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PROJECT

REPORT

Electric Vehicle Infrastructure Barriers

Research Report for Transport & Environment

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Terms and Conditions

The key content of this report was researched and drafted between October and December 2020. As such, the report content reflects Cenex's best understanding of the subject matter as of this period in time. Owing to the innovative and fast-moving nature of the industry that this report concerns, events may since have occurred that impact some of this report's findings and recommendations.

Document Revisions

No.	Details	Date
1	First draft for client review	30/10/2020
2	Updated draft for client review	04/12/2020
3	Final version for publication	22/01/2021

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Abbreviations

API	Access Point Interface
CIIF	Charging Infrastructure Investment Fund
DUoS	Distribution Use of Service
EV	Electric Vehicle
NPPF	National Planning Policy Framework
TUoS	Transmission Use of Service
UoS	Use of Service

Executive Summary

Transport & Environment have commissioned Cenex to produce this research report into the barriers preventing the growth and effective operation of the UK's electric vehicle (EV) charging infrastructure network. Specifically, this report was intended to meet the following research objectives:

- Identify and the key barriers to the expansion and effective operation of the UK's electric vehicle (EV) charging infrastructure network; and
- Propose policy solutions to address the key barriers identified.

The report explored barriers across four themes that were identified by Cenex through an internal workshop session. These themes are:

1. Poorly Defined and Inadequately Resourced Role of Public Sector
2. Cost of High-Power Charging Infrastructure Installations
3. Difficulty Meeting User Needs in Commercially Unattractive Locations
4. Market Competition Harming the Electric Vehicle Driver Experience

Through desk-based study, 19 barriers were identified. Based on Cenex's 15-years of EV infrastructure project experience, each identified barrier was provided with a score qualifying the impact and scale of its negative effect on the EV charging infrastructure network. These scores were used to rank the barriers and identify the top five barriers that Cenex considers most responsible for preventing the growth and effective operation of the UK EV charging infrastructure network.

This report found that the five most significant **barriers** to the growth and effective operation of the UK EV charging infrastructure were:

A. Capital and revenue funding

The lack of revenue funding made available to local authorities by UK Government is preventing them from committing staff resource to deliver and manage high-quality local charging infrastructure networks.

B. Lack of accessible, clearly targeted capital funding to cover grid reinforcement costs

Prohibitively expensive grid reinforcement costs impact the commercial viability of installing high-power EV charging infrastructure – including rapid and ultra-rapid chargepoints. Expecting the private sector to cover the full extent of these costs is unrealistic.

C. Absence of accurate open data on location, specification, and status of infrastructure

In the UK at present, the only source of live data is privately owned and the only source of open data is not live. This prevents market competition in developing software solutions that improve the EV user experience.

D. Absence of enforceable planning requirements

Ensuring that new-built residential and non-residential developments are equipped to support the transition to EVs will ensure that a greater number of UK residents can be provided access to a convenient and cost-effective means to recharge an EV. National regulations enforcing this requirement upon developers has not been forthcoming.

E. Property leaseholders and tenants cannot unilaterally install domestic chargepoints

Requiring the permission of a freeholder or landlord of a property can present a barrier that prevents a property leaseholder or tenant from installing a domestic EV chargepoint. There is no legal obligation for this permission to be granted, nor is there funding available to support the additional costs that may be incurred in cases where additional works are required to install an EV chargepoint (e.g. in communal car parks).

This report proposes 21 different policy **solutions** aimed at addressing each identified barrier, with most solutions potentially addressing more than one barrier. Each proposed solution was scored against its likely cost and complexity, based on Cenex's understanding of the EV charging infrastructure industry. Solutions were also scored for impact, based on the significance of the barriers it would address.

Following a scoring and ranking exercise, the ten highest-scoring **solutions** were as follows:

1. **UK Government to provide clear guidance, and an instruction or obligation for local authorities to take action to lead or facilitate EV chargepoint installations**

   This will address varying levels of engagement between different local authorities, ensuring that the UK's EV charging infrastructure network achieves comprehensive national coverage and provides a consistent and high-quality service to consumers. It will also raise awareness of EV charging infrastructure in a planning context, making planning authorities more likely to see value in awarding planning permission to develop EV charging infrastructure hubs and imposing requirements to install chargepoints in new developments.

2. **UK Government to develop and publish detailed, official guidance outlining a consistent delivery approach for local authorities**

   Official guidance will address the lack of in-house EV charging infrastructure expertise within local authorities. This will reduce the revenue funding required for local government officers to explore and evaluate different delivery approaches, and support local authorities to deliver EV charging infrastructure of appropriate quality and quantity to meet demand. This guidance must be official in order to command the confidence of local authorities.

3. **Create a government-sponsored network to help local authorities co-ordinate EV charging infrastructure rollout**

   Allowing local authorities to share knowledge and experience in a structured way will support local government officers to make evidenced decisions based on established best-practice. The network should be co-ordinated by a secretariat body, who are independent from government and industry, who would organise events and become a central knowledge bank and point of contact for local authorities undertaking EV charging infrastructure installation.

4. **Introduce and enforce secondary legislation to regulate the level of service provided by the EV chargepoint operators**

   Primary legislation has been introduced through the Automated and Electric Vehicles Act (2018) and this should now be strengthened with secondary legislation to ensure that chargepoints within the UK's EV chargepoint network meet certain standards for reliability and access. This will increase the robustness of the chargepoint network and improve consumer confidence in EVs.

5. **Target the Rapid Charging Fund solely at electricity network upgrades**

   The Rapid Charge Fund is expected to make funding available to support the installation of high-power EV charging infrastructure in areas where the existing electricity supply requires significant and costly upgrades. In order to ensure that this funding achieves the greatest impact possible, it should be targeted specifically to electricity network upgrades – where there is a market failure – and not be used to support other costs, such as charging equipment and equipment installation – where there is no market failure.

6. **Update the National Planning Policy Framework to reflect the importance of EV charging infrastructure**

   At present, the National Planning Policy Framework makes reference to renewable energy installations and advises local planning authorities to consider the environmental benefits of such developments when coming to a planning decision. No such equivalent advice exists for EV charging infrastructure, yet this also has environmental benefits that may arguably be felt more locally. The National Planning Policy Framework should therefore advise local authorities to consider these benefits when assessing planning applications for EV charging infrastructure developments.

7. **Fund the development of a new open EV chargepoint database, providing open access to live EV chargepoint network information**

   Open access to live chargepoint information will unlock a competitive marketplace for software developers to introduce user-focussed services that improve the EV user experience. Such information will also be necessary to accurately monitor compliance with any regulations around the level of service provided by UK chargepoint network operators.

8. **Introduce a legal definition of price transparency, in the context of EV charging infrastructure**

   At present, price transparency in the EV charging infrastructure industry is thought to require nothing more than a price displayed on an EV chargepoint before use. This does not necessarily allow consumers to make effective choices as, by the time they see this price, they may already effectively be committed to paying it to complete their journey. There should be structured debate on what constitutes true price transparency for EV charging infrastructure. The outcome of this debate should be refined into a legal definition which can then be used to ensure that EV-owners have the means to make effective consumer choices on how they charge their EV.

9. **Make Rapid Charging Fund payable only to electricity network operators**

   To maximise the impact of the Rapid Charging Fund, it should be made payable only to electricity network operators. This will further reduce the likelihood that the funding will be used to support costs that the private sector has proven itself already capable of covering (e.g. chargepoint equipment and equipment installation).

10. **Further specify the definition of “ad hoc access”, consulting the public if necessary**

    The definition of “ad hoc access” is set in the Alternative Fuels Infrastructure Regulations (2017) and requires EV chargepoint network operators to provide a means of using charging infrastructure without first having to sign-up to a membership service. In response to this, many chargepoint operators now offer two or more different usage tariffs depending on whether or not a user signs-up to a membership service. It should be debated whether this practice is against the spirit of the original definition, and whether this practice is impacting consumer confidence in EVs. If both are found to be the case, the definition should be strengthened.

Introduction

Introduction to Cenex

Cenex was established as the UK's first Centre of Excellence for Low Carbon and Fuel Cell technologies in 2005.

Today, Cenex focuses on low emission transport & associated energy infrastructure and operates as an independent, not-for-profit research technology organisation (RTO) and consultancy, specialising in the project delivery, innovation support and market development.

We also organise Cenex-LCV, the UK's premier low carbon vehicle event, to showcase the latest technology and innovation in the industry.

Our independence ensures impartial, trustworthy advice, and, as a not-for-profit, we are driven by the outcomes that are right for you, your industry and your environment, not by the work which pays the most or favours one technology.

Finally, as trusted advisors with expert knowledge, we are the go-to source of guidance and support for public and private sector organisations along their transition to a zero-carbon future and will always provide you with the insights and solutions that reduce pollution, increase efficiency and lower costs.

To find out more about us and the work that we do, visit our website:

www.cenex.co.uk

Introduction

Emissions from road transportation are a key contributor to both climate change and air pollution. The emissions produced by road transportation are arguably more challenging to reduce than those associated with, for example, the energy sector. Between 1990 and 2019, total UK carbon emissions reduced by 41%, but emissions from UK transport reduced by only 4.6%[1]. Over this period, road traffic has increased by roughly a third meaning that, despite improvement in vehicle technology, transport has since become the largest contributor to UK greenhouse gas emissions. Road transport also contributes to local air pollution, with the emission of nitrogen dioxide (NO_2) and particular matter (PM_x) contributing to levels of pollution that are thought to cause between 28,000 and 36,000 premature deaths a year in the UK[2].

In light of the UK Government's legal commitments to become net-zero carbon by 2050 and to maintain acceptable levels of air quality, action is increasingly being taken to reduce emissions from road transport. While removing the need for individuals to use or own a car can bring about the greatest reductions in emissions, many people require the use of a private car to go about their day-to-day lives. For this reason, zero-emission electric vehicles (EVs) have emerged as a well-favoured solution to reducing emissions from road transport, especially for cars and vans.

One of the requirements of a shift to EVs is the need to progressively replace the network of filling stations with recharging infrastructure. For many, this infrastructure is only likely to be needed when completing long journeys but for others – such as those who do not have the means to recharge their vehicle at overnight – the provision of effective charging infrastructure is essential to making EVs a feasible mobility option.

Whilst there has been significant growth in the number of public EV chargepoints available in the UK, provision is still seen to be lacking by consumers. A 2020 survey commissioned by the UK Society of Motor Manufacturers and Traders found that 44% of motorists consider a lack of local charging infrastructure as being a barrier to purchasing an EV[3]. This indicates that, in order to make EVs a feasible choice for all UK residents, further action is required to expand the UK's EV charging infrastructure network.

Research Objectives

Transport & Environment have commissioned Cenex to conduct a desk-study to meet the following research objectives:

- Identify and the key barriers to the expansion and effective operation of the UK's electric vehicle (EV) charging infrastructure network; and
- Propose policy solutions to address the key barriers identified.

This report reflects findings gathered from a combination research from external evidence sources and Cenex's own sector experience, dating back to 2005.

[1] UK Office for National Statistics, 2020, *2019 UK Provisional Greenhouse Gas Emissions*. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875482/2019_UK_greenhouse_gas_emissions_provisional_figures_statistical_summary.pdf

[2] Public Health England, 2019, *Public Health England publishes air pollution evidence review*. Available online: https://www.gov.uk/government/news/public-health-england-publishes-air-pollution-evidence-review#:~:text=Air%20pollution%20is%20the%20biggest,lung%20cancer%2C%20and%20exacerbates%20asthma

[3] The Society of Motor Manufacturers and Traders, 2020, *"Billions invested in electric vehicle range but nearly half of UK buyers still think 2035 too soon to switch"*. Available online: https://www.smmt.co.uk/2020/09/billions-invested-in-electric-vehicle-range-but-nearly-half-of-uk-buyers-still-think-2035-too-soon-to-switch/

Report Structure

This research content of this report is divided into six sections. The first four sections represent barrier categories that were developed by Cenex, based on its experience of the electric vehicle and EV charging infrastructure sectors. The fifth focusses solely on solutions to identified barriers. The final section produces a summary of barriers and solutions identified in the report.

The sections are as follows:

- Barriers
    - Poorly Defined and Inadequately Resourced Role of Public Sector
    - Cost of High-Power Charging Infrastructure Installations
    - Difficulty Meeting User Needs in Commercially Unattractive Locations
    - Market Competition Harming the Electric Vehicle Driver Experience
- Solutions
- Summary

Barriers

For each barrier, Cenex has provided the following information:

- A unique ID number, for reference purposes
- A score from one to ten for impact
    - 1 = Barrier having little or no impact on the installation or effective operation of EV charging infrastructure
    - 5 = Barrier having a modest but noticeable impact on the installation or effective operation of EV charging infrastructure
    - 10 = Barrier effective preventing any EV charging from being installed or operated effectively
- A score from one to ten for scale
    - 1 = Barrier influences a niche or highly localised area of the wider EV charging infrastructure network
    - 5 = Barrier influences one or more specific but important areas of the wider EV charging infrastructure network
    - 10 = Barrier has a national impact, effecting the entire EV charging infrastructure network
- A total score, representing the product of the scores for impact and scale
- A rank, where the lowest number represents the greatest barrier

Solutions

For each solution, the following information is provided:

- A unique ID number, for reference purposes
- A score from one to ten for cost
    - 1 = Cost of solution likely to be over £1bn
    - 3 = Cost of solution likely to be £50-500m
    - 5 = Cost of solution likely to be £1-10m
    - 8 = Cost of solution likely to be £10-100k
    - 10 = Solution would be without additional cost

- A score from one to ten for complexity
    - 1 = Solution would be highly complex to implement, to the point where it is not likely to be feasible
    - 5 = Solution is no more or less simple than could be reasonably expected when addressing barriers to growth in a comparatively young industry sector
    - 10 = Solution would be easily implemented with only minor, targeted changes to the status quo
- A score for impact, derived from the sum of the scores given to the barriers which the solution addresses
- A total score, representing the product of the scores for cost, complexity and impact
- A rank, where the lowest number represents the best proposed solution
- An additional “Linkage” score from one to three against each barrier that the solution is targeted towards
    - 1 = The solution would make a minor contribution to overcoming the given barrier
    - 2 = The solution would have a significant contribution, but not sufficient for it to overcome the given barrier on its own
    - 3 = The solution would entirely overcome the given barrier

Summary

The summary contains the following:

- A scatter-graph plot of all identified barriers, illustrating the impact and scale of each barrier
- A table summarising the scores and rank given to each barrier
- A scatter-graph plot of all proposed solutions, illustrating the impact and simplicity of each barrier
- A table summarising the scores and rank given to each solution

The Four Key Themes

The barriers described in this report have been divided into four themes. These themes are:

1. Poorly Defined and Inadequately Resourced Role of Public Sector
2. Cost of High-Power Charging Infrastructure Installations
3. Difficulty Meeting User Needs in Commercially Unattractive Locations
4. Market Competition Harming the Electric Vehicle Driver Experience

Poorly Defined and Inadequately Resourced Role of Public Sector

Electric vehicles and EV charging infrastructure both represent relatively new sectors within the UK market. The environmental need for society to shift from petrol and diesel powered vehicles to electric alternatives is well understood, but the challenge of achieving this transition inevitably requires a degree of public sector intervention. In this section, we examine barriers that consider whether the lack of clearly defined public sector roles and responsibilities is slowing or preventing the growth and effective operation of the UK EV charging infrastructure network. Also whether local authority resources are sufficient. The section considers the roles of the UK Government and local authorities, and identifies barriers that are being created by a lack of targeted intervention, strategic clarity and delivery capability.

Cost of High-Power Charging Infrastructure Installations

One of the biggest practical differences between owning a petrol or diesel vehicle and owning an electric vehicle is the refuelling experience. A conventional petrol or diesel vehicle can be refuelled at a fuel station in under five minutes, whereas fully recharging an EV can take anything from half an hour to half a day, depending on the type of charging infrastructure used.

To ensure that EVs represent a viable alternative to petrol and diesel vehicles, we must ensure that the UK's EV charging infrastructure network is equipped with an adequate quantity of well-located high-power chargepoints, capable of refuelling an EV in the shortest time possible. Such infrastructure can draw as much 350 kW of power from the grid – an amount of power that could supply at least five small commercial buildings[4] – and therefore typically requires significant electricity grid reinforcement to install. Upgrading the electricity grid adds significant cost to install high-power EV charging infrastructure and little action has yet been taken to help meet this cost. This section explores the barriers that are being created by the existing electricity network, including the cost of grid upgrades, how those costs are currently covered and how those costs are communicated to EV charging infrastructure network planners.

Difficulty Meeting User Needs in Commercially Unattractive Locations

Certain areas of the EV charging infrastructure network are more commercially viable than others. As a rule of thumb, the most attractive commercial proposition is to install high-power charging infrastructure in high-footfall locations. In such a setting, a rapid or ultra-rapid EV chargepoint could refuel over a dozen vehicles a day at roughly £12 per vehicle[5], making the investment attractive, even when considering the increased capital costs associated high-power charging infrastructure.

In other settings, such as residential or rural areas, it is unlikely that such demand exists, making them less commercially attractive. In locations where an EV chargepoint is unlikely to be used more than twice a day, it can be difficult to achieve an attractive return on investment against the cost of a conventional, low-powered EV chargepoint. Even so, providing infrastructure in such locations is essential to making sure that all UK residents can access the cost and convenience of being able to recharge an EV close to their home. This section explores what barriers are preventing EV charging infrastructure from being installed in areas where demand exists – or will exist – but does not currently present an attractive commercial proposition.

Market Competition Harming the Electric Vehicle Driver Experience

This section focusses less on the extent of the UK's EV charging infrastructure network, and more on whether it is being operated efficiently and in the best interests of EV owners. After years of mostly unregulated expansion, the UK EV infrastructure consists of 50 different networks, each providing slightly different levels of service at slightly different costs. Whilst many EV chargepoint network operators undoubtedly provide a quality service to EV owners, the fragmentation of the wider infrastructure network may serve to confuse consumers. This has an impact on the EV driver experience, especially for those who rely on public charging infrastructure. This section explores how the operation of the UK's existing EV charging infrastructure network is potentially undermining consumer confidence in EVs, and the barriers that are preventing this from being addressed.

[4] Assuming max 69 kVA connection for a small commercial premises, derived from Western Power Distribution guidance

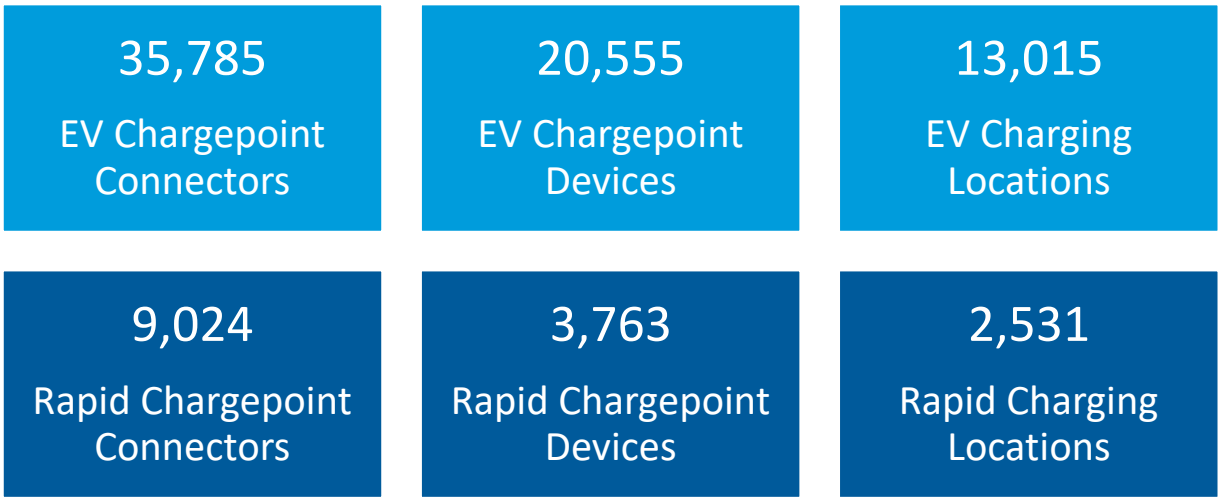
[5] Assuming 40 kWh charge provided at 30p/kWh

Background

Current Status of the UK Electric Vehicle Charging Infrastructure Network

Statistics showing the number of EV chargepoints installed in the UK are available from Zap-Map. This is presently regarded as the most accurate and up-to-date source of information on the UK's EV charging infrastructure network, and is now used by UK Government within its statistical publications on the subject.

According to information made freely available by Zap-Map[6], at time of writing there are:



Data collected by the Department for Transport[7] indicates that, as of Q2 2020, there were 300,931 plug-in cars and vans registered in the UK. This suggests that, in the UK at present, there is:

- One public chargepoint connector for roughly every five battery electric vehicles
- One public chargepoint connector for roughly every nine plug-in vehicles on the road; and
- One public rapid chargepoint device for roughly every 80 plug-in vehicles on the road.

