✓	✓	✓	-

In many places on the UK's Strategic Road Network, CPOs will only be able to install high-powered chargepoints with new or upgraded connections to the electricity network; in many cases, these grid connections will be expensive. To address this, the Government has proposed the Rapid Charging Fund, which will pay for upgraded grid connections at some key locations. In 2019, National Grid proposed that the Government put in place a funding mechanism to pay for grid upgrades at motorway service areas; these strategic grid connections would be sufficient to meet the long-term demand for high-powered EV chargepoints at these locations.[169] We expect that this is one option the Government will consider for the Rapid Charging Fund.

In many cases, paying for a single large grid connection now is likely to be cheaper than paying for many small grid connection upgrades over time. This strategic approach to grid connections would be similar to the Government's plans for offshore wind, where the Government is reviewing the process for coordinating grid connections between multiple wind farms (Box 2).

169. National Grid (January 2019). *Supporting the growth of electric vehicles.* Link. Page 10.

Box 2: Offshore Transmission Network Review.[170]

Offshore wind farms require long and expensive connections to the onshore electricity grid. To date, each offshore wind farm in the UK has built its own connection to the onshore grid. The current approach makes project developers responsible for building both the offshore wind farm and the associated grid connection. This gives project developers more control over all aspects of their project, reducing the risk of delays caused by a third party failing to deliver the connection required to connect the offshore wind farm to the grid.

However, the existing approach does not allow for coordination between projects, which can raise overall costs. For example, consider two offshore wind farms that are planning to connect to the same point on the onshore electricity grid, with one connecting in 2025 and one in 2030. To reduce overall costs, these two wind farms could share the same grid connection. A coordinated approach could also reduce disruption to the local environment and to residents, as debated recently in the UK Parliament.[171]

Under a coordinated system, the first wind farm would build a large 'strategic grid connection' in 2025, which would be used by the second wind farm when it connects in 2030. One downside of this approach is that the second wind farm may never be built, so the 'strategic grid connection' may not be fully utilised, raising overall costs for customers.

In July 2020, BEIS announced the 'Offshore Transmission Network Review', which will consider how to develop a coordinated approach to grid connections for offshore wind farms, including how to facilitate shared grid connections.[172] To support the review, the Electricity System Operator (National Grid ESO) has published a report on the potential cost savings from a coordinated approach.[173]

For EV chargepoints, a coordinated approach and investment in 'strategic grid connections' could also reduce overall costs for customers, although this will vary from location to location.

There are two main options to deliver 'strategic grid connections' for high-powered chargepoints:

- The Government could operate new grid connections, either directly through the Office for Zero Emission Vehicles (OZEV) or by setting up an arms-length delivery body.
- The Government could issue tenders for new grid connections, which would be owned and operated by the private sector. As with tenders for chargepoints, the LCCC would be the counterparty for these contracts, which could be structured as a minimum revenue guarantee, a regulated asset base, or a cap and floor on revenue.

In both cases, the operator of the new grid connection would lease connection capacity to CPOs and other users, potentially including operators of hydrogen electrolysers.

In the UK, there are many project development companies and electrical contracting businesses that could deliver grid connections for high-powered chargepoints. These companies have a background in the construction and operation of solar farms, wind farms, battery storage and gas-fired peaking plants; therefore, they are well placed to deliver any required grid connection upgrades, working alongside the owners of the UK's electricity networks. By contrast, it is hard to see the Government quickly and cost-effectively building, owning and operating grid connections for EV chargepoints, even via an arms-length delivery body.

