

# IMPACT

FROM INSIGHT TO INFLUENCE

## SSEN Equal Electric Vehicles

Literature Review and  
Engagement Findings

Prepared for SSEN

Prepared by Impact

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## Glossary

Abbreviation	Term
<b>EV</b>	Electric vehicle
<b>BEV</b>	Battery electric vehicle
<b>PHEV</b>	Plug-in hybrid electric vehicle
<b>Ofgem</b>	Office of Gas and Electricity Markets
<b>DNO</b>	Distribution Network Operator
<b>OLEV / OZEV</b>	Office for Low Emission Vehicles / Office for Zero Emission Vehicles
<b>ICE</b>	Internal Combustion Engine
<b>CCS</b>	Combined Charging System
<b>CHAdemo</b>	“Charge de Move” (“Charge and Go”)
<b>PSR</b>	Priority Services Register
<b>V2G</b>	Vehicle to Grid
<b>UKCSI</b>	UK Customer Service Index
<b>CPO</b>	Charge Point Operator

# 1. Executive Summary

Central to the successful transition to electric vehicles (EVs) for energy companies is Ofgem’s principle that “no-one is left behind”. Understanding consumer vulnerability is crucial to ensuring all customers are able to access decarbonised transport and investment decisions are made to benefit all, not just the majority. EVs are becoming the transport method of choice for a growing number of domestic drivers, steered by government policy and consumer environmental sentiment.

A key customer group with vulnerabilities in the context of driving EVs are drivers and passengers with mobility impairments. Although consideration must also be given to removing barriers for other customers who could be vulnerable in this circumstance such as drivers who are elderly, those in remote rural areas, and drivers who may have trouble understanding new technology (such as those who cannot speak functional English, drivers with learning difficulties and those who are digitally disengaged).

Drivers with vulnerabilities face many of the same barriers as the wider driving population when making the switch to EVs including cost, range anxiety and access to charge points (especially for those without private off-street parking at home). Some barriers are more specific, especially for drivers or car passengers with a mobility-impairment who are particularly reliant on their cars. The key barriers identified for drivers and passengers with vulnerabilities are:

- **Lack of information on EVs and accessible charging:** There is a shortage of easily available information to help encourage drivers with a mobility impairment to switch to an EV (especially for those that don’t use, or don’t qualify for help from Motability or similar companies). Digitally disengaged drivers are unlikely to be exposed to information about EVs and need particular consideration. Drivers are very unlikely to have seen disabled EV charge points and may assume EVs are not suitable for them. Low familiarity with how EVs work and where they can be charged mean many vulnerable drivers won’t even consider an EV. More prominent signage, public charging infrastructure, and availability of extended test drives are all needed to raise the profile of EVs amongst this group.
- **Availability and accessibility of charge points:** There are few disabled parking spaces equipped with EV charge points, and charge points, connectors and cables are not easy to use for drivers with mobility problems. Public charge points are unlikely to have dropped kerbs, and may have impact-barriers around them making access difficult. Many mobility-impaired drivers have no off-street parking (or not enough space to park and access charger) and would need to rely on public charge points.
- **Cost:** Driving can be more expensive for drivers with a mobility impairment, and the relatively high upfront cost of EVs is a barrier as well as the cost of modifications to enable driving, getting in and out of the car, or storing mobility equipment. There is little awareness of how much lower costs can be over the lifetime of the car / lease compared to ICE cars.
- **Psychological barriers like range anxiety:** Drivers with a mobility impairment like to plan their journeys in detail to avoid surprises, and range anxiety is a problem when many public charge points are difficult to use for those with mobility problems. Range can also be reduced by additional power needs when driving (including using hoists / driving modifications, and needing a higher air con temperature for example). Anecdotal evidence of drivers running out of power mid-journey only fuel range anxiety.

Charging infrastructure is being rolled out across the UK at a fast pace bolstered by government / local authority funding (particularly in cities in England) and innovations developed by private companies. However, it is important this fast-paced deployment of charging infrastructure is inclusive to all different types of drivers to ensure no-one is left behind in the transition to net zero. For example, a move towards faster chargers, charging networks using unobtrusive charge points in keeping with the existing street landscape, and inductive charging using induction plates fixed to the ground, can benefit all drivers, including those with a vulnerability, by making charging quicker

and easier. That said, there is little evidence of ambition to speed up the rollout of EV charge-enabled disabled parking bays or to improve access to information on EVs and charging for drivers with a vulnerability.

Distribution Network Operators (DNOs) and electricity suppliers are engaging with drivers with a vulnerability to differing extents, and there are a number of trials currently in progress looking at ways to best meet the increased energy demand for EV charging whilst ensuring the resilience of the network and providing all customers with a cost-effective electricity supply. Smart charging and vehicle-to-grid or home schemes are being used to manage EV electricity demand and can also play a role in ensuring that customers with a vulnerability are given equal access to the benefits of EVs.

This document outlines the key findings from a comprehensive literature review exploring enablers, barriers and solutions to EV adoption, specifically among drivers who are mobility impaired. The findings from qualitative primary research conducted by Impact are included, comprising feedback from depth interviews with a range of expert stakeholders (15 interviews) and customers with mobility impairments (19 interviews). Engagement covered thoughts on barriers to EV uptake among drivers with a vulnerability, and highlighted possible solutions that could help facilitate uptake.

## 2. Introduction

The growth in electric vehicles (EVs) has been fast paced across the globe and in the UK<sup>1</sup>, and is set to continue over the coming decade. The UK Government's Ten Point Plan for a Green Industrial Revolution<sup>2</sup>, published in November 2020, set out plans to stop the sale of new petrol and diesel vehicles by 2030 and the sale of hybrids by 2035. The Scottish Government has committed to reducing emissions by 75% by 2030 and have mandated a net zero target by 2045. As part of this, the Scottish Government has committed to phase out the sale of new petrol and diesel vehicles by 2030 and in the public sector fleet by 2025.

In 2020, EVs accounted for more than one in ten car sales in the UK, with pure battery electric vehicle (BEV) sales nearly tripling year-on-year from 37,850 to 108,305<sup>3</sup>. BEVs, rather than plug-in hybrid electric vehicles (PHEVs), will play a key role in decarbonising transport as they emit zero carbon directly. Strong growth is forecast over the next decade despite the disruption caused by Covid-19 in 2020 and 2021. This is an important trend considering the transport sector were the single largest source of emissions in the UK, accounting for over a third of all carbon dioxide emissions in 2019<sup>4</sup>.

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<sup>1</sup> Deloitte Insights: Electric Vehicles. Setting a course for 2030. <https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/electric-vehicle-trends-2030.html>

<sup>2</sup> 10 Point Plan:

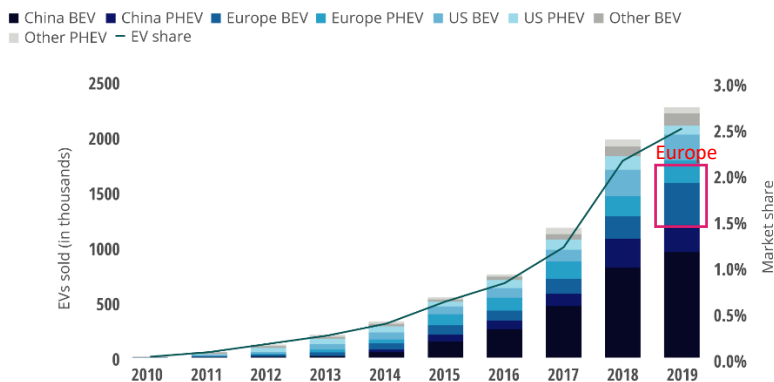
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/936567/10\\_POINT\\_PLAN\\_BOOKLET.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf)

<sup>3</sup> Utility week: data from Society of Motor Manufacturers and Traders (SMMT) <https://utilityweek.co.uk/plug-in-electric-vehicles-made-up-one-in-ten-cars-sold-in-2020/>

<sup>4</sup> <https://www.ashurst.com/en/news-and-insights/insights/the-future-of-electric-vehicle-charging/>



## EVs: annual passenger-car and light-duty vehicle sales in major regions



Source: Deloitte analysis, IHS Markit, EV-volumes.com<sup>2</sup>

Deloitte Insights | deloitte.com/insights

Encouragingly, growth in EV sales has been in BEVs rather than by PHEVs, particularly in Europe. This highlights the importance of providing a national network of EV charging points and supporting home and work charging point installations accessible to all.

In Europe, Nordic countries and the Netherlands lead the way in EV uptake<sup>8</sup>. Deloitte attributes this to “favourable government policies and a change in consumer attitudes... driven primarily by growing concerns about climate change”. Whilst it isn’t the fastest growing EV market, the UK has experienced triple-digit growth since 2019 and Ofgem are supporting this by working with DNOs to manage the growing demand for electricity to power EVs. Whilst predicting future uptake of EVs is challenging, Ofgem has committed to ensuring it creates a system “that allows the uptake of EVs to happen without unnecessary barriers”<sup>5</sup>. It is therefore imperative to understand future motivations and usage patterns of all drivers so that DNOs can ensure they can deliver a safe and reliable electricity network.

A key aspect of ensuring there are not unnecessary barriers impeding the uptake of EVs is ensuring no-one is left behind in the transition. This principle must be applied to all aspects of the green energy transition,<sup>6</sup> and any research and planning must include people with vulnerabilities. The regulator defines a customer as vulnerable when their personal circumstances and characteristics combine with aspects of the market to create situations where they are:

- Significantly less able than a typical consumer to protect or represent their interests in the energy market; and/or
- Significantly more likely than a typical consumer to suffer detriment.

Although there are numerous groups that can be considered vulnerable using this definition, many of them do not have any specific needs relating to driving or EV charging (or have particular needs that make them unable to drive e.g., visual impairments). Whilst the main barrier to EV engagement is likely to be mobility-related, it is important to consider other vulnerabilities that may cause difficulties in accessing or adapting to new technology. These include drivers who are elderly, those in fuel poverty, those with disabled or neurodiverse family members, drivers with learning difficulties, and those who do not speak functional English. The barriers for these drivers are more cognitive than practical and are likely to require carefully targeted communication and education rather than physical

<sup>5</sup> Ofgem Future Insights Series: Implications of the transition to electric vehicles.

[https://www.ofgem.gov.uk/system/files/docs/2018/07/ofg1086\\_future\\_insights\\_series\\_5\\_document\\_master\\_v5.pdf](https://www.ofgem.gov.uk/system/files/docs/2018/07/ofg1086_future_insights_series_5_document_master_v5.pdf)

<sup>6</sup> <https://www.ofgem.gov.uk/news-blog/our-blog/networks-fit-net-zero>

adaptations to EV infrastructure. SSEN with the Centre for Sustainability and Western Power Distribution are investigating these barriers separately as part of the '[Smart and Fair?](#)' social injustice project<sup>7</sup>.

According to forecasts by Ricardo in their 2020 report for Motability<sup>8</sup>, by 2035, up to 50% (1.35 million) of all drivers or passengers with a disability (estimated at 2.7 million) are expected to be partially or wholly reliant on public EV charging infrastructure. Nearly a million of these disabled drivers are unlikely to be able to charge their vehicle at home. It is therefore imperative that public charging infrastructure is made accessible to vulnerable drivers so they are able to fully benefit from the EV revolution.

This report provides a summary of the enablers and barriers for **drivers with physical impairments and disabilities, and those with mobility issues caused by age or medical conditions** adopting EVs. A literature review was conducted to first gather evidence of what is currently known about this group in the public domain, in relation to driving electric vehicles. Findings were then tested with industry stakeholders to gain a deeper understanding of issues and challenges from their nuanced perspective. Stakeholders were combined into three types; transport, technology and accessibility to ensure we spoke to a wide range of industry experts. To test findings Impact conducted one mini focus group with a representative from each stakeholder type. Additionally, 13 online in-depth interviews lasting 45 minutes were conducted with industry stakeholders, led by an experienced moderator using a discussion guide to ensure key points of barriers, enablers and innovation were discussed.

Once an industry perspective was collected, the study then sought to understand how this translated into thoughts and experiences from mobility-impaired drivers. Project partner Disabled Motoring UK (DMUK) provided access to a subset of their members to gain a more comprehensive understanding of customer experience and to review challenges and solutions from their perspective. In-depth interviews lasting 45 minutes were conducted with 19 DMUK members split between EV and Internal Combustion Engine (ICE) drivers, and non-drivers (who were driven by another person). We refer to this group as those with a mobility impairment or disability throughout this report. The drivers in this group might be Blue Badge holders or might self-identify as having specific physical needs that affect their interaction with driving. Throughout the report we refer to the insights from the literature review alongside findings from the stakeholder and mobility-impaired driver interviews. It should be noted key findings from the primary research cannot be taken as nationally representative of different stakeholder and customer groups due to the low sample size.

### 3. Moving towards an EV future

The UK's ambition to phase out ICE vehicles requires extensive growth in EV charging infrastructure. Indeed, the government Office for Low Emission Vehicles (OLEV) has changed its name to the Office for Zero Emission Vehicles (OZEV), highlighting the focus on BEV rather than PHEV vehicles going forward. EV charging infrastructure can be broadly divided into four categories:

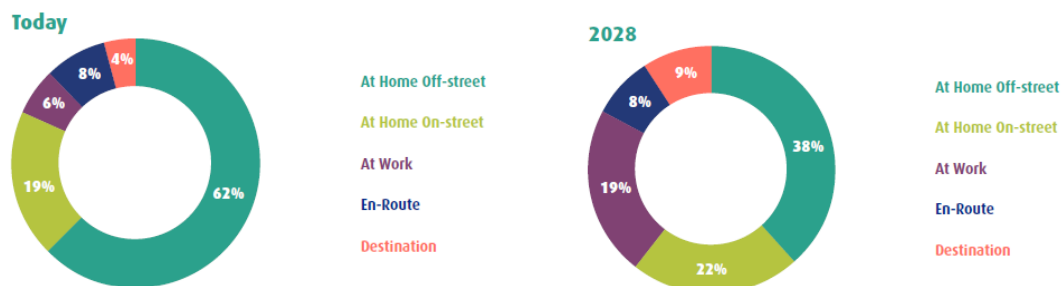
- At home (on street and off street)
- At work
- En-route (on roads and motorways)
- Destination (e.g. supermarkets and shopping centres)

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<sup>7</sup> <https://www.cse.org.uk/projects/view/1359>

<sup>8</sup> "Electric Vehicle charging infrastructure for people living with disabilities" Report for Motability (the charity) by Ricardo. September 2020

According to research by UK Power Networks, currently 62% of charging is off-street at home. This is expected to reduce to 38% by 2028, with increases in work and destination charging<sup>9</sup>. When looking to understand how drivers with a mobility impairment can be supported in the transition to EVs, it is important to consider the challenges they may face when interacting with charging infrastructure in each of these categories.



Source: UKPN EV Strategy 2019

The above data is based on UK Power Network’s region (London and South East England) and is therefore more urban than SSEN’s Scottish and Southern England regions. London and the South East also benefit from a larger public transport network which will impact on the importance of driving (and therefore EV uptake) for customers in that region. A June 2020 report for SSEN by Regen on forecasting low-carbon energy uptake<sup>10</sup> looked at charging infrastructure and behaviour in the SSEN licence areas. The report confirmed that rural areas have higher levels of off-street parking compared to urban areas. A transport expert stated “in a rural area you’re potentially more likely to have access to a driveway or some kind of outdoor space that you could get an electric charging point installed. So I think in urban areas the concerns are more where would I charge my vehicle, would that be in some kind of public place that we drive to”. However, there is high granularity variation in this trend, often associated with affluence and detached/semi-detached housing. 60% of homes have access to off-street parking in the Southern licence area and 70% in the Scottish licence area. These homes are predominantly rural / semi-rural and customers in these areas will have a heavily reliance on their personal cars. Therefore, aside from other contributing variables, Scotland would expect to see more off-street domestic EV chargers per household than Southern England.

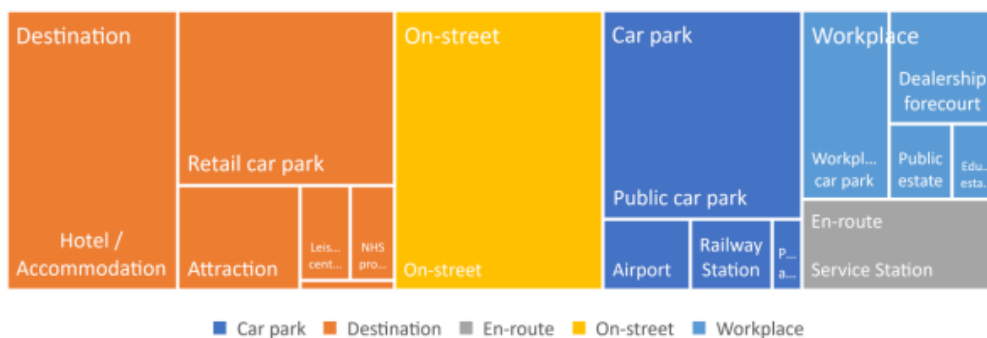
The diagrams below show the current mix of public EV charge point locations in each area. The size of each shape represents the proportion of total charge points accounted for by each location type. It is clear that on-street charging infrastructure is much more developed in Southern England than in Scotland (where public and workplace car parks make up a larger proportion of current charge points):

Public charging points in **Southern England**. (Source: Zap Map 2020):

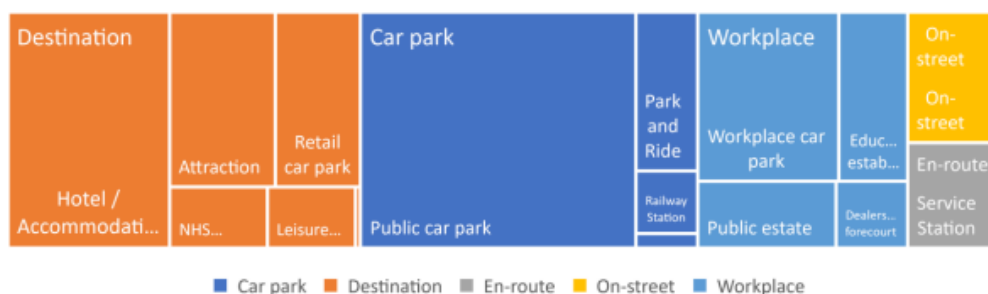
<sup>9</sup> UK Power Networks: Electric Vehicle Strategy – November 2019

<sup>10</sup> High granularity projections for low carbon technology uptake - electric vehicle, heat pumps and solar PV, Results summary for SSEN Southern and Scottish licence areas Project: SSEN Electric Vehicle Forecasting - Multisite 0120 Reference: 52330, June 2020





Public charging points in **Scotland** (Source: Zap Map 2020):



Three-quarters of EV chargers in Scotland are operated by ChargePlace Scotland, a national network of charge points developed by the Scottish government. This more centralised approach to charging infrastructure has resulted in a greater proportion of EV chargers in car parks, park and rides, public estates and educational centres. A transport expert stated “I think we’ve [in Scotland] definitely got tougher climate change targets than the rest of the UK and most of our targets are several years earlier than the rest of the UK ... I can’t speak for the whole of Scotland, I just know about the North East really, but certainly both the local authorities have EV strategies, they’re really keen to roll out the development of installing EV chargers”. In contrast, in the Southern licence area the majority of charging infrastructure is operated by private ventures. Half of charge points in the Southern licence area are operated by three main private installers: Pod Point, POLAR and Ubitricity. This has resulted in more decentralised EV charging infrastructure, including in settings such as on-street, retail car parks, hotels and other destination locations.