Vehicles per chargepoint device is a more appropriate metric for rapid chargepoints. This is because rapid chargepoint typically have two or three connectors, but only one connector is likely to be compatible with a given EV and only one connector can typically be used at the same time. This issue does not exist for the lower-powered forms of charging that make up the majority of the UK's existing EV charging infrastructure network. Lower-powered chargepoints typically use a more universally compatible connector and, where more than one connector is available, each connector can typically be used simultaneously.

Since data was first collected in 2011, the increase in plug-in vehicle registrations has largely been mirrored by growth in the number of chargepoints available on the EV charging network. Figure 1 (page 17) shows growth in plug-in vehicle registrations, derived from statistics from the Department for Transport. This is accompanied by Figure 2 (page 18), showing information from Zap-Map on the growth of the UK EV charging infrastructure network.

[6] Zap-Map, *EV Charging Stats*, accessed December 2020, https://www.zap-map.com/statistics/#points

[7] Department for Transport, VEH0131 dataset, accessed October 2020. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/917207/veh0131.ods

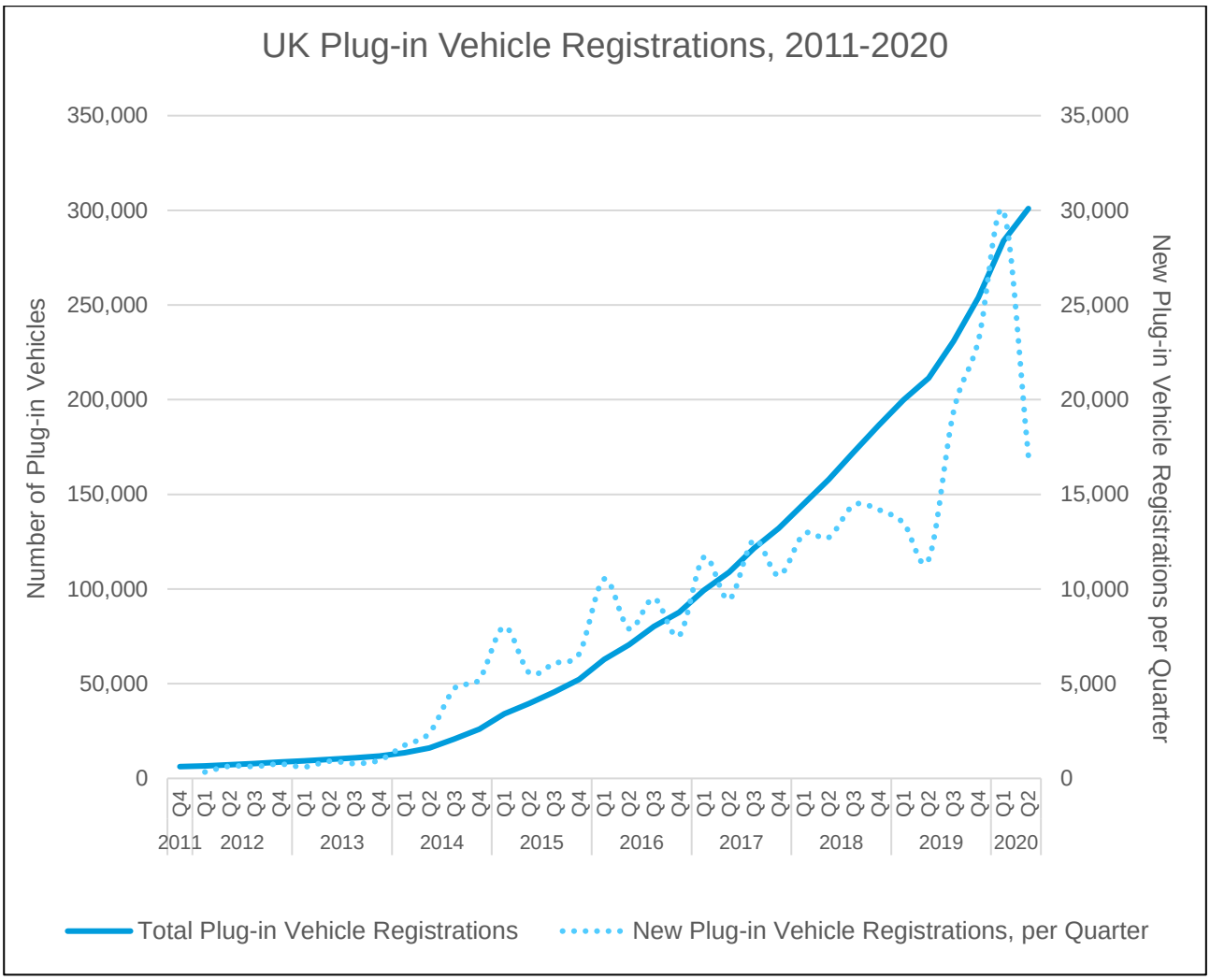


Figure 1; Graph showing cumulative and quarterly registrations of plug-in vehicles in the UK, Q4 2011 to Q2 2020.

Figure 2 shows that the growth of the EV charging infrastructure network began to gather pace from around 2018, potentially reflecting the following:

- Increased corporate investment in the UK EV charging infrastructure sector. For example, BP acquiring Chargemaster[8], Shell acquiring NewMotion[9], Engie acquiring ChargePoint Services (previously known as GeniePoint)[10], EDF acquiring Pod Point[11]
- Introduction of new, low-cost, high-coverage EV charging technologies (such as lamp-post chargepoints), combined with the availability of public funding to install such technologies, via the Office for Low Emission Vehicles' On-street Residential Chargepoint Scheme

[8] BP, 2018, *BP buys UK's leading EV charging company*. https://www.bp.com/en/global/corporate/news-and-insights/reimagining-energy/bp-buys-ev-charging-company-chargemaster.html

[9] NewMotion, 2017, *NewMotion welcomes acquisition by Shell, one of the world's leading energy providers*. https://newmotion.com/en-gb/knowledge-centre/pressroom/newmotion-welcomes-acquisition-by-shell-one-of-the-worlds-leading-energy

[10] Engie, 2019, *Engie accelerates its EV ambitions with the acquisition of ChargePoint Services*. https://www.engie.co.uk/about-engie/news/engie-accelerates-its-ev-ambitions-with-the-acquisition-of-chargepoint-services/

[11] EDF Energy, 2020, *EDF acquires Pod Point, one of the UK's largest EV charging companies*. https://www.edfenergy.com/media-centre/news-releases/edf-acquires-pod-point

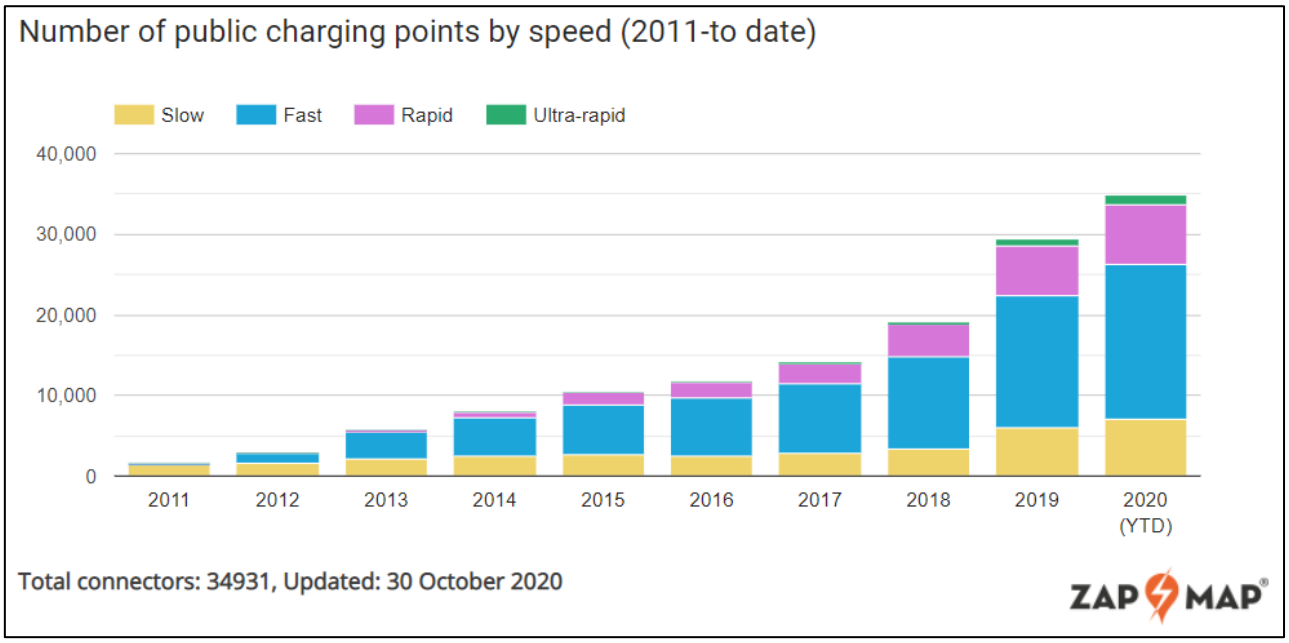


Figure 2; Graph showing number of EV chargepoints in the UK, 2011 to 2020. Source: Zap-Map

Future Growth in the Electric Vehicle Charging Infrastructure Network

Growth in the UK EV infrastructure sector is tied to growth in EV registrations. Therefore, to predict the amount of EV charging infrastructure likely to be needed in the future, we first need to predict the number of EVs that are likely to be on UK roads.

On 18th November 2020, the UK Government announced its intention to end the new sale of petrol and diesel vehicles by 2030, and hybrid vehicles by 2035[12]. This replaced its previous ambition to end the new sale of petrol and diesel cars by 2040, as set out in UK Industrial Strategy, more specifically The Road to Zero strategy[13]. The UK's national ambition signals that an increase in the number of EVs registered in the UK is all but certain, reflected by various industry views on the exact trajectory that the uptake of EVs will take.

Where there is little disagreement, from both industry and consumers, is that significant growth in EV sales necessitates (and may even be dependent upon) a similarly significant growth in the UK's public networking of EV charging infrastructure. It is also important to ensure that the UK's EV charging infrastructure network is operated efficiently to maximise the number of vehicles that can be serviced by a single chargepoint. The barriers described in this report therefore cover obstacles preventing the growth of the network – in terms of quantity of EV chargepoints – but also to the efficient operation of the network.

A recent study by the International Council on Clean Transportation[14] considered the likely future uptake of EVs, as well as the likely EV charging infrastructure demand that each EV was likely to create. Whilst the findings of this study are subject to debate, the study effectively illustrates that, to date, certain regions have done more to support the adoption of EVs than others. This highlights that the challenge of establishing a fit-for-purpose nationwide network of EV charging infrastructure will require greater action in certain regions, which the study illustrates in a map (Figure 3, page 19).

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[12] UK Government, November 2020, *Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030*. Available online: Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030 - GOV.UK (www.gov.uk)

[13] UK Government, 2018, *The Road to Zero – Next steps towards cleaner road transport and delivering our Industrial Strategy.* Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

[14] International Council on Clean Transportation, 2020, *Quantifying the electric vehicle charging infrastructure gap in the United Kingdom*. Available online: https://theicct.org/publications/charging-gap-UK-2020

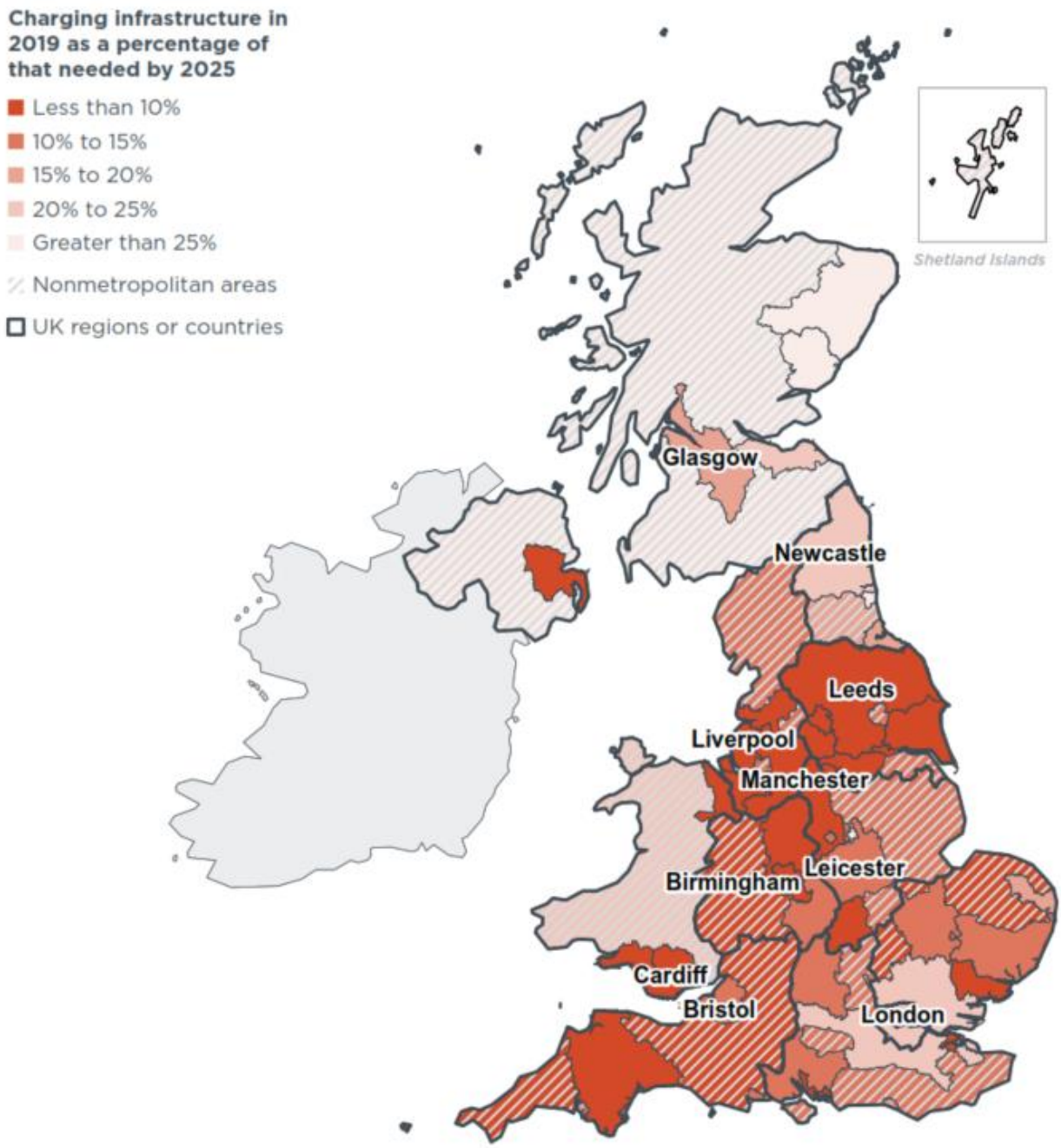

Figure 3; Map of UK regions, showing percentage of EV charging infrastructure installed as of 2019, relative to what will be needed by 2025 for electric vehicle shared increasing to 70% of new vehicles by 2030. Source, ICCT report Quantifying the Electric Vehicle Charging Infrastructure Gap in the UK, 2020.

1. Poorly Defined and Inadequately Resourced Role of Public Sector

This section covers the following barriers:

Barrier ID	Barrier	Impact	Scale	Score	Rank
1.1	Variance in Level of Engagement and Approach Taken by Local Authorities	7	7	49	6
1.2	Debatable Justification for Local Government Intervention	3	4	12	17
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	5	9	45	8
1.4	Capital and Competition Funding	8	9	72	1
1.5	Split Accountabilities Between Tier 1 and Tier 2 Local Authorities	5	5	25	15
1.6	UK Government Orchestrating Unhelpful Competition Between Local Authorities	2	8	16	16

1.1 Variance in Level of Engagement and Approaches Taken by Local Authorities

There is significant variation in the level of engagement shown by local authorities, resulting in different approaches to providing EV charging infrastructure being employed. The primary consequence of this divergence in approach is that some local areas benefit from a far better provision of EV charging infrastructure than others. Figure 4 illustrates this variation, comparing the number of chargepoints per 100,000 residents in each UK local authority[15].

A small number of local authorities have been highly engaged in the wider e-mobility agenda for several years and, as a result, have become national exemplars with well-developed local EV chargepoint networks. Such authorities include: Dundee City Council; Nottingham City Council; Oxford City Council; Milton Keynes Council; Coventry City Council; and the Greater London Authority (although there remains varying levels of engagement between London Boroughs).

However, many UK local authorities are either yet to seriously explore the provision of public charging infrastructure or have only recently begun to do so. This presents a barrier to expanding the UK's EV charging infrastructure network within areas with less engaged local authorities. Ultimately, the consequence of this is that, from one location to another, it may be easier or more difficult to own an EV.

This has remained the case for several years and, for local authorities who have been late to engage, the lasting effects of their inaction mean it could take several years for them to provide comparable provision to authorities who were quicker to engage.

In November 2019, The UK Secretary of State for Transport said: "*Your postcode should play no part in how easy it is to use an electric car, and I'm determined electric vehicles become the new*

[15] Map comparing local authorities available online: http://maps.dft.gov.uk/ev-charging-map/

normal for drivers"[16]*.* This is therefore an issue that the UK Government is aware of and intends to address but, as yet, the only direct action that has been taken is to provide local authorities with the means to compare their performance with other local authorities.

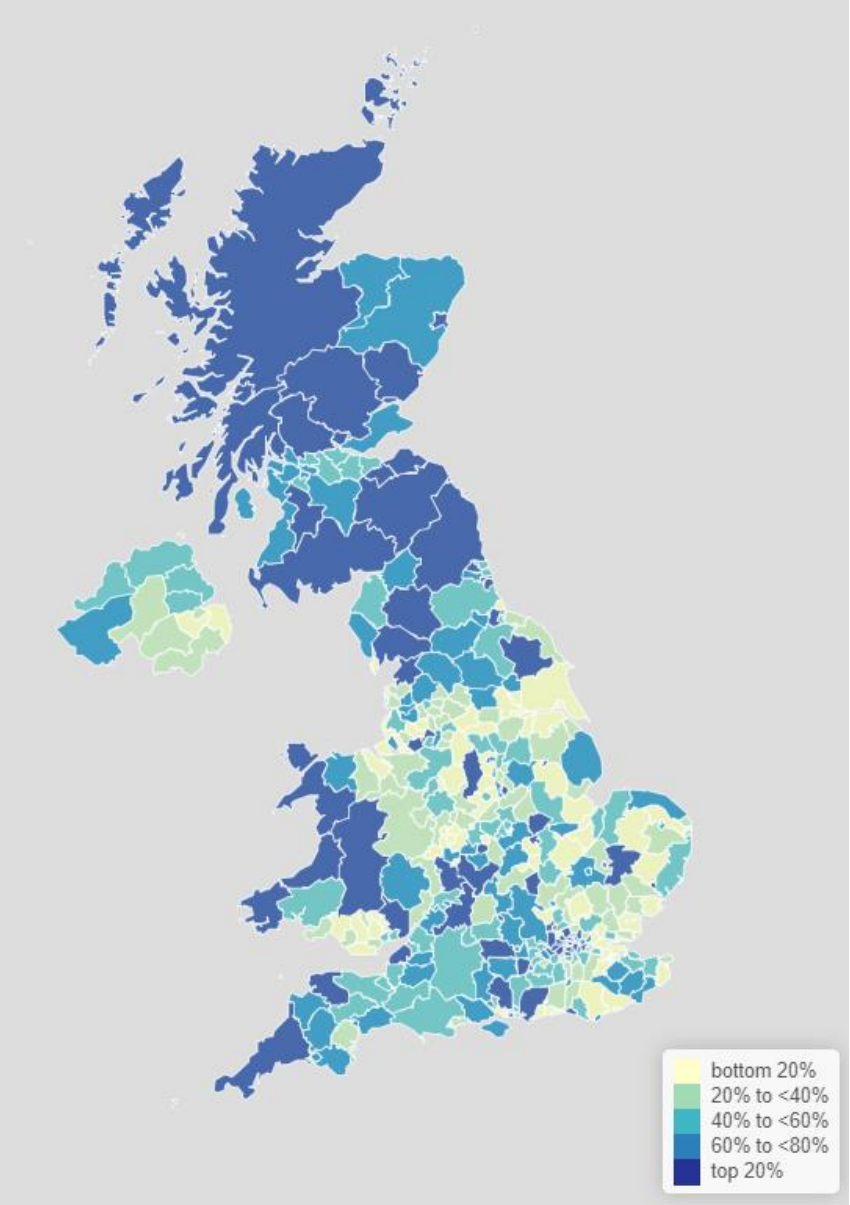

Figure 4; Comparison of electric vehicle charging infrastructure provision, expressed in chargepoints per 100,000 population, by local authority. Source: UK Department for Transport, based on data provided by Zap-Map.