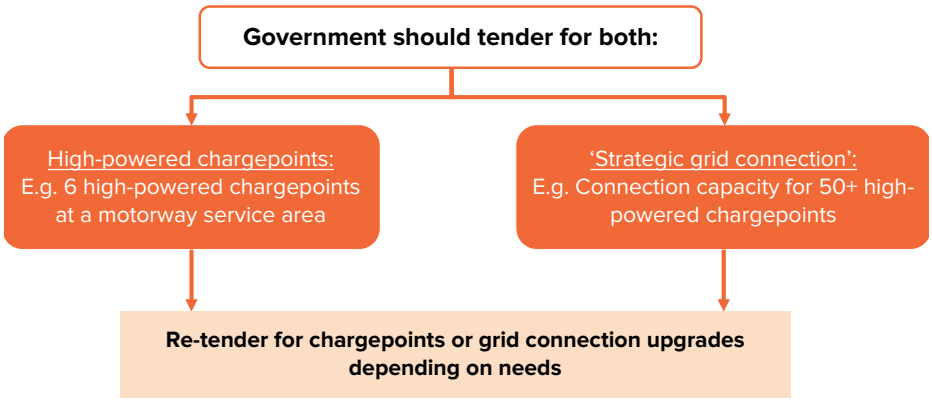
170. BEIS (updated August 2020). *Offshore Transmission Network Review terms of reference.* Link
171. Parliament TV (Thursday 5 November 2020). *Extract 4.52pm – 6.00pm.* Link; Adjournment Debate: Offshore wind transmission connections.
172. BEIS: *Offshore Transmission Network Review.* Link
173. NG ESO (updated December 2020). *Offshore Coordination Project.* Link

Today, the Government successfully tenders for energy projects delivered by the private sector, including the Contracts for Difference (CfD) regime for renewables like offshore wind.[174] Through Ofgem, the UK has a well-developed regime for regulating privately-owned electricity network companies, which could be applied to new strategic grid connections for high-powered chargepoints.

By combining the tendering processes for high-powered chargepoints and strategic grid connections, the Government could determine, through competition, whether the cost of installing chargepoints to meet current demand is cost-effective or whether a larger 'strategic grid connection' offers better value for money.

Figure 21 shows how the Government could apply this tendering model to its target for six high-powered chargepoints at every motorway service area in England by 2023.

Figure 21: Proposed tendering process for high-powered chargepoints and strategic grid connections.



The Government would run a tender for two possible solutions:

1. High-powered chargepoints to meet short-term demand – for example, six high-powered chargepoints at each motorway service area in England by 2023.
2. A 'strategic grid connection' to meet long-term demand for high-powered chargepoints – for example, a grid connection with capacity for 50+ high-powered chargepoints.

CPOs would submit bids that could use a range of technical solutions, including new or upgraded grid connections and/or battery storage.

The Government would assess which tender provides the best value-for-money. In some locations, it will be cost effective to build six high-powered chargepoints now, perhaps using battery storage to reduce any required upgrades to the grid connection. In these cases, the Government (through the LCCC) would enter into a long-term contract with the CPO to build, own and operate the high-powered chargepoints. In future years, the Government would tender for additional chargepoints in these

174. BEIS (updated October 2019). *CfD Allocation Round 3: Results*. Link

locations, if the private sector has not delivered them, again assessing whether a 'strategic grid connection' is more cost-effective.

In some locations, the tendering process will demonstrate that it is more cost-effective to build a 'strategic grid connection' large enough to meet the long-term demand for high-powered chargepoints. In these cases, the Government (through the LCCC) would enter into a contract with a company that would own and operate the grid connection. Once the contract is in place for a larger grid connection, the Government could re-tender for the high-powered chargepoints if the private sector does not deliver them.

To ensure fairness, any new grid connections must be properly regulated.

Any new strategic grid connections funded by the Government are likely to be valuable assets, as they will provide connection capacity for high-powered chargepoints. The Government must ensure that these new grid connections provide fair access to all potential users and that they provide value for money to taxpayers, by ensuring that the new connections are used efficiently.