There are nearly 2,200 domestic off-street (home) EV chargers in Scotland and over 16,300 in the Southern licence area. The number of off-street home chargers is expected to rapidly increase, then level out by 2040 once the existing petrol and diesel vehicle stock are almost entirely replaced by EVs. SSEN is likely to see the greatest density of home charge points in more rural and more affluent areas, where more off-street parking exists per household than in urban areas.

A lack of public charging points is a well-documented barrier to EV uptake even though most charging is taken care of at home. For mobility impaired drivers with off-street home charging this brings benefits as they have the reassurance that their car is charged and ready before leaving home, and they no longer need to visit petrol stations which can be challenging for those with mobility difficulties. This is mentioned by a driver interviewed “not having to buy petrol, things like not having to go to filling stations, that would be a great advantage” [5, SSEN, M, 55-64]. However, there is some risk if an overnight power interruption means the EV can’t be charged. This is particularly important in rural areas which are more reliant on overhead power lines which are more likely to be damaged causing power cuts. Rural power networks must be made more resilient to improve the EV experience. If EVs are going to be accessible to all, then public charging infrastructure must be available to the 62% of UK drivers that do

not have a private parking space (34% park on-street, 28% have non-private off-street parking such as a car park) according to a 2016 English Housing survey<sup>11</sup>.

In England, en-route and destination charging are set to benefit from a £500 million programme of government investment in infrastructure announced in the March 2020 budget, including a Rapid Charging Fund to increase the number of rapid charging points on A roads and motorways<sup>12</sup>. Scotland, Wales and Northern Ireland are not included in this investment although ChargePlace Scotland currently provide over 1,000 public charge points and have plans to install 800 new public charge points<sup>8</sup>. The UK government has set a target of one in every 5 public parking spaces in the UK to include EV chargers by 2025<sup>13</sup>. There are currently 18,000 EV charge points in the UK, of which 3,100 are fast chargers (43kW and above). Many of these will have dual connectors enabling two EVs to charge simultaneously. They are predominantly privately funded (i.e. home, workplaces and destinations such as supermarkets) although government funding is being rolled out via OZEV. Grants are available from OZEV for home charge points under the Electric Vehicle Homecharge Scheme (EVHS) providing up to 75% or £350 towards charger installation. This type of grant is also available in workplace, on-street and taxi firm charge points. These numbers are growing steadily as demand increases, with the biggest rises in London and Scotland where ambitious local authorities are conducting trials<sup>14</sup>.

With investment in EV charging points, comes investment in parking space design and connectivity. Designs and technologies must be future-proofed to encourage investment, particularly from the private sector. Regulations and best practice guides to EV parking design are being used to ensure consistency and accessibility for all, across the UK. These include the Alternative Fuels Infrastructure Regulations 2017 and the Automated and Electric Vehicles Act 2018<sup>15</sup> at a national level. In London, the London Mayor's EV Infrastructure Taskforce published its delivery plan in June 2019 and asked BEAMA (the trade association for energy infrastructure companies) to write a best practice document. It provides *"best practice and guiding principles for the planning, design, manufacture and procurement of public EV charging infrastructure. It is designed for use by manufacturers of public EV charging infrastructure, providers of services related to public EV charging, investors in EV infrastructure and planners at local, regional or national level."*<sup>15</sup> The importance of ensuring accessibility for drivers with a mobility impairment is mentioned briefly with a few practical considerations: *"placement [of EV parking] should consider facilitating access and use by people with physical disabilities. This might mean considering the space around disabled car parking spaces to allow for movement with a cable, having a dropped curb, ensuring the slant of the screen is appropriate for people with visual impairments, and other measures."*

Internationally, there is relatively little publicly available information about supporting drivers with a mobility impairment to drive EVs. Countries such as the Netherlands, Norway and China have all successfully encouraged EV uptake through a mixture of taxation incentives, car / charge point discounts and public-private partnerships to install charging infrastructure. Norway has the highest percentage of zero emission vehicles in the world with 70% of passenger vehicles being plug in EVs compared to only 10% in the UK as of August 2020<sup>3</sup>. Norway's transition to EV was enabled by tax incentives for drivers and a significant public investment in charging infrastructure. The state provided an initial EUR 7 million for 1,900 charge points up to 2011, followed by a further EUR 4.6 million invested

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<sup>11</sup> Connected Kerb: Electric Vehicles – Moving from early adopters to mainstream buyers.

<sup>12</sup> Policy Paper: Government vision for the rapid charge point network in England. 14th May 2020

<https://www.gov.uk/government/publications/government-vision-for-the-rapid-charge-point-network-in-england/government-vision-for-the-rapid-charge-point-network-in-england>

<sup>13</sup> British Parking Association: Connected Values – Integrated systems and thinking in parking. December 2020.

<sup>14</sup> DfT Electric Vehicle Charging Device Statistics – 11th June 2020.

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/891900/electric-vehicle-charging-device-statistics-april-2020.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/891900/electric-vehicle-charging-device-statistics-april-2020.pdf)

<sup>15</sup> BEAMA Best Practice for Future Proofing Electric Vehicle Infrastructure – March 2020

into fast charging network more recently. The US has incorporated some guidance for providing access for disabled drivers into EV legislation via the United States Access Board (an independent federal agency that promotes equality for people with disabilities). California is the first state to incorporate a requirement for this into the building code; other states such as Virginia, North Carolina, Ohio, Michigan, and Colorado provide guidelines<sup>16</sup>.

One current challenge to a widespread, accessible charging network is the interoperability of different charging connectors. This barrier is not specific to drivers with a mobility impairment although the additional complexity of finding a charging point suitable for both their EVs charger type *and* their mobility requirements presents a challenge. *David Livermore from AccessAble* mentions “when we think about Highways England, motorway service areas, they’re all tethered cables, but they release differently. So some use an app, some use a fob. They’re at different heights. So the physical aspect of that is one. And then on-street ones don’t necessarily have a tethered cable, so then it’s about bringing your own cable and how they hook into... So again, you’re into consistency issues and mobility issues.”. EV charging methods can be broken down into two main connector types: AC and DC. AC connectors include standard 3-pin plugs, type 1 and type 2 connectors and are slower to charge than DC connectors (CHAdEMO, CCS and Tesla Type 2). The connector type depends on the brand of EV and so the charge point network needs to incorporate a number of connector types. In the UK, Type 2 is the most common AC connector and CCS and CHAdEMO are the predominant DC connectors<sup>17</sup>.



Although more powerful chargers provide a faster charge, many drivers prefer to use slower chargers as they believe it is better for prolonging battery lifespan.

## 4. Understanding drivers with a mobility impairment or another vulnerability

Drivers with a mobility impairment as defined in the introduction (drivers with physical impairments / disabilities and those with mobility issues caused by age or medical conditions) make up a small but significant proportion of the UK driving public. The Papworth Trust calculates there are 13.3 million disabled people living in the UK, with mobility

<sup>16</sup> <https://www.parking-mobility.org/wp-content/uploads/2019/03/18-02-Green-standard.pdf>

<sup>17</sup> Cenex: EV charging in car parks: A Study of Innovative Solutions to Charging EVs in Car Parks commissioned by Innovate UK. April 2019

being the most common disability, affecting 52%<sup>18</sup>. This equates to 6.9 million potential drivers with a mobility impairment or disabled car passengers with the charity estimating that 38% of those with a mobility difficulty drive as their main mode of transport, and 30% are a passenger in a car as their main mode.

Language is important. Using the term 'vulnerable' to describing a cohort of drivers with an impairment can have negative connotations because it frames the individual as being incapable of performing particular activities due to fragility which isn't always the case. Citizens Advice have pointed out there are many forms of vulnerability based on an individual's situation, so using the term in isolation can be misleading, as it groups together a large cohort of people. There could be individuals made vulnerable by the location of the charger (e.g. having a charger down a dark alley) for example and those made vulnerable by not being able to read and understand payment meter instructions, both of which are very different challenges. Furthermore, a part of an individual's 'vulnerability' is linked to availability of information and being able to plan for circumstances which may prohibit their movement. Hence, drivers should be distinguished as those with a 'physical disability' or 'physical impairment' moving away from the word vulnerable, as they are only vulnerable in a situation which hasn't been accommodated to their needs. Drivers interviewed for this project were aware of the limitations put upon them by their physical, mental and age related conditions but did not generally consider themselves as "vulnerable".

Non-physical challenges should also be considered when understanding barriers to driving and adoption of EVs. For example, those who experience a hearing or visual impairment will need specialised assistance in particular in circumstances like gaining assistance at a charge point e.g. helplines or having to hand different sets of glasses to view written information at charging and payment stations. It has also been reported by stakeholders that a small fraction of drivers owning a driving licence may not be able to read so would need visual instructions. Consideration also has to be given to those with cognitive impairments, as these individuals wouldn't have any issues with physical aspects of charging but would with understanding charging and payment mechanisms.

A research project by Zap Map and Motability in December 2020 interviewed 2,200 EV drivers and found that only 8% of them self-identified as disabled<sup>19</sup>. This is significantly lower than the 20% rate of disability we expect to see within the UK population, suggesting that uptake of EVs amongst drivers with a mobility impairment is lower than for those non-disabled drivers. Catherine Marris, Innovation Lead at Motability: *"We know that one in five people in the UK are disabled and Motability's recent research estimated that there will be 2.7 million disabled drivers or passengers by 2035, with 1.35 million expected to be partially or wholly reliant on public charging infrastructure. As we approach what will be a transformative energy transition in the UK, there is a robust social and commercial case for ensuring that EV charging infrastructure is accessible for disabled people. If we want to work towards a society and economy that is inclusive for all, then accessibility must be a priority."*<sup>19</sup>

2.44 million blue badges were held in the UK in 2020<sup>20</sup>. Blue badges allow disabled drivers and passengers to park in disabled bays or on yellow lines so they are near their destination. This is an important audience to consider when planning for access to EV infrastructure, but it must be noted that not all car users that consider themselves to have a mobility impairment will have, or be eligible for, a blue badge. Also, because many blue badges are held by able-bodied drivers for their disabled passengers, we do not expect the same barriers to EV charging to apply as the able-bodied driver will naturally look after the car's charging needs.

Another way to identify drivers with a mobility impairment is via the Motability scheme (or similar schemes offered by companies including Specialist Vehicle Hire and Mobility Vehicle hire). This allows drivers that receive mobility

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<sup>18</sup> Papworth Trust: Disability Facts and Figures 2018. <https://www.papworthtrust.org.uk/about-us/publications/papworth-trust-disability-facts-and-figures-2018.pdf>

<sup>19</sup> <https://www.zap-map.com/electric-vehicle-charge-points-lack-accessibility/#more-126495>

<sup>20</sup> <https://www.gov.uk/government/statistics/blue-badge-scheme-statistics-2020>

benefits (the main ones being Higher Rate Mobility Component of Disability Living Allowance or Enhanced Rate Mobility Component of Personal Independence Payment, both £62.50 per week) to spend the allowance on a 3 year lease car which can be adapted to meet their needs. There are approximately 630,000 cars of all types bought through the scheme currently. The scheme has also recently entered into a partnership with BP whom offer free BP Pulse home charge point installation when the customer purchases a fully electric car (BEV)<sup>21</sup>. The customer agrees for their details to be passed onto a BP installer by the dealership and the charge point is installed free of charge. Not all drivers with a mobility impairment will qualify for Motability (e.g. if they are older than 64 years) and not all those who qualify will choose to use the scheme. Some prefer to buy a car outright, use a different finance model, or use their allowance on other transport methods. Approximately 630,000 mobility-impaired drivers in the UK qualify for Motability, which is a small proportion of the c.2m disabled drivers registered with the DVLA. Only a third of those that qualify currently use Motability [Data provided by DMUK]. The large group of non-Motability customers may qualify for £350 towards the purchase and installation of a home charge point installation with an OZEV grant although the drivers interviewed for this study were not aware of this. It is particularly important to consider the needs of vulnerable drivers that do not use Motability as, without this information channel they are at risk of being left behind in the switch to EVs.

Of particular interest to DNOs is drivers with a mobility impairment on the Priority Services Register (PSR). Although not all PSR registered drivers are mobility-impaired, and not all drivers with a mobility impairment will be registered on the PSR, this is a core dataset that can help SSEN identify areas that might require additional support in EV transition. SSEN has developed a powerful customer mapping tool<sup>22</sup> that enables different customer characteristics to be overlaid onto a map at local authority and Lower-layer Super Output Areas (LSOA) levels. The mapping tool has identified the following areas as having a high proportion of drivers, and a high proportion of customers on disability benefits:

- Scotland:
  - Aberdeenshire (excluding Aberdeen City): Cults, Bieldside and Milltimber East
  - Moray: Cullen, Portknockie, Findochty, Drybridge and Berryhillcock, Fochabers, Aultmore, Clochan and Ordiquish
  - Fife: Knock Hill Landward
  - East Dunbartonshire: Keystone and Douglaston, Lennoxton
- Southern:
  - Chichester: Chichester and Arun
  - Eastleigh
  - Isle of Wight
  - New Forest
  - Wiltshire
  - Mendip
  - South Somerset
  - Dorset: West Dorset, Purbeck

Conditions affecting drivers with a mobility impairment that could impede access to EV charging include<sup>23</sup>:

CONDITION	IMPACT ON DRIVING
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<sup>21</sup> <https://news.motability.co.uk/scheme-news/an-easy-charging-solution-for-electric-vehicle-customers/>

<sup>22</sup> SSEN customer mapping tool. Access only available from SSEN <https://ssen.cse.org.uk/>

<sup>23</sup> <https://www.drivingmotability.org.uk/information/help-to-drive-with-common-medical-conditions-and-disabilities/>



Arthritis and musculoskeletal problems	Causes joint pain, restricted movement and physical weakness which can impact ability to lift fuel nozzle / EV charge cable. Drivers may require automatic cars, adaptations for getting in and out of the car, adaptations for hand controlling pedals, additional mirrors and sensors / cameras to aid restricted neck movement, cruise control / lighter steering / self-parking systems, wheelchair accessible car / hoists / ramps
Back problems	Pain and loss of sensation can affect getting in and out of the car and using pedals. Drivers may require automatic cars, adaptations for getting in and out of the car, adaptations for hand controlling pedals, additional mirrors and sensors / cameras to aid restricted neck movement, cruise control / lighter steering / self-parking systems. Heated seats can also help with pain, as can planning extra stops to stretch and change position
Old age	Can impact mobility, sight, hearing and cognitive abilities. Drivers may require adaptations for getting in and out of car, help to lift fuel nozzle / EV charge cable, seat belt pulling aids, additional heating, self-parking and additional mirrors / sensors, easy storage and access to walking aids (stick, walker etc) and changes to driving behaviour, i.e. drive with larger gap to car in front, plan journey to avoid busy junctions, drive at quieter times of day / only in daylight
Multiple Sclerosis (MS)	Can cause loss of dexterity, muscle weakness, fatigue, vision problems which can impact ability to lift fuel nozzle / EV charge cable. Drivers may require adaptations for getting in and out of car, adaptations for using pedals / one handed steering, wheelchair accessible car / hoists / ramps
Stroke	Brain injury that can cause long term problems with movement, especially on one side of the body, cognitive ability (including spatial awareness) and psychological issues such as anxiety. Drivers may need adaptations for getting in and out of car, help to lift fuel nozzle / EV charge cable, easy storage and access to walking aids (stick, walker etc), single handed steering aids, keypad control for indicators, horn etc, wheelchair accessible car / hoists / ramps
Amputation or other limb disability	Drivers may require adaptations for use with, or without prosthetic limbs. They may need adaptations for accessing car, help to lift fuel nozzle / EV charge cable, using pedals, steering and secondary controls. Also, storage of and access to wheelchairs and walking aids including hoists and ramps

There are over 400 different adaptations available through Motability (and similar companies including Specialist Vehicle Hire and Mobility Vehicle hire). Not all adaptations are suited to all cars, and the underfloor or boot positioning of EV batteries can preclude some adaptations (e.g. needing a lower floor to enable enough head height for wheelchair users). This reduces the choice of vehicles available to drivers with a mobility impairment requiring adaptations. Furthermore, dependent on the adaptations made to the car, the range is typically less in a real world setting than stated by manufacturers due to increase in the electricity demands of hoists / ramps / driving modifications and the weight of the car. This is an area which needs significant improvement to reduce range anxiety when driving long distances with additional equipment / adaptations.