1.2 Debatable Justification for Local Government Intervention

Anecdotally, an important reason for the different level of engagement by local authorities is that there is disagreement even within local councils as to whether providing EV charging infrastructure is their responsibility. This debate is somewhat warranted, as there is little or no precedence to speak of. For instance, local authorities do not operate conventional fuel stations or supply electricity in their area.

Equipped with an understanding of e-mobility, many local authorities reason that providing EV charging infrastructure will support the uptake of EVs, thereby improving urban air quality and

[16] UK Department for Transport, 2019, *New 'league table' reveals electric car charging availability across UK as Transport Secretary calls on local authorities to do more*. Available online: https://www.gov.uk/government/news/new-league-table-reveals-electric-car-charging-availability-across-uk-as-transport-secretary-calls-on-local-authorities-to-do-more

protecting public health - which *is* a statutory duty of local authorities. This is reflected in the many published Air Quality Supplementary Planning Documents which list provision of EV charging infrastructure as a mitigation measure.

Another rationale often explored by local authorities is that, by providing EV charging infrastructure, they can develop a new revenue stream, which is increasingly important after over a decade of cuts to their central grants. In order to deliver their statutory duties, local authorities first have a duty to remain solvent.

However, without informed voices expressing such arguments in session, local councils that are ignorant to the benefits of EVs can, through their inaction, create local political barriers to installing EV charging infrastructure. In such cases, EV charging provision is reliant on private investment on private land and the opportunity is lost to offer charging in popular and convenient local authority owned car parks, or on-street near housing without off-street parking. An unambiguous statement of the requirement for local authorities to facilitate the rollout of charging would address this barrier.

1.3 UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace

When the UK Government's Plugged-in Places Scheme ended in 2013, over 4,000 chargepoints had been installed across eight different areas. At the time, the UK Government expressed on the scheme's .GOV landing page[17] the that it would "*aim to work with the EV charging infrastructure industry to provide infrastructure that delivers greater interoperability, better accessibility and helps with longer journeys".* Five years on, the UK Government passed the Automated and Electric Vehicles Act 2018, taking primary powers to potentially regulate the industry. This may suggest that the UK Government believed that the UK's mostly unregulated EV charging infrastructure industry was failing to develop the network in the best interests of the nation.

In the context of the UK's EV charging infrastructure network, the Automated and Electric Vehicles Act 2018 potentially imposes requirements in connection with:

- Payment methods;
- Equipment performance, maintenance and availability;
- Equipment components;
- Co-operation between operators (sharing facilities or information);
- Making important information available to users;
- Ensuring that important information is based on live data; and
- Meeting "smart charging" standards.

As yet, no secondary legislation has been passed to further define or enforce any of these requirements, although the UK Government has signalled its intent to introduce secondary legislation including regulations for smart charging.

Seven years after identifying, through the Plugged-In Places Scheme, that there was a need for the UK's EV charging network to meet certain standards in order to develop in the interests of the user, the UK Government is still yet to enforce any regulations to ensure those standards are met, despite apparent concerns that the industry was not self-regulating in the interests of those who depend on it. Whilst this does not necessarily present a barrier to the growth in the scale of the UK's EV charging infrastructure network, it presents a significant barrier to the quality of the network. Until regulations are set to achieve a desired standard of service and those regulations are enforced effectively, there is an ongoing risk that all EV charging infrastructure installed is cumulatively worsening the EV user experience. Regulation of chargepoint operators could address this barrier.

In October 2020, the UK Secretary of State for Transport announced that the UK Government intends to begin a public consultation to inform the development and implementation of stronger regulations for the UK's EV charging infrastructure industry. This consultation is expected to look at

[17] UK Office for Low Emission Vehicles, 2013, *Guidance: Plugged-in Places*. Available online: https://www.gov.uk/government/publications/plugged-in-places/plugged-in-places

how regulation can improve the driver experience by, for example, setting standards for pricing and data availability[18].

1.4 Capital and Competition Funding

An issue often expressed by local authorities is that the funding offered to them by the UK Government for charge point installation can often only be allocated to capital expenditure. Additionally, the funding is not spread between all UK authorities and is instead offered on a competition basis, meaning that only the most engaged local authorities are likely to benefit from it (exacerbating barrier 1.1). This restriction does not apply solely to EVs and EV charging infrastructure funding, but its consequences are arguably more significant in this case.

Such capital funding schemes run by the UK Government include:

- Go Ultra Low City Scheme, £40m, 2015[19]
- OLEV Taxi Scheme (over two rounds), £14m & £7m, 2015 & 2018 respectively[20]
- OLEV On-street Residential Chargepoint Scheme, cumulative allocated budget of £30m from December 2016 to present[21] (actual budget expenditure unknown)

Firstly, by not offering revenue funding, the UK Government put local authorities in a position where ongoing costs to plan and manage the delivery of capital investment in EV infrastructure often need to come from an authority's core budget. The demands on core budgets are many and, in some local authorities, a business case for investing in EV charging infrastructure may fail on this basis, even if external capital funding has been made available by the UK Government.

Secondly, even if a local authority considers it worthwhile to allocate revenue funding from their core budget, it is possible that this will be done to a budget, rather than to a quality – where the cheapest chargepoint is put before the most reliable during procurement. Such an approach leaves no room to build knowledge and expertise, or to learn from the successes and failures of other local authorities. This therefore makes it more likely that a local authority may repeat avoidable mistakes during the planning, procurement, delivery and operation of EV charging infrastructure. It also heightens the dependency on a small number of staff (often a single officer), who organically acquire knowledge and experience that is then lost in the event of staff departures.

Cenex is aware of at least one example of a local authority utilising European Structural Investment Funds (ESIF) to install EV charging infrastructure (Devon County Council, DELETTI Programme). These funds include a revenue budget and therefore had previously been available to overcome the issue of capital-only funding. Whether or not similar funding will continue to be made available post-Brexit is dependent on the development of a comparable UK-led funding scheme (referred to as the UK Shared Prosperity Fund in the 2017 and 2019 Conservative manifestos). The Local Government Association is pressing the UK Government to provide a commitment to offer such a fund[22].

1.5 Split Accountabilities Between Tier 1 and Tier 2 Local Authorities

Providing EV charging infrastructure is a relatively new concept to UK local authorities and, as such, there are elements of the UK's local governance systems and structures that make this difficult. In

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[18] Auto Express, 6th October 2020, *EV chargepoints face regulatory crackdown*. Available online: https://www.autoexpress.co.uk/news/353349/ev-chargepoints-face-regulatory-crackdown

[19] UK Office for Low Emission Vehicles, accessed October 2020, *£40 million to drive green car revolution across UK cities*. Available online: https://www.gov.uk/government/news/40-million-to-drive-green-car-revolution-across-uk-cities

[20] UK Office for Low Emission Vehicles, accessed October 2020, *Ultra Low Emission Taxi Infrastructure Scheme: winners*. Available online: https://www.gov.uk/government/publications/ultra-low-emission-taxi-infrastructure-scheme-round-2

[21] UK Office for Low Emission Vehicles, accessed October 2020, *On-street Residential Chargepoint Scheme guidance for local authorities.* Available online: https://www.gov.uk/government/publications/grants-for-local-authorities-to-provide-residential-on-street-chargepoints

[22] Local Government Association, 2017, *Beyond Brexit: future of funding currently sourced from the EU (LGA discussion document).* Available online: https://www.local.gov.uk/beyond-brexit-future-funding-currently-sourced-eu-lga-discussion-document

the view of Cenex, the most significant of these local governance issues is the split of responsibilities between tier 1 and tier 2 local authorities.

Under most circumstances, a tier 1 local authority (typically city, metropolitan borough and county councils) holds responsibilities for highways, but its constituent tier 2 local authorities (typically district and borough councils) hold the responsibility for environmental health, planning and car parks. This split of responsibilities can create barriers to EV infrastructure deployment where the priorities of tier 1 and constituent tier 2 authorities are not aligned or coordinated.

In the case where a tier 1 authority is engaged with the e-mobility agenda, but a tier 2 authority is not, the tier 1 authority is limited to providing charging infrastructure in on-street locations. However, it is unlikely that a tier 1 authority would proceed to do this without the co-operation of the constituent tier 2 authority, as unilateral action would be likely to create tension and could ultimately be halted through either the local planning process or objections to traffic regulation orders (TROs) imposed by the tier 1 authority. Cenex is not aware of any example of unilateral action by a tier 1 authority, although comparisons may be drawn from how Transport for London rolled out EV charging infrastructure across Greater London by initially only installing infrastructure on land owned by the Greater London Authority. In this case, London Boroughs had no means to object, as they had no claim to the land.

What is far more common, in Cenex's experience, is when an engaged tier 2 authority struggles to receive support from a disengaged tier 1 authority. Whilst a tier 2 authority can unilaterally install EV charging infrastructure in off-street car parks, it cannot install on-street infrastructure, as this typically falls within the highways responsibilities of a tier 1 authority. This creates a barrier to installing on-street infrastructure, for example, in residential areas where there is no public or private off-street parking available. It is likely for this reason that, anecdotally, Cenex understands that much of OLEV's On-street Residential Chargepoint Scheme is spent on installing infrastructure in off-street car parks.

Overcoming this barrier requires co-ordination between tier 1 and tier 2 authorities, which relies on each authority having a clear strategy, a lead officer with an understanding of the practicalities of installing EV charging infrastructure and the appropriate forums for discussion and alignment.

1.6 UK Government Orchestrating Unhelpful Competition Between Local Authorities

As was noted in barrier 1.1, in November 2019 the UK Government started publishing statistics relating to number of EV chargepoints installed by local authority[23]. In a press release, these statistics were described as a "league table", providing an indication that the intent of UK Government was to encourage competition between local authorities.

A degree of competition may be helpful as a call-to-action and, by writing to council leaders to ask them to act, it is clear that this was very much the intention of the Secretary of State for Transport. However, competition it is also arguably at odds with the co-operation required between local authorities if the UK is to develop a fit-for-purpose, national EV charging infrastructure network that works for all UK residents, regardless of their home address.

By creating a quantitative "league table", the UK Government risks sending a message that quantity is more important than quality. Lessons learned from the initial development of the UK's EV charging infrastructure network have made it clear that this is not a sensible approach. For instance, several documented learnings from the Plugged-In Places Scheme, which ended in 2013, indicate the need

[23] UK Department for Transport, 2019, *New 'league table' reveals electric car charging availability across UK as Transport Secretary calls on local authorities to do more*. Available online: https://www.gov.uk/government/news/new-league-table-reveals-electric-car-charging-availability-across-uk-as-transport-secretary-calls-on-local-authorities-to-do-more

to prioritise quality[24]. Zap-Map's 2019 EV owner survey supports this, showing that 70% of the EV owners surveyed value reliability above all else when it comes to public charging infrastructure[25].

Another issue that is potentially introduced by inciting competition between local authorities is that authorities may become less likely to take the additional time to work with neighbouring authorities; and instead individually pursue the quickest and cheapest path to installing as many chargepoints as possible. This is bad practice for two reasons. Firstly, by not co-ordinating with neighbouring authorities, residents will likely be forced to use infrastructure from several different operators, providing no consistency and potentially damaging the user experience. Secondly, by not co-ordinating with neighbouring authorities, an opportunity is missed to pool resources and access greater economies of scale that would serve to reduce overcall capital and operating costs.

[24] UK Office for Low Emission Vehicles, 2013, *Lessons Learned from the Plugged-in Places Projects,* Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/236750/plugged-in-places-lessons-learnt.pdf

[25] Zap-Map, 2019, *EV Charging Survey*. Available to purchase online: https://www.zap-map.com/ev-charging-survey/

2. Cost of High-Power Charging Infrastructure Installations

This section covers the following barriers:

Barrier ID	Barrier	Impact	Scale	Score	Rank
2.1	Lack of Accessible, Clearly Targeted Capital Funding to Cover Grid Reinforcement Costs	8	8	64	2
2.2	Inaccessible £400m Charging Infrastructure Investment Fund	2	2	4	19
2.3	Transparency of Electricity Network Status and Reinforcement Costs	6	8	48	7
2.4	Distribution Network Regulatory Framework Preventing Investment Ahead of Need	5	8	40	11
2.5	Developing on Green Belt Land	3	2	6	18

2.1 Lack of Accessible, Clearly Targeted Capital Funding to Cover Grid Reinforcement Costs

Arguably the greatest and most long-standing barrier to the deployment of rapid and ultra-rapid charging infrastructure has been the lack of public funding to help cover the cost of upgrading the grid. These costs can dwarf the equipment and installation costs of the charging infrastructure itself and undermine what is otherwise likely to be a viable long-term commercial proposition. Figure 5 (page 27), taken from the UK EVSE Procurement Guide[26], shows how connection costs can escalate significantly for high-power EV charging infrastructure installations – especially once the installation necessitates the installation of a dedicated substation.

It is a well-represented view that providing large hubs of rapid and ultra-rapid EV charging infrastructure that can provide 80% charge to an EV in as little as 15 minutes will unlock additional demand for EVs. However, these kinds of installation can incur grid connection costs that run into six and sometimes seven figures.

As an indication of scale, industry-sourced costings, used by Cenex to estimate EV chargepoint installation costs, indicate that a rapid charger costs around £25-30k to install, before grid reinforcement costs are accounted for. If a rapid charging hub hosts around 20 rapid chargepoints, the costs associated with the charging infrastructure are not likely to exceed around £600k. Depending on the nature and location of the site, providing the 1.2 MVA grid capacity approximately required to power the charging hub could more than double the cost of developing the hub. As these costs are chargeable to the developer of the hub, this therefore presents a significant financial barrier to rolling out high-power EV charging infrastructure installations. This is especially the case in areas where there is little or no existing electricity supply, which typically includes locations close to the strategic road network where high-power infrastructure is arguably most needed.

[26] UK Electric Vehicle Supply Equipment Association, 2019, *Making the right connections – General procurement guidance for electric vehicle charge points*. Available online: https://www.r-e-a.net/wp-content/uploads/2020/03/Updated-UK-EVSE-Procurement-Guide.pdf

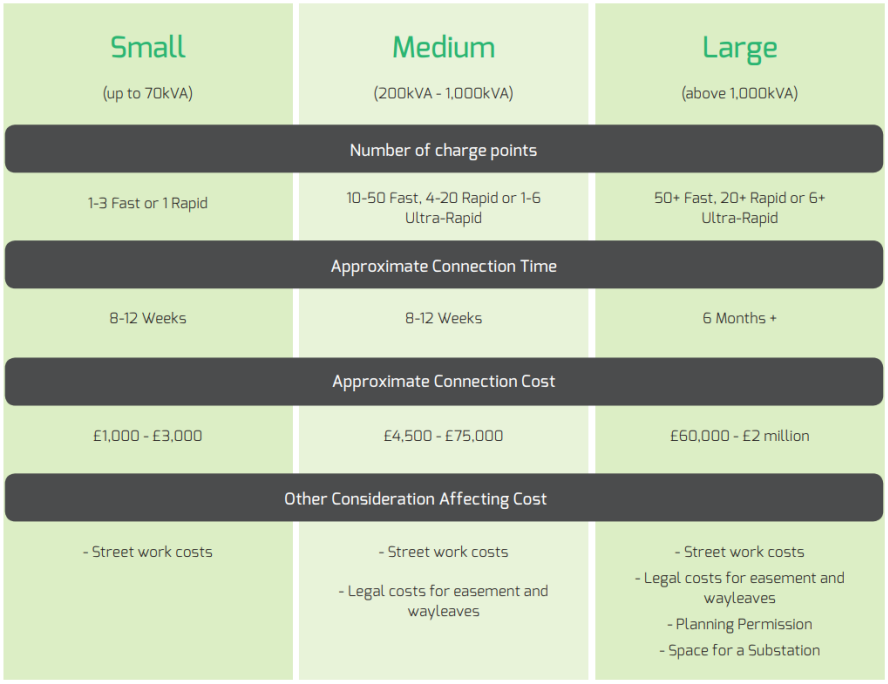

Figure 5; Illustrative example of costs and timescales associated with connecting electric vehicle charging infrastructure to the electrical distribution network. Source: UK EVSE Procurement Guide

The UK Government is aware of this barrier. Within its March 2020 budget, it announced that it would offer a Rapid Charging Fund, "*as part of a £500m commitment for EV charging infrastructure*"[27]. The fund is intended to cover a portion of costs of installing high-power EV charging infrastructure at sites across England's strategic road network where upgrading the grid is a barrier to the development.

Whilst there is a clear need for this funding, questions remain about how much funding will be made available, how the fund will be delivered and who will be the recipients of the fund. In order to offer value to the taxpayer, it is important that the Rapid Charge Fund is not directed at EV rapid charging equipment and installation costs; the c.3,500 rapid and ultra-rapid chargers that have already been installed in the UK indicate that there is no market failure to address in this area. Instead, it is the view of Cenex that the Rapid Charge Fund should only be payable directly to electricity network operators – including DNOs and/or National Grid, as applicable. Doing so will ensure that the taxpayer investment is locked within electricity grid infrastructure – long-lived assets with lasting economic and societal value – whilst providing no opportunity for developers to hide EV charging infrastructure equipment and installation costs under the guise of grid upgrades.

If the funding were to be targeted exclusively at electricity network operators, it follows that the delivery of the funding could be overseen and administered by Ofgem. There is precedent for Ofgem providing funding to DNOs for innovative and forward-looking activities, delivered through the Network Innovation Allowance (NIA) and the Network Innovation Competition (NIC) funding streams. Some of these funded activities are already targeted at EVs and EV charging – such as the Electric Nation project, run by Western Power Distribution[28].

2.2 Inaccessible £400m Charging Infrastructure Investment Fund

The Charging Infrastructure Investment Fund (CIIF) is a £400m fund, split 50/50 between HM Treasury and Zouk Capital, the fund manager that was appointed after a competitive tendering exercise. The CIIF was announced as part of the UK budget in 2017, and a competitive tendering exercise to identify a private sector fund manager ran from July to September in 2018.

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[27] UK Government, May 2020, *Policy paper: Government vision for the rapid chargepoint network in England*. Available online: https://www.gov.uk/government/publications/government-vision-for-the-rapid-chargepoint-network-in-england/government-vision-for-the-rapid-chargepoint-network-in-england

[28] Western Power Distribution, Electric Nation, https://electricnation.org.uk/, accessed October 2020.

The purpose of the CIIF was to increase the amount of capital invested in the EV charging infrastructure sector and accelerate the expansion of the UK's charging infrastructure network. The fund was not targeted at any specific type of infrastructure, with a document from HM Treasury stating that the CIIF was intended to support EV charging infrastructure installation "*along key road networks, in urban areas and at destinations*"[29]. Anecdotally, Cenex is aware that the CIIF was conceived, developed and established with limited input from relevant departments within UK Government (such as the Department for Transport, or the Office for Low Emission Vehicles), which may have contributed to the specification of the CIIF being less specific than previous or subsequent EV infrastructure funding schemes offered by UK Government.

A fundamental requirement of the CIIF was that it would need to offer HM Treasury a commercial rate of return on its investments. Fund managers investigating the CIIF have called this approach into question, believing that achieving such a return would be unrealistic and potentially damage the value to private investors.

Zouk capital was appointed to manage the fund and, as part of the bidding process, were invited to propose a "seed asset" – an at-market asset that the fund would invest in immediately after launch. Zouk capital proposed InstaVolt as their seed asset – a company that Zouk was already invested in through one of its existing funds. Anecdotally, several individuals within the industry regarded this as a conflict of interest, unfairly advantaging InstaVolt by providing it with preferential access to £200m of taxpayer funding.

It was announced in January 2021 that Zouk Capital has raised sufficient private investment to bring the total value of the CIIF to £380m of its £400m target[30]. To date, the only investment made by the CIIF that has been publicised was to fund the rollout of rapid charging infrastructure at McDonalds restaurant drive-through sites across the UK[31]. However, evidence of other partnerships that have been entered into by the CIIF can be found through its Companies House filings[32].

In principle, the CIIF could have been the most flexible source of capital funding available to install EV charging infrastructure in the UK. For example, until the announcement of the Rapid Charge Fund in 2020, the CIIF offered the potential to be the only capital funding pot to be made available for rapid and ultra-rapid EV charging infrastructure. However, clear information regarding how and under what terms the CIIF can be accessed has not been forthcoming. Whilst this does not present a direct barrier to the expansion of the UK's EV charging infrastructure network, it is arguably a missed opportunity. Managed more openly, the CIIF could have a widespread positive impact on the provision of EV charging infrastructure in the UK. In its current form, the extent of its impact is largely unknown.

2.3 Transparency of Electricity Network Status and Reinforcement Costs

At the present time, there is no consistent, freely accessible means for EV charging infrastructure network planners to understand and plan around the existing constraints of the UK's electricity network.