These grid connections could be used by:

- High-powered chargepoints for cars and vans, including proprietary networks like Tesla Superchargers;
- Ultra-high-powered chargepoints for Heavy Goods Vehicles, which are likely to draw over 1 MW (1,000 kW) of electricity per chargepoint;
- Hydrogen electrolysers, which would use electricity to generate low-carbon hydrogen for hydrogen-powered HGVs;
- Connections for EV chargepoints at nearby fleet depots for buses, vans and HGVs. For example, Pivot Power's 'Energy Superhub Oxford' project includes proposals for up to 25 MW of capacity for EV charging that could be connected to local fleet depots;[175]
- Generators including solar farms, which could share the grid connection without impacting on capacity for EV charging; and
- Energy storage projects including battery storage, which could contribute to EV charging at peak times, increasing the number of EVs that can be charged at any given time.

Given the importance of these new grid connections, they should be regulated by Ofgem, which regulates electricity networks in Great Britain. Ofgem could adapt the existing regulatory framework for Independent Distribution Network Operators (IDNOs), which operate local electricity networks on new housing estates and commercial developments.[176]

The Government should consider extending this support for strategic grid connections to hubs of rapid and high-powered chargepoints in urban areas. These chargepoints would be particularly valuable for taxi and private hire drivers as well as for drivers with no access to home charging, such as those without off-street parking. One study reported that, between

175. Pivot Power (April 2020). *Oxford kickstarts EV revolution with Energy Superhub Oxford.* Link

176. Ofgem (undated). *Independent Distribution Network Operators.* Link

2014 and 2017, half of all rapid charging sessions in California took place less than ten miles from home.[177] More recent data may show different results due to the increased range of newer EVs and the growth in high-powered chargepoints on strategic routes.

Recommendation 4: Where chargepoints receive public support, the Government should regulate the maximum price charged..

Principle:	Innovation	Competition	No excessive prices	Give EV drivers confidence	Good charging experience
Addressed?	-	-	✓	-	-

As discussed earlier in this report, once EV chargepoints are installed, they are often a natural monopoly. For example, if one company installs chargepoints on all of the lampposts in a neighbourhood, then it is unlikely that another company will install more chargepoints on those streets. This creates a risk that CPOs will exploit local monopolies to charge excessively high prices.

Where CPOs install chargepoints without Government support, there is often healthy competition between chargepoint operators that helps keep prices low. Examples include chargepoints installed at supermarkets, many of which offer free charging for customers. The Tesla Supercharger network also offers competitive pricing to Tesla owners, which encourages drivers to buy Tesla vehicles.

Where CPOs do receive Government support, for example through ORCS, there is a strong case to cap the maximum price charged. Today, the pricing offered by most slow/overnight chargepoints is controlled by Local Authorities, either because the Local Authority owns the chargepoints or through commercial agreements with CPOs.

In this report, we recommend that the Government allows privately-owned CPOs to access public funding directly. With less public sector control, there's a stronger case for a price cap, at least in the short to medium term. The same argument applies to high-powered chargepoints that receive Government support.

In the longer term, healthy competition may develop across the whole of the UK between different CPOs offering different charging speeds at different locations. As competition develops, the Government should consider reducing its involvement in the EV charging sector, including by reducing public funding for chargepoints and potentially by relaxing any price caps. Because our recommended approach is based on regular tenders, the Government could make incremental changes to the contracting process for future tender rounds. This could include relaxing rules over price caps and changes to the definition of 'underserved areas', amongst other changes.