Whilst home location doesn't change the extent to which a driver is mobility-impaired, rural drivers are considered more vulnerable in terms of EV charging access. Rural customers are used to a higher number of power outages due to the network being predominantly made up of overhead lines in these areas. EV uptake may be slower for this group as customers are wary of power cuts leaving their EVs without charge when they need it. Drivers are also likely

to have less access to public transport and are necessarily more reliant on private cars. Furthermore, journey lengths in rural areas are longer than for urban dwellers leading to greater range anxiety, and increased importance of having access to a network of accessible en-route and destination charge points. This was echoed by stakeholders who recognised rurality as an area of challenge but for reasons not necessarily associated with disability or mobility, but range anxiety which is heightened by drivers conducting long journeys and having to ensure they have enough charge to get home. This anxiety can be somewhat mitigated by having access to a home charge point and this group are more likely to have a driveway to install a home charger at, thus are less reliant on public chargers if their battery is fully charged each time a journey is made. Additionally, for disabled or mobility impaired motorists having a home charger mitigates the challenges of using ICE fuel stations which can be difficult to use and help isn't always available.

However, home charging as a solution for rural drivers should be caveated by the fact that additional reinforcement of underground cables and overhead lines maybe required from DNOs to accommodate increased network capacity for connections in rural areas. Local authorities dealing with a geographically complex region must also be considerate of drivers living in rural locations, especially when one round trip can be 100 miles long in extreme circumstances. Moreover, there are technological barriers to overcome when considering charging mapping and payment apps in rural areas, due to inconsistent internet speeds / coverage when installing chargers in remote areas. This is a particular challenge faced by charge point operators when installing hubs in areas with weak broadband.

It should be noted around 4% of the UK still do not have access to internet at home with those over 65 less likely to have access and those considered disabled under the Equality Act slightly more likely to report not using the internet in the last 3 months<sup>24</sup>. Recent government guidance on accessing home chargers through the Electric Vehicle Homecharge Scheme (EVHS) state the charger must be smart<sup>25</sup>. The Automotive and Electric Vehicles Act 2018 which closed its consultation in 2020, also mandated that all home chargers should be smart<sup>26</sup>. The government define a charger to be 'smart' if it can receive and send information, this can be done via charge point internet, phone app or smart meter. Thus, there needs to be a solution for those who do not have access to the internet or have poor broadband connectivity. Whilst it is possible to install a charger without connecting to the internet, it would be to the detriment of the user in terms of knowing how much your vehicle is charged when not residing within it, making use of Time of Use (ToU) tariffs and having access to cheaper electricity. It is imperative this segment of people is catered to in rural areas.

Consideration must also be given to drivers with a vulnerability that may have difficulty adapting to new technology or being able to easily use EVs. These drivers require additional guidance to make the switch to EVs and include:

- Elderly drivers
- Drivers with learning disabilities (including dyslexia, dyspraxia, autism and ADHD)
- Drivers who don't speak functional English
- Drivers who live in fuel poverty (although financially accessing the technology may be more of a challenge than understanding the technology)

Although most are still perfectly capable of getting around independently, older individuals are more likely to have some sort of impairment and come across circumstances which they find challenging in an EV. As *Caroline Jacobs*

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<sup>24</sup> Internet Access – household and individuals dataset 2020. Office of National Statistics.

<sup>25</sup> <https://www.gov.uk/government/publications/electric-vehicle-homecharge-scheme-minimum-technical-specification/electric-vehicle-homecharge-scheme-minimum-technical-specification#charging-equipment-requirement>

<sup>26</sup> <https://www.gov.uk/government/consultations/electric-vehicle-smart-charging/public-feedback/electric-vehicle-smart-charging-consultation-summary-of-responses>

from Research Institute for Disabled Consumers (RIDC) points out “impairments that come with ageing, you’re a little bit frailer, you’ve got less strength, you’ve definitely got less strength in your hand and arthritic hands. So, that sort of dexterity side of things... there’s a level of visual impairment that comes where you’re perfectly able to drive – there are also a lot of different glasses involved; driving glasses, Zap-Map glasses are different glasses – maybe reading instructions on a charge point.”

Stakeholders interviewed noted that not all elderly individuals come across challenges when driving an EV but they do often take extra care in establishing the new processes which come with learning about a new vehicle. This is echoed by a technology expert who noted “elderly drivers make up a section of EV drivers, typically from technical backgrounds looking to run their car cheaply” but often are technologically disadvantaged, taking longer to understand things and asking for paper version of online apps. This element of learning new technology takes longer to adjust to, hence Citizens Advice felt elderly drivers should be split between those digitally confident and not.

Communication is key for these driver groups. New concepts, technology, and anything that may be different to their ICE car experience should be explained clearly, in writing, in an accessible format. This could be distributed through organisations such as Mind and Age UK, and also through driving specific channels. Most available information on driving support for these groups is around the process of learning to drive. The same learnings can be applied to transitioning to EVs. For instance, the importance of repeating information many times, taking extra time for the information to be absorbed, and using written prompts in prominent places in the car to remind drivers of what has changed<sup>27</sup>.

It will also be important to adapt technology to these drivers. Interactions with technology include: EV parking bay signage, instructions on how to use charge points, apps used for charge point mapping and payment, and apps / in-car displays showing battery and charging status. Development of all of these should take accessibility into account: Can they be understood visually without needing to read all of the text? Can they be easily translated into different languages (e.g. app provision in different languages)? Are the colours, symbols and structure consistent across different regions and operators to reduce confusion?

Non-physical impairments can also challenge the ability of drivers to access EVs. As well as the cognitive difficulties already described for drivers, family members with vulnerabilities can increase the challenges faced. For instance, one disabled driver interviewed has a son whose additional needs would make stopping en-route to charge difficult. “If I was to have to get Jack out of the car halfway, for anything more than like five minutes, to do a charge or even stop with him in the car for more than five minutes, it's going to be impossible.” [ICE driver, female, aged 35-44].

Drivers with a mobility impairment often have elements of their lives that could impact their interaction with EV charging even if it isn’t directly related to their driving. For instance, people with mobility impairments may need to plan more time at the beginning and end of their drive to get to and from their destination, e.g. getting in and out of the car including storing walking aids, and using hoists, ramps and rooftop storage boxes. They may also find it less easy to access emergency help and may put more time into planning their journey, ensuring they have checked tyre pressures, and have food / drink / warmth / medication supplies with them in the car. As a final time pressure, the journeys of drivers with a mobility impairment will often be timebound e.g. travelling to medical appointments, pre-booked activities, and the possibility of needing to stop mid-journey for a time consuming EV charge can cause anxiety.

The key challenges for drivers with a mobility impairment or another vulnerability accessing EV charging infrastructure are detailed in section 6 and include:

- Having space to get in and out of the car

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<sup>27</sup> <https://www.apass4u.co.uk/blog/2016/02/learning-to-drive-with-learning-difficulties/>

- Having space to manoeuvre wheelchair / walking aids in and out of the car
- Physical strength to connect charging cables
- Physical ability / flexibility and space to reach and charge point especially where it requires two hands
- Reliable information about charge point locations, availability, speed and accessibility to manage anxiety and enable better journey planning

These challenges can result in heightened anxiety for drivers with disabilities and impairments, as they are not only having to overcome the general barriers of finding a suitable charge point, but also being able to use it without assistance. Thus the availability of information is crucial to dispel worries drivers may have. *David Livermore at AccessAble*, a charity which helps provide this type of information stated “Anybody who would regard themselves as having access challenges and access requirements, where information can provide some support in either reducing some anxiety or understanding how they can have an experience in that particular environment is what the information’s there for”.

Anxiety is generally increased if someone is not able to access their usual facilities due to the distance of the charge point from the venue, and for some, the increased planning can take away from the independence that driving gives them. Further consideration should be given to those with mental health conditions and anxiety whom may require more assistance when coming across challenging circumstances, as they may struggle asking for help or not want to get out of the car. *Caroline Jacobs at RiDC points out* “you could find yourself in situations where you need medication, you need loos, and you can’t get to these things. So, anxiety definitely increased..... it’s sort of multiplied in some way by some people with certain disabilities, some of the independence they gained by driving a car would be lost by driving an electric car”.

Those with an EV will have done extensive research before even test driving the vehicle they’d like to purchase to ensure it is the right fit for them. And those with a significant disability or mental cognition difficulties might have an appointee to help them with financial decisions. *Hayley Ingram at Motability Scheme* describes this “I think from a customer perspective, what we would normally have from that type of customer is an appointee. So, somebody who would do, effectively a line agreement, which is what our leasing is. So, we would probably have an appointee who would, maybe not make the decisions but again, could possibly be the one who does make the decision about the car that that customer has”.

Although often if their mental health condition is manageable the individual is able make informed decisions if the information provided to them is adapted to their needs, to aid comprehension. *Colin McAllister from the John Clarke Motor Group* explained: “The Apps are [good], it depends on what type of learning difficulty they’ve got, obviously. That’s such a broad spectrum. But a lot of autistic people if you get them focused on it that becomes the centre of their universe and they’ll know everything about it, and be totally obsessed with it.” Hence, accessibility of information and ease of understanding are crucial things which would assist customers in planning their journey appropriately so they’re prepared for charging method, space, and payment.

## 5. Enablers for EV usage for drivers with a mobility impairment

It is worth noting that there are many positive benefits to switching to EVs for drivers with a mobility impairment. Perhaps the biggest motivator for encouraging consideration of an EV is **familiarity**. Most ICE drivers, and especially those with disabilities or impairments (as interviewed for this research), have a notion that EVs are “the future” and are better for the environment, but have very little knowledge beyond that. Once they are given information about how EVs could work for them, and the benefits of EVs, they generally form a positive opinion and are more likely to consider switching.

## 5.1 Charging at home

Although there are challenges accessing EV charge points, the alternative isn't necessarily any better. ICE cars can only be refuelled by visiting a petrol station. Parking accurately, getting out of the car with an often very small gap between the car and fuel pump, manoeuvring the heavy pump nozzle, and paying (either at pump or in the petrol station building) can all be difficult for those with mobility issues as one driver explained "Not having to go to filling stations, that would be a great advantage because you know, there are days when I go, especially with some of the big forecourts, you fill up and then you've got to totter across to go and pay or whatever, you know there are days when I don't really feel up to doing that" [*ICE driver, SSEN, Male, aged 55-64*]. Certain innovations do help, i.e. phoning ahead or using an app such as Fuel Service or a My Hailo fob<sup>28</sup> to alert forecourt staff that the driver requires assistance. However, there can still be lengthy waits for someone to come and do a serviced refuel, staff are not always sufficiently trained in disabilities, and there can be problems with payment i.e. card payment terminals often aren't mobile enough that a driver can pay whilst sitting in the car.

Being able to charge at home provides independence and reduces anxiety by providing reassurance of guaranteed full charge for their journey. This also removes the experience of having to stop at a petrol station to refuel ICE cars, which is a challenge for some who don't have assistance whereas charging at home is done in the comfort of a familiar area. Even if an individual's disability or mobility impairment is severe, they are more likely to be able to plug in to charge their vehicle at home with assistance from friends, family or a carer. One accessibility expert mentioned "If you couldn't do it yourself, then you'll just know that someone, your next door neighbour or your carer or whoever, could... You'd sort something out, I think and that would be a much easier thing for your child to do".

Full EV cars (BEV) require no refuelling and use sophisticated monitoring so that the driver knows how much charge (and range) is left in the battery through the car. This reduces the risk of needing to charge during a journey, as drivers can plan their charge before leaving home. Assuming a driver with mobility impairments has off-street parking, and an EV charge point installed, they can always make sure their car has enough charge for the entirety of their planned journey, even if charging is required more often than a refuel of an ICE car (depending on EV battery size and ICE engine size).

## 5.2 Car journey length and range

The average car journey length is 8.4 miles in England<sup>29</sup> and 9.0 in Scotland<sup>30</sup>. Moreover, Motability members with a disability tend to have a lower car mileage than other drivers<sup>31</sup>. With most journeys being short, EVs would seem to be a very good fit for drivers with a mobility impairment as they would never need to visit a petrol station and would rarely need to charge en-route as even a small EV such as the Renault ZOE can drive 245 miles on a single charge. Stakeholders agreed with this sentiment believing that EVs are a good fit for those with a disability or mobility impairment because their journey lengths tend to typically be shorter. Hayley Ingram at Motability Scheme mentions "Lots of our customers do short repetitive journeys for which an electric car is absolutely perfect. And what we're finding I think is that most people, and this is the wider market as well, not just our disabled customers, are moving away from range anxiety because cars are coming on with big electric ranges". Hence, range anxiety should be reduced with a home charger and coupled with test drives, customers generally will feel more secure in their car.

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<sup>28</sup> <https://www.disabledmotoring.org/> and <https://www.myhailo.co.uk/>

<sup>29</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/905948/nts0303.ods](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/905948/nts0303.ods)

<sup>30</sup> <https://www.transport.gov.scot/publication/transport-and-travel-in-scotland-2019-results-from-the-scottish-household-survey/table-td5a-distance-distance-km-summary-statistics-by-mode-of-transport-2019/>

<sup>31</sup> <https://www.motaclarity.co.uk/news/buying-an-ex-motability-car>



Drivers interviewed agreed that their day-to-day journey lengths are relatively short, with their cars being essential for them to maintain an independent lifestyle. "Electricity is pretty much free to harvest via a couple of different methods... And I just think, well, why be so negative and selfish? I don't use my car the way I used to. It's purely a means of transport now. My option of going on long, lengthy journeys. Probably few and far between now. So why not go electric?" [ICE driver, UKPN, Male, aged 55-64]. All journeys have been severely curtailed during the coronavirus pandemic: "[Pre-covid] About once a week I would go to a supermarket for a top-up shopping. About once a week I have a medical appointment, either at the clinics, or at my GP or whatever. And I used to go out about once a week as well, to a place where I could use my mobility scooter with the door and my partner and go out for a good long walk." [EV driver, SSEN, Male, 65-79]. Many drivers regularly drive longer distances (1-3 hours) to visit family, attend medical appointments, and for leisure. Some have a partners / spouse that tends to drive the longer distances whilst others are keen drivers who embrace the opportunity for a road trip and like to stay in control.

One thing that all drivers interviewed had in common was that they plan their journeys in detail, particularly if it is a new destination. Planning includes checking the route / traffic, checking parking (often by using Google Street View), and investigating possible stopping points for toilets / facilities if needed en-route. "I always made sure I knew where the parking space was before I went anywhere. I used to look it up on my iPad and have a look at it and phone up sometimes if it didn't look alright." [ICE driver, SSEN, Female, Aged 80+].

The importance of public infrastructure becomes even more of a priority when an individual doesn't have the ability to install a home charger at their property. Despite the fact longest distance journeys are often a one-off trip to visit family or friends, there is concern about the amount of accessible charging infrastructure to enable the long-distance journey. However, this type of driving does cause more distress due to the increased planning element and factoring time spent charging along with facilities available. If an individual isn't comfortable making a long-distance journey in an EV, some companies offer free ICE car loans to Motability drivers that want to do a long journey and have range or charging anxiety, as well as advice and support to make Motability applications. Other companies including Specialist Vehicle Hire and Mobility Vehicle hire offer similar support to mobility-impaired drivers although awareness of such competitors to Motability is currently low.

Furthermore, what hasn't been factored into the range is the impact of mobility equipment and additional extra load which increase the power used by the car as mentioned by a stakeholder: "Although not all will be short distance drivers, and many will still have kids and extra loads to put in the car which can affect range. Mobility scooters especially can be very heavy". (Richard Shakespeare, a former Chair and current member of SSEN's Inclusive Service Panels).

### 5.3 Cost to Run

There are also financial benefits to owning EVs. The upfront cost of the vehicle may be higher (which can be a challenge if the driver is limited to mobility allowance rates and isn't able to top up with their own money) but great savings can be made over the lifetime of the car. Motability (and other companies such as Specialist Vehicle Hire and Mobility Vehicle hire) offer cars which often do not require a big lump sum payment upfront and are affordable through monthly payments, with typical leasing cost based on the residual value of the car. However, some drivers remarked that it remained difficult to afford a decent sized EV that comes in under the Motability cap unless they are able to put in a large upfront payment. EVs are typically 15% more expensive than ICE cars currently but this should be equal by the end of 2021 and with the increased availability of second-hand cars, ownership is set to increase. Therefore, as the second hand EV market increases, the residual value will also decrease making lease costs cheaper. EVs can save £1,000 a year on fuel, tax exemptions, congestion charges and maintenance. However, stakeholders noted exemptions on congestion charge are not very well communicated and differed by local authority, meaning many aren't aware of this perk. Some of these savings are also made from holding a Blue Badge, this is helpful as vehicle adaptations for disabled drivers can be expensive – The Papworth Trust estimates that disabled people spend an average of £550 a month on costs related to their disability including specialised

equipment and additional costs such as extra heating<sup>18</sup>. An example for a full EV charge at home would cost £8.40 for a 60kW battery with 200-mile range, potentially rising to £13 for a one hour 200-mile fast charge at service station<sup>32</sup> which is significantly less than filling a petrol or diesel tank.

Furthermore, EVs are cheaper to maintain as there are fewer moving parts to check and look after compared to ICE cars. Brake pads need replacing less often as braking is done by the engine (when you take your foot off the accelerator the battery starts to charge and the car slows down), there is no oil to change and no filters to replace. For Motability or other lease car drivers, the concern about the cost of replacing an EV battery is generally unwarranted as the battery guarantee is longer than a typical car lease.

There is low awareness of the actual costs of owning and running an EV (discussed in more detail in the 'Barriers' section of this report), although EV owners do appreciate the cost savings: "I presumed running costs would be tiny, and they are indeed tiny. The most important, the biggest running cost is my insurance" [EV driver, SSEN, Male, aged 65-79].