Identifying the most convenient and commercially viable locations for infrastructure is already a challenge, especially for organisations with limited experience in the energy sector. This challenge can be overcome by using a combination of local knowledge and open data. Once ideal locations have been identified and confirmed, the next step is typically to contact the local DNO and ask for budget estimates to establish a connection point to install EV charging infrastructure at each site.

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[29] HM Treasury, 2019, *Details of the operation of the Charging Infrastructure Investment Fund*. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834758/Details_of_the_operation_of_the_CIIF.pdf

[30] Zouk Capital press release, 11th January 2021, "*Zouk Capital announces third close in charging infrastructure investment fund*". Available online: https://www.zouk.com/news/38-infrastructure/244-zouk-capital-announces-third-close-in-charging-infrastructure-investment-fund

[31] McDonald's press release, 6th June 2020, "*McDonald's Partners with InstaVolt to Create Electric Vehicle Charging Network as UK Prepares for Green Recovery*". Available online: https://www.mcdonalds.com/gb/en-gb/newsroom/article/News.ev_rollout.html

[32] UK Companies House filings for Zouk Charging Infrastructure Investment Fund Limited Partnership. Available online: https://find-and-update.company-information.service.gov.uk/company/LP020179/filing-history

Network connection costs typically vary from one site to another, depending on its proximity to an existing electrical supply and the strength of that supply. It is not until budget estimates are received from the DNO that an organisation planning to install EV charging infrastructure knows the full extents of the cost of the installation and can fully assess the business case. Should the estimates indicate that connections costs for a given site are too high for the site to remain commercially viable, that site may need to be dismissed from consideration and an alternative site identified. This resembles a process of trial-and-error which poses barriers to the growth of the UK's EV infrastructure network.

The main issue that this causes is that it can significantly slow the process of planning EV charging infrastructure networks. Having to go back and forth to the local DNO is not a quick process. In a recent project, Cenex submitted locations to a DNO to allow them to produce connection estimates and the process took around one month to complete for 16 sites – including time taken to identify the correct member of staff within the DNO to submit queries to. If this process needs to be repeated multiple times as alternative sites are considered, it can add unexpected and unnecessary time to the planning process.

Some DNOs do provide limited information – usually in the form on online heatmaps – to help EV charging networking planners to focus their efforts on locations with a strong grid connection. The most detailed information currently available is provided by Western Power Distribution, whose online EV Capacity Map[33] provides a substation-level view of locations that are more or less likely to have capacity. Whilst this tool is not perfect – it presents information in a generalised way that is only useful up to a certain point in the planning process – it is the best example that Cenex is currently aware of. Another example of note is Scottish Power Energy Network's "Charge" tool, being developed in partnership with EA Technology[34]. This tool promises to provide a level of detail that has not historically been available, overlaying transport and energy data to identify locations where there is likely to be both demand for EV charging infrastructure and an electrical supply to support its use.

However, most DNOs only offer freely-available grid capacity data to the primary substation level, which has limited use in the context of EV charging infrastructure network planning. EV charging infrastructure network planners who work in areas that are provided with this level of information are at a disadvantage when compared to those in areas with access to more granular information.

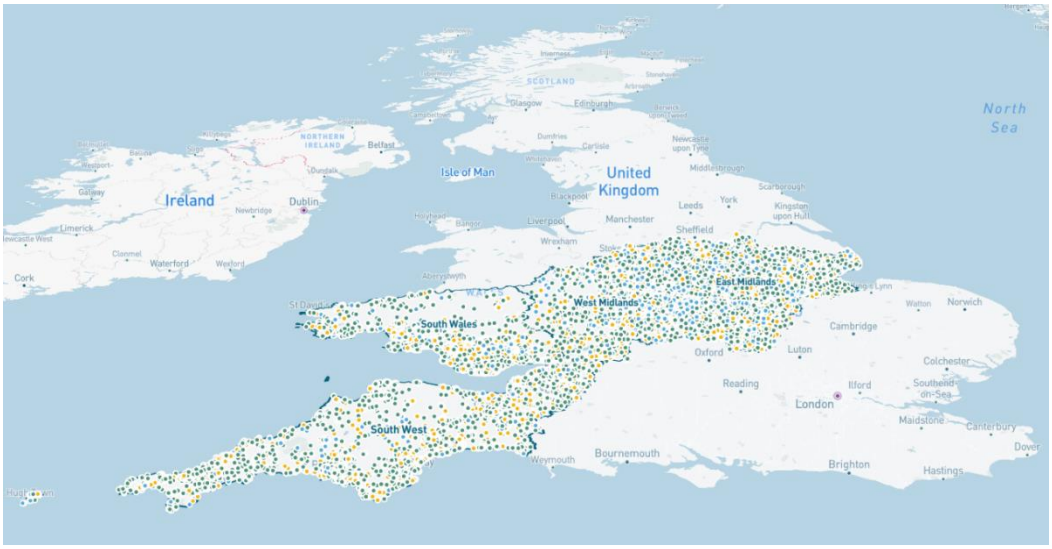

Figure 6; Screenshot of Western Power Distribution EV Capacity Map.

[33] Western Power Distribution, *EV Capacity Map*. https://www.westernpower.co.uk/smarter-networks/electric-vehicles/ev-capacity-map, accessed October 2020.

[34] SP Energy Networks, *Charge.* https://www.spenergynetworks.co.uk/pages/charge.aspx, accessed October 2020

2.4 Distribution Network Regulatory Framework Preventing Investment Ahead of Need

As identified by the Energy Systems Catapult in a 2018 report on Preparing the UK Electricity Networks for Electric Vehicles[35], the current regulatory framework for making investment in the UK electricity network has made network operators reluctant to invest ahead of need. This presents an avoidable barrier to the expansion of the UK's EV charging infrastructure network, as it potentially results in the need for electricity network upgrades to be undertaken several times in the same location to support additional charging infrastructure installations, undertaken in response to increasing demand. In doing so, additional costs are incurred by the owner of the infrastructure and potential long-term network reinforcement cost savings are not achieved.

The Energy Systems Catapult identifies forecasting risks as a key factor in the electricity network operators' reluctance to invest ahead of need to support the long-term growth of the EV charging infrastructure. However, the source of the risk is arguably a product of the current funding model for investing in the electricity network. Under existing regulations, the cost of investing in the UK's electricity network – also known as "anticipatory reinforcement" – is covered by either or a combination of:

- The connection customer – the individual or organisation that triggered the need for the works
- Use of Service (UoS) fees, including Distribution Use of Service (DUoS) and Transmission Use of Service (TUoS) – a socialised cost that is charged to all electricity users via electricity bills

Regardless of the source of funding, investing ahead of need to support future EV charging infrastructure installations presents challenges which need balancing. Charging the connection customer for anticipatory reinforcement places the risk onto the EV chargepoint owner and causes them to incur a cost that threatens the commercial viability of the infrastructure. In contrast, funding anticipatory reinforcement though Use of Service fees means that the costs will ultimately be incurred by all electricity users, regardless of whether they own an EV or not. This could be perceived as unfair, particularly on low income groups and those already in fuel poverty, who cannot afford to meet higher electricity costs and are less likely to own an EV either now or in the near future.

An open letter from Ofgem explains and balances the strengths and weaknesses of these different funding options in more detail[36], illustrating that there is no silver bullet within the existing regulatory framework. There has therefore been limited anticipatory investment in the UK electricity network to prepare it for additional demand for EV charging infrastructure, even though there are potentially significant advantages in making such investment.

2.5 Developing on Green Belt Land

An issue that Cenex believe may present an avoidable barrier to EV charging infrastructure installation in the future is the rigidity of the planning system, specifically in the context of installing high-power EV charging hubs on designated green belt land. These sites can be amongst the most ideal locations to host large hubs of EV charging infrastructure and, by ruling them out of consideration, opportunities may be missed to rapidly expand the provision of EV charging infrastructure in the UK.

The reason why green belt land is often ideal for large EV charging hubs is that the land typically resides on the periphery of urban centres and, by installing EV charging infrastructure in such locations, drivers can be discouraged from entering urban areas. In the long term, this can help to reduce urban congestion, especially where EV charging hubs are co-located with park-and-ride bus services to facilitate onward connections into nearby towns and cities.

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[35] Energy Systems Catapult, 2018, *Preparing UK Electricity Network for Electric Vehicles*. Available online: https://es.catapult.org.uk/wp-content/uploads/2018/07/Preparing-UK-Electricity-Networks-for-Electric-Vehicles-FINAL.pdf

[36] Ofgem, 2015, Open letter: *Quicker and more efficient distribution connections.* Available online: https://www.ofgem.gov.uk/ofgem-publications/93479/quickerandmoreefficientdistributionconnections-final-pdf

Using green belt land to host large EV charging hubs reduces the need for civil engineering to take place in an urban environment, avoiding the costs and disruption that this causes. Green belt land also affords a developer the space required to install renewable energy generation and energy storage equipment, which can support the operation of an EV charging hub, support the resilience of the wider electricity network and reduce the long-term carbon footprint of the site and the EVs that use it.

According to the UK National Planning Policy Framework (NPPF), green belt land has the following objectives:

- To check the unrestricted sprawl of large built-up areas
- To prevent neighbouring towns from merging into one another
- To assist in safeguarding the countryside from encroachment
- To preserve the setting and special character of historic towns
- To assist in urban regeneration, by encouraging the recycling of derelict and other urban land

Local authorities regularly conduct green belt assessments that identify which objectives specific packets of green belt land are contributing towards, and the extent to which they do so. In some cases, a packet of green belt land will only be contributing to certain objectives, rather than all the objectives set out in the NPPF.

Whilst certain objectives of green belt land should rightfully prohibit it from being developed into an EV charging hub, it is arguable that such a development would not necessarily prevent a packet of land from achieving other objectives, specifically:

- To check the unrestricted sprawl of large built-up areas
- To prevent neighbouring towns from merging into one another

Where a packet of green belt land is meeting *only* these objectives, the installation of an EV charging hub on a small portion of the land would arguably not detract from it achieving its objectives, as the development would not significantly expand the footprint of an urban area, and potentially may not even fall within an existing urban footprint. It could also be argued that developing an EV charging hub at such a site may provide further protection against future development, as such development would be hindered by the need to be planned around an EV charging hub. This may serve to further prevent urban sprawl and the merging of neighbouring towns, thereby continuing to meet two of the objectives of green belt land.

3. Difficulty Meeting User Needs in Commercially Unattractive Locations

This section covers the following barriers:

Barrier ID	Barrier	Impact	Scale	Score	Rank
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	9	6	54	5
3.2	Absence of Enforceable Planning Requirements	7	8	56	4
3.3	Scalable Technological Solutions to Provide Charging in Less Lucrative Locations Are Not Yet At Market	8	5	40	11
3.4	Cheap Domestic Electricity Tariffs and Value Added Tax Puts Public Charging Infrastructure at Constant Disadvantage	6	6	36	13

3.1 Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints

For multi-occupancy dwellings with communal car parks, it is not uncommon for the car park to be owned by the freeholder of the building and leased to the freeholders, leaseholders or tenants of the individual dwellings within the building. In the context of providing EV charging infrastructure, this presents several complications.

Firstly, the consent of the freeholder is required to install the infrastructure, which they are unlikely to have any contractual or wider legal obligation to provide. In the case of a tenant wishing to install a chargepoint in a communal car park, they would require the consent of their landlord and potentially also of the building freeholder, adding additional complication. In a property system where estate agents and building management companies often prevent tenants and leaseholders from engaging directly with landlords and freeholders, residents of multi-occupancy dwellings could well be discouraged from owning an EV by the complexity of installing a domestic chargepoint.

Secondly, how a resident is charged for the electricity provided by the chargepoint is unclear, as it may not be possible to power the chargepoint from a specific domestic electricity supply. This is particularly the case for communal car parks where residents have a dedicated parking bay. A similar issue applies to how operation and maintenance costs are covered.

Thirdly, the cost of installing a chargepoint in a communal car park where residents have allocated parking bays could vary considerably from one space to another. For example, a resident who is allocated a bay that backs onto a wall that sits near the building's distribution board could potentially install a cheaper, wall-mounted chargepoint without need to dig through the surface of the car park. On the other hand, a resident in another location may need to spend additional money to install the required electrical cables beneath the surface of the car park.

Finally, in communal car parks where residents do not have allocated parking bays, spreading the cost of installing communal EV charging infrastructure between all of the building's residents is likely to cause conflict. This is especially likely to be the case in the short-term, where those who will directly benefit from a communal chargepoint are likely to be strongly outnumbered by those who do not.

Under European Law, Article 8 of the Energy Performance of Buildings Directive (EPBD)[37] mandates that "*Member States shall provide for measures in order to simplify the deployment of recharging points in new and existing residential and non-residential buildings and address possible regulatory barriers, including permitting and approval procedures, without prejudice to the property and tenancy law of the Member States".* As yet, it has not been made clear whether the UK Government intends to introduce measures to this effect, or what form such measures might take.

3.2 Absence of Enforceable Planning Requirements

Whilst effective planning requirements with no direct impact on provision of EV charging infrastructure within existing properties and developments, they are essential if the UK is to ensure that new buildings are equipped to host EV charging infrastructure – either at the point of construction or at a later date. Doing so will ensure that residents of new-built properties will be able to access either dedicated or communal domestic charging infrastructure, regardless of the nature of their dwelling.

The principal barrier to achieving this is a lack of enforceable planning requirements. In the absence of such requirements, property developers have no incentive to accommodate EV charging infrastructure at the construction stage. Until this barrier is overcome, newbuilt multi-occupancy developments will continue to succumb to the same issues as the UK's existing stock of housing without dedicated off-street parking – as described under barrier 3.1.

Several local authorities have introduced planning requirements to ensure that new developments have a specified number of EV chargepoints included. An example of such local action can be found in The London Plan[38], which includes a requirement for newly-developed car parks to include chargepoints in 20% of parking bays. However, in its experience of working with local authorities who have implemented such requirements, Cenex has found that planning authorities are prepared to overlook such requirements if it will contribute to securing much needed investment in the development of local housing and employment sites. Because of this, it is Cenex's view that only national regulation can address this barrier.

Responding to the need for widespread regulation in this sector, in 2018 the European Parliament passed an amendment to the Energy Performance of Buildings Directive (EPBD)[39] to mandate, under Article 8 of the directive, that member states introduce legislation with the following impact:

- Existing non-residential car parks with more than 20 spaces should have installed a minimum number of recharging points (to be decided by the member state) by 2025.
- New non-residential buildings – or those undergoing major renovation – with more than ten car parking spaces must install at least one chargepoint, and install ducting to support the future installation of chargepoints for at least one in five parking bays.
- New residential buildings – or those undergoing major renovation – with more than ten parking spaces must provide ducting to support the future installation of chargepoints to every parking bay.

The UK Government subsequently proposed to transpose these requirements into UK law by making an amendment to English Building Regulations (where possible, as Building Regulations cannot enforce regulations on existing buildings). It ran a public consultation between July and October 2019 to gather views on its proposals. These proposals matched the requirements of the EPBD for new buildings, and specified a requirement for existing buildings with more than 20 parking spaces

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[37] Directive (EU) 2018/844 of the European Parliament and of the Council, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L0844&from=EN#d1e803-75-1

[38] Greater London Authority, 2016, *The London Plan*. Available online: https://www.london.gov.uk/sites/default/files/the_london_plan_2016_jan_2017_fix.pdf

[39] Directive (EU) 2018/844 of the European Parliament and of the Council, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L0844&from=EN#d1e803-75-1

to provide at least one EV chargepoint by 2025[40]. At time of writing, the UK Government is analysing the responses received to the consultation and it was indicated by a relevant Civil Servant from the Department of Business, Energy and Industrial Strategy during an event on 22nd October 2020 that there is no specific timescale for any further announcements.

3.3 Scalable Technological Solutions to Provide Charging in Less Lucrative Locations Are Not Yet At Market

Traditional public EV charging infrastructure takes the form a free-standing columns or cabinets, with sockets or cables to allow vehicles to connect. In order to withstand the rigours of deployment within the public realm, these units are typically large and sturdy and require civil engineering works to be installed – all of which add cost to the equipment and the installation. In high-footfall areas, this cost can be justified against the revenue gained through the present or future demand for the infrastructure. However, in areas where demand is likely to be lower, the cost of the infrastructure impacts its commercial viability and presents a barrier to its installation.

This is particularly the case in residential areas where, even if a significant number of nearby residents were to adopt EVs, the infrastructure is most likely be used during the evening and overnight. This means that each chargepoint would be unlikely to provide more than two full charges per day, if even that. By comparison, a rapid chargepoint in a high-footfall location could be used to provide in excess of a dozen full charges per day, making it a considerably more attractive commercial proposition, even if it incurs higher capital costs.

Even with the limited potential utilisation of public EV charging infrastructure in less desirable locations, a small number of uses could be sufficient to return a small profit on the charging infrastructure. However, in the case of conventional EV charging infrastructure, it is unlikely that this profit would provide a return on the initial capital investment that would be desirable to a private investor.

In order to make EV charging infrastructure viable in these locations, technological solutions must be developed that can reduce the capital investment required for both equipment and installation. To demonstrate the importance of lower-cost technologies, Cenex has developed an illustrative business case that compares the number of uses required to achieve specific returns on investment between conventional chargepoints and a hypothetical lower-cost alternative. This shows that, when applying a usage tariff of 22p/kWh, a conventional chargepoint would require 3.6 uses per day to achieve a five-year return on investment. By comparison, a lower-cost alternative would only require one use per day to achieve the same return. The full results are shown in Table 1.

Several technologies already exist that offer the potential to reduce the capital cost of EV charging infrastructure in specific locations. Many of these technologies are at market and have been deployed in a number of locations. However, it is the view of Cenex that no technological solution has yet been developed that is without significant compromise. Appendix A provides a detailed comparative assessment of various novel EV charging technologies, including strengths and weaknesses.

To address the impact of the initial capital outlay on the commercial viability of EV charging infrastructure in less attractive locations, OLEV introduced the On-Street Residential Chargepoint Scheme (ORCS) in December 2016. Under this scheme, local authorities can apply to receive the lesser of £7,500 or 75% of total capital costs associated with installing EV charging infrastructure in residential locations where households do not have ownership of a dedicated parking bay. Table 1 shows the potential positive impact that ORCS funding can have on the commercial viability of EV charging infrastructure. In the case of a conventional EV chargepoint with an assumed total capital cost of £11,000 and a usage tariff of 22p/kWh, the application of ORCS funding can facilitate a five-year return on investment with 1.4 uses per day, compared to 3.6 uses per day before the fund is applied.

[40] HM Government, 2019, *Electric Vehicle Charging in Residential and Non-Residential Buildings*. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/818810/electric-vehicle-charging-in-residential-and-non-residential-buildings.pdf

Table 1; Number of daily uses required to achieve specified levels of return on investment for a conventional vs low-cost novel chargepoint, with and without a capital contribution for the Office for Low Emission Vehicles On-street Residential Chargepoint Scheme. Figures compared across usage tariffs, expressed in cost per kilowatt hour.

Assumed costs for conventional chargepoint and grid connection are adapted from costings observed in previous projects.Cost for low-cost specialised infrastructure are illustrative of a lower-cost alternative and not based on a specific product. Assumed average charge time of 5.12 hours per use derived from statistics sourced from the UK Office for Low Emission Vehicles. Baseline operating and maintanence costs are assumed to be identical for conventional and novel equipment.

Equipment Type and OLEV Funding Contribution	RI Period	Uses Per Day Required by Tariff			
		20p/kWh	22p/kWh	25p/kWh	30p/kWh
Conventional 11 kW chargepoint, incl. grid connection (assumed £11,000)	Cover OpEx	0.81	0.40	0.23	0.13
	10-yr RI	4.02	2.01	1.15	0.67
	5-yr RI	7.23	3.61	2.06	1.20
	3-yr RI	11.51	5.75	3.29	1.92
Conventional 11 kW chargepoint, incl. grid connection (assumed £3,500 after max eligible funding from OLEV ORCS)	Cover OpEx	0.81	0.40	0.23	0.13
	10-yr RI	1.83	0.91	0.52	0.30
	5-yr RI	2.85	1.42	0.81	0.47
	3-yr RI	4.21	2.11	1.20	0.70
Indicative Cost of Low-Cost Specialised Novel Chargepoint (assumed £2,000)	Cover OpEx	0.81	0.40	0.23	0.13
	10-yr RI	1.39	0.69	0.40	0.23
	5-yr RI	1.97	0.99	0.56	0.33
	3-yr RI	2.75	1.38	0.79	0.46
Indicative Cost of Low-Cost Specialised Novel Chargepoint (assumed £500 after max eligible funding from OLEV ORCS)	Cover OpEx	0.81	0.40	0.23	0.13
	10-yr RI	0.95	0.48	0.27	0.16
	5-yr RI	1.10	0.55	0.31	0.18
	3-yr RI	1.29	0.65	0.37	0.22

Whilst the ORCS fund has been generally well received, questions remain as to whether local authorities are truly equipped to apply the fund correctly. Under its guidance to local authorities, OLEV states that the fund can only be applied in locations that "*meet current or anticipated future demand*"[41], which is something that even specialist consultants cannot determine beyond a reasonable amount of doubt.