177. Nicholas, M. and Tal, G. (October 2017). *Survey and data observation on consumer motivations to DC Fast Charge.* Link

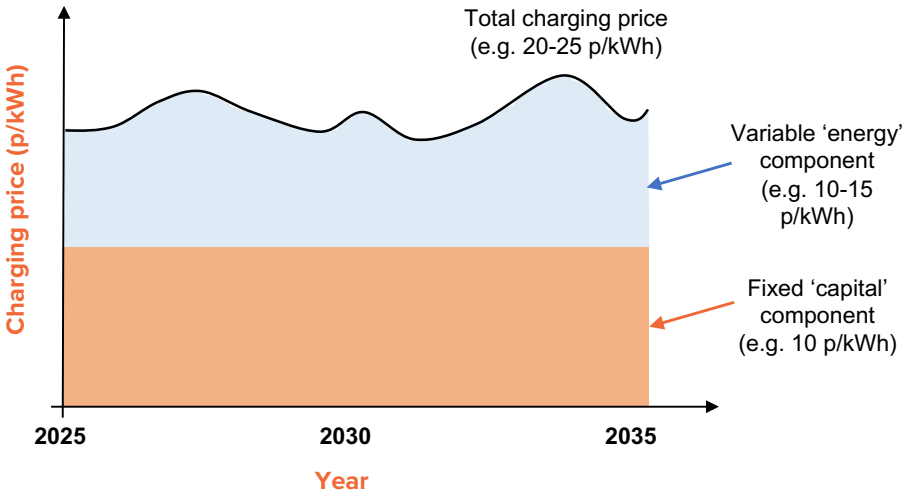
We recommend that, where CPOs receive Government support, the maximum price charged by operators should be capped. The price cap should include a fixed 'capital' component and a variable 'energy' component that represents the underlying cost of electricity. Slow/overnight chargepoints could be allowed to charge a fixed capital component, for example 10 p/kWh, plus a variable energy component set by Ofgem, for example around 15 p/kWh. This would result in a total price cap of around 25 p/kWh (Figure 22).

For high-powered chargepoints, the fixed capital component should be higher, reflecting higher capital costs including grid connection costs. The fixed capital component should be set ahead of the tender round so that CPOs can calibrate their bids accordingly.

Our recommended approach is intended as an alternative to market-wide price regulation, which would be controversial, difficult to administer, and unnecessary in many cases. By focusing on chargepoints that receive Government support, the Government can ensure value for money for taxpayers through a proportionate measure that does not affect the whole market.

Any pricing restrictions would need to carefully consider how to accommodate 'idle fees', which allow CPOs to charge drivers an additional fee if they leave their vehicle connected to the chargepoint once it has finished charging.

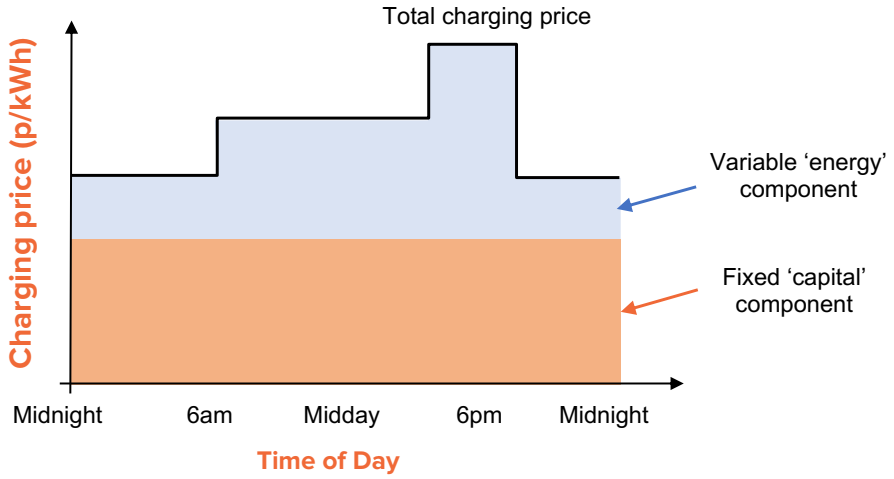
Figure 22: Example regulation of maximum price charged by chargepoints that receive Government support.