Although the mix of different Charge Point Operators (CPOs) and connector types can be confusing, most public charge points have a choice of connector types, or (for slower chargers) drivers can use their own cable that came with their car. Apps such as ZapMap detail the different connector types and charging rates on a map of charge points, but as yet there is no mention of how accessible each charge point is to those with mobility-impairments. ICE drivers have little understanding of the different connector types unless they have actively considered an EV. This lack of awareness means that the barrier is not apparent until they start to do their research. Drivers leasing an EV from Motability also get free installation of a home charge point (saving up to £800) and access to the Polar (BP Pulse) charging network - saving £7.85 per month - as part of a partnership with BP Chargemaster<sup>33</sup>. *Hayley Ingram at Motability Scheme points out* "Everything is fully included so, realistically their only cost should be their fuel that they put in it. Now that will be on average twelve to fifteen pence per mile effectively. Now, if you have an electric car, that is about three to five pence a mile. Now, bearing in mind that's their only cost, we would hope that we would have more customers engaged."

Leasing companies such as Motability and organisations that represent and support disabled drivers (such as Disabled Motoring UK) are important channels for educating drivers about the enablers of EVs. However, there is a large group of drivers with disabilities or impairments that do not use any of these organisations. It is these drivers that are at most risk of being left behind as they will have the least access to information.

## 5.4 Additional benefits

It is also important to consider enablers for other vulnerable groups. As discussed in section 4, drivers that may have difficulty adopting new technologies will have additional barriers to transitioning to EVs. Elderly drivers may fall into this group. Age UK offers a range of services to older people including transport. Whilst not primarily aimed at drivers, the following benefits of their electric vehicles used for transport in Cornwall<sup>34</sup> can also be applied to drivers:

- They help build community resilience (empowering the public to harness local resources / expertise to help their community to plan and adapt to Long term social and environmental changes)
- They are environmentally friendly
- They are easy to use and fully accessible
- They are cost-effective

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<sup>32</sup> Guide to EVs for disabled drivers. March 2019 <https://www.ucan2magazine.co.uk/motability/electric-cars-disability>

<sup>33</sup> <https://news.motability.co.uk/scheme-news/an-easy-charging-solution-for-electric-vehicle-customers/>

<sup>34</sup> <https://www.ageuk.org.uk/cornwall/our-services/electric-vehicles/>

- They reach some of the most isolated people
- They are peaceful and serene

The environmental feel-good factor is something which appeals to many and is seen as an added benefit when considering switching to EVs. *Caroline Jacobs from RiDC points out* “It’s the same reason that anybody else would like to have an electric car. They feel that it’s a good thing to do for the environment, it’s a green thing. They would like to not be churning out fumes. So, in principle people do want to go green.” Drivers consistently mentioned a desire to be more environmentally friendly as their primary motivation should they switch to an EV.

Additionally, the design of EVs can benefit drivers with a mobility impairment as the lack of a gearbox with an automatic car frees up space internally. Often those that lease a car through a disability specialist such as Motability, Specialist Vehicle Hire or Mobility Vehicle hire will have an automatic gear stick, so their transition to driving an EV isn’t as dramatic as someone moving from a manual drive to automatic. Automatic cars are also preferred by many drivers with a mobility impairment as they are less physically demanding to drive. That said, some elderly drivers interviewed for this research were loyal to manual cars as they are familiar with them and believe they meet their needs better (e.g. different pedals / different handbrake placement). Also, the battery of an EV can reduce boot space which leaves less space for medical equipment and often a larger car will be required.

Customers with mobility impairments aren’t always the driver of the car (family / carers) and so many mobility related barriers are less of an issue than for customers who are vulnerable and drive themselves. Car owners who do not drive themselves are not, however, passive consumers. They appreciate the independence that having their own car gives to them (even if they need to organise for someone else to drive it) and are often fully engaged in the decision making and purchase process. As one mobility impaired car owner explained: “Anybody and everybody [can drive my car] I’ve got an open insurance... Carers, friends, family, everybody... I would say that I am a very strong, independent individual.” *[ICE owner / non-driver, WPD, Female, aged 65-79].*

## 5.4 Support provided by organisations to transition to EV

### 5.4.1 Car Manufacturers and charge companies

Motability and other disability leasing companies play a big role in enabling the purchase and modification of EVs to make them fit for purpose for those with additional mobility requirements. Organisations such as Allied Motoring specialise in the production of fully wheelchair accessible cars and multi-purpose vehicles which can then be leased or purchased through Motability. Motability also has a scheme where it assesses the suitability of an EV to an individual by taking photos and measurements of the boot space to establish whether a wheelchair or mobility equipment will fit into their chosen car. This offering will be further developed to help assessing the suitability of charge socket placement and charging cables in the future. Motability also works with manufacturers to communicate what their drivers are looking for and provide the widest choice to drivers, advocating on behalf of drivers to push for more wheelchair accessible vehicles (WAVs). “We deal with the manufacturers and agree purchasing terms effectively on a quarterly basis with thirty-two different manufacturers and we will then buy the cars that our customers want through their franchise dealers. ...The choice is definitely increasing” *Hayley Ingram at Motability Scheme*. Furthermore, Motability work with BP Solar to offer free charging to customers, either by providing a free charge point fitted at home or by accessing the BP Polar network of public charge points. It was noted that other dealerships also offer similar incentives, and free charging at dealership sites.

This type of support is really important because more often than not, individuals with a disability or physical impairment are not provided with the same customer services as someone without additional lifestyle challenges “we find when they [Motability customers] come into site, they make an appointment with us because they don't

want to be messing around, they feel a lot of places treat them like a second-class citizen, so they'll phone to make an appointment and get a feel for how they're treated. They'll come in at a specific time, because, they've got to organise stuff. It's like a military operation for them to do anything. They'll come in and they'll have done their research, saying, I know this and I know that and I know this, and I want to see this car because I'm concerned about this one bit" *Colin McAllister at John Clarke Motor Group.*

That said, many drivers with disabilities and impairments either don't qualify for Motability or choose not to use Motability. These drivers are likely to be exposed only to "mass market" information on cars and EVs and may be less likely to consider an EV as suitable for them. There is another group of drivers that are digitally disengaged and will not have the same access to information as digitally confident drivers. It is important that non-Motability and non-digital vulnerable drivers are identified and provided with information in a clear and appropriate format.

Urban Electric "pop up" pavement charge points also take into consideration the needs of drivers with disabilities as drivers can use their app to raise the bollard out of the ground and stop it at a length most beneficial to them. This solution works well for EV drivers who also own a smart phone, but needs additional work to be suitable for those with non-smart phones. *Keith Johnston at Urban Electric* explains "Because we're on the pavement we've tried to design a charge point that works for everybody. In addition to minimising the street scope impact, our key design criteria is that it meets both the minimum height for socket regulations and the guidelines for inclusive mobility. Because our charge point goes up and down we don't have safety bollards around the charge point. When it's up it's going to have a car parked next to it, therefore not really likely to drive into it, so we don't need loads of safety bollards. The height of the bollard, the height of the socket is hip height."

Vulnerable drivers interviewed were most likely to say they would go to Motability and/or a trusted local dealership for information and support. Many drivers are very loyal to a particular manufacturer that they know meets their needs and having a local dealership for their preferred make of car is important. They want to know that they will get a personal level of service and information they can trust. Two drivers interviewed described how the closure of their local dealerships had been a major challenge when they wanted to get a new car. Using dealerships as a channel of information will be important for convincing the majority of drivers with disabilities or impairments to switch to EVs.

## 5.4.2 Accessibility Organisations

Organisations like AccessAble and People's Parking are working to provide more information in the public domain which is easy-to-read and in pictorial formats about accessibility at car parks, charger points and other facilities. AccessAble and People's Parking are hoping to work together more to audit car parks and public spaces with a mind to provide drivers with a disability or mobility impairment more information on accessibility. Zap-Map already have a payment functionality to the app so that drivers can check location and availability of charge points, and pay for charging all within the one app. This has been furthered by AccessAble who are developing a website that will connect to Zap-Map and give additional information about charge point accessibility e.g. height as it was highlighted there are differences in provision between local authorities. *David Livermore at AccessAble* mentions "What we were going to include is the process of payment, as well as the specific on how you use it. So you've got the physicality of how high it is, in terms of how it operates, as well as the charges. And there's a link through to Zap Map as well. So you can see if it's actually working".

The RiDC (Research Institute for Disabled Consumers) and DMUK (Disabled Motorists UK) were both mentioned by drivers as organisations that would be trusted to provide information and advice on EVs. That said, drivers with disabilities or impairments are most likely to contact their dealership, Motability, or other (non disability-specific) organisations such as Car Wow or Which?, or do a Google search if they wanted information about EVs.

### 5.4.3 DNOs

DNOs have a unique and essential role in this area by supporting all customers thinking of installing an EV charger. Across the UK, when a EV charger is going to be installed, be that domestic or commercial, off-street or on, the DNO must be notified to ensure the safety of the property and that the network has sufficient capacity to support the charger, which is especially important as EVs become more widely used. To make this process simple for drivers, all UK DNOs provide guides and webpages related to this topic, often covering the following areas:

- A step-by-step guide on how to get a charger installed
- Types of chargers and the impact these have on the electricity network
- Timings and costs of getting the charger installed
- SSEN provide an online application form and signpost their EV strategy. Additionally, offering a PDF document to explain EVs further and the step-by-step connection process
- Electricity North West (ENWL) and Northern Powergrid (NPG) include flow charts to visually explain their involvement in the process
- Western Power Distribution (WPD) provide an EV capacity map of their region, showing where capacity is strongest and weakest in minute detail and whether managed charging would be needed. WPD believe this map would be particularly useful for local authorities before installing public charging infrastructure.

In addition, some DNOs do also play a more general role in educating their customers about EVs. SSEN, ENWL, UK Power Networks (UKPN), NPG, SP Energy Networks and WPD all included broader information on their website including:

- What EVs are
- Costs of running
- Frequently asked questions (FAQs) about EVs
- Government grants
- ENWL and UKPN also included links to ZapMap.

## 6. Barriers to EVs for drivers with a mobility impairment

There are four main barriers to nationwide EV uptake, which government and industry are addressing:

1. Availability and cost of EVs
2. Range anxiety (actual range, plus charger availability)
3. Inadequate charging infrastructure and high connection cost for EV charger, especially in areas with little residential electricity demand
4. Flexibility of choice between different charger providers in terms of both a lack of a universal connector, and different payment models / apps between providers

These barriers do not differ for drivers with a mobility impairment and for the most part nor do the solutions, although there are some additional considerations for this group. For this report we are focused more specifically on the barriers to EV charging for those drivers with disabilities or elderly drivers, and what this could mean for SSEN in helping to ensure 'no one is left behind' in the switch to EVs.

Improving accessibility of EV charging is beneficial to all drivers, not just the mobility impaired, as highlighted in a Connected Kerb report<sup>11</sup>: *"Current charging points are difficult to use for many disabled drivers and this needs to be*



*addressed as adoption becomes mainstream. 84% of both EV owners and non-EV owners agreed that charging points need to be adapted for users with disabilities.”*

The barriers recognised by stakeholders are similar to those identified in the literature review. However, they can vary dependent on the perspective of stakeholder, with technological and transport experts believing charging stations and technology approval to be a barrier in transitioning people to EVs, whilst accessibility experts recognised the whole range of different challenges dependent on the impairment or disability the individual might have.

For drivers with disabilities or impairments, barriers are dependent on the individual’s level of familiarity with EVs. For those with very little knowledge, the top barriers are perception of cost and range anxiety. Those with more awareness are more likely to state practical barriers such as physical ease of charging. Barriers decrease with first hand experience of EVs as one driver explained: “I still have a little bit of anxiety about going on a long journey, but otherwise yes, I'd say they've pretty much disappeared now [that I have experience of driving an EV].” [EV driver, SSEN, male, aged 55-64].

## 6.1 Barrier 1: Availability and accessibility of charge points

The physical act of using an EV charge point can be a real challenge for those with mobility problems, with different considerations depending on the charge point location. Having access to a domestic off-street charging point at home means drivers can ensure it is sited in an accessible position. Drivers without home charge points, and those requiring en-route or destination charging are likely to experience greater challenges depending on the nature of their mobility problems. Zap-Map, the leading EV charge point mapping service polled 2,200 EV drivers in a 2020 study, of which 8% were disabled<sup>19</sup>. The survey identified some specific issues experienced by disabled EV drivers:

- Finding a public EV charger that they could access given their mobility needs
- The physical force required to connect the connector
- The weight of charging cables
- Lack of dropped kerbs
- Unsuitable parking arrangements at EV charge points

Dr Ben Lane, Zap-Map’s CTO and Joint MD: *“The results of the Zap-Map/Motability survey should serve as a warning to the industry to sit up and take notice. Many disabled people will be thinking about investing in an electric vehicle but could be put off by a lack of accessibility at public charge point locations.”*<sup>19</sup>

### 6.1.1 EV Charging at home

Those fortunate enough to have off-street parking at home are able to have some input into choosing the most accessible charger location. However, unless the driveway / off-street parking is very spacious, drivers with a mobility impairment may need to park at a certain angle to be able to comfortably get themselves and any mobility aids in and out of the car. This might not be the most convenient angle to connecting to an EV charge point. Choice of car can help in this situation as some have side / rear charging sockets and some have a socket on the bonnet.

The SSEN / Regen study<sup>10</sup> showed that drivers with a mobility impairment in non-urban areas and more affluent areas are likely to have better access to private off-street parking due to a greater prevalence of properties with driveways. These areas will have the most significant growth until 2040 when it will level off due to saturation of EVs in the market. There are currently over 16,000 domestic charge points in SSEN’s Southern England license area, and over 2,000 in the Scotland license area.

Drivers with off-street parking are concerned about the cost of installing a charge point and may not be aware that this is often covered by Motability / other financing deals. Those with the lowest familiarity (including some very elderly drivers) are worried about having trailing cables from their home plug sockets out to the car. "If I've got to plug a cable in every night it's like where do I leave it when I'm not using it. How awkward fiddly is it to plug it in, I don't have the best dexterity in the world." [ICE driver, WPD, Male, aged 45-54].

### 6.1.2 EV charging in public car parks

Aside from residential parking, most EV charge points are in car parks (45% in public car parks, 34% in retail car parks<sup>35</sup>). EV parking spaces are not usually as large as disabled (Blue Badge) parking spaces. Disabled EV parking spaces are few and far between, with the UK's first only installed in January 2019 in a new public NCP car park in Salford. Sean Fenney, NCP Head of Operations for Manchester said "We were pleased to be able to add our first dual electric charging bay for our disabled customers, as we expect that to be a very real need in the near future<sup>36</sup>."

It has also been noted that some disabled parking has been converted into EV spaces, which limit the space available for those still driving petrol cars. "I think Warwick service station on the M4 is a good example, spaces that were accessible spaces have now been replaced by spaces for electric vehicles, which means that actually the disabled parking has been moved further from the door, and they weren't particularly close to the door, they weren't lots of them in the first place. I think we've lost two or three I noticed last time. So I've ended up, rightly or wrongly, previously going, well there's probably more people with a disability that need a space than there are currently using electric vehicles, I need to park near the door, so I'm going to park in the electric vehicle space, even though I don't have one because I need the space." *Accessibility expert*. Drivers interviewed also shared anecdotal evidence of disabled parking spaces being converted into EV charging spaces, or being lost altogether to redesign access to retail spaces (e.g. garden centres and shopping centres) during the coronavirus pandemic. In 2016, the EV Association Scotland released their Electric Vehicle Charging Infrastructure design guide. A specific recommendation is made not to turn existing disabled parking spaces into shared EV spaces as combining them deprives the disabled users of spacious parking spaces that are near the prime locations. This is in line with guideline examples from the USA, which state that accessible EV chargers should always be in addition to existing disabled parking spaces<sup>8</sup>.

In 2020 the British Parking Association (BPA) conducted a unique nationally representative survey of parking perceptions amongst 3,007 drivers, including 468 disabled drivers<sup>37</sup> (not necessarily EV drivers). Parking was found to have a significantly higher impact on disabled drivers in comparison to the general driving population, placing higher value on the need for parking management and enforcement. Significantly more disabled than non-disabled drivers said they were dissatisfied with parking in their local area, with "not convenient / not close to where I shop or pursue leisure activities" being a key reason for dissatisfaction.

Whilst there are standards for the design of car parking spaces, including disabled bays, there is currently no particular guidance for disabled EV charging spaces. Disabled Motoring UK (DMUK) has launched a parking standard called the Disabled Parking Accreditation (DPA) which recognises off-street car parks that are accessible to disabled people and will soon include a dedicated section on EV charge point provision. It is an independent not-for-profit, IPO recognised scheme run by DMUK and managed by the British Parking Association<sup>38</sup> and aims to improve parking standards for disabled drivers. DMUK is working with Motability, OZEV and British Standards to lay down these new standards for disabled EV charge point provision and will publish these once they are agreed. The People's Parking

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<sup>35</sup> British Parking Association: Connected Values – Integrated systems and thinking in parking. December 2020

<sup>36</sup> First disabled EV parking space: <https://chargedevs.com/newswire/a-charging-spot-for-disabled-ev-drivers/>

<sup>37</sup> [Public Perceptions of Parking BPA Dec2020.pdf](https://www.britishparking.co.uk/public-perceptions-of-parking-bpa-dec2020.pdf) (britishparking.co.uk)

<sup>38</sup> <https://www.disabledmotoring.org/>

accreditation also aims to improve car parks for customers by highlighting those with facilities for disabled people, parents, commuters, cyclists, motorcyclists, EVs and those who drive wheelchair accessible vehicles or camper vans. Car park operators can sign up to the accreditation and receive guidance and benefits such as being listed on the database and compliance with the Equality Act 2010, but this is not mandatory<sup>39</sup>. The DPA currently has no mention of recommendations for accessible EV charge points.