In the experience of Cenex, OLEV have been appropriately flexible with local authorities to approve applications where a degree of common-sense and local knowledge has been applied during the identification of potential residential EV chargepoint locations. However, it is also the experience of Cenex that, in the absence of in-house expertise, some local authorities have been put off by the more intangible ORCS criteria, and have therefore been reluctant to make use of the funding. For those authorities who have not been dissuaded by this criteria, a question still remains about whether or not the locations they have identified truly offer value to the taxpayer, as no consistent approach to identifying the most ideal locations has been communicated to local authorities.

3.4 Cheap Domestic Electricity Tariffs and Value Added Tax Puts Public Infrastructure at Constant Disadvantage

Under the UK's existing tax system, VAT is charged at a rate of 5% for domestic supplies and 20% in virtually all other settings. Whilst this has little impact on the commercial viability of rapid charging infrastructure (which typically charged around 30-40p per kWh – a considerable mark-up on the

[41] UK Office for Low Emission Vehicles, 2020, On-street Residential Chargepoint Scheme, guidance for local authorities. Accessed October 2020. Available online: https://www.gov.uk/government/publications/grants-for-local-authorities-to-provide-residential-on-street-chargepoints/grants-to-provide-residential-on-street-chargepoints-for-plug-in-electric-vehicles-guidance-for-local-authorities

wholesale electricity cost), it has a more pronounced impact in residential settings. In such locations, the additional 15% VAT charged to non-domestic electricity supplies makes EV charging cost-parity between residents with and without access to their own chargepoint virtually impossible to achieve.

Additionally, to Cenex's knowledge, even the most competitive of public EV chargepoint tariffs are still a significant amount greater than the cost of domestic electricity. This is before considering that time-of-use tariffs are increasingly coming to market that, under rare circumstances (usually overnight, when electricity demand is low and renewable energy generation supply is high), enable a domestic electricity customer to be paid to charge their EV.

This discrepancy between electricity costs and VAT tariffs is likely to mean that, even with an adequate provision of public charging infrastructure, residents who rely solely on public infrastructure will pay more to fuel an EV than those who are able to charge their vehicle from their own domestic supply. An illustrative example of this is shown in Table 2. This shows that a wider equalities and fairness issue could potentially be inadvertently created as a result of the transition to EVs, but such issues are beyond the immediate scope of this report.

Table 2; Comparison of user cost of charging an EV using a domestic electricity supply vs public EV chargepoints. Cost per charge and per 10,000 miles do not account for efficiency-related losses during charging.

Chargepoint Type	Pre-Tax Cost (per kWh)	VAT (per kWh)	Total Tariff (per kWh)	Cost per 40 kWh charge	Cost per 10,000 miles (0.3 kWh/mile)
Domestic	10p	5% = 0.5p	10.5p	£4.20	£315
Domestic w. 20% VAT	10p	20% = 2p	12p	£4.80	£360
Public Standard (7 kW)	16.6p	20% = 3.4p	20p	£7.20	£540
Public Rapid (50 kW)	29.2p	20% = 5.8p	35p	£14	£1,050

It is arguable that a rapid or ultra-rapid chargepoint provides a fundamentally different service to a domestic chargepoint (e.g. charging en route to a remote destination), thereby justifying higher usage tariffs. The same cannot be said of a chargepoint located in a residential area that is intended predominantly for overnight use. Therefore, whilst this does not present a direct barrier to the overall growth of the UK's EV charging infrastructure network, it serves to further dissuade investment in residential charging infrastructure, where the immediate comparison and perceived competition between domestic and non-domestic electricity tariffs is most pronounced. This may lead to a lack of infrastructure provision and EV uptake in such locations.

4. Market Competition Harming the Electric Vehicle Driver Experience

This section covers the following barriers:

Barrier ID	Barrier	Impact	Scale	Score	Rank
4.1	Single-Supplier Exclusivity for Infrastructure at Motorway Services	9	5	45	8
4.2	Absence of Accurate Open Data on Location, Specification and Status of Infrastructure	6	10	60	3
4.3	Complex, Inconsistent and Obscure User Pricing Structures	6	7	42	10
4.4	True "Ad Hoc" Access Not Being Provided	5	6	30	14

4.1 Single-Supplier Exclusivity for Infrastructure at Motorway Services

The adequate provision of rapid and ultra-rapid chargepoints along the UK's network of major roads and motorways is key to unlocking greater demand in EVs. Such infrastructure provides current and future EV owners with greater confidence that EVs are able to comfortably complete long-distance journeys, reducing "range anxiety". The need for high-power charging infrastructure along the strategic road network was highlighted in a 2019 report by National Grid, who identified that proving ultra-rapid charging infrastructure at existing motorway services was "*the most convenient and cost-effective way to address range anxiety*"[42].

Whilst the technological and economic barrier of preparing the grid for high-power infrastructure is covered in section 2 of this report, there is also a contractual barrier preventing the expansion of EV charging infrastructure at motorway services.

In 2011, Ecotricity begun to roll-out 50 kW rapid chargers at motorway services throughout the UK as part of its Electric Highway network. At the time, the equipment they installed was adequate, if not state-of-the-art, in both its specification and its quantity. What has become apparent in the years since is that Ecotricity invested its capital to install this equipment in return for exclusivity agreements with several motorway service area (MSA) operators (including Welcome Break and Roadchef).

The exact details of the exclusivity agreements held between Ecotricity and MSAs are unknown, but their impact has become greater and more obvious in the years since they were signed.

In the Zap-Map EV Charging Survey 2019[43], Ecotricity's Electric Highway network was identified as the network that is most frequently used by EV owners. 61% of EV owners responding to the survey indicated that they regularly use the Electric Highway network, compared to 52% and 46% for the Polar (owned by BP Chargemaster) and Pod Point networks, respectively. The Zap-Map EV Charging Survey also asked responders to express their satisfaction with all of the UK's major EV chargepoint networks and, despite it being the most well-used network, Ecotricity's Electric Highway network did not reach the top ten.

The exclusivity agreements have not only prevented other EV charging infrastructure providers from installing equipment at most MSAs, but have also removed the free market forces that may otherwise

[42] National Grid, 2019, *Supporting the growth of electric vehicles*. Available online: https://www.nationalgrid.com/document/125116/download

[43] Zap-Map, 2019, *EV Charging Survey.* Available to purchase online: https://www.zap-map.com/ev-charging-survey/

have encouraged Ecotricity to ensure that its Electric Highway network was offering an acceptable level of service to its users. The agreements between Ecotricity and MSAs have therefore introduced a market failure in what is regarded as a vitally important area of the UK's EV charging infrastructure network.

4.2 Absence of Accurate Open Data on Location, Specification and Usage of Infrastructure

A frustration that is commonly expressed by EV owners is when they arrive to use a public chargepoint only to find that it is either already in use or is out of service. This frustration is particularly fierce when the EV owner has no alternative means to refuel their vehicle, potentially resulting in them requiring roadside assistance from a breakdown cover provider. This could be avoided if accurate and up-to-date information was made readily available to EV drivers and advanced booking was possible.

Another benefit of an open dataset of live chargepoint information is that it would allow third party software developers – including vehicle OEMs, web developers and app developers – greater freedom to create front-end services that meet the needs of users. Whilst it is perhaps unfair to say that services do not already exist that are achieving this, the number would increase and the additional free-market competition may result in greater levels of innovation and ultimately better quality services.

An example of open data creating such a competitive environment is the London Datastore[44] that, amongst other things, makes live transport information freely available to software developers. As a result, companies have been able to offer and enhance services such as CityMapper, Google Maps and Uber to provide users with accurate, up-to-date information to help them plan and complete journeys across London. Were comparable open data freely available to software developers, it would not be unreasonable to expect that new services would become available to help EV drivers to plan their journeys based on not just the location of charging infrastructure, but also its real-time availability.

To Cenex's knowledge, the only service providing live information on the location and status of chargepoints across the whole UK EV infrastructure network is Zap-Map. However, live data is not provided by all networks, meaning that the reliability of some of the information shown is not always clear. Additionally, the data behind the information is held by Zap-Map and not made available on an open basis.

Open data on the UK's EV charging infrastructure network has been available through the National Chargepoint Registry (NCR) since it was announced by UK Government and first developed by Pod Point in 2011[1]. The Alternative Fuels Infrastructure Regulations (2017)[4], specifies that EV chargepoint operators must provide data on the location of their chargepoints on an open and non-discriminatory basis, and it is strongly encouraged (though not mandatory) that this is fulfilled through provision of data to the NCR. However, as provision of data to NCR is not directly enforceable, updates are often not provided to the quality or regularity as would be required to give users confidence of the completeness and accuracy of the data. As a result, third parties looking to use the data to provide services such as satellite navigation often rely on additional data sources to compliment and complete the data held in the NCR.

In addition, while the NCR is capable of accepting live data (typically termed "Dynamic") providing information on availability of a chargepoint, this data is not currently provided by any chargepoint operators.

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[44] Greater London Authority, *London Datastore*, accessed October 2020. https://data.london.gov.uk/

[1] Department for Transport, 2011, *Mapping the country's charging points.* Available online: https://www.gov.uk/government/news/mapping-the-countrys-charging-points

[4] UK Statutory Instruments, *The Alternative Fuels Infrastructure Regulations*, 2017. Available online: https://www.legislation.gov.uk/uksi/2017/897/contents/made

A key limitation preventing the chargepoint operators from providing dynamic data is that it is not equipped with an input API (Access Point Interface) that would allow chargepoint operators to continually upload up-to-date information on their chargepoints. Instead, chargepoint operators are required to upload information manually – either in bulk or one chargepoint at-a-time – to add their chargepoints to the database and repeat the process to update the data concerning each chargepoint. As a result, uploading data is a time-consuming task, and keeping that data up-to-date can become a significant ongoing resource commitment.

The NCR is already equipped with an output API to allow service providers to have continual access to the data, demonstrating to an extent that the absence of an input API is a matter of funding, rather than technology. It should be noted that, since 2015, Cenex has administered the NCR on behalf of the UK Government. As well as these practical limitations, the provision of dynamic chargepoint data is a highly sensitive topic as, depending on the type and granularity of data provided, it may be possible for competitors or investors to calculate usage statistics for a specific chargepoint operator, therefore providing competitor intelligence around their revenue which would directly impact stock prices and company valuations. As a result, it is essential that any move towards making dynamic data open to the public is carefully considered and delivered through consultation with the industry.

It is public knowledge that OLEV intend to commission a significant upgrade to the NCR over the coming years, with consideration of improvements such as APIs and dynamic data very much in mind. In the meantime, however, funding for the service is limited and therefore significant updates and improvements are unable to be implemented. In June 2018, OLEV awarded a £53k contract to Unboxed Consulting to conduct a discovery phase exercise to engage with a wide range of stakeholders, assess their needs and determine how the NCR could best be updated to meets these needs[2]. The work was completed in Summer 2018, and its findings indicated that:

- The NCR provides incomplete, inaccurate data which users are required to clean and filter, which is expensive;
- Usability for both data providers and users is poor; and
- The NCR should be providing data and not interfaces.

Building on the results of the discovery phase, in March 2020, OLEV awarded a £209k contract to KPMG to undertake a "policy alpha". The purpose of this work is to "*rigorously test policy and digital options to make static and dynamic chargepoint data openly available with a view to remove barriers to the uptake and use of EVs*"[3]. At time of writing, this project is ongoing.

While the sensitivity around the provision of dynamic data, combined with the need for a single, open source database means that this policy alpha is entirely necessary, it is the view of Cenex that significant improvements could be made to the NCR in parallel to this work, were funding made available. In order for the existing NCR to become a truly effective open data source, a combination of the following would be required:

- Funding to correctly implement an input API and upgrade the database system to meet current cybersecurity standards;
- Clarification and enforcement of regulations set out in The Alternative Fuels Infrastructure Regulations (2017)[4], specifying that EV chargepoint operators must provide data on the location of their chargepoints on an open and non-discriminatory basis, specifying clearly that this should be done through the NCR and setting out the speed and regularity with which this should be carried out; and

[2] GOV.UK Digital Marketplace, 2018, *Discovery Phase – National Chargepoint Registry 2.0*. Available online: https://www.digitalmarketplace.service.gov.uk/digital-outcomes-and-specialists/opportunities/6633

[3] GOV.UK Digital Marketplace, 2020, *Open Public Chargepoint Data – Policy Alpha*. Available online: https://www.digitalmarketplace.service.gov.uk/digital-outcomes-and-specialists/opportunities/11648

[4] UK Statutory Instruments, *The Alternative Fuels Infrastructure Regulations*, 2017. Available online: https://www.legislation.gov.uk/uksi/2017/897/contents/made

- The expansion of the regulations set out in The Alternative Fuels Infrastructure Regulations (2017) to specify that EV chargepoint operators must provide dynamic data on the status of their chargepoints (including whether they are in/out of use, and in/out of service) on an open and non-discriminatory basis. Data provided would not be made publicly available in its raw form, but could be anonymised to provide critical insights, both publicly and to policy makers, which could support the development of the EV charging industry.

It is Cenex's belief that, were these steps to be taken, the NCR would quickly become a best-in-class service which provides essential decision making insights to government and the wider industry.

4.3 Complex, Inconsistent and Obscure User Pricing Structures

There is considerable diversity in the tariffs charged by the UK's EV charging infrastructure operators, and also in how these tariffs are structured. Certain voices within the UK EV charging infrastructure industry claim that price transparency has been achieved, on the simple basis that the costs for using public charging infrastructure are displayed on the chargepoint before use. However, it could be argued that the amount of different EV chargepoint usage tariffs presented to the UK consumer prohibit all but the most committed EV owners from understanding how to get the best value from their EV. By not providing consumers with clear, consistent and accessible information to determine what the *exact* running costs of an EV are going to be, it is Cenex's view that - when taken as a whole – the UK's EV charging infrastructure network is not offering true price transparency to the consumer.

Several UK EV chargepoint network operators offer multiple tariffs, typically offering lower tariffs in return for a monthly membership fee, or simply in return for signing-up to a free membership scheme. Understanding whether or not a membership fee represents good value for money not only requires an EV owner to understand their existing vehicle usage behaviours, the efficiency of their EV and how both factors influence the amount of charge required by the vehicle. Cenex considers it unrealistic to expect such a level of understanding from the consumer. Some examples of this practice are as follows:

- BP Chargemaster (costs are for rapid charging)
  - 40p/kWh for contactless payment car users
  - 35p/kWh for Polar Instant app users
  - 20p/kWh with £7.85 per month Polar Plus membership fee
- Ecotricity Electric Highway (costs are for rapid charging)
  - 15p/kWh for existing Ecotricity customers
  - 30p/kWh for those who are not Ecotricity customers
- ESB EV Solutions (costs are for rapid charging)
  - 29p/kWh for ESB RFID card or EV Plug In users
  - 25p/kWh with £4 per month ESB membership
- Char.gy (costs are for slow and standard charging, typically up to 7 kW)
  - 33p/kWh for pay-as-you-go customers using Char.gy web app
  - 19.5p/kWh, with first 200 kWh free with £38.99 Char.gy Casual membership
  - Unlimited free charging with £68 Char.gy Plus membership

Some UK EV chargepoint network operators charge connection fees; flat rate charges that are applied as soon as an EV charging session begins. These fees are intended to dissuade EV owners from using a chargepoint unless they require a significant amount of charge, thereby ensuring that the chargepoint is more likely to be available for those who need it most. Examples of such arrangements include:

- Engie GeniePoint (costs are for rapid charging)
  - £1.80 connection fee
  - 30p/kWh thereafter

Whilst the above examples charge users by kilowatt hour, other UK chargepoint network operators charge per minute. Structuring tariffs in this manner is increasingly uncommon, but an example of such a tariff is:

- Source London (costs are for 22 kW chargepoints)
    - 14.3p per minute for pay-as-you-go users
    - 9.5p per minute with £4 per month Source London Full membership
    - 11.9p per minute with one-off £10 fee for Source London Flexi membership

All information provided in this sub-section was sourced from the websites of each respective chargepoint network operator, and was correct as of 28th October 2020.

4.4 True "Ad Hoc" Access Not Being Provided

The UK's EV charging infrastructure network is complex, arguably to the extent that it dissuades individuals from purchasing an EV. At time of writing, a list of public EV chargepoint networks kept by Zap-Map indicates that there are 50 different networks in the UK, including a number of smaller local networks and networks dedicated to recharging electric taxis[45]. Whilst the complexity of the UK EV charging infrastructure network is ultimately the product of the sheer number of different operators, it is undoubtedly worsened by the need for users to become members of various network to, at the very least, get the best deal possible when charging their EV.

The Alternative Fuels Infrastructure Regulations 2017 state that, as of 18th November 2018, every public charging infrastructure operator in the UK should be providing "ad hoc" access[46]. In the regulations, this is defined as "*the ability for any person to recharge an electric vehicle without entering into a pre-existing contract with an electricity supplier to, or infrastructure operator of, that recharging point*". By the letter of these regulations, it is arguable that the UK's major chargepoint network operators are compliant. However, it is also arguable that the spirit of these regulations is not being honoured by several operators.

As expressed in barrier 4.3, several operators charge different tariffs to those who are signed up to their network and those who are not. Imposing additional charges for "ad hoc" access to a chargepoint puts the user in a position where they must choose between cost and convenience, and either decision could be considered a compromise. However, by the terms of The Alternative Fuels Infrastructure Regulations 2017, this practice is compliant, regardless of the impact it might have on consumer confidence in EVs or in the UK's EV charging infrastructure network.

Additionally, most operators of slower forms of charging infrastructure (3.5-7 kW) require the use of an internet enabled device to access a chargepoint – typically either a smartphone app or a web app. Gaining access to a chargepoint by this means requires the user to firstly have an internet enabled device and secondly to have the ability to use it. Some may argue that, in the present age, the vast majority of the UK population meet one or both of these requirements. However, the need to download an app (with or without the need to sign-up to a chargepoint network) arguably does not adhere to the definition of "ad hoc" access, as stated by The Alternative Fuel Infrastructure Regulations 2017. However, it should be noted that, by adding a more standard means of payment to charging infrastructure (such as a contactless payment card reader), additional capital and operating costs are incurred. These additional costs would be particularly unwelcome to operators of lower-powered forms of EV charging infrastructure, where commercial viability is already difficult to achieve (see barriers 3.3 & 3.4).

[45] Zap-Map, *Public charging networks*, accessed October 2020. https://www.zap-map.com/charge-points/public-charging-point-networks/

[46] UK Government, *The Alternative Fuels Infrastructure Regulations, Regulation 5, 2017*. Available online: https://www.legislation.gov.uk/uksi/2017/897/regulation/5/made

Solutions

This section will provide further information on the policy solutions linked to the barriers identified in this report.

1. Provide local authorities with ringfenced capital and revenue funding for EV chargepoint installation and management

Cost	2	Complexity	8	Impact	8	Rank	13

Barriers Addressed		Linkage
1.1	Variance in Level of Engagement and Approach Taken by Local Authorities	2
1.2	Debatable Justification for Local Government Intervention	3
1.4	Capital and Competition Funding	3

By providing local authorities with ringfenced funding dedicated to EV chargepoint installation and management, the UK Government signals a clear message that it expects local authorities to take action and provides them with the means to do so. It is particularly important that this funding can be used to cover revenue costs, thereby allowing local authorities to dedicate resource and enable them to set and meet targets on the quality as well as the quantity of infrastructure they provide.

Ensuring such funding is being utilised correctly and offering value to the taxpayer would require a level of UK Government oversight that has not yet been required within the context of EV charging infrastructure. Therefore, there is inherent complexity in the administration of such funding.

Linkage to Barriers

- 1.1: This will remove one of the causes of variation between the level of EV charging infrastructure provision between different local authorities. However some variation is likely to remain without detailed guidance being made available to standardise the approaches taken by authorities.
- 1.2: The intent expressed through making such funding available will remove the need for internal debate around whether local authorities should be involved in the rollout of EV charging infrastructure, instead allowing local authorities to focus on how best to allocate their newly available resources in the best interests of their residents.
- 1.4: Assuming that the capital and revenue funds made available are adequate, this will overcome any barriers that authorities currently face due to the lack of such funds.

2. Ministry of Housing, Communities and Local Government provides clear guidance, instruction or obligation for local authorities to take action

Cost	9	Complexity	8	Impact	9	Rank	1

Barriers Addressed		Linkage
1.1	Variance in Level of Engagement and Approach Taken by Local Authorities	2
1.2	Debatable Justification for Local Government Intervention	2
1.5	Split Accountabilities Between Tier 1 and Tier 2 Local Authorities	2
1.6	UK Government Orchestrating Unhelpful Competition Between Local Authorities	1
2.5	Developing on Green Belt Land	1
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	1
3.2	Absence of Enforceable Planning Requirements	2

There are several sources of guidance available to local authorities, some of which are commissioned by UK Government. However, no detailed guidance has yet been offered to local authorities directly from the UK Government. By producing targeted guidance that adequately evidences the case for local government intervention, UK Government can increase the engagement of UK local authorities in a supportive manner, prompting them to consider how they may best act in the interests of their residents and local businesses to support the use of EVs in their local area.