In future, the Government and CPOs may want to introduce 'time of use pricing' for the electricity supplied by chargepoints. Time of use pricing would see lower prices charged at off-peak hours, including overnight and at weekends (Figure 23), and would encourage drivers to charge their EVs during off-peak hours, which would help to reduce the strain on the electricity grid. Our proposed contract structure would allow time of use pricing in future, through changes to the variable energy component of

the price cap. This contract structure could also allow innovative offerings, such as by allowing a driver's home energy supplier to supply the energy used at public chargepoints.

Figure 23: Example 'time of use pricing' for EV chargepoints.



The Government should consider harmonising VAT rates that apply to home charging and to public chargepoints.

If a driver charges their EV at home, then the electricity used is liable for Value Added Tax (VAT) at a rate of 5%. However, public EV chargepoints attract 20% VAT.[178] This difference means that drivers without access to off-street parking are likely to pay more to charge their EV than those who can charge at home, which is arguably unfair to those drivers. Because of Brexit, the UK Government has more freedom to set VAT rates; the Government should consider using this freedom to align VAT rates for home charging and at public chargepoints.

Recommendation 5: To improve the customer experience, chargepoints that receive public support should be required to provide full interoperability and high levels of reliability.

Principle:	Innovation	Competition	No excessive prices	Give EV drivers confidence	Good charging experience
Addressed?	-	-	-	✓	✓

EV drivers often complain about the UK's fragmented system of EV chargepoints, which requires them to sign up to multiple apps.[179] Drivers can also experience poor reliability, with some chargepoints regularly out of service. Poor reliability can have a big impact on drivers, particularly at motorway service areas where the nearest alternative chargepoint could be many miles away.

178. OLEV (undated). *Tax benefits for ultra-low emission vehicles*. Link. Page 6.

179. The Government's intention for all new rapid and high-powered chargepoints to offer card payments has improved the situation. However, apps are still required for slow/overnight chargepoints.

To make chargepoints easy to use, the Government could mandate interoperability between chargepoint networks using powers under the Automated and Electric Vehicles Act 2018 and the Alternative Fuels Infrastructure Regulations 2017.

Depending on how the Government uses these powers, the regulations might apply to the whole EV charging market, which may not be appropriate. For example, there's no evidence that the Government needs to regulate Tesla's proprietary Supercharger network. Similarly, there are strong incentives for supermarkets and other destinations to provide customers with a good EV charging experience. However, where chargepoints receive Government support, there is a good case for the Government to mandate higher standards of interoperability.

The Government should require EV chargepoints that receive public support to offer 'roaming' capability.

To improve the EV charging experience, the Government has said that all new rapid and high-powered chargepoints should offer credit and debit card payments.[180] EV drivers will no longer need to sign up to an app or a subscription to access a high-powered chargepoint. Once these changes are implemented, charging an EV at a high-powered chargepoint will be similar to filling up a petrol or diesel car. However, the Government should go further to make the EV charging experience better than conventional petrol or diesel refuelling.[181]

When the Government procures EV chargepoints, it should require CPOs to allow third-party apps to access live information on chargepoint status and to process payments. This would encourage app developers to create new offerings, similar to the way in which TfL's Open Data initiative allows third-party apps like Citymapper and Google Maps to integrate live bus and Tube data into their services.[182] The Government has said that it expects industry to develop a roaming solution. The tendering process offers the Government a way to accelerate this process.

The Government should also consider whether to require CPOs to offer car-authorised payments. With car-authorised payments, there is no need for the driver to present a payment card or to use an app to pay for a charging session. Instead, the EV and the chargepoint communicate with each other and payments are automated, similar to the way Tesla vehicle owners pay for charging at Tesla Superchargers.

In the United States, the Electrify America chargepoint network now offers car-authorised payments through the 'Plug&Charge' system, which is governed by ISO 15118.[183] Plug&Charge only works with EVs that have compatible communications hardware and software. Today, the Ford Mach-E offers Plug&Charge, with more compatible vehicles expected in 2021.[184] The Government will need to decide whether it wants to specify the capability for car-authorised payments, and whether this should be through Plug&Charge or an alternative system.