Various codes of practice on accessible EV parking spaces operate in the USA, which broadly advise the following<sup>16</sup>:

- *Accessible spaces at EV charging stations should not count toward the minimum number of accessible car and van parking spaces required in a parking facility*
- *Charging stations should be located so they have access for a person in a wheelchair on an accessible path*
- *Reach range and turning radius requirements from ADA (Americans with Disabilities Act) are good standards for accessing the equipment*
- *Use caution that bollards and wheel stops do not obstruct the use of the charging station*
- *In lieu of a specific requirement, the number of accessible EV charging spaces provided should be evaluated by taking the total number of EV charging spaces and assuming these are a separate facility when applying the table of required accessible parking spaces*
- *Consideration should be taken when locating stations so that cords do not block pedestrian paths or accessible routes when plugged into a vehicle*
- *Accessible EV charging spaces should be distributed on a site in a similar concept to the requirements for other ADA parking spaces*
- *Charging equipment should not encroach into parking spaces or access aisles*
- *Charging equipment can be shared between an accessible EV charging space and a regular EV charging space*

Charge point location within a car park depends on ventilation and cooling needs as airflow is critical for safe operation and to prevent overheating. Ceiling placement has been considered to save space in car parks<sup>17</sup>. But this presents particular challenges to drivers with a mobility impairment who may be unable to reach up high for the cable.

In December 2020, Gridserve opened the world's first fully electric forecourt in Braintree, Essex<sup>40</sup>. It provides charging (with a choice of speeds and costs) for up to 36 cars at the same time along with retail units, toilet / changing facilities, free WiFi and business meeting rooms. Whilst there are standard disabled parking bays, these are not EV charge points, and there is no mention of enhanced accessibility of the charge points on their website.

### 6.1.3 EV charging on street

Charge points can often be located in dark areas, without additional security monitoring. This can be a safety risk to drivers with a mobility impairment who may find it more convenient to wait inside the car for it to charge than to leave the car and walk to a shop or better lit area. On street charge points are unlikely to offer the fastest charge speeds as more powerful chargers are most likely to be used for inter-city journeys, i.e. at motorway service stations and tourist destinations<sup>17</sup>.

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<sup>39</sup> <https://www.peoplesparking.org/Benefits>

<sup>40</sup> <https://gridserve.com/braintree-overview/>

Drivers with disabilities and impairments describe how they plan their journeys in detail before leaving home, and parking is the most important thing to plan. Drivers will check parking apps and use tools such as Google Streetview to make sure they know where will be most suitable to park to be near their destination, and have enough room to exit the vehicle and take any mobility equipment out. The perception amongst mobility impaired ICE drivers is that finding parking spaces that meet their access needs and have the right charge point connector will make parking much more difficult.

On street charge points rarely have a dropped curb, making access difficult for drivers that have problems walking or lifting their legs. Drivers with a mobility impairment may have to stand in the road / gutter if there is no dropped kerb, where it is more likely to be dirty and slippery, particularly in poor weather.

In general, local authorities are not prioritising EV charging points currently as the demand for EVs is still relatively low, hence those we engaged with reported no specific considerations for EV designs for mobility impaired drivers so far. This will come once demand has increased within their region and investment is provided by central government. Local authorities do face challenges in identifying where to put charge points; rapid versus fast or standard and suitable locations to put these different hubs. Traffic management also provides an additional challenge: fitting chargers into busy streets and finding solutions close to popular destinations which won't increase congestion. This inherently creates competition for busy locations in terms of ICE parking versus EV parking. Furthermore, there is also a conflict of putting roadside chargers in where it may restrict mobility alongside the pavement for pedestrians. Some local authorities are very knowledgeable and have an 'expert' in the department, whereas others haven't started to consider charging stations. Hence, national coordination and strategy is needed to ensure all authorities are approaching this issue consistently.

From a technical perspective for charge point companies, collaboration with local authorities and DNOs is important; "It's a very complex thing because the process of on-street infrastructure involves the DNO's in grid connections, so, is there available power? For example, not a hundred percent of streets are suitable... Is there sufficient power that's within affordable reach? ...Are the utilities where the utilities map says they are?" *Keith Johnson at Urban Electric*

There is some appetite amongst private companies and start-ups to create new charge point innovations that could help overcome barriers. Although commercially, it is only those companies with significant funding who are able to develop these innovations because funding and support is mainly provided for standard 'slow' Type 2 7-22KW AC charging projects and it can therefore be difficult to make a profit. More support is needed for companies developing solutions for more niche barriers (including mobility-impaired drivers).

#### 6.1.4 Practicalities of using EV charge points

The Research Institute for Disabled Consumers (RiDC) published a research report in July 2020<sup>41</sup> that included the results of a practical exercise where drivers with a mobility impairment were asked to test a range of EV charge point designs. The research highlighted the challenge ahead in making EV charge points truly accessible:

- Not enough room to get wheelchair around to charger
- Charger position and cable length means car has to be parked in very specific way
- Cable can get in way of opening boot – problem for WAV (Wheelchair Accessible Vehicles) and getting mobility aids out
- Cables are heavy and stiff. Hard to carry and plug in if physically weak or using crutches / stick.

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<sup>41</sup> Research Institute for Disabled Consumers (RiDC): Going Electric? Research report into the accessibility of electric vehicles. July 2020.

- Cable would get dirty from resting on the floor which is unpleasant for wheelchair users to hold on their lap, particularly in wet weather
- It is hard to line up the connector to plug in correctly especially when leaning from a wheelchair
- Chargers aren't all under cover (it is difficult to hold an umbrella at same time for all drivers but especially mobility-impaired)
- Most charge points require two-handed operation e.g. to manoeuvre cable or lift the flap before plugging in connector

A Zap Map/Motability survey in December 2020<sup>19</sup> also asked disabled EV drivers for their experiences of charging and found that one third of disabled people surveyed had difficulties locating a suitable charger that could meet their needs, with one in seven noting their very specific challenges with the weight of charging cables. The survey also revealed that some users experienced difficulties with the force required to attach the connector, the lack of dropped kerbs around charge points, and unsuitable parking arrangements.

Mobility impaired ICE drivers interviewed for this report generally had little understanding of the ease (or not) of using a charging point as they had never had reason to look at them properly. Drivers with experience (either from owning their own EV or seeing friends / family experiences) were more likely to agree with the barriers identified in the literature review. "I'm more mobile than some. I was going to say that does seem a barrier for people in a wheelchair, the height of the cables or the weight of dragging them across. I could manage that reasonably well. The only one I did have some slight reservations about having watched various videos and so on, is I noticed the MG electrics where the plug is under the front radiator grill it hinges upwards so you have to get down quite low to see what you're doing to get the plug in. I might have problems with that." [ICE driver, SSEN, Male, aged 55-64]. One driver explained the practical difficulties he sometimes faces with his EV: "I turned up at one place right and it was almost as though he had just decided that no disabled person was going to be able to do this on their own because they had put the damn thing onto a curb that was far too big to go up, a really chunky curb and then they'd put their bollardy things obviously to protect it from being bashed into, sort of in the way and I was stuck. Fortunately, there was people charging their car next to me and I just said, can you give me a hand and they were fine with it. They just plugged it in for me and that was great but there's no need for that" [EV driver, SSEN, Male, aged 55-64].

From a technological point of view there are limited innovations which could improve the thickness or weight of the cable and charge point providers haven't given much consideration to this issue yet, hence dexterity is still a challenge for many at charging points. Individuals have become familiar with asking for support at petrol stations with the touch of a button to alert the staff that they need help refuelling. Nothing like this exists at charging stations apart from a helpline but this can vary dependent on charger, so if a customer struggles from a dexterity point of view there isn't any additional support available which inherently creates more anxiety for the driver, in case they do have issues with the charger. There is also an inconsistency of chargers and leads which can create confusion for the driver. This was stated by Disabled Motoring UK and AccessAble as being an additional challenge when it comes to assessing how accessible the charger is to the individual.

This was also echoed by BPA study<sup>30</sup>, revealing safety and convenience of locations were significant concerns when parking for disabled drivers, with notable dissatisfaction concerning bay sizes and obstructive parking in comparison to other drivers. Disabled drivers were less sensitive to the cost of parking than non-disabled drivers, and were more likely to state environmental considerations as a factor when deciding where to park.

Other sources provide evidence of further challenges accessing charging equipment. Chargers are typically at standing height which is difficult to access for wheelchair users and those with height limiting mobility issues. This

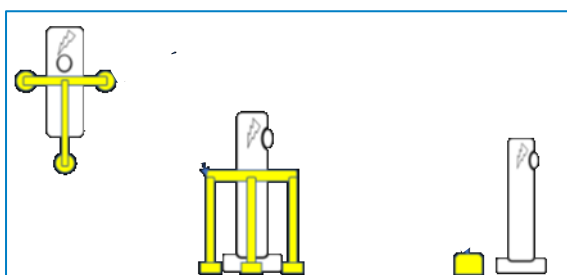


problem has been addressed in other areas such as washbasins in toilet facilities, car park payment machines, and lower counters in shops, but it is not currently a consideration for many EV charge point providers. The IET (Institute of Engineering and Technology):

*“propose that similar height considerations are made for charging equipment, where the mounting height of the charger is no more than 0.75m and the control screen is no higher than 1.2m above the ground. However, for charge points, particularly wall mounted units, once a vehicle is parked, access to the charge point can be restricted, with a wheelchair user potentially unable to move between parked cars to reach the wall to plug-in. Disabled parking bays tend to be more generously sized, but charging may remain an issue within these bays and there will be opportunities for design innovation.<sup>17</sup>”*

Anti-collision bollards / barriers and wheel stops fixed to the ground are recommended by the IET Code of Practice on Electric Vehicle Charging Equipment Installation and are often used around EV charge points to prevent vandalism or being hit by cars<sup>17</sup>.

Examples of anti-collision barriers to protect charge points:



These all cause access issues to drivers with a mobility impairment. They may make it harder to stretch and reach the charge point and they may mean there isn't enough room for a wheelchair to get right up to the charge point.

The 2016 California Building Code<sup>42</sup> has clear guidance on providing accessible EV charging points. This includes requirements for unobstructed accessible routes between parking space and charger, access aisles extending the full width of the parking space, and that the charging cable must meet reach and clear floor space access standards.

## 6.2 Barrier 2: Cost

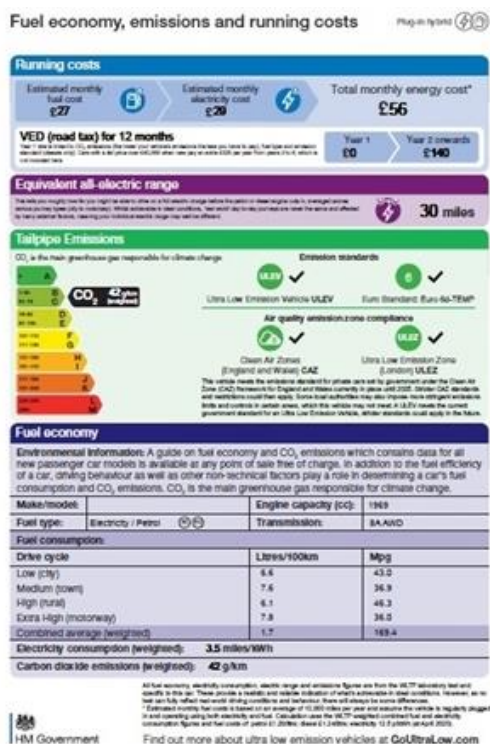
As detailed in the previous section, cost can be an enabler to EVs as the saving versus ICE car fuel is significant. However, depending on circumstance of the driver, the upfront car cost, electricity and maintenance can be more expensive than for ICE cars. Driving can already be more expensive for drivers with a mobility impairment than able-bodied due to adaptations needed to the car, increased insurance costs, and additional mobility equipment needs. The Motability scheme (covered by the Higher Rate Mobility Component of the Disability Living Allowance) will organise and fund many adaptations to the car for those drivers that use / qualify for it but this does not cover all costs. Wheelchair users and those who require substantial mobility equipment also have to consider the size of vehicle to ensure there is enough boot space. Many drivers are worried that the placement of batteries in the boot (and reduced boot space) would mean they would need a larger, more expensive car to fit their mobility equipment into.

Additionally, not all EVs are suitable for all mobility related adaptations and so options can be limited when drivers are looking for a new EV (especially larger vehicles). Some drivers find they are encouraged down the route of buying a

<sup>42</sup> 2016 South California Building Code: [file:///C:/Users/NB/Downloads/EVCSPresentation\\_04-07-17p.pdf](file:///C:/Users/NB/Downloads/EVCSPresentation_04-07-17p.pdf)

van as affordable EVs just aren't large enough for their needs. John Clarke Motor Group believe the challenge post Brexit is getting enough cars shipped to the UK due to the change in regulations, which make shipping to the UK more difficult, hence fewer ranges of cars available. More battery manufacturers in the UK would help combat this issue to an extent. The "Smart and Fair?" project conducted by CSE, SEN and WPD aims to help support EV take-up. The project is looking at the capabilities, characteristics and attributes which are required of consumers to switch to and benefit from EVs<sup>7</sup>.

A government report in July 2020 suggests this barrier can be addressed with better, standardised labelling to show costs of EV over lifetime of car, rather than just comparing purchase price with ICE cars. Such as the new environmental labelling by Low Carbon Vehicle Partnership shown below:<sup>43</sup>



Perceptions from ICE car drivers with disabilities or impairments are that EVs are very expensive, and that they won't get as much for their money (especially if subject to the Motability cap). "It would depend on the cost. I mean I have to pay extra for the vehicle and the modifications and I've then got to pay extra again for a charging point. It all adds up" [ICE driver, WPD, Male, aged 45-54]. Drivers expect batteries and maintenance to be expensive but appreciate that most of this would be covered by lease payments. Better information and labelling would improve price perceptions as most drivers interviewed for this research did not have a good understanding about the savings possible with EVs over the whole lifetime of the car.

### 6.3 Barrier 3: Psychological barriers like range anxiety

The range (number of miles that can be driven in one full charge of the battery) is well documented as a barrier to EV uptake in the general population. Drivers with a mobility impairment are likely to be more risk averse<sup>44</sup> than able-

<sup>43</sup> Department of Transport and OLEV: Driving and accelerating the adoption of electric vehicles in the UK. July 2020

bodied drivers and are more likely to be affected by EV range anxiety<sup>41</sup>. Being able to travel independently is key, and so journeys are often subject to a higher level of planning and preparation than for able-bodied drivers. Uncertainty about where and when they may be able to charge is a key barrier for many drivers with a mobility impairment. The amount of time out of their day needed to find a charger and charge their car is a further unknown.

Drivers with a mobility impairment may also have specific needs that genuinely impact the range of their EV battery, potentially giving them a lower range. Average journeys for drivers with a mobility impairment are short, and tend to be on minor roads. These journeys are more susceptible to heavy traffic and roadwork delays and such “stop and go” driving can have a big impact on range.

Mobility-impaired drivers interviewed agreed that EV range would be suitable for the majority of their regular drives but would be wary about relying on public charge points for longer journeys. "Yes, but like I say, ninety nine percent of our journeys are quite short anyway. So it wouldn't be a major problem. The only time it might be a problem is if we go on holiday anywhere." [EV driver, SSEN, Male, aged 55-64]. Holidays are often taken in the car, and range anxiety can be a major barrier, especially abroad: "In present car, I've got heated seats, a heated steering wheel, if I've got the fan going as well and the radio on, all of that is draining power, which reduces range. We aim, when we were driving through France, Spain, Portugal, to do roughly around three hundred miles a day and then we've pre booked a hotel in the area that we're going to. So I'd want to be sure that I could do all of that and find a charging point..." [ICE driver, UKPN, Male, aged 80+]

Drivers use words such as “panic”, “stranded” and “stuck” when talking about range anxiety and the possibility of running out of electricity mid-journey. This emotive language needs to be countered with real life solutions. For instance, one EV driver ran out of power and was helped by a nearby house who let him plug into his garage power socket overnight.

Adaptations to a car to help with mobility issues often use more energy than an un-adapted car. Adaptations to help with driving (hand leavers to replace pedals, steering balls, keypad controls etc) and adaptations to help getting in and out of the car (powered seats, hoists, wheelchair ramps) will all have an impact on range both due to the extra power they use, and the additional weight load of the car. Having the heating (or heated seats) on more than average can help manage conditions such as arthritis and back pain and this energy use can also reduce range. Given the fact we know this drains the battery, specific uses haven't been taken in consideration by manufacturers. Hence, the ranges advertised are ideals which don't take into account additional equipment on board. Furthermore, some motorists naturally have range anxiety from the poor reliability of their electric wheelchair, so accuracy with ranges is important as it enables individuals to trust the vehicle and plan efficiently for those journeys which are longer than their average. *Caroline Jacobs at RiDC* states “Technical thing, which is that some drivers have basically got hoists and things like that in their cars which use electricity, or they're using a lot of air conditioning or heating or something – I think it was the aircon that was the main thing – but other aids and equipment that drivers with a disability use that actually charge against your battery. You might find you get there, and then you can't get your hoist working because the battery has gone flat. You can't actually get out of the car.”

Research by Connected Kerb has identified a concern amongst disabled drivers that disabled blue badge parking spaces are being removed to make way for more (non-blue badge) EV charge parking spaces. This perception was repeated by the drivers interviewed for this research and fuels the perception amongst some drivers with a mobility impairment that EVs are not appropriate for them.

TfL (Transport for London) are committed to increasing EV uptake amongst disabled and elderly drivers and have identified the above psychological barriers as important to overcome. In TfL's 2016 report<sup>44</sup> they found that drivers

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<sup>44</sup> <http://content.tfl.gov.uk/gauging-interest-for-evs-among-disabled-and-elderly-drivers.pdf>

with a mobility impairment are reliant on their cars, risk averse and “*acutely aware of, and sensitised to, anything potentially going wrong and disrupting their experiences*”.