Providing such guidance presents the opportunity for the UK Government to set out a best-practice example that it ideally expects local authorities to follow. In such an example, the UK Government could encourage local authorities to co-operate with neighbouring authorities, pooling resources where possible. Local authorities could also be provided with information to encourage and allow them to make planning decisions that will have long-term positive impact on the feasibility of using an EV in their local area.

Whilst producing such guidance is a comparatively simple exercise, its impact would ultimately come down to the receptiveness of local authorities. Inevitably some authorities will value such guidance more than others, limiting the overall impact the guidance could have. For this reason, it is important that the guidance is produced by the UK Government (with input from industry, as needed) and sponsored by relevant Ministers in order to give it a level a legitimacy that will command the attention of both elected members and directors within all UK local authorities.

The impact of any guidance on the need for local government action would be improved if it were supported by other, more practical, delivery-orientated measures. Specifically, introducing this guidance alongside a consistent delivery approach (solution 3) and a professional network to enable local authorities to co-ordinate and share expertise (solution 4) would enable local authorities to translate political decisions into effective action.

Linkage to Barriers

- 1.1: This is likely to reduce the varying engagement between different authorities, but some authorities may still decide to take more active roles than others without the commitment of funding.
- 1.2: This will reduce the need for internal political debate on whether local authorities should be involved in EV charging infrastructure deployment but, without commitment of funding, some debate would remain on *how* such involvement would be funded.
- 1.5: A consistent obligation would provide motivation for tier-1 and tier-2 local authorities to co-ordinate activities, reducing the likelihood of one party refusing to engage. However, this does not remove the fundamental need for co-ordination between authorities and therefore does not remove the barrier entirely.
- 1.6: This will provide an obligation for authorities to act on their own terms, but does not remove the impact that numbers-based competition may have on the consistency of the UK's EV charging infrastructure network.
- 2.5: An obligation will bring the need to support EV charging infrastructure development to the attention of planning authorities who may then begin to take it into consideration when assessing the use of green belt land. However, pressures to preserve the green belt are likely to supersede the need to provide EV charging infrastructure without the provision of very specific guidance on the topic.
- 3.1: An obligation will raise local government awareness on the need to support residents of rented or leased properties in installing domestic charging infrastructure, potentially resulting in local action between local authorities and landlords – particularly for social housing. However, social housing tenants may be less likely to own an EV and local authorities cannot enforce these requirements upon local landlords without new UK-wide legislation.
- 3.2: An obligation will bring the need to support EV charging infrastructure development to the attention of planning authorities and may begin to influence planning decisions and the enforcement of those decisions, but further planning-specific guidance is needed if this is to be consistently applied in local planning processes.

3. Department for Transport, Department for Business, Energy and Industrial Strategy and Crown Commercial Services to develop and publish detailed, official guidance outlining consistent delivery approach for local authorities

Cost	8	Complexity	6	Impact	8	Rank	2

Barriers Addressed		Linkage
1.1	Variance in Level of Engagement and Approach Taken by Local Authorities	1
1.4	Capital and Competition Funding	2
1.5	Split Accountabilities Between Tier 1 and Tier 2 Local Authorities	1

Whilst solution 2 may be effective in increasing local government engagement at a political and director-level, further guidance would be required in order to translate this engagement into delivery. There is therefore a need for delivery-level guidance for local authorities, providing local government officers with no prior experience of EV charging infrastructure with access to resources that enable them to make effective decisions in the development of their local EV charging infrastructure networks.

As was the case in solution 2, such guidance is already available, but none of which has been developed and published directly by the UK Government. It is important that this detailed technical guidance is officialised by the UK Government, as this will provide local government officers and elected members with confidence that they are taking the correct approach.

Official guidance would remove some of the need for revenue investment by local authorities, as it would enable officers to follow a tried-and-tested process, rather than embark on a voyage of discovery. This consistent process would reduce the variation in the approaches taken by different local authorities, contributing to a better user experience across the UK's entire EV charging infrastructure network.

The impact of this delivery-level guidance would be increased if it were delivered alongside effective policy and strategy guidance (solution 2) and supported by a professional network to facilitate co-ordination and knowledge sharing between local authorities (solution 3).

Linkage to Barriers

- 1.1: This guidance will provide authorities with detailed guidance on how they can install or support the installation of EV charging infrastructure. However, the extent to which this guidance is followed is still likely to vary without more general guidance first being provided to policy-makers.
- 1.4: Detailed guidance reduces the need either to develop in-house expertise or to outsource, resulting in reduce revenue costs to local authorities. However, some costs will inevitably still exist unless adequate funding is made available.
- 1.5: This guidance will make the importance of co-ordination between tier-1 and tier-2 authorities very clear. However, in practice, co-ordination between different local authorities is likely to be more forthcoming if there is first some general guidance to state the case for co-ordination at a political and/or director level.

4. Create a government-sponsored network to help local authorities co-ordinate EV charging infrastructure rollout

Cost	7	Complexity	6	Impact	9	Rank	3

Barriers Addressed		Linkage
1.1	Variance in Level of Engagement and Approach Taken by Local Authorities	2
1.4	Capital and Competition Funding	1
1.5	Split Accountabilities Between Tier 1 and Tier 2 Local Authorities	2
1.6	UK Government Orchestrating Unhelpful Competition Between Local Authorities	3
3.2	Absence of Enforceable Planning Requirements	2

Several forums already exist whereby local government officers can network with and learn from the experiences of colleagues from other local authorities. However, these forums are sporadic, infrequent and, where they are organised by UK Government, they are generally attached to a specific funding announcement (which often serves to restrict debate and discussion to the topic of the announcement).

In order to deliver a joined-up network of EV charging infrastructure across the UK, there should be a joined-up network of local government officers. This network should be open to all local authorities, featuring elements of structured knowledge transfer and organic discussion. It should be run on a regular basis, occurring at least twice a year to ensure it is able to keep pace with a rapidly developing industry. With the growing acceptance of online conferencing technology, establishing such a network would be relatively simple and cost-effective.

The successful delivery of this local government network will require a secretariat body that is responsible for organising and running events and activities, as well as co-ordinating knowledge transfer between the network, the UK Government and industry. Such a body could also serve as a centre of excellence for local authorities, becoming a single point of contact for local government officers to access guidance on EV charging infrastructure implementation and operation. It is important that the secretariat body is independent from both industry and UK Government. This will ensure that the network is operated fairly, does not distort market competition and that its advice is guided by the needs of local authorities.

Linkage to Barriers

- 1.1: For those participating in such a network, it will provide a forum to ensure that consistent approaches are taken between different authorities. However, without any obligation to participate, variance will remain between authorities that do and do not engage with the network.
- 1.4: This will provide local authorities with access to first-hand knowledge from their peers and from industry experts, reducing the revenue funding required to develop in-house expertise or to outsource. However, revenue funding will still need to be committed to allow participation in such a network and more broadly for supporting the rollout of EV charging infrastructure. Additional detailed guidance would still be required to fully remove the need for training or outsourcing.
- 1.5: A network could be an ideal forum to facilitate co-ordination between tier-1 and tier-2 local authorities. However, this would be dependent on whether or not those authorities engage with the network.
- 1.6: A network would facilitate discourse and co-operation at a local, regional and national level, providing local authorities with a greater perspective of the “big picture” and replacing competition with co-ordination.
- 3.2: By co-ordinating actions taken by local planning authorities at a regional or national level, developers will face a united front, removing the potential for developments to be

relocated to areas where EV charging infrastructure is not included within local planning requirements. However, this barrier is likely to remain in some form until legislation is passed at a national level.

5. Introduce and enforce secondary legislation to regulate level of service provided by industry

Cost	6	Complexity	6	Impact	10	Rank	4

Barriers Addressed		Linkage
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	1
4.1	Single-Supplier Exclusivity for Infrastructure at Motorway Services	3
4.2	Absence of Accurate Open Data on Location, Specification and Status of Infrastructure	3
4.3	Complex, Inconsistent and Obscure User Pricing Structures	2
4.4	True "Ad Hoc" Access Not Being Provided	2

The Automated and Electric Vehicles Act 2018 takes primary powers to potentially regulate the UK EV charging infrastructure network in the following ways:

- Impose restrictions on the "*performance, maintenance and availability of public charging or refuelling points*";
- Require operators "*to provide a prescribed method of payment or verification for obtaining access to the use of public charging or refuelling points*"; and
- Require operators "*to make available prescribed information*" relating to their chargepoints, including live data on whether the chargepoint is available.

By introducing secondary legislation to specific and enforce exact requirements in these areas, it would prevent the installation of any further EV charging equipment that is not providing users with a desirable level of convenience. Over a longer timescale, it would also ensure that the legacy chargepoint network is upgraded to better serve consumers.

Whilst introducing and enforcing secondary legislation would have significant impact in addressing barriers to the growth of a fit-for-purpose UK EV charging infrastructure network, finding a balance between the needs of users and the capabilities of the EV charging infrastructure industry will require significant research and consultation.

Linkage to Barriers

- 1.1: The extent of the barrier to the growth and effective operation of the UK EV charging infrastructure network that is caused by a lack of industry-wide regulation would be reduced through secondary legislation, but adherence to regulation may remain low unless robust definitions are developed to key service-level criteria (e.g. "ad hoc access"). Additionally, legacy equipment is likely to take years to meet any new standards set.
- 4.1: Regulating the level of service provided by chargepoint network operators will lead to corrective action being taken to ensure that EV charging infrastructure at MSAs is fit for purpose.
- 4.2: Legislation should enforce a legal requirement for charging infrastructure network operators to provide data into an open data platform.
- 4.3: Regulation could introduce a set framework that simplifies and brings consistency to the way that EV charging infrastructure networks structure and advertise their usage tariffs. However, as an emerging market, it is unlikely that any action will completely remove the potential for consumer confusion in EV charging infrastructure pricing.

- 4.4: By enforcing the provision of “ad hoc access” for all or for certain types of public EV charging infrastructure, secondary legislation would contribute to overcoming the lack of such access. However, the success of such legislation will be dependent on developing a clear and workable definition of “ad hoc access”.

6. Target Rapid Charging Fund solely at electricity network upgrades

Cost	10	Complexity	9	Impact	4	Rank	4

Barriers Addressed		Linkage
2.1	Lack of Accessible, Clearly Targeted Capital Funding to Cover Grid Reinforcement Costs	3
2.4	Distribution Network Regulatory Framework Preventing Investment Ahead of Need	2

The UK Government is in the process of developing the Rapid Charge Fund. By making this fund available solely for the purpose of electricity network upgrades, it will remove a barrier around the high-cost of electricity network upgrades without distorting competition in the UK EV charging infrastructure market. Providing this funding to also absorb the costs of such upgrades into the wider tax system, where it is distributed more fairly throughout society – based on level of income, rather than electricity usage.

As the scheme has already been announced and the funding has already been allocated, implementing this solution is little more than a matter of choice and therefore comparatively simple. However, should the fund be accessible to parties other than electricity network operators (e.g. EV infrastructure installers, landowners), there is a possibility that the fund could be used to cover costs that would have been incurred even without the need for costly grid upgrades (e.g. civil works, electrical cabling). This could serve to reduce the overall impact of the fund.

Linkage to Barriers

- 2.1: Funding targeted solely at electricity network upgrades will completely remove the barrier posed by the lack of such funding.
- 2.4: Providing funding for electricity network upgrades will allow electricity network operators to conduct upgrades potentially ahead of need, where EV infrastructure may be required in the near-future (e.g. at motorway services). However, electricity network operators will need to be guided by UK Government, local authorities and the EV charging infrastructure industry in order to ensure this funding is correctly applied.

7. Make Rapid Charging Fund only payable to electricity network operators

Cost	10	Complexity	6	Impact	4	Rank	9

Barriers Addressed		Linkage
2.1	Lack of Accessible, Clearly Targeted Capital Funding to Cover Grid Reinforcement Costs	2
2.4	Distribution Network Regulatory Framework Preventing Investment Ahead of Need	2

Building on solution 6, the impact of the Rapid Charge Fund could potentially be increased by ensuring that only electricity network operators had access to the funding. This would prevent the funding being used to cover costs that would have been incurred even without the need for grid upgrades, ensuring that it is precisely targeted and does not distort competition in the EV charging infrastructure market. Were the funding to be targeted in such a way, it would be sensible for the fund to be managed by Ofgem, who already deliver and manage funding schemes targeted at the UK’s electricity network operators. Alternatively, the fund could be managed by the National Infrastructure Commission or directly by OLEV, providing it was operated on the same terms.

This solution introduces some additional complexity involved in developing the administrative processes and systems that facilitate the delivery of funding to the electricity network operators.

Linkage to Barriers

- 2.1: Funding targeted solely at electricity network upgrades will completely remove the barrier posed by the lack of such funding. However, this approach may complicate the installation process by requiring close co-ordination between electricity network operators and EV charging infrastructure installers.
- 2.4: Providing funding for electricity network upgrades will allow electricity network operators to conduct upgrades potentially ahead of need, where EV infrastructure may be required in the near-future (e.g. at motorway services). However, electricity network operators will need to be guided by UK Government, local authorities and the EV charging infrastructure industry in order to ensure this funding is correctly applied.

8. Conduct and publish a review of the Charging Infrastructure Investment Fund

Cost	9	Complexity	9	Impact	1	Rank	15

Barriers Addressed		Linkage
2.2	Inaccessible £400m Charging Infrastructure Investment Fund	2

As the Charging Infrastructure Investment Fund is 50% co-funded by the taxpayer, its activities and dealings should arguably be known to the public, along with information on how organisations can access the fund. This would likely have limited impact, as the fund is managed by a private entity and therefore access to the fund is beyond the direct control of the UK Government. However, managed correctly, the CIIF could present a valuable option to help the owners of motorway services and commercial property to finance large-scale installations of public charging infrastructure. Without awareness of the CIIF or how it can be accessed, this opportunity is lost and the value of the fund will remain indeterminable.

Linkage to Barriers

- 2.2: A review of the funding will not inherently make the fund more accessible, but it will make the fund more visible, allowing potential investible businesses and projects to come forward and explore how the CIIF can support them. The additional visibility may also lead to political pressure being applied to ensure that the CIIF is operated more strongly in the interests of decarbonising transport, rather than solely to financial gain.

9. Standardise grid capacity information provided by electricity networks and develop a national electricity network grid capacity dataset

Cost	6	Complexity	4	Impact	2	Rank	17

Barriers Addressed		Linkage
2.3	Transparency of Electricity Network Status and Reinforcement Costs	3

Making consistent, standardised information on grid capacity available at the planning stages of EV charging infrastructure network development would assist local authorities and landowners in make effective decisions. Each of the UK's DNOs currently offer systems which provide a degree of information to this effect, but the information is not always fit-for-purpose in the context of planning for EV charging infrastructure. Were DNOs required to provide the same data and make that data freely available, local authorities and landowners could target short-term EV charging infrastructure installations at locations where electrical capacity is already available, thereby reducing the cost and time associated with the installations.

At the very least, such a system should illustrate, for any given location:

- The capacity available for EV charging infrastructure installations

- The approximate costs that would be incurred to connect EV charging infrastructure to the grid

It should be expected that such information would be for guidance purposes only, and in no way replace the need for EV chargepoint installers to engage with the local DNO. This solution would still have great positive impact on the planning stages of EV chargepoint network development and reduce the bespoke case-load of DNO network designers who have to assess incoming applications. Delivering such a system would require Ofgem to specify what data each DNO would be expected to provide and manage that data on an ongoing basis. This would introduce some complexity, even if DNOs should have much of the required data available already.

Linkage to Barriers

- 2.3: Standardising the information provided by distribution network operators will overcome the barrier caused by this information being inconsistent and not always available.

10. Update the National Planning Policy Framework to reflect the importance of EV charging infrastructure

Cost	7	Complexity	7	Impact	7	Rank	6

Barriers Addressed		Linkage
1.2	Debatable Justification for Local Government Intervention	2
2.5	Developing on Green Belt Land	2
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	2
3.2	Absence of Enforceable Planning Requirements	2

It is important that, as part of local planning decisions, local authorities are aware of the positive impact that EV charging infrastructure can have – both for the local environment and the local economy. Section 14 of England's current National Planning Policy Framework covers how the UK Government expects local authorities to make planning decisions to meet the challenge of climate change and, within this section, no specific references are made to EV charging infrastructure. Such references could be made to encourage local planning authorities to consider EV charging infrastructure on a similar basis to renewable energy installations. Following the current wording of the NPPF, references could signal to local authorities that the UK Government expects that:

- Local planning authorities should recognise the wider contribution that even small EV charging infrastructure installations can have in cutting greenhouse gas emissions.
- Local planning authorities should approve an application to install EV charging infrastructure if its impacts are (or can be made) acceptable.
- Local development plans should identify opportunities for providing EV charging infrastructure.

The impact of these changes would be limited to situations where planning permissions is required, which is not the case for most small-scale EV chargepoints installations. However, it may encourage developers to include EV charging within their development plans, and may also assist in making land available to install large high-power EV charging hubs.

Linkage to Barriers

- 1.2: Updating the NPPF will provide local authorities with clear guidance on how their should integrate EV charging infrastructure into their local plans. However, this only covers charging infrastructure being installed in new developments and additional action would be required to ensure authorities support installations in new developments.
- 2.5: An update to the NPPF could serve to guide local authorities on the occasions where installing EV charging infrastructure would have little or no impact on the integrity of the

green belt. However, the extent to which this guidance was adhered to will remain somewhat dependent on wider guidance being made available to local authorities on the value of EV charging infrastructure.

- 3.1: An update to the NPPF could guide local authorities on the importance of EV charging infrastructure being included within new developments, reducing the need for tenants and leaseholders to retrospectively install domestic EV charging infrastructure. This may also guide local authorities on how to support local tenants, leaseholders, landlords and freeholders to install domestic chargepoints. However, this solution will not impose any enforceable requirements to that effect.
- 3.2: An update to the NPPF will form the basis for enforceable planning guidance to be developed at a local level. However, without national legislation, the effectiveness of this local guidance is likely to vary between different local authorities.

11. Amend building regulations to ensure that all new developments include or are equipped to host EV charging infrastructure

Cost	8	Complexity	4	Impact	5	Rank	12

Barriers Addressed		Linkage
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	1
3.2	Absence of Enforceable Planning Requirements	3

The UK Government is in the process of analysing responses to a consultation regarding changes to Building Regulations that would ensure that newly built residential and non-residential buildings include EV chargepoints, or are made ready for chargepoints to be installed at a later date. It is important that, at the very least, the UK Government carries out its initial proposals which stated that:

- New non-residential buildings – or those undergoing major renovation – with more than ten car parking spaces must install at least one chargepoint, and install ducting to support the future installation of chargepoints for at least one in five parking bays.
- New residential buildings – or those undergoing major renovation – with more than ten parking spaces must provide ducting to support the future installation of chargepoints to every parking bay.

It is also important that these requirements are not undermined by exemptions that serve to provide property developers with a means to avoid them. In its proposals, the UK Government suggested that an exemption would apply if the cost of meeting the above requirements was great enough to prevent a development from taking place. This introduces the possibility for property developers to build a business case that deliberately lacks headroom for EV charging infrastructure.

Linkage to Barriers

- 3.1: Changes to building regulations may have an indirect impact on whether landlords and/or freeholders permit the installation of domestic EV chargepoints in their properties, as their properties may lose value or attract lower rent owing to comparisons with newer properties that include EV charging infrastructure. However, this influence is unlikely to take effect for several years, if not decades.
- 3.2: A change to national building regulations will apply enforceable requirements upon all residential buildings to include a specific number of EV chargepoints.

12. Provide a legal obligation for building freeholders and landlords to facilitate the installation of domestic EV chargepoints

Cost	8	Complexity	3	Impact	3	Rank	16

Barriers Addressed		Linkage
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	1
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	2

At present, Cenex is not aware of any legislation that obliges property freeholders and landlords to facilitate the installation of domestic EV charging infrastructure at the request of their leaseholders and tenants. In the case of tenants living in properties with off-street parking, the approval of a freeholder or landlord is the only significant barrier that would prevent the property occupier from installing an EV chargepoint, as the costs are low and the chargepoint is contained fully within their property. Imposing a legal obligation would therefore empower tenants and leaseholders to have an EV chargepoint installed.