The Government also needs to consider whether it should regulate the communications systems that EV chargepoints use to communicate

180. HM Gov (2019). *News story: All new rapid chargepoints should offer card payment by 2020.* Link.

181. We also note that, from our conversations with CPOs, card payments won't be cost-effective for slow/overnight chargepoints, due to the high cost of installing card payment technology relative to the cost of a slow/overnight chargepoint.

182. Transport for London (undated). *Open data users.* Link

183. Kane, M. Inside EVs. (November 2020). *Electrify America launches Plug & Charge payment technology.* Link

184. Moloughney, T. Inside EVs (December 2020). *Watch Ford Mach-E demonstrate its Plug&Charge technology.* Link

with Distribution Network Operators, the Electricity System Operator (ESO), energy suppliers and others. In 2019, the Government issued a consultation on EV smart charging.[185] In the consultation, the Government stated that the smart meter system, operated by the Data Communications Company, is currently the lead option to provide smart charging of EVs. The Government is expecting to take a decision on the preferred system in 2021 or 2022, so that a long-term solution can be in place by 2025. Any system for EV smart charging in homes could also be applied to public EV chargepoints, particularly to slow/overnight chargepoints.[186]

The Government should also require high levels of reliability, enforced through contractual penalties.

Where the Government supports public EV chargepoints, it should include minimum reliability standards for chargepoints. If chargepoints are unavailable too often, or are not repaired quickly enough, then CPOs should be required to pay a financial penalty. These penalties should be specified in the long-term contracts.

As with interoperability, long-term contracts offer the Government a way to enforce high levels of reliability without resorting to market-wide regulation.

185. DfT and OLEV (Updated May 2020). *Closed Consultation: Electric vehicle smart charging.* Link

186. A driver's demand for EV charging is likely to be more flexible at a slow/overnight chargepoint. For example, a car may be plugged in for 12 hours overnight but only need to charge for 3-4 hours, offering significant potential for smart charging.

7. Policy timeline

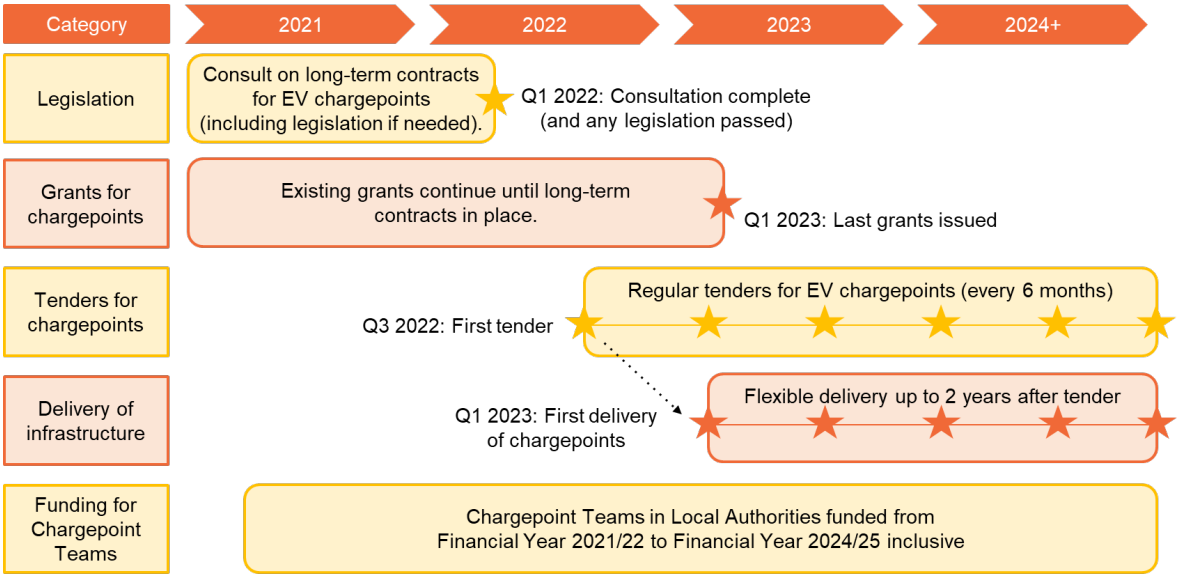
The main recommendation in this report is for the Government to procure EV chargepoints through competitive tenders, focusing on areas that are underserved. Subject to passing any necessary legislation, the first tenders could be held in mid-2022. This would allow the first chargepoints to be delivered from the start of 2023 (Figure 24).