Any loss of independence from having problems with their car or finding themselves out of charge can increase anxiety. Needing to stop en-route to charge an EV is challenging when there is very little information on where accessible charge points are, and whether they are busy / operational even when using apps such as Zap Map. Confusion over the different payment models for Charge Point Operators, and whether the correct connector type is available can heighten anxiety levels.

Solutions must be simple and reliable. Both TfL and the Department for Transport (DfT)<sup>45</sup> agree that exposure is important to reassure drivers with a mobility impairment. Access to information on nearby EV charge points could be improved, and test drives should be encouraged (although drivers with a mobility impairment don't necessarily want to be treated any differently than able-bodied drivers). EV test-drive sites such as the Milton Keynes EV Experience Centre<sup>45</sup> could be rolled out nationally to enable drivers to test out EVs although there is currently no mention of any special help for drivers with a mobility impairment on their website. The DfT also recommends extended no-fee Personal Contract Plan / lease cancellation periods (Try before you buy) or short-term 2-3 month or monthly leasing options so that drivers can try living with an EV (and charging it) without paying high car hire rates.

#### 6.4 Barrier 4: Lack of information on accessible charging

Specialist organisations such as Motability, Disabled Motoring UK and publications such as UCan2 the driving magazine all provide information on driving EVs. However, this information is not presented unless drivers have reached the consideration stage of their EV decision making journey, and actively search for it. In addition to this, many drivers with a mobility impairment do not consider themselves disabled as such and wouldn't necessarily be exposed to specialist messaging. Without more widespread knowledge of and exposure to EVs, assumptions that EV charging isn't practical for these drivers with a mobility impairment will be difficult to address.

Most of the mobility-impaired drivers interviewed would firstly look to non-disabled specialist motoring organisations for their information. This includes local dealerships (preferably a trusted dealership that they already know), Which? And motoring websites such as Car Wow. "I'd probably do a very small amount of research myself. More of my dealer or dealership you know, bring me up to speed." [ICE driver, UKPN, Male, aged 55-64]. Motability was the most popular disability-specific information source, but not all drivers use Motability.

It is also important to consider the needs of neurodiverse drivers. One driver interviewed felt that his ADHD would make spending the necessary time researching EVs difficult. Clearly signposted, easy to digest information would be needed in this instance.

A survey by the Research Institute of Disabled Consumers (RiDC)<sup>41</sup> found that 73% of disabled (ICE car) drivers thought EV chargers they had seen were not accessible or easy to use. 66% would consider driving an EV but 59% would only consider a hybrid, not full EV due to charging concerns. Drivers interviewed for this research concurred with this. Hybrids are felt to be a more realistic and reassuring option than full EV, providing greater flexibility. One disabled EV (self-charging hybrid) driver said that they would get a plug-in hybrid in the future as their hybrid experience has convinced them they could do most of their journeys purely on electric charge. This highlights the importance of familiarity and experience.

Improving access to test drives and increasing the length of test drives would significantly improve familiarity amongst mobility-impaired drivers. Test drives of 48 hours up to a week would give a real insight into how an EV

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<sup>45</sup> <https://evexperiencecentre.co.uk/>

would work for each individual. Drivers are open to this, even if it means a spouse or other friend / family member would need to drive if required modifications aren't available on the test vehicle.

One way to increase exposure of EV charging to drivers with a mobility impairment would be to improve signage for street and car park EV charge points. Current signage is not consistent across Local Authorities and car park operators and is not always easy to see. Often the only signage will be on the ground or will be a small nondescript sign. These may be successful in showing EV owners where to park, and ICE drivers where not to park, but do not help with wider awareness building for non EV drivers.



*DfT approved standard signage for EV charging bays<sup>46</sup>*

The decision making journey towards EV ownership is likely to include researching online maps and apps showing the locations of EV charge points. The different Charge Point Operators all provide these (and many drivers will subscribe to one particular operator, e.g. Motability drivers are given free access to the Polar network) and other companies provide maps of all charge points such as Open Charge Map, and the most popular, Zap Map. None of these maps currently provide information on whether a charge point is accessible (dropped kerb, bollards that might impede access etc). Hence, anxiety of charging is heightened due to a lack of information available on different types of chargers, where they exist, what measures are in place from an accessibility point of view and what to do in an event where a charger is broken or not fit for purpose and re-arranging their route. Regionality is also a factor, as noted by John Clarke Motors: BP Solar are teaming up with Charging Network Scotland, meaning drivers have access to 6,500 charging stations in Scotland via an App which alleviates the payment challenges and consistency of charger encountered. *David Livermore at AccessAble* points out "I think.. lack of consistency just leads... It can be problematic. How do you use them? So when we think about Highways England, motorway service areas, they're all tethered cables, but they release differently. So some use an app, some use a fob. They're at different heights. So the physical aspect of that is one. And then on-street ones don't necessarily have a tethered cable, so then it's about bringing your own cable and how they hook into... So again, you're into consistency issues and mobility issues".

Furthermore, due to the large number of different charging stations available, there are an equal number of payment and charging methods (in terms of inserting the cable) which make the whole scenario a little harder to understand, as some charging networks haven't been invested in for a while, don't have helplines or provide good apps to aid usage. These challenges are heightened for those who are not as familiar with apps and smartphones. With the new technology that is released, written guides will become available but it has been pointed out that a small number of those who drive cannot read, so there needs to be a broader focus on how things are communicated through signage and imagery rather than written text. Additionally, sometimes with a carer, the individual with the disability or impairment may still need to conduct the payment themselves so may need support in doing that.

EV drivers interviewed tend to have good knowledge of their local charge points but will also use ZapMap for less familiar destinations. They also have apps for paying for different charge point operators (e.g. Ecotricity) which they use as reassurance should they need to charge unexpectedly. "I've even pre-charged a couple of them, so that if I ever get stuck outside, I've got the local one, I can look it up and plug in, no problem." [EV driver, SSEN, Male, aged

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<sup>46</sup>Energy Saving Trust: Positioning charge points and adapting parking policies for electric vehicles. August 2019. <https://www.energysavingtrust.org.uk/sites/default/files/Local%20Authority%20Guidance%20-%20Positioning%20charge%20points.pdf>



65-79]. There were no issues with chargepoint information, although drivers would appreciate having access to accessibility information about public charge points.

There are currently very few designated disabled EV charging bays. The NCP car park in Salford is believed to be the first to offer an EV charge point in a disabled bay, with connectivity for two blue badge vehicles<sup>36</sup>. Local Authorities do have an obligation to ensure accessibility for disabled drivers although there is currently a clear gap in legislation, with no explicit regulation as to what this entails. TfL have produced Guidance for implementation of electric vehicle charging infrastructure which provides some best practice examples including Westminster Council, who consider suitability for disabled drivers when choosing locations for their on-street charging points<sup>47</sup>. The report recommends that local authorities: “position the charging point at 45 degrees to maximise accessibility (for disabled as well as non-disabled users). As with parking meters, the controls should be at a height which permits access by wheelchair users”.

## 7. Innovative solutions to EV charging

The pace of development in EV car and charging technology is incredibly fast. As EV batteries develop and improve the range of cars at all price points, demand for EVs increases and so does demand for charging infrastructure. The government ambition to install fast charge points in 20% of all parking spaces<sup>35</sup> is challenging, but there are many public and private funded innovations coming to market that will help meet demand.

### 7.1 Shorter term solutions

The below section outlines solutions which are more traditional in nature to resolve access and uptake challenges in the short term, in absence of new product innovation. These include financial support, car adaptations, charge point adjustments, and simplifying payment processes.

#### 7.1.1 Financial incentives

Financial incentives are unlikely to increase uptake for EV with mobility-impairments on their own. As mentioned by *Chris Girling at DMUK* “if somebody believes they can't physically use an EV then the financial incentive isn't going to make a difference because they couldn't do it even if they wanted to”. Hence there has to be a multifaceted approach in encouraging uptake of EVs as financial incentives are the middle step in transitioning, the first is to trust and approve of the car.

There is a need for government ambition for both financial investments to encourage EV uptake on a larger scale: “If the Government could do anything, they would do like a swappage scheme, like they did when we came out of the recession with the scrappage scheme. A swappage scheme with an incentive to move into electric vehicles but at the same time do a test drive. We do a lot with vehicles, we'll do £500 off the car if you test drive it first... But getting that actual experience of electric vehicles... There is [an incentive] just now because you've got a grant. So, you'll get a government grant of five thousand pound and there's an extra one in Scotland with three and a half thousand pounds on top of that. But it's not really pushed, it's not really well known” *Colin McAllister at John Clarke Motor Group*

Financial incentives to increase local authorities to input EV chargers could be effective. This was noted by charge company *Urban Electric* whom offer different financial options when the authority doesn't have a budget dedicated to electric vehicle uptake. “The first is, if a local authority has ambitions to own and operate its own charging

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<sup>47</sup> [http://app.thc.co.uk/WLA/wt.nsf/Files/WTA-3/\\$FILE/EVCP-guidance-version-1-Apr10%5B1%5D.pdf](http://app.thc.co.uk/WLA/wt.nsf/Files/WTA-3/$FILE/EVCP-guidance-version-1-Apr10%5B1%5D.pdf)

network, then it will use the on-street residential charging grant of seventy five percent and it will fund the balance of twenty five percent itself. It can then just simply buy our charge points and we'll maintain them and it can add it to its own network, or we can operate it for them. The second scenario is, the council wants to have some skin in the game and they seventy five percent funding, but they ask us to pay the twenty five percent balance and the operational costs and to operate the network for them. So, we will do that under a revenue share agreement. Third option, where the council can't afford to roll out infrastructure at scale. Or, they don't have enough resources of staff, they don't have the experience and so on. We offer, and this is our preferred model, is a fully funded owned and operate solution whereby we will do everything and pay for everything under a Long term agreement with the local authority. We very much want to work with utilities like SSEN, work with them providing what is a unique solution" *Keith Johnston at Urban Electric*

Drivers agreed that financial incentives would help motivate them to switch to EV but only if other barriers (information, access to charging, range anxiety and boot size) were resolved first. Drivers would expect financial incentives to come from a range of sources: Government / local authorities, Motability, car dealerships, and the manufacturers themselves.

### 7.1.2 Car design and alterations

There is a need for consistency in car design to ensure adaptations can be made to a variety of cars and not just a particular few who are designed a certain way which allow the adaptation. The designs need to take into account all types of modifications like also need to take into account sufficient space for medical equipment needed to fit into the boot space. *Chris Girling at DMUK states* "there's the issue of the battery's not impacting boot space. Which I know a number of manufacturers have touched on in the past, and they have worked on that. But that needs to be across the board so every vehicle is useable".

### 7.1.3 Trial experience

Several accessibility-focused stakeholders as well as the drivers interviewed felt that drivers with mobility-impairments need to be able to try out an EV for a sufficient period in order to gain confidence. This trial experience needs to be longer than the typical trial period to enable them to trust the car in different scenarios and understand the range conducting different types of journeys with equipment. Customers with mobility impairments or disabilities have unique needs, so need to feel reassured they'll be able to use an EV and understand the different mechanisms associated with an EV. *As Hayley Ingram at Motability Scheme states* "it's about being able to make an informed decision I think isn't it? Is it about being able to, and almost experience, use the vehicle for a period of time? There's no point having it for a couple of hours because you don't need to charge it but having access to a vehicle that you could test to see whether it works for you or not."

### 7.1.4 Charge point design innovations

Stakeholders believed that charge point innovation to make charging more widely available and more accessible is key. Consideration should be given to the practicalities of EV charging, especially for those drivers with physical impairments or disabilities. For example, making lightweight chargers or chargers that can be used sitting down more widely available, or ensuring sufficient space available around an EV charging parking space, or ensuring payment machines are accessible to all. The design of charge points should be assessed to make them more user-friendly to enable plugging in and payment to be a seamless experience.

As mentioned in section 5.1, the UK has recently opened the world's first all-EV charging service station in Braintree, Essex, and a Salford car park has been the first to include a disabled EV charging bay. There are also numerous innovations in charger design, particularly how chargers fit with other street furniture.

Connected Kerb are a Charge Point Operator that specialises in residential on-street charging and has designed an innovative installation approach which reduces the size and amount of street furniture<sup>48</sup>. Utilising a 'Node Box' which allows Connected Kerb to remove the intelligence from the physical charge point and hosts power and data below the pavement meaning a reduction in the size of the charge point itself and other associated street furniture freeing up pedestrian space and access.

Adding EV charge points to **lamp posts** is a natural evolution for existing street furniture. German firm Ubitricity (UK's largest public EV charging network with over 2,554 charge points)<sup>49</sup> has designed a socket that can quickly and cheaply (c.£1,000 per lamp post) be fitted to the existing maintenance panel on lamp posts.



This requires very little additional electricity supply (minimum requirement of 5.5kW) although it does mean drivers need to carry and stow their own type 2 cable to use. Either the cable itself can hold the customer billing details and measure the amount of electricity used (although this has theft concerns) or the driver scans a QR code on the lamp post to make payment. With 7.5 million lamp posts in the UK, according to Highways Agency figures, it could be the most affordable answer to improved EV infrastructure. The charge points are being trialled in London boroughs including Richmond, Kensington and Southwark. These charge points might benefit many drivers with a mobility impairment as they are unlikely to be surrounded by any barrier, and usually have a lower height socket than purpose built charge points although they will still have a kerb to negotiate.

Similar conversions can be made to the **roadside street cabinets** used to link public telephone exchanges to households for phone and broadband services. German telecoms firm Deutsche Telekom is working on converting 12,000 street cabinets into charging stations, each able to supply two vehicles with enough power in one hour for a range of between 50km and 75km<sup>50</sup>. In the UK, Virgin Media is also in the process of converting underground cable ducts and street cabinets to provide 1,200 charge points<sup>51</sup>.

Another innovation that doesn't create additional clutter on pavements is **Trojan chargers**<sup>52</sup>. These are mounted underground, flush with the pavement every 5 metres along a street. EV drivers pay for an aluminium lance that they slot into the charger and from there they plug their own cable in.

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<sup>48</sup> Connected Kerb <https://www.connectedkerb.com/approach>

<sup>49</sup> <https://www.ubitricity.com/ubitricity-becomes-the-uks-largest-public-ev-charging-network/>

<sup>50</sup> <https://www.nsenergybusiness.com/features/electric-vehicle-charging-innovations/#>

<sup>51</sup> <https://www.energylivenews.com/2019/11/18/virgin-media-owner-to-plug-in-1200-ev-charging-points/>

<sup>52</sup> Trojan Energy: <https://www.trojanenergyltd.com/>



Again, this requires drivers to carry and stow equipment and the bulk and weight may pose a challenge for drivers with a mobility impairment although as the target user is a resident without off street parking, the lance could be stored at home without having to manoeuvre into the boot. UK Power Networks is working in partnership with Trojan Energy and Brent and Camden councils to trial 200 chargers on residential streets. Trojan Energy have stated their desire to develop products with people with mobility impairments in mind, both drivers and pavement users. *“The upper part of the lance flexes to prevent kicks from damaging it while also preventing any injury to anyone accidentally colliding with it. This part of the design is at the request of a partially sighted panel we've worked with who have walked into other chargepoints. Our chargepoints are designed around pavement users as well as EV drivers.”*

### 7.1.5 Innovation in EV charging management, payment and speed

A key challenge for charging infrastructure is prioritising charging, especially when demand exceeds supply. This also impacts range anxiety (not being able to find an available charge point when you need one), particularly for drivers with a mobility impairment. **Transactive control** is one way to manage this as explained by Cenex: *“The transactive control concept is best described with an example below: An EV driver enters the parking garage and is low on battery. They need to charge their car as soon as possible for a scheduled departure in a few hours. However, on arrival, all the EV charging spots are occupied. The EV driver finds a current user of the EV charging spots (directly or through an app) who is willing to delay the charging of his own car and receives a financial compensation. Current parked users can then submit ‘bid’ prices to disconnect and allow the new user to charge, or the new user can submit ‘offer’ prices which can then be accepted or rejected by existing users<sup>17</sup>.”* Transactive control does not appear to be subject to practical trials yet but a workable framework has been developed by U.S. Department of Energy’s (DOE) Argonne National Laboratory<sup>53</sup>. A transport-focused stakeholder said that unique roadside EV chargers could be added in city locations for customers with disabilities to use, who would be unable to park their car at chargers further out of the city and walk from there.

One documented barrier to EV charging is the confusion over more than 40 different charge point operators, each requiring different payment apps or subscriptions. Charge Point Operators (CPOs) are working on a number of interoperability solutions including roaming / bilateral agreements between CPOs. The recent introduction of contactless credit / debit card payment infrastructure is also making CPO choice more flexible for drivers. Third party aggregators such as Hubeject and Zap Pay<sup>54</sup> are providing innovative consumer facing solutions. These apps enable drivers to pay for their charge through the app no matter which operator owns the charge point. They provide live status updates, charging history, PDF VAT receipts and 24/7 customer support. A support helpline for Zap Pay will be provided by EVA Global, the leading e-mobility service provider. Transport-focused stakeholders interviewed agreed that roaming protocols should be introduced to allow drivers to plug in their car at any charger and for the charge to go back to a single bank account. These additional benefits, if clearly communicated, may help to reassure drivers with a mobility impairment about the ease of using public EV charging.

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<sup>53</sup> <https://www.anl.gov/es/article/transactive-vehicle-charging-framework-developed-at-argonne>

<sup>54</sup> <https://www.zap-map.com/zap-map-launches-zap-pay-simple-way-to-pay-for-ev-charging/>

There are other non-digital solutions which can provide support. Ensuring that there are people on hand to ask for help when its needed would also be beneficial. For example, a car park employee plugging in the charger for you, or a helpline to call. Drivers suggested that they would like the option of serviced charge points, e.g. at existing fuel stations. This would enable drivers to use familiar methods (e.g. the My Hailo fob) to summon help to plug in their car. “Some of the charge points operators that you get they will have twenty-four seven customer service, but not all of them do. So, a phone number that you could ring if you were experiencing any problems and you could see how that might be particularly useful if you were vulnerable, if you needed help using that charge point.” Accessibility-focused stakeholder.