Linkage to Barriers

- 1.3: By ensuring that landlords and freeholders are obliged to facilitate domestic EV chargepoint installations, the UK government will be reducing the dependency that some EV drivers would otherwise have on public infrastructure, thereby reducing the impact of poorly regulated public infrastructure. However, most EV drivers will require the use of public infrastructure and the quality of this infrastructure remains critical to overcoming range anxiety.
- 2.4: Introducing a legal obligation will ensure that leaseholders and tenants are permitted to install domestic EV charging infrastructure. However, in some cases the associated costs will be prohibitively high, necessitating additional funding from UK Government.

13. Introduce funding to enable domestic EV chargepoint installations in communal car parks

Cost	3	Complexity	5	Impact	2	Rank	19

Barriers Addressed		Linkage
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	2

Whilst solution 12 would provide a legal obligation for freeholders and landlords to facilitate the installation of EV chargepoints for use by their leaseholders and tenants, the costs would inevitably need to be covered by the occupier of the property – either through an upfront payment, or through additional property rent or lease costs.

In the case of tenants or leaseholders living in properties that encompass a dedicated parking bay, the costs for installing an EV chargepoint are likely to be low, and are already supported by the UK Government's Electric Vehicle Homecharge Scheme[47].

However, those living in multi-occupancy developments with communal car parks may incur significant additional costs associated with the need for free-standing (as opposed to wall-mounted) chargepoints and potentially with the installation of electrical cabling underneath car park surfaces. The costs associated with an EV chargepoint installation of this nature are comparable to the cost

[47] Office for Low Emission Vehicles, 2020, *Electric Vehicle Homecharge Scheme: guidance for customers.* Available online: https://www.gov.uk/government/publications/customer-guidance-electric-vehicle-homecharge-scheme/electric-vehicle-homecharge-scheme-guidance-for-customers

of installing a public EV chargepoint. It would therefore be unrealistic and arguably unfair to expect these costs to be covered by solely by the occupiers of the building.

By providing funding to cover the additional costs inherent in installing EV charging infrastructure in communal car parks, a greater proportion of the population will be able to access a domestic EV chargepoint, ensuring that they can access a similar level of cost and convenience as is available to those with dedicated, off-street parking.

Linkage to Barriers

- 2.4: Providing funding for leaseholders and tenants to install domestic EV chargepoints would support them where the installation costs are significantly higher than a typical chargepoint installation. However, this funding may not come to bear if landlords and freeholders are not obliged to grant permission for the installation to take place.

14. Continue to incentivise research and development in novel charging technologies

Cost	3	Complexity	8	Impact	1	Rank	21

Barriers Addressed		Linkage
3.3	Scalable Technological Solutions to Provide Charging in Less Lucrative Locations Are Not Yet At Market	2

For individuals without dedicated off-street parking, having convenient access to a chargepoint is essential to make an EV a feasible mobility option. However, conventional EV charging infrastructure technologies can often not be commercially viable in residential areas, owing to lower levels of demand compared to other locations (e.g. retail districts, motorway services). Some technologies are already at market that address this barrier, but none are without a degree of compromise. It is important that the UK Government – through Innovate UK – continues to fund research and development in this area, in order to improve the business case for installing EV charging infrastructure in less lucrative but nonetheless essential locations (e.g. residential and rural areas). Once ideal technological solutions are developed, funding should then be provided to get them to market and manufacture them at scale.

Linkage to Barriers

- 3.3: Supporting the development of novel charging technologies whilst the market is not yet self-sustaining may result in new technologies which grow the marketplace, create jobs and support the uptake of EVs. However, no guarantee can be made that these technologies will make it to market.

15. Facilitate interaction between stakeholders from challenging market sectors and technology developers

Cost	7	Complexity	3	Impact	9	Rank	11

Barriers Addressed		Linkage
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	1
3.2	Absence of Enforceable Planning Requirements	1
3.3	Scalable Technological Solutions to Provide Charging in Less Lucrative Locations Are Not Yet At Market	2

Building on solution 14, a greater level of interaction between technology developers and stakeholders from more challenging market sectors (e.g. residents, landlords, freeholders of properties without off-street parking, or in rural areas) would assist in developing technologies that are specialised to meet the needs of users. Cenex is not aware, for example, that there is any interaction between the construction sector and EV charging infrastructure technology developers.

However, a degree of interaction may help to identify needs that were previously unknown to technology developers and ensure that new EV charging infrastructure technologies comes to market that address these needs.

An ideal method for this inter-sector collaboration to be facilitated is via the Knowledge Transfer Network (KTN), an organisation that frequently acts as an independent "match-maker" within the context of UK Government innovation funding. These activities could also be supported to an extent by the local government network proposed in solution 4. In any case, efforts to facilitate collaboration between disparate sectors would have greater impact if it were accompanied and supported by innovation funding (as per solution 14).

Linkage to Barriers

- 3.1: Interaction with property developers, landlords and tenants can help technology developers to engineer solutions that reduce the cost and/or complexity of installing domestic EV charging infrastructure for tenants and leaseholders. However, this provides no obligation for landlords or freeholders to adopt such technologies, nor does it support tenants or leaseholders to cover the costs.
- 3.2: Interaction between property developers and technology developers can help to engineer solutions that reduce the cost of including EV charging infrastructure within new residential or commercial developments. Regardless of this, such technologies will fundamentally always add cost to a development and therefore, without wider regulation, the availability of the technology will be no guarantee that it will then be deployed.
- 3.3: In general, the interaction between technology developers and users from "hard-to-reach" areas of the market will have the benefit of designing technologies to meet more challenging requirements. However, this will need to be supported by funding to enable technology developers to bring their innovations to market.

16. Conduct a public consultation to identify a fair solution to the EV inequity between different demographic groups

Cost	7	Complexity	4	Impact	1	Rank	20

Barriers Addressed		Linkage
3.4	Cheap Domestic Electricity Tariffs and Value Added Tax Puts Public Charging Infrastructure at Constant Disadvantage	1

Several elements of the UK's current electricity market currently serve to put those with dedicated off-street parking at a considerable advantage over those without. There is an appreciation that this inequity exists and, without action, will continue to exist, but there is little or no suggestion how it may be addressed. Should, for example, VAT be charged at 20% for electricity used to charge an EV? If so, what would be to prevent an EV owner from avoiding this tax by charging their vehicle from a domestic three-pin socket?

It is the view of Cenex that the inequity between EV users in different demographic groups will inevitably require a significant departure from the status quo. Ensuring that any changes made are guided by the will of the public is essential and therefore consultation with the public should begin sooner rather than later.

Linkage to Barriers

- 3.4: A consultation will help the UK Government to gauge the attitude of the public on how to address the disparity between those with and those without off-street parking. Significant further action will be required to translate the findings of this consultation into workable policy proposals.

17. Facilitate co-operation between EV infrastructure providers and vehicle OEMs to develop integrated technological solutions

Cost	7	Complexity	2	Impact	7	Rank	14

Barriers Addressed		Linkage
3.4	Cheap Domestic Electricity Tariffs and Value Added Tax Puts Public Charging Infrastructure at Constant Disadvantage	3
4.2	Absence of Accurate Open Data on Location, Specification and Status of Infrastructure	2
4.4	True "Ad Hoc" Access Not Being Provided	3

Facilitating interaction between EV chargepoint providers and the automotive sector is key to developing an integrated infrastructure system that is easy to use and priced equally for all users, regardless of their postcode or property tenure. By agreeing common standards between the EV and charging infrastructure industries, the process of recharging could be simplified by using direct communication from the vehicle to the chargepoint, with billing potentially handled by a single party, potentially charging a single rate, rather than several different chargepoint network operators each with different costs.

A significant advantage that Tesla have over every other EV and EV charging infrastructure OEM is that they have invested to create their own dedicated network of EV chargepoints. For the owner of a Tesla vehicle, this has multiple benefits but arguably the greatest of them all is that Tesla vehicles can use Tesla chargepoints by simply plugging in, with billing handled through communication between the chargepoint and the vehicle. Ensuring that the wider automotive and EV charging infrastructure sectors are capable of providing such functionality is essential to making the UK's EV charging infrastructure network simpler and easier to use. It is also a potential means by which the costs of running an EV can be made fairer across different demographic groups, as users from different demographic groups could be charged the same electricity costs and taxes to charge an EV.

In the medium-term future, when the majority of UK motorists drive an EV, an integrated system that robustly determines miles driven and electricity consumed could also present a technological pathway to replacing vehicle excise duty and fuel duty. As a result of the popularisation of the EV, UK Government will inevitably need to consider how it will adjust its tax systems to maintain its current level of tax receipts. Fuel duty and vehicle excise duty will need to evolve to reflect new technology and one popular view is that they should be replaced by a pence-per-mile tax system.

Linkage to Barriers

- 3.4: Developing a system by which payment for EV charging is managed by the vehicle rather than by the chargepoint is, at present, the only apparent solution that would completely remove the disparity in charging costs between those with and those without off-street parking.
- 4.2: Co-ordination between EV OEMs and EV charging infrastructure providers will help co-ordinate the provision of consistent EV charging network data, allowing EV owners access to reliable network information from their vehicle's onboard systems. However, without a legal obligation for EV charging network operators to make the appropriate data available, there is no assurance that the entire network would be captured within such systems.
- 4.4: Developing a system by which payment for EV charging is managed by the vehicle will provide "plug-and-charge" convenience to EV drivers. This is the pinnacle of ad hoc access.

18. Improve or remove exclusivity agreements between MSAs and chargepoint operators

Cost	5	Complexity	3	Impact	3	Rank	18

Barriers Addressed		Linkage
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	1
4.1	Single-Supplier Exclusivity for Infrastructure at Motorway Services	3

EV chargepoints in motorway service areas are of critical importance to increasing EV uptake, as they hold the key to reducing "range anxiety", providing convenient locations to charge an EV during long journeys. In preventing other suppliers from competing to provide EV charging infrastructure at these locations, the exclusivity agreements held between Ecotricity and MSAs have created a market failure. This has resulted in neither an adequate quantity nor quality of EV charging infrastructure being available along much of the UK's strategic road network. To address this market failure, the UK Government should intervene to ensure a high quality of charging experience.

Linkage to Barriers

- 1.3: The poor level of service provided by infrastructure at MSAs is arguably the most visible consequence of the UK Government's lack of regulation. However, addressing this would only represent a small part of the wider network and the barrier to which a lack of regulation is preventing it from operating in the interests of the user.
- 4.1: By improving or removing the exclusivity agreements between MSA's and chargepoint operators, the barriers that this presents are also removed.

19. Fund the development of a new open database, providing live EV chargepoint network information

Cost	7	Complexity	9	Impact	4	Rank	7

Barriers Addressed		Linkage
4.2	Absence of Accurate Open Data on Location, Specification and Status of Infrastructure	3
4.3	Complex, Inconsistent and Obscure User Pricing Structures	2

Instant access to open data providing live information on the UK's charging infrastructure network is essential to allow technology developers to create useful services that make EV ownership more convenient. Such services include accurate EV chargepoint maps and EV route planners. Whilst such services already exist, they are often based on inaccurate or incomplete data, and there is little competition to encourage innovation.

The UK Government is currently exploring how to update its current EV charging infrastructure database – the National Chargepoint Registry. In its position as the current administrator of the National Chargepoint Registry, Cenex recommends that the UK Government provides funding to either update the existing database or create a new open database to allow EV chargepoint network operators to continuously upload live information.

In addition, the UK Government should more actively enforce regulations included within The Alternative Fuels Infrastructure Regulation 2017 that require UK EV chargepoint network operators to upload information to an open database. These regulations should ideally also be extended to specify that live data is provided that indicates whether or not an EV chargepoint is in service and/or in use.

Linkage to Barriers

- 4.2: Funding the development of a new open chargepoint database would remove the barrier created by its absence.

- 4.3: An open dataset, containing pricing information for chargepoints on the whole UK charging infrastructure network would allow software developers to create services by which simplify the user experience by making usage tariffs easier to understand. However, this would not remove the underlying complexity of the tariffs and some confusion is therefore likely to remain.

20. Further specify the definition of "ad hoc" access, consulting the public if necessary

Cost	7	Complexity	5	Impact	6	Rank	10

Barriers Addressed		Linkage
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	1
4.3	Complex, Inconsistent and Obscure User Pricing Structures	2
4.4	True "Ad Hoc" Access Not Being Provided	3

The definition of “ad hoc” access, as stated in The Alternative Fuels Infrastructure Regulations 2017, requires EV chargepoint network operators to ensure that their equipment can be accessed without prior need to sign up to a contract. This definition has left room for EV chargepoint network operators to offer a pay-as-you-go tariff, alongside cheaper tariffs that require a user to sign up. Not only does this introduce additional complexity to usage tariff structures, but it is also arguably not meeting the spirit of the regulations, as users are still obliged to sign-up to membership services to access best value.

The UK Government could address these barriers by tightening the definition of “ad hoc” access to prevent EV charging infrastructure operators from imposing higher tariffs on users who do not wish to sign up to a network. Many of the UK’s EV charging infrastructure networks already meet this definition and, under current regulations, those that do not should at least have means to meet this definition without the need to upgrade their equipment or systems. Therefore this solution would be relatively simple to implement and would have the positive impact of simplifying the process of using a public EV chargepoint.

Linkage to Barriers

- 1.3: Requiring proprietary network cards and apps to access EV charging infrastructure is a consequence of a historic lack of regulation that has impacted the effective operation of the wider network. Developing the legal definition of “ad hoc” access will contribute to removing this barrier. However, the barrier is widespread and multiple solutions are required to fully overcome it.
- 4.3: Developing the definition of “ad hoc” access may encourage greater competition between EV charging network operators to offer simpler user experiences, especially if the results of a public consultation show this to be of importance (as some user surveys have previously suggested). This may result in network operators presenting users with fewer or only one tariff. However, they will be under no obligation to do so and other solutions will be required to overcome this barrier.
- 4.4: Developing a clear, robust definition that truly represents “ad hoc” access will, alongside existing primary legislation, increase the provision of such access.

21. Introduce a legal definition of price transparency, in the context of EV charging infrastructure

Cost	8	Complexity	5	Impact	6	Rank	8

Barriers Addressed		Linkage
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	1
4.3	Complex, Inconsistent and Obscure User Pricing Structures	2
4.4	True "Ad Hoc" Access Not Being Provided	2

Price transparency is key to enabling free market competition. The structure of tariffs charged by several of the UK's largest EV charging infrastructure operators can be difficult to understand and therefore consumers are put in a position where they are unable to determine what choices represent best value to them. For an EV user, not being able to identify best value may be frustrating. For non-EV users, the vast array of prices and tariff structures may serve to dissuade them from owning an EV.

By introducing a legal definition for price transparency, in the context of EV charging infrastructure, the UK Government can position itself to enforce regulations that ensure that consumers have the information they need to get the best value from an EV. To ensure industry buy-in, the definition should be developed in consultation with the EV charging infrastructure sector, EV owner groups and non-EV drivers.

Linkage to Barriers

- 1.3: Lack of UK Government intervention has contributed to the present diversity in the structure and the costs of user tariffs across the UK's EV charging infrastructure network. This step will contribute to overcoming the widespread consequences of the lack of Government intervention to date but would need to be combined with several other solutions to have a significant impact.
- 4.3: Introducing a legal definition of price transparency will compel EV charging network operators to simplify their pricing structures, where this is not already the case. However, as an emerging market, some complexity is inherent as many consumers are yet to familiarise themselves with the marketplace.
- 4.4: A degree of "ad hoc" access is a potential bi-product of price transparency, as simpler pricing structures inherently simplify the user process of choosing a chargepoint that offers best value and familiarising themselves with how this chargepoint can be accessed. However, this would not inherently result in true "ad hoc" access were it not accompanied by a stronger definition to support the enforcement of existing legislation.

Summary

Barriers

Figure 7 summarises the 19 barriers identified in this report, plotting them against their respective scores for impact and scale. Table 3 provides further information on each of the barriers, including total score and overall rank.

Barriers are coloured in accordance with their respective theme. The colours are as follows:

- Poorly Defined Role and Inadequate funding of Public Sector
- Cost of High-Power Charging Infrastructure Installations
- Difficulty Meeting User Needs in Commercially Unattractive Locations
- Market Competition Harming the Electric Vehicle Driver Experience

The top five barriers identified in this report are denoted in *italic* font.

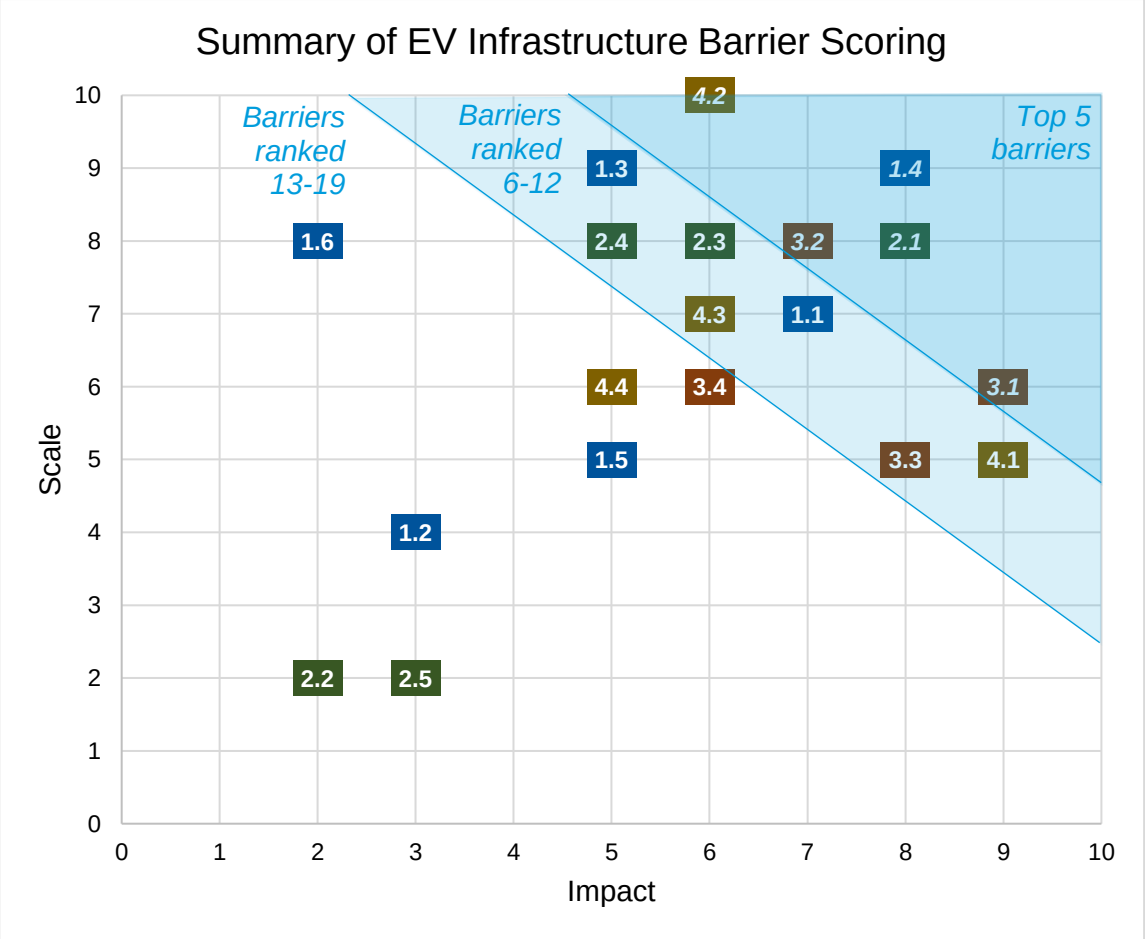

Figure 7; Scatter graph showing all identified barriers to the growth and effective operation of the UK EV charging infrastructure network, plotted against their scores for impact and scale.

Table 3; List of all identified barriers to the growth and effective operation of the UK EV charging infrastructure network , including scores for impact and scale, total score and rank.

Barrier ID	Barrier	Impact	Scale	Score	Rank
1.1	Variance in Level of Engagement and Approach Taken by Local Authorities	7	7	49	6
1.2	Debatable Justification for Local Government Intervention	3	4	12	17

Barrier ID	Barrier	Impact	Scale	Score	Rank
1.3	UK Government Reluctance to Enforce Regulations Upon the Electric Vehicle Charging Infrastructure Marketplace	5	9	45	8
1.4	Capital and Competition Funding	8	9	72	1
1.5	Split Accountabilities Between Tier 1 and Tier 2 Local Authorities	5	5	25	15
1.6	UK Government Orchestrating Unhelpful Competition Between Local Authorities	2	8	16	16
2.1	Lack of Accessible, Clearly Targeted Capital Funding to Cover Grid Reinforcement Costs	8	8	64	2
2.2	Inaccessible £400m Charging Infrastructure Investment Fund	2	2	4	19
2.3	Transparency of Electricity Network Status and Reinforcement Costs	6	8	48	7
2.4	Distribution Network Regulatory Framework Preventing Investment Ahead of Need	5	8	40	11
2.5	Developing on Green Belt Land	3	2	6	18
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	9	6	54	5
3.2	Absence of Enforceable Planning Requirements	7	8	56	4
3.3	Scalable Technological Solutions to Provide Charging in Less Lucrative Locations Are Not Yet At Market	8	5	40	11
3.4	Cheap Domestic Electricity Tariffs and Value Added Tax Puts Public Charging Infrastructure at Constant Disadvantage	6	6	36	13
4.1	Single-Supplier Exclusivity for Infrastructure at Motorway Services	9	5	45	8
4.2	Absence of Accurate Open Data on Location, Specification and Status of Infrastructure	6	10	60	3
4.3	Complex, Inconsistent and Obscure User Pricing Structures	6	7	42	10
4.4	True "Ad Hoc" Access Not Being Provided	5	6	30	14

Priority Barriers

After applying a rank based on the scores attributed to each barrier, the barriers identified in this report have been narrowed down to the top five that, in the view of Cenex, represent the most impactful and large-scale barriers impacting the expansion and effective operation to the UK's EV charging infrastructure network. These barriers are summarised in Table 4.