Until the tenders are in place, the Government should continue to support slow/overnight chargepoints with grants via the ORCS scheme. The ORCS scheme would therefore stop at the end of the 2022/23 Financial Year.

It might be possible for the Government to implement tenders more quickly. If this is possible, then the Government should prioritise tenders for high-powered chargepoints and associated grid connection upgrades, which are currently not eligible for support under the ORCS scheme. This will allow the first high-powered chargepoints and associated infrastructure to be delivered in line with the Government's aim to have six high-powered chargepoints at every motorway services area in England by 2023.

We recommend that the Government funds Chargepoint Teams in Local Authorities for four years, starting in April 2021 (Financial Year 2021/22). This will give all Local Authorities the resources to support the rollout of EV chargepoints in their areas.

Figure 24: Recommended policy timeline.



8. Conclusion

The Government's commitment to phase out new petrol and diesel cars by 2030 reflects the urgent need to clean up the transport sector, which is the leading contributor to greenhouse gas emissions in the UK.

The deliver the phase-out, the Government must ensure two things:

1. Drivers must have a choice of EVs and other Zero-Emission Vehicles (ZEVs) at a reasonable price.
2. Drivers must have affordable and convenient options to charge their EV regardless of where they are in the UK and regardless of their circumstances; this includes drivers with no access to off-street parking.

To ensure an adequate supply of ZEVs, Policy Exchange has previously recommended a California-style Zero-Emission Vehicle mandate ('ZEV mandate'), which would require car manufacturers to sell an increasing proportion of ZEVs or to buy credits from those who do.[187] A ZEV mandate uses market competition to minimise the cost of the transition to Zero-Emission Vehicles. A mandate would also free up the money that the Government currently spends on purchase subsidies for EVs; this money would be better spent on support for a national network of EV chargepoints.

in order to deliver a comprehensive network of chargepoints, the Government could choose to expand its existing grant scheme for Local Authorities (ORCS), which funds up to 75% of the cost of installing chargepoints. However, this is unlikely to deliver a comprehensive network of chargepoints, in part because ORCS requires Local Authorities, rather than private sector CPOs, to lead on deploying EV chargepoints in their area. Also, grants cannot address 'demand risk', which keeps the cost of financing chargepoints relatively high.

Instead of grants, the Government should forge a new approach to EV chargepoints, based on its success in with renewable energy projects such as offshore wind farms. The Government should replace grants with long-term contracts for CPOs, similar to the Contracts for Difference (CfD) regime that supports renewables such as offshore wind. These long-term contracts should be awarded through regular, competitive tenders.

The Government should also apply this approach to high-powered chargepoints on strategic routes, including associated connections to the electricity grid.

Long-term contracts for CPOs, combined with a ZEV mandate, offer a comprehensive strategy to deliver the phase-out of petrol and diesel vehicles. Combined with appropriate industrial strategy, these policies have the potential to decarbonise road transport whilst attracting car manufacturers to make Zero-Emission Vehicles in the UK as part of a green industrial revolution.

187.Policy Exchange (July 2020). *Route '35*. Link

£10.00
ISBN: 978-1-913459-54-3

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Westminster
London SW1P 3AE

www.policyexchange.org.uk