Having a choice of charge points at a range of different speeds is important to drivers. Battery life can be best maintained by trickle charging at slower speeds, generally overnight at home. Faster chargers also play an important role enabling drivers to charge quickly, thereby taking less time out of their day, especially if the charge need is en-route of at a short stay destination such as a supermarket or motorway service station. **Ultra-rapid charging** (350kW) can charge a battery from 10% to 80% in only 20 minutes, or 100km of range in 10 minutes. There are currently no EVs able to accept such fast speeds (the Porsche Taycan can charge at 225kW) although charge points will be able to adapt to the maximum power each car is able to use. Ionity<sup>55</sup>, a joint venture between Mercedes-Benz, Ford, BMW, Volkswagen, Audi and Porsche, is rolling out 2,400 ultra-rapid charge points across Europe (including the UK) with the aim of installing a charge point every 100 miles along Europe’s motorways and A roads. This innovation could go a long way to reduce range anxiety, with the reassurance that charging doesn’t need to take a lot of time out of a driver’s day, although accessing faster charging speeds does cost more, at approximately 69p per kW.

## 7.2 Advanced solutions

### 7.2.1 Inductive charging

One innovation that could make a significant difference to ease of charging for drivers with a mobility impairment is inductive charging. Inductive charging involves an incumbent transmission plate fixed to the ground which passes electricity through an air gap of 4 inches to a magnetic coil receiver pad fitted to the underside of the car. Instructions on the car infotainment display tell the driver when the car is correctly aligned with the transmission plate. It does require a high level of parking accuracy although the development of self parking features in cars will be beneficial in enabling inductive charging - autonomous EVs will be able to use ‘vehicle-to-infrastructure’ sensors to locate and align parking more accurately than a motorist could. The Cenex / Innovate UK study<sup>17</sup> says “*Inductive charging offers an attractive alternative for motorists as it does not require a connector cable between the vehicle and charge point. This reduces the poor aesthetic and safety concerns of charging cables protruding from both vehicle and charge point.*”

There was some prior awareness of inductive charging among accessibility-focused stakeholders who considered this to be the best solution to the challenges faced by drivers with a disability. The convenience aspect of inductive charging, especially for drivers with mobility impairments, was a positive. This could be even more valuable if accessible inductive chargers had similar plates available for electric wheelchairs nearby: “Realistically induction charging is the biggest thing that would work, particularly for our customers, the convenience of that” *Hayley Ingram at Motability Scheme*. “So if you could drive it on to that, you didn’t need to mess around with the cable but I could still get out and go into the service station... if it’s going to take an hour, I can go and get out, so I’ve physically got the space around the car, that would solve a lot of the concerns for me” *Richard Shakespeare, former Chair and current member of SSEN’s Inclusive Service Panels*.

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<sup>55</sup> <https://ionity.eu/en/design-and-tech.html>



The mobility-impaired drivers interviewed for this research were not aware of inductive charging, but once told about it most of them agreed that this would be an excellent solution to remove charging barriers. "I'd much rather have a wireless charging unit. That would be fantastic, which I could just park over somewhere and just switch it on." [EV driver, SSEN, Male, aged 65-79]. Drivers raised a few potential barriers, most of which could be resolved with more information:

- Charging might not be as fast or as reliable as a plug in charger (e.g. if car isn't perfectly aligned on top of induction plate)
- Floor plate could be a trip hazard
- Drivers wary of requiring building work to fit home charging plate
- Cost of fitting charging plates to car and home
- Access (could other EV drivers "steal" your electricity by parking on your drive?)

Some stakeholders shared these concerns about the practicalities of home installations: "I think that will resolve so many barriers, for so many people. I think it will drive up confidence. I think the difficulty is going to be installing them in people's homes, so whether cars will be able to be charged inductively and through a plug, ...I think that could potentially be an issue but with on street, I think that's going to be great and I also suggested that they do it, that you could drive your wheelchair over it and inductively charge that too because they're always running out" *Helen Dolphin at People's Parking.*

Current inductive charging pads provide relatively slow charging speeds, with the Society of Automotive Engineers (SAE) recently agreeing a common standard for wireless charging speeds up to 11kW<sup>56</sup>. Many wireless technology suppliers are trialling faster 22kW versions and companies such as Momentum Dynamics in the US are demonstrating high powered solutions from 50kW to 450kW<sup>57</sup>. Moving to inductive charging could be a risk for early adopters as there are different types of chargers coming onto the market, and not all cars will work with all chargers (although it is possible to retrofit a receiver pad). Inductive charging may need significant incentives to encourage drivers to opt for one technology over another. Early forecasts estimate inductive chargers will cost £400/kW for domestic 3.2kW chargers and £850/kWh for large applications (100kW+)<sup>17</sup>.

Connected Kerb, have taken an agnostic approach to its wireless charging strategy and developed strategic partnerships with wireless technology providers and planning to deploy wireless charging solutions in car parks, taxi ranks and residential streets.<sup>58</sup> Other inductive charging trials are running with (mainly) start-up firms across the world, from the US, to Brazil, Western and Eastern Europe, India, China and Malaysia.

Magment, a German firm has developed a concrete material for EV charging - an amalgamation of current cement technology with recycled magnetic particles<sup>58</sup>. This provides effective energy transfer with high safety and could even be used for inductive charging on roads, enabling EVs to charge while they are driving. Cenex, Western Power Distribution, Coventry City Council, Coventry University and Toyota are collaborating on a £417,000 project to assess the viability of under road inductive charging technology<sup>59</sup>. The 14 month long project which started in December 2020 will investigate whether inductive charging technology could be installed under the roads of Coventry. The aim is that this will relieve pressure on the National Grid and alleviate range anxiety by making EV charging quicker and more accessible. It is thought that fleet vehicles would benefit especially due to their long driving distances, but there is clear appeal for all drivers, not least those who are mobility impaired.

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<sup>56</sup> <https://www.drivingelectric.com/your-questions-answered/40163/wireless-charging-for-electric-cars-explained>

<sup>57</sup> <https://momentumdynamics.com/thetech/>

<sup>58</sup> <https://www.magment.de/en-news-blog/tag/Connected+Kerb>

<sup>59</sup> <https://www.cenex.co.uk/news/ultra-durable-powertrains-in-development-for-autonomous-vehicles-of-the-future/>

## 7.2.2 Vehicle-to-grid charging

People with a vulnerability, including people with mobility impairments, are likely to be disproportionately affected by any disruption to their home electricity supply. They may have additional electricity needs (e.g. powering medical or mobility equipment or requiring extra heating) and they may be less able to manage the impact of a power cut for numerous reasons. One solution could be vehicle-to-grid (V2G) or vehicle-to-home (V2H) charging to give drivers with a mobility impairment peace of mind that the energy stored in their EV could be used to power their home if necessary. V2G enables storage of excess energy produced by renewable generation (solar PV, wind turbines) meaning less reliance on the grid, and a move towards energy sustainability for consumers able to install solar PV.

V2G technology is coming online with a number of large scale projects. In the UK, Octopus Energy was the first to offer Nissan Leaf customers V2G bi-directional charging using their Powerloop bundle product<sup>60</sup>. This is currently only available to customers in the UK Power Networks DNO region. Eligible homes are fitted with a bi-directional charger which will charge EVs in off-peak hours when electricity is at its lowest price, and then sell the same energy back to the grid when prices are higher, thereby reducing a customer's energy costs and helping to manage demands on the grid.

There are also many international V2G projects, such as three in operation by the Mobility House based in Germany, Switzerland and the US<sup>61</sup>. The Mobility House specialises in integrating battery storage solutions into the electricity grid. The Johan Cruijff Arena in Amsterdam and part the Waken music festival in Germany have both used visitors' EVs to store electricity and provide power back to the venues. Even more ambitiously, the Portuguese island of Porto Santo is planning to become completely fossil fuel free through using renewable energy and using the island's EVs to store and manage the power generated.

Currently only CHAdeMO charging technology (used in Nissan EVs) supports V2G technology. It is unlikely to be widely available through other manufacturers until at least 2025 according to Electric Nation<sup>62</sup>. Once access to the technology is available, V2G is seen to be a major factor in the UK being able to realise ambitions to reach net zero. Assuming that the technical challenges can be resolved, a whole-system analysis suggests V2G related savings will be worth £3.5 bn/year by 2040<sup>63</sup>.

Both the drivers and stakeholders interviewed could see the benefits of V2G technology, but didn't think it would be a primary driver of individuals switching from ICE to EV. It would be a "nice to have" that would, in reality, only benefit a small number of (especially rural) customers. "You never know when the power's going to go off. Sometimes it does, especially like last time when we had the storms. It doesn't take much, a tree comes down and knocks out a power grid somewhere. If you go off-grid at least that way you can plug your car in and you know you might not be able to achieve the whole house but you know, came the fridge going if need be and the freezer." [*ICE driver, SSEN, Male, aged 55-64*]. Both groups felt this could be of particular benefit to vulnerable customers in rural areas who are more likely to suffer power cuts (although rural drivers interviewed did say that power cuts are much less frequent than they used to be): "Vehicle to grid charging that's a fabulous thing and that particularly for rural customers, here in Scotland whenever we have a big storm you know the rural people are always disadvantaged because they've got no power" *Colin McAllister at John Clarke Motor Group*. The group most interested in V2G were customers that rely on electrical mobility / medical equipment at home, for instance, stair lifts, bed hoists, breathing

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<sup>60</sup> <https://www.octopusev.com/powerloop>

<sup>61</sup> [https://www.mobilityhouse.com/int\\_en/vehicle-to-grid](https://www.mobilityhouse.com/int_en/vehicle-to-grid)

<sup>62</sup> <https://electricnation.org.uk/2020/09/02/the-future-of-vehicle-to-grid-ev-charging/>

<sup>63</sup> Imperial College and Ovo Energy. Blueprint for a post-carbon society.

<https://www.ovoenergy.com/binaries/content/assets/documents/pdfs/newsroom/blueprint-for-a-post-carbon-society-how-residential-flexibility-is-key-to-decarbonising-power-heat-and-transport/blueprintforapostcarbonsocietypdf-compressed.pdf>

apparatus and dialysis machines. They felt that using V2G would mean local energy could be shared more fairly amongst the community.

Drivers were concerned however, that V2G could mean that their car wasn't fully charged when they needed to use it, which would be a barrier to them signing up to a V2G scheme. They would also like to tie this in with other ways of generating their own power, for instance charging their EV with power from their own solar panels. Stakeholders agreed that power cuts could make EV drivers more vulnerable, especially those in rural areas. Some felt that other batteries might be a more suitable solution to integrate into the home than relying on V2G.

There is also a need for market standards and regulations to be reviewed to enable wider spread of V2G: "I'm a great exponent these days for a V2G, but it's the similar sort of thing to inductive charging. We don't yet have the European standard to V2G, so until we get that, we can't even really... we've done V2G projects. We want to use it, but until you've got some standards and the marketplace is adapted for it, because at the moment, the marketplace works against V2G" *A transport-focused stakeholder.*

## 8. Whose responsibility is it to enact change?

### 8.1 National government regulation

At a national level, many stakeholders felt that the role of the UK Government is key and should provide a clear direction for progress. There is a need for a clear top-down national approach and overarching government regulation which would provide consistency and guidance to those who need to ensure there is provision of EV charging for all on a local level: "I'd agree with this idea of a national strategy and that's for the EV charging infrastructure. But, more generally all these local authorities I think about decarbonisation and all these different efforts with varying level of expertise and knowledge. I think that is something that they could all really benefit from more information and support to help them get those tenders right ... it's also important for government to support but local governments to try and get the right expertise in there, because I think it is that question of consistency and just making sure there's fair access for everyone" *An accessibility-focused stakeholder*

Drivers agree that the government must play a role in encouraging national uptake of EVs otherwise the large-scale behaviour change necessary just won't happen (particularly for drivers with disabilities or impairments who are less likely to be technology early adopters). There is a particular need for better legislation both in terms of ensuring EVs and charge points are accessible, and in terms of standards for charging behaviour. For instance, if someone is injured tripping over a charging cable, who is liable?

Regulation is key to ensure there is consistency in standards and accessibility for all: "It feels like it's some kind of regulation that needs to be put in place that says if you install a charge point, it needs to have the following, and then the charge point networks and the charge point owners all need to work together to, to make sure that that is, is in place." *A technology-focused stakeholder.* "I think the government has a responsibility for standards, and I think they should be requiring that this new infrastructure meets accessibility standards. And if they don't exist, they should be setting them, not just throwing in a blue badge parking space as a token thing." *Caroline Jacobs at RiDC*

As part of a larger £7 million investment into zero emission mobility, earlier this year Transport Scotland invested £210,000 to explore ways of making charging solutions more accessible. Keith Robertson, Lead for Roads, Infrastructure and Active Travel at the Mobility and Access Committee Scotland said "As Scotland moves towards a

net zero carbon economy it is imperative that Scottish Government make it inclusive for all on this transformational journey”<sup>64</sup>.

Finally, the government also have a role to play in disseminating accurate information and ensuring the population develop a good understanding when it comes to EVs. Misinformation being spread by lobbyists and the media which could be corrected through government-led education: “There's was a great example of, it's referred to as Aston-gate. Aston Martin was behind a report that came out in the market about how un-environmentally friendly EV's were. It got picked up by every major newspaper and then debunked the next day with the real data” *Chris Pateman-Jones at Connected Kerb*

## 8.2 The role of local government

Stakeholders emphasised the importance of local government in relation to:

- Supporting accessible EV charging via parking solutions: “[Local authorities] could insist on there being a certain number of bays in well located places, where people actually want to park, as in EV charging points. I think they could have impact there and also ensuring that within their own car parks, they don't just have EV bays, they have accessible EV bays as well”. *Helen Dolphin at People's Parking*
- Induction charging: Supporting the expansion of an inductive charging network on public roads, and car parks: “If they are put into pavements for example, there's going to have to be enough space for wheelchair users to pass them without getting in the way of them when charging. If you can't get past it as a pedestrian or a wheelchair or a parent with a pushchair then it's not going to be viable for the local authority's point of view. So, then they're not going to adopt it.” *Chris Girling at DMUK*
- Parish councillors: “An awful lot of the work that we're doing is in the market towns ... and increasingly we're talking to villages and parishes as well about how you can do it on a smaller scale in those sorts of environments. I mean I live in a village, and I wonder around the village looking, going oh we could do that there, we could do that there” *A transport-focused stakeholder*

However, lack of funding and rigidity of local authority investment can be a barrier: “Access to charge points is a big issue at the moment, it's hard for local authorities to get funding and start innovating as they are typically on 15-year investment cycles and changes of government don't help.” *Sophie Adams, OZEV*

## 8.3 The role of DNOs

As explored in section 5.4.3, DNOs play an important role in this area, given their key responsibility for transferring electricity from the national grid to commercial and domestic users, including managing the electricity demand for EV chargers.

The regulatory body Ofgem is clear that DNOs have a central role to play in “greening” the energy system, for example, by ensuring that the roll-out of electric vehicles (expected to boom by 2030) isn't held back by a lack of charging points connected to the electricity network<sup>65</sup>. Ofgem has called for DNOs to maximise the use of smart charging (managing charging so that EVs are charged at less demanding times on the grid) to enable 60% more EVs to connect using existing grid capacity. Ofgem have also emphasised a key focus for DNOs on encouraging positive and inclusive innovation: using innovation to benefit customers with vulnerabilities while preventing those

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<sup>64</sup> <https://www.transport.gov.scot/news/new-funding-to-improve-charge-point-accessibility/>

<sup>65</sup> <https://www.ofgem.gov.uk/news-blog/our-blog/networks-fit-net-zero>

customers being excluded by other innovative changes<sup>66</sup>. Any major investment in infrastructure to increase network capacity would have ramifications eventually for costs passed on to customers, and Ofgem is keen that customers with a vulnerability (including people with a mobility impairment) are not financially disadvantaged. DNOs do actively support their customers with a vulnerability, with details of how they do this included into their annual Stakeholder Engagement and Consumer Vulnerability (SECV) submissions. This illustrates how DNOs proactively engage with their stakeholders “in order to anticipate their needs and deliver a consumer focused, socially responsible and sustainable energy service”<sup>67</sup>.

The challenge is to ensure that joined-up thinking is evident so that strategies for customers with a vulnerability and EV initiatives are linked. Their understanding of customers with a vulnerability means DNOs are also well placed to communicate their needs to the wider EV charging industry. DNOs can also play a role in ensuring organisations consider the needs of all drivers with a vulnerability: mobility-impaired, but also those that may have difficulty in adopting new technology. The role of DNOs as enablers of collaboration should not be underestimated. This project is one example of this: SSEN has brought together different stakeholders including DMUK and Connected Kerb to facilitate cross-industry discussion of the barriers facing vulnerable customers as the UK transitions to an EV focused transport network. This ongoing collaboration will encompass an even broader range of stakeholders and will encourage organisations to take responsibility for removing barriers.

DNOs can also play a role in sharing data to facilitate the expansion of the EV charging network. For instance, SSEN are currently running project on Near Real-time Data Access (NeRDA)<sup>68</sup> – a small scale project to test the sharing of near real-time DNO electricity data with 3<sup>rd</sup> party stakeholders. This will make it easier for local authorities, charge point operators and other stakeholders to plan, install and monitor charge point infrastructure without delays in accessing the required data.

Stakeholders recognised that in order to enact change, there is a need for collaboration between relevant organisations, including DNOs, government, industry and charities / organisations. Sharing of data and expertise can help ensure a future where EVs are accessible to all, and that the benefits of an EV are widely communicated and understood. *Sophie Adams at OZEV* stated “It’s not just about saying, oh this is cheaper, but it’s also getting that message to consumers, through however many different channels and through a lot of different manners. So say Motability, or other charities or we’re looking at AA and new Automotive and people like that to really say, why is it cheaper and proving that”. Trade bodies that represent charge point operators should also help with the coordination of accessible EV charging. *Nick Sacke at Comms365* mentions “Data acquisition, sharing, your use of data in more creative and powerful ways, scalable ways, to make these things possible.”

Individual DNOs are working on different strategies and initiatives to ready their network regions for the growth in EVs. For instance, Scottish and Southern Electricity Network’s (SSEN’s) EV strategy was published in March 2020<sup>69</sup>. The DNO needs to manage different net zero and EV targets in its Scottish (2032 new ICE ban, 2045 net zero<sup>8</sup>) and Southern (2035 new ICE ban, 2050 net zero) regions. It is planning up to £30billion in distribution network reinforcement by 2030. SSEN’s strategy includes more mentions of the needs of customers with a vulnerability than in other DNO strategies. The strategy includes an E Tourism innovation project to understand how increased EV uptake and tourist patterns will impact seasonal peak demand. This will presumably help provide EV charging capacity and resilience in rural areas. The vulnerability of drivers with a mobility impairment is mentioned in the strategy: “*In storm or outage scenarios, it will be necessary to prioritise the needs of customers who become*

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<sup>66</sup> [https://www.ofgem.gov.uk/system/files/docs/2020/01/consumer\\_vulnerability\\_strategy\\_2025.pdf](https://www.ofgem.gov.uk/system/files/docs/2020/01/consumer_vulnerability_strategy_2025.pdf)

<sup>67</sup> Ofgem. Decision on the RIIO-ED1 Stakeholder Engagement and Consumer Vulnerability Incentive 2019-20 (27<sup>th</sup> November). Decision Letter.

<sup>68</sup> [https://www.smarternetworks.org/project/nia\\_ssen\\_0050](https://www.smarternetworks.org/project/nia_ssen_0050)

<sup>69</sup> <https://www.ssen.co.uk/WorkArea/DownloadAsset.aspx?id=19141>



vulnerable when their ability to charge their EV is hampered. We will consider how we can protect these customers and their need to charge in the same way we protect other customers with a vulnerability.” SSEN is also updating definitions of vulnerability to include customers for whom an inability to use transport when needed would make them vulnerable, giving them the extra support and protections they need. SSEN is also working with the Centre for Sustainable Energy (CSE) as part of the ‘Smart and Fair?’ project to explore the capabilities, characteristics and attributes which are required of consumers to get and benefit from EV.

UK Power Networks published its EV strategy in November 2019<sup>9</sup> and referenced the challenge of encouraging and supporting EV uptake to help meet low carbon targets, whilst also managing electricity demand. “How many EVs should we facilitate by using smart solutions before we consider investing in more infrastructure?”. The strategy doesn’t specifically mention support for drivers with a mobility impairment or customers with a vulnerability. It mentions social obligations but only in terms of value for money. “Ultimately we have a social obligation to deliver the best environmental outcomes at the lowest cost possible by investing in the right locations just in time while avoiding stranded assets.... Customers are at the centre of our EV strategy. Delivering choice and transparency is critical in facilitating the transition for customers. Choice includes providing our evolving customers new innovative and alternative connection products such as timed and flexible connections alongside our traditional offerings.”

The UK Power Networks strategy references the difficulties faced by DNOs in getting data on number of EVs purchased. They are working with OLEV to improve this but it currently makes it difficult to plan for local increases in electricity demand. There is no mention of whether an increase in data availability will include data on different customer vulnerabilities. The DNO also explains Project Shift<sup>70</sup>, a large scale true smart charging trial utilising V2G technology with 1,000 EV drivers across London, the South East and East of England. There is no mention whether drivers with a mobility impairment are part of the trial.

SSEN has announced a £7.5million strategic partnership with Transport Scotland and SP Energy Networks (SPEN) to deliver more electric vehicle charging points in Scotland<sup>71</sup>, with a specific mention of accessibility in the partnership. Western Power Distribution launched their Electric Vehicle Strategy in April 2020<sup>72</sup> which includes £58 million allocated for Electric Vehicle investments but doesn’t mention support for drivers with a mobility impairment. Electricity North West (ENWL) is halfway through project Reflect<sup>73</sup> which aims to produce prototype tools and methodologies that can be used by DNOs to improve the electricity demand forecasting for EV charging by reflecting the regional uncertainties around slow and ultra-fast EV charging. This is important in terms of capacity forecasting but doesn’t concern drivers with a mobility impairment particularly. Northern Powergrid has completed a three year project with Newcastle University on forecasting the impact on the grid of V2G technology<sup>74</sup> and also led the largest ever project under Ofgem’s Low Carbon Networks Fund (LCNF): the Customer-Led Network Revolution project (CLNR)<sup>75</sup>. This was a far-reaching programme of research with some inclusion of EVs but not in relation to vulnerability or accessibility.

South California is seen as having an advanced EV strategy and has been advising UK Power Networks. The region offers grants to employers for the purchase and installation of workplace EV charging infrastructure, as well as

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<sup>70</sup> <https://innovation.ukpowernetworks.co.uk/projects/shift/>

<sup>71</sup> [http://news.ssen.co.uk/news/all-articles/2019/august/charging-ahead-with-evs/#:~:text=Scottish%20and%20Southern%20Electricity%20Networks%20\(SSEN\)%20has%20joined%20the%20Scottish,m%20strategic%20partnership%20announced%20today.](http://news.ssen.co.uk/news/all-articles/2019/august/charging-ahead-with-evs/#:~:text=Scottish%20and%20Southern%20Electricity%20Networks%20(SSEN)%20has%20joined%20the%20Scottish,m%20strategic%20partnership%20announced%20today.)

<sup>72</sup> <https://www.westernpower.co.uk/smarter-networks/electric-vehicles>

<sup>73</sup> <https://www.enwl.co.uk/go-net-zero/innovation/smaller-projects/network-innovation-allowance/enwl022---reflect/>

<sup>74</sup> [https://www.smarternetworks.org/project/nia\\_npg\\_014](https://www.smarternetworks.org/project/nia_npg_014)

<sup>75</sup> <http://www.networkrevolution.co.uk/>

discounts on EVs to drivers considering switching from ICE vehicles<sup>76</sup>. South California Edison offers customers Time of Use tariffs to charge their EV at cheaper times of day, and US\$1,000 grants for customers leasing or buying an EV<sup>77</sup>. Other incentives include EV drivers qualifying for single driver use of High Occupancy Vehicle (carpool) lanes.

Although no stakeholder directly referenced the role DNOs should play, People's Parking stressed the importance of grid capacity going forward: "Lots of people say, I blame the government but I think it's all sorts of different things... people don't realise, you can't just say, oh I want ten EV bays in that car park. They might not have the grid capacity to do that or they put them in and the lights go out. People think that they can just put EV charge points in wherever."

## 8.4 Other organisations with responsibility

There are many different organisations and sectors currently looking at how to ensure the move to EV is accessible to all. This provides opportunities for cross-industry collaboration (such as the SSEN working group that produced this report). Tackling the barriers in a collaborative way will maximise time and cost efficiencies across the industry and benefit all drivers in the long run.

### 8.4.1 The role of the automotive industry

As some barriers relate to the design of EVs and chargers, stakeholders felt that designers and manufacturers should resolve these issues. Though it's important that **all** manufacturers and designers take the needs of different drivers into consideration: "Definitely whoever is designing the charge points, the connectors, the cables – there are an awful lot of stakeholders along the way." *Caroline Jacobs at RiDC*. And: "I'm not sure that enough companies are thinking about the grips on the handles, and this kind of thing. It's probably, for a lot of providers, kind of, the last thing on the list perhaps. Whereas obviously for somebody with dexterity issues it's kind of the first thing they're going to think about" *Chris Girling at DMUK*.

Drivers also expect "customer facing" channels such as dealerships and organisations such as Motability and other disability leasing companies to be at the forefront of supporting and advocating for mobility-impaired drivers. They are most familiar with these organisations and would expect them to offer the best information and help. Consistency and training are important though. If a dealership doesn't have an EV expert available (as they might have a Motability expert) then drivers will immediately be put off from doing further research.

### 8.4.2 The role of car park owners & operators:

Car park owners have a responsibility when planning where to install chargers that the space is accessible for all drivers, including those with mobility impairments who may require more space and features such as dropped curbs: "If you're a petrol station or garage or supermarket putting one of these in your carpark, I think you have a responsibility to make that an accessible space. It's interesting, of all the legislation that's out there about accessibility and the Equality Act, actually they should be making them accessible as the landlord of that space" *Caroline Jacobs at RiDC*.

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<sup>76</sup> Connect SoCal Electric Vehicle Strategy:

[http://scag.iqm2.com/Citizens/Detail\\_LegiFile.aspx?Frame=&MeetingID=2052&MediaPosition=&ID=1953&CssClass=](http://scag.iqm2.com/Citizens/Detail_LegiFile.aspx?Frame=&MeetingID=2052&MediaPosition=&ID=1953&CssClass=)

<sup>77</sup> <https://www.sce.com/th/node/1272>

## 9. Conclusions

The uptake of EVs, particularly pure battery EVs is increasing exponentially and EVs are becoming the most logical option for many drivers. The much discussed 'green recovery' from the Covid-19 pandemic has the potential to increase the market share of EVs even further as long as it is accompanied by significant investment (both public and private) in charging infrastructure.

Drivers with a vulnerability, including people with mobility impairments, are often more risk averse<sup>44</sup> and are slower to adopt EVs than the wider driving population<sup>19</sup>. Many drivers with a mobility impairment are able to access EVs even if they require adaptations to their vehicles through Motability or other disability leasing firms, although not all mobility-impaired drivers will qualify for Motability support (e.g. they must be of working age, precluding elderly drivers). These drivers also face a number of barriers to EV charging, some of which are common to all drivers such as range anxiety, and some which are mobility-specific such as requiring larger parking spaces to be able to get in and out of their car along with mobility aids. This makes it even more important that their needs are considered as public charging infrastructure is developed further.

Key barriers identified for drivers with a disability or mobility impairment include:

- Availability and accessibility of charge points: There are few disabled parking spaces equipped with EV charge points, and charge points, connectors and cables are not easy to use for drivers with mobility problems
- Cost: Driving can be more expensive for drivers with a mobility impairment, and the relatively high upfront cost of EVs is a barrier, especially for those over 65 who don't qualify for the Motability Scheme
- Psychological barriers like range anxiety: Drivers with a mobility impairment can be more risk averse and range anxiety is a problem when many public charge points are difficult to use for those with mobility problems
- Lack of information on accessible charging: There is a shortage of easily available information available to encourage drivers with a mobility impairment to switch to an EV. Drivers are not used to seeing disabled EV charge points and may assume EVs are not suitable for them.

The enablers which could be better communicated to drivers with a mobility impairment include:

- Extended test drives and better communication about EVs will increase familiarity. More familiar drivers are less likely to state as many barriers as the less-engaged
- Battery range of even smaller EVs should be sufficient for most drivers considering their typically low average mileage
- EVs can provide significant cost savings over the lifetime of the car / lease than an ICE car equivalent including savings on road tax, maintenance, and fuel
- Mobility-impaired drivers like to plan journeys and parking in detail. Apps and on-board computers used to monitor charge as well as EV charge point maps are a benefit for these drivers that appreciate having information at their fingertips
- Innovations from Connected Kerb and others are improving on-street charge point access for drivers without a private driveway or garage, meaning all EV owners should eventually be able to charge overnight at or near their home
- No longer needing to visit petrol stations which can be a physical challenge for many
- Drivers with a mobility impairment can also benefit from a number of financial incentives to start driving EVs. There are also many organisations that offer information and support to mobility-impaired drivers once they start to consider EVs.

Engaging with drivers with a vulnerability or mobility impairment will be a key aspect of ensuring no one is left behind in the transition to electric vehicles. There is also an opportunity to investigate new services to assist drivers who may become more vulnerable as a result of having a power cut and their EV not being charged when they need it. Direct engagement can be achieved through primary research as well as inviting the involvement of organisations that support motorists with a disability and organisations / local authorities involved in the roll out of EV charging infrastructure.

This report has described currently known barriers and enablers to EV uptake for vulnerable motorists; and has highlighted many of the innovations in development that may help overcome barriers. Further research will provide invaluable insight into the relative importance of the barriers and enablers, and seek to identify additional challenges and solutions.

Barrier	Solutions	Who could implement this solution?	Speed of implementation
Access to public charge points	Explore regulation to ensure provision of public charging on a local level. <ul style="list-style-type: none"> <li>Taking into account disabled/vulnerable consumers with on and off-street charging experience.</li> </ul>	Collaboration between National Government and charge point operators	Mid term
	Support accessible EV charging via parking solutions in line with a Parking Standard <ul style="list-style-type: none"> <li>No. of charge points</li> <li>No. of designated parking</li> <li>Signage</li> <li>Space and features for manoeuvring</li> <li>Cover</li> </ul>	Local Government, private car park owners, accessibility charities	Short-mid term
	Explore viability of an inductive charging network on public roads.	Collaboration between automotive industry, DNOs, government, private companies and consumers	Long term
	Explore alternative solutions are available for smart charging for those without internet access and /or those who need technological support. <ul style="list-style-type: none"> <li>Car technology</li> <li>Non-smart phone access to charger</li> </ul>	National Government, charge point operators and automotive industry	Mid term
	Retrofit existing charging points to ensure that they are accessibility for more citizens.	Charge point owners	Long term
	Understand the customer's needs of enroute charging beyond accessibility i.e leisure, social, medical needs (pharmacy etc).	Research agency Panel of customers to co-create and prototype	Short term

		effective communication/ solutions	
Sharing of industry learnings	Provide additional support to organisations to accommodate accessibility provisions for EVs and chargers. <ul style="list-style-type: none"> <li>• Information</li> <li>• Education of new Standards</li> </ul>	National and Local Government	Long term
	Investigate opportunities for data partnerships <ul style="list-style-type: none"> <li>• Charge point operators</li> <li>• Car dealerships</li> <li>• DNOs</li> </ul>	Collaboration between Charge point operators, car dealerships and DNOs.	Mid term
EV myths and psychological barriers	Offer extended-length accessible test drives or short-term low commitment rentals that allow customers to experience an EV in their daily lives.	Automotive Industry	Mid term
	Investigate impact of modifications on battery range and provide information in car show rooms.	Automatic Industry	Short term
	Consider education opportunities from journey of consideration to purchase intent. <ul style="list-style-type: none"> <li>• Ensure there are incentive for car dealerships to sell EVs</li> </ul>	Collaborative between accessibility charities and Automotive industry	Short term
Cost	Investigate opportunities to offer grants to those not able to access Motability support <ul style="list-style-type: none"> <li>• Marketing available grants</li> </ul>	National Government	Mid term
	Increase financial incentives for EV drivers <ul style="list-style-type: none"> <li>• Charge point accessibility for those without a driveway</li> </ul>	National Government and Automatic Industry	Long term
Lack of information on EVs and accessible charging	Consider education opportunities via multiple communication channels suited to those with disabilities or mobility impairments	Collaboration between automotive industry, DNOs, government, and private companies	Short term
	Understand the customer journey (focus on the early stage of consideration) and their decision-making process through engagement	Research agency, Panel of customers to co-create and prototype effective communication/ solutions	Short term
Lack of awareness of benefits of EV battery in event of a power cut	Communicate the benefits of vehicle-to-grid charging, by targeting those customers that would benefit most via PSR registration	SSEN, other DNOs, marketing agency, and retailers	Long term



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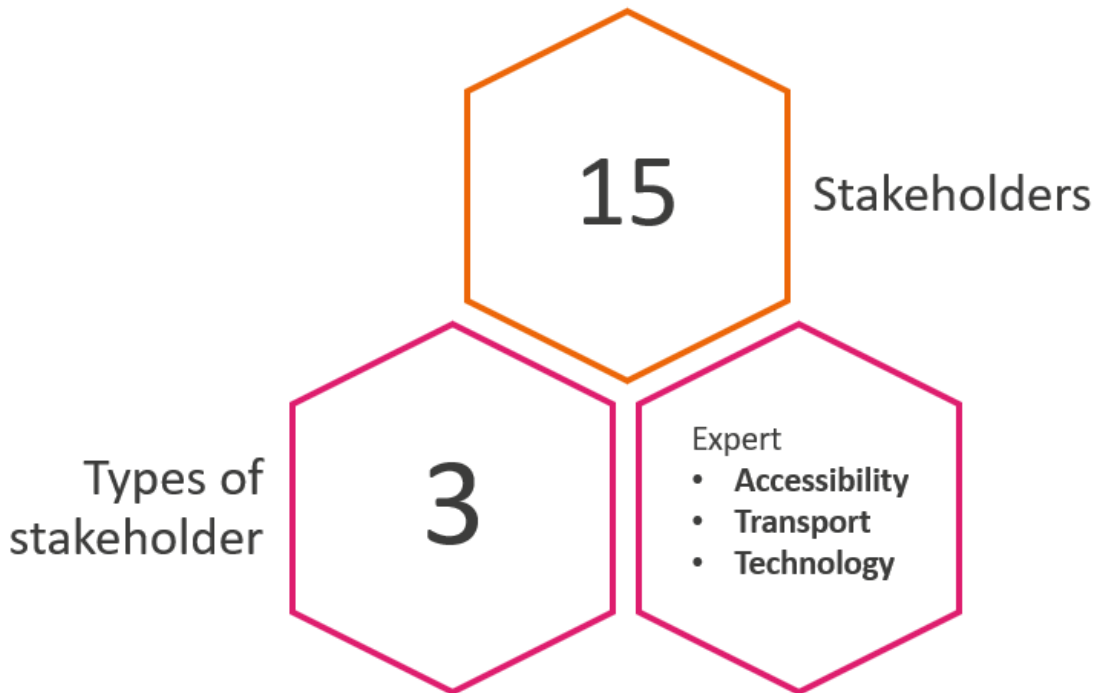
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# 11. Appendix