Table 4; Top five identified barriers to the growth and effective operation of the UK EV charging infrastructure network .

Barrier ID	Barrier	Rank	Associated Solutions
1.4	Capital and Competition Funding	1	1; 3; 4

Barrier ID	Barrier	Rank	Associated Solutions
2.1	Lack of Accessible, Clearly Targeted Capital Funding to Cover Grid Reinforcement Costs	2	6; 7
4.2	Absence of Accurate Open Data on Location, Specification and Status of Infrastructure	3	5; 17; 19
3.2	Absence of Enforceable Planning Requirements	4	2; 4; 10; 11; 15
3.1	Property Leaseholders and Tenants Cannot Unilaterally Install Domestic Chargepoints	5	2; 10; 11; 13; 15

Solutions

Figure 8 summarises the 21 solutions proposed to meet the barriers identified in this report, plotting them using their respective scores for cost, complexity and impact. Table *5* provides further information on each of the solutions, including total score and overall rank.

The top ten solutions, as ranked by their total score, are shown in **dark blue**.

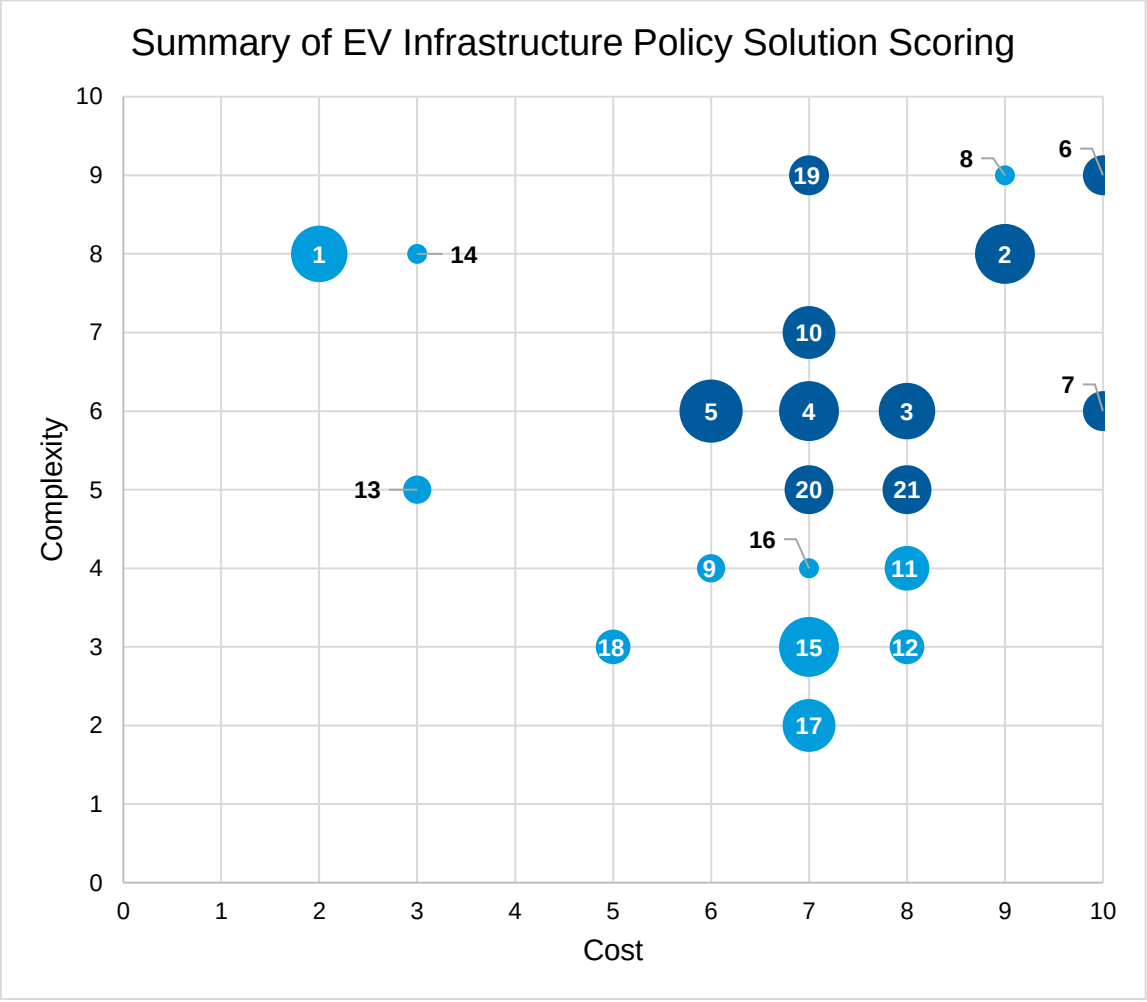

Figure 8; Scatter graph showing all proposed solutions to identified barriers preventing the growth and effective operation of the UK EV charging infrastructure network, plotted against their scores for cost and complexity (higher scores denote more desirable outcome). The size of each point corresponds to its score for barrier impacts.

Table 5; List of all proposed solutions to identified barriers preventing the growth and effective operation of the UK EV charging infrastructure network , including scores for cost, complexity and impact, as well as total score and rank.

Solution ID	Solution	Cost	Comp-lexity	Impact	Rank
1	Provide local authorities with ringfenced capital and revenue funding for EV chargepoint installation and management	2	8	8	13
2	Ministry of Housing, Communities and Local Government provides clear guidance and instruction or obligation for local authorities to take action	9	8	9	1
3	Department for Transport, Department for Business, Energy and Industrial Strategy and Crown Commercial Services to develop and publish detailed, official guidance outlining consistent delivery approach for local authorities	8	6	8	2
4	Create a government-sponsored network to help local authorities co-ordinate EV charging infrastructure rollout	7	6	9	3
5	Introduce and enforce secondary legislation to regulate level of service provided by industry	6	6	10	4
6	Target Rapid Charging Fund solely at electricity network upgrades	10	9	4	4
7	Make Rapid Charging Fund only payable to electricity network operators	10	6	4	9
8	Conduct and publish a review of the Charging Infrastructure Investment Fund	9	9	1	15
9	Standardise grid capacity information provided by electricity networks and develop a national electricity network grid capacity dataset	6	4	2	17
10	Update the National Planning Policy Framework to reflect the importance of EV charging infrastructure	7	7	7	6
11	Amend building regulations to ensure that all new developments include or are equipped to host EV charging infrastructure	8	4	5	12
12	Provide a legal obligation for building freeholders and landlords to facilitate the installation of domestic EV chargepoints	8	3	3	16
13	Introduce funding to enable domestic EV chargepoint installations in communal car parks	3	5	2	19
14	Continue to incentive research and development in novel charging technologies	3	8	1	21
15	Facilitate interaction between stakeholders from challenging market sectors and technology innovators	7	3	9	11
16	Conduct a public consultation to identify a fair solution to the EV inequity between different demographic groups	7	4	1	20
17	Facilitate co-operation between EV infrastructure providers and vehicle OEMs to develop integrated technological solutions	7	2	7	14
18	Remove the exclusivity agreements between MSAs and chargepoint operators	5	3	3	18

Solution ID	Solution	Cost	Comp-lexity	Impact	Rank
19	Fund the development of a new open database, providing live EV chargepoint network information	7	9	4	7
20	Further specify the definition of "ad hoc" access, consulting the public if necessary	7	5	6	10
21	Introduce a legal definition of price transparency, in the context of EV charging infrastructure	8	5	6	8

Priority Solutions

Following a ranking exercise, the top ten solutions proposed within this report are summarised in Table 6. This table shows which barrier each solution is intended to address.

Table 6; Summary of top ten identified solutions, including associated barriers.

Solution ID	Solution	Rank	Associated Barriers
2	Ministry of Housing, Communities and Local Government provides clear guidance and instruction or obligation for local authorities to take action	1	1.1; 1.2; 1.5; 1.6; 2.5; 3.1; 3.2
3	Department for Transport, Department for Business, Energy and Industrial Strategy and Crown Commercial Services to develop and publish detailed, official guidance outlining consistent delivery approach for local authorities	2	1.1; 1.4; 1.5
4	Create a government-sponsored network to help local authorities co-ordinate EV charging infrastructure rollout	3	1.1; 1.4; 1.5; 1.6; 3.2
5	Introduce and enforce secondary legislation to regulate level of service provided by industry	4	1.3; 4.1; 4.2; 4.3; 4.4
6	Target Rapid Charging Fund solely at electricity network upgrades	4	2.1; 2.4
10	Update the National Planning Policy Framework to reflect the importance of EV charging infrastructure	6	1.2; 2.5; 3.1; 3.2
19	Fund the development of a new open database, providing live EV chargepoint network information	7	4.2; 4.3
21	Introduce a legal definition of price transparency, in the context of EV charging infrastructure	8	1.3; 4.3; 4.4
7	Make Rapid Charging Fund only payable to electricity network operators	9	2.1; 2.4
20	Further specify the definition of "ad hoc" access, consulting the public if necessary	10	1.3; 4.3; 4.4

Linking Barriers to Solutions

This report has sought to propose at least one practical or policy solution to each barrier that has been identified. Certain solutions would contribute, to varying extents, towards overcoming more than one barrier. Likewise, certain barriers may potentially require the application of more than one policy solution to be effectively overcome.

Figure 9 shows a matrix illustrating the connection between the barriers identified and the solutions proposed in this report. Descriptions of each barrier and solution can be found in Table 3 (page 58) and Table *5* (page 61) respectively. The strength of the linkage between barrier and solution is denoted by a score from one to three. These scores were provided based on Cenex's industry knowledge and experience and carry the following definitions:

1. The solution would make a minor contribution to overcoming the given barrier;
2. The solution would have a significant contribution, but not sufficient for it to overcome the given barrier on its own;
3. The solution would entirely overcome the given barrier;

		Solutions																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Barriers	1.1	2	2	1	2																	
	1.2	2	2								2											
	1.3					1							1						1		1	1
	1.4	3		2	1																	
	1.5		2	1	2																	
	1.6		1		3																	
	2.1						3	2														
	2.2								2													
	2.3									3												
	2.4						2	2														
	2.5		1								2											
	3.1		1								2	1	2	2		1						
	3.2		2		2						2	3				1						
	3.3														2	2						
	3.4																1	3				
	4.1					3													3			
	4.2					3												2		3		
	4.3					2														2	2	2
	4.4					2												3			3	2

Figure 9; A matrix illustrating the connection between the barriers identified and the solutions proposed in this report. The strength of the linkage between barriers and solutions is denoted by the numbers 1 to 3, as defined in the methodology.

Figure 10 shows a similar matrix, but where barriers and solutions are displayed in rank order, based on their respective scores. The matrix is divided into four sections, denoted by different colours. These colours are defined as:

- Green: priority solutions applicable to priority barriers.
- Blue: non-priority solutions applicable to priority barriers
- Yellow: priority solutions applicable to non-priority barriers
- Grey: non-priority solutions applicable to non-priority barriers.

Barriers (rank order from top to bottom)	Solutions (rank order from left to right)																				
	2	3	4	5	6	10	19	21	7	20	15	11	1	17	8	12	9	18	13	16	14
1.4		2	1										3								
2.1					3				2												
4.2				3			3							2							
3.2	2		2			2					1	3									
3.1	1					2					1	1				2			2		
1.1	2	1	2										2								
2.3																	3				
1.3				1				1		1						1		1			
4.1				3														3			
4.3				2			2	2		2											
2.4					2				2												
3.3											2										2
3.4														3						1	
4.4				2				2		3				3							
1.5	2	1	2																		
1.6	1		3																		
1.2	2					2							2								
2.5	1					2															
2.2															2						

Figure 10; A matrix illustrating the connection between the barriers identified and the solutions proposed in this report. The strength of the linkage between barriers and solutions is denoted by the numbers 1 to 3, as defined in the methodology. Sollutions are listed left to right in order of descending rank. Barriers are lised top to bottom in order of descending rank. Connections shown in green denote priority solutions to priority barriers. Connections in blue show non-priority solutions applicable to priority barriers. Connections in yellow show priority solutions applicable to non-priority barriers. Connections in grey show non-priority solutions applicable to non-priority barriers.

This matrix illustrates that addressing priority barriers may require the implementation of non-priority solutions. Equally, applying priority solutions may contribute to overcoming non-priority barriers. The findings of this report can be read to focus on overcoming the most significant barriers or applying the most impactful and cost-effective solutions. From a pragmatic perspective, applying the findings of this report in a solutions-orientated view has the advantage of achieving the greatest and most widespread impact at the lowest cost.

Conclusion

Barriers

Based on a combination of analysis, desk study, industry experience and anecdotal testimony, this report identified 19 barriers that are currently restricting the growth and/or the effective operation of the UK's EV charging infrastructure network. Each barrier was scored against criteria for scale and impact, contributing to a total score that was used to rank each barrier in order of significance. Following this ranking exercise, the top five barriers identified in this report are listed from highest to lowest rank as follows.

A. Capital and revenue funding

The lack of revenue funding made available to local authorities by UK Government is preventing them from committing staff resource to deliver and manage high-quality local charging infrastructure networks. Without committing revenue funding, there is a risk that local authorities will either take no action or do the bare minimum within their existing revenue budget to meet current demand from residents. In order to improve consumer confidence in EVs, local authorities require revenue funding to effective lead or facilitate the provision of high-quality local charging infrastructure.

B. Lack of accessible, clearly targeted capital funding to cover grid reinforcement costs

Prohibitively expensive grid reinforcement costs impact the commercial viability of installing high-power EV charging infrastructure – including rapid and ultra-rapid chargepoints. Expecting the private sector to cover the full extent of these costs is unrealistic as, in certain scenarios, they can increase the overall cost of installing infrastructure by millions of pounds. There is currently no existing mechanism by which these costs can be easily reclaimed by EV charging infrastructure installers. As a result, they create a market failure that is mostly limiting the installation of high-power charging infrastructure to locations where there is already a strong supply of electricity – but not necessarily the most convenient locations for users.

C. Absence of accurate open data on location, specification, and status of infrastructure

In the UK at present, the only source of live data is privately owned and the only source of open data is not live. This prevents market competition in developing software solutions that improve the EV user experience. Without open data, there is little or no route to market for software developers who wish to develop services that improve the EV driver experience. Unless this data is live, any software that is developed is likely to be based on unreliable data, introducing the potential to mislead consumers and worsen the EV driver experience rather than improve it.

D. Absence of enforceable planning requirements

Ensuring that new-built residential and non-residential developments are equipped to support the transition to EVs will ensure that a greater number of UK residents can be provided access to a convenient and cost-effective means to recharge an EV. National regulations enforcing this requirement upon developers has not been forthcoming and the current proposals are undermined by potential loopholes that exempt developers from having to meet the requirements. Without enforceable planning requirements, new-build residential and commercial property owners and tenants will face considerably greater costs to retrofit chargepoints at a later date, as they will potentially need to dig up surfaces and establish new electrical connections to install the equipment.

E. Property leaseholders and tenants cannot unilaterally install domestic chargepoints

Requiring the permission of a freeholder or landlord of a property can present a barrier that prevents a property leaseholder or tenant from installing a domestic EV chargepoint. There is no legal obligation for this permission to be granted, nor is there funding available to support the additional costs that may be incurred in cases where additional works are required to install an EV chargepoint (e.g. in communal car parks). Unless tenants and leaseholders are supported in their endeavours to install EV charging at their properties, they will be restricted from accessing the same cost and convenience benefits as those who are able to install a chargepoint at home.

Solutions

To overcome the barriers identified in this report, 21 policy solutions were proposed, of which most were considered to potentially address more than one barrier. These solutions were provided scored for their likely cost, complexity and impact and ranked to identify the most high-impact, deliverable solutions. Based on this ranking exercise, the top ten solutions proposed to remove barriers to EV charging infrastructure provision are listed from highest to lowest rank as follows.

1. **UK Government to provide clear guidance, and an instruction or obligation for local authorities to take action to lead or facilitate EV chargepoint installations**

   This will address varying levels of engagement between different local authorities, ensuring that the UK's EV charging infrastructure network achieves comprehensive national coverage and provides a consistent and high-quality service to consumers. It will also raise awareness of EV charging infrastructure in a planning context, making planning authorities more likely to see value in awarding planning permission to develop EV charging infrastructure hubs and imposing requirements to install chargepoints in new developments.

2. **UK Government to develop and publish detailed, official guidance outlining a consistent delivery approach for local authorities**

   Official guidance will address the lack of in-house EV charging infrastructure expertise within local authorities. This will reduce the revenue funding required for local government officers to explore and evaluate different delivery approaches, and support local authorities to deliver EV charging infrastructure of appropriate quality and quantity to meet demand. This guidance must be official in order to command the confidence of local authorities.

3. **Create a government-sponsored network to help local authorities co-ordinate EV charging infrastructure rollout**

   Allowing local authorities to share knowledge and experience in a structured way will support local government officers to make evidenced decisions based on established best-practice. The network should be co-ordinated by a secretariat body, who are independent from government and industry, who would organise events and become a central knowledge bank and point of contact for local authorities undertaking EV charging infrastructure installation.

4. **Introduce and enforce secondary legislation to regulate the level of service provided by the EV chargepoint operators**

   Primary legislation has been introduced through the Automated and Electric Vehicles Act (2018) and this should now be strengthened with secondary legislation to ensure that chargepoints within the UK's EV chargepoint network meet certain standards for reliability and access. This will increase the robustness of the chargepoint network and improve consumer confidence in EVs.

5. **Target the Rapid Charging Fund solely at electricity network upgrades**

   The Rapid Charge Fund is expected to make funding available to support the installation of high-power EV charging infrastructure in areas where the existing electricity supply requires significant and costly upgrades. In order to ensure that this funding achieves the greatest impact possible, it should be targeted specifically to electricity network upgrades – where there is a market failure – and not be used to support other costs, such as charging equipment and equipment installation – where there is no market failure.

6. **Update the National Planning Policy Framework to reflect the importance of EV charging infrastructure**

   At present, the National Planning Policy Framework makes reference to renewable energy installations and advises local planning authorities to consider the environmental benefits of such developments when coming to a planning decision. No such equivalent advice exists for EV charging infrastructure, yet this also has environmental benefits that may arguably felt more locally. The National Planning Policy Framework should therefore advise local authorities to consider these benefits when assessing planning applications for EV charging infrastructure developments.

7. **Fund the development of a new open EV chargepoint database, providing open access to live EV chargepoint network information**

   Open access to live chargepoint information will unlock a competitive marketplace for software developers to introduce user-focussed services that improve the EV user experience. It will also be necessary to accurately monitor compliance with any regulations around the level of service provided by UK chargepoint network operators.

8. **Introduce a legal definition of price transparency, in the context of EV charging infrastructure**

   At present, price transparency in the EV charging infrastructure industry is thought to require nothing more than a price displayed on an EV chargepoint before use. This does not necessarily allow consumers to make effective choices as, by the time they see this price, they may already effectively be committed to paying it to complete their journey. There should be structured debate on what constitutes true price transparency for EV charging infrastructure. The outcome of this debate should be refined into a legal definition which can then be used to ensure that EV-owners have the means to make effective consumer choices on how they charge their EV.

9. **Make Rapid Charging Fund payable only to electricity network operators**

   To maximise the impact of the Rapid Charging Fund, it should be made payable only to electricity network operators. This will further reduce the likelihood that the funding will be used to support costs that the private sector has proven itself already capable of covering (e.g. chargepoint equipment and equipment installation).

10. **Further specify the definition of “ad hoc access”, consulting the public if necessary**

    The definition of “ad hoc access” is set in the Alternative Fuels Infrastructure Regulations (2017) and requires EV chargepoint network operators to provide a means of using charging infrastructure without first having to sign-up to a membership service. In response to this, many chargepoint operators now offer two or more different usage tariffs depending on whether or not a user signs-up to a membership service. It should be debated whether this practice is against the spirit of the original definition, whether this practice is impacting consumer confidence in EVs. If both are found to be the case, the definition should be strengthened.

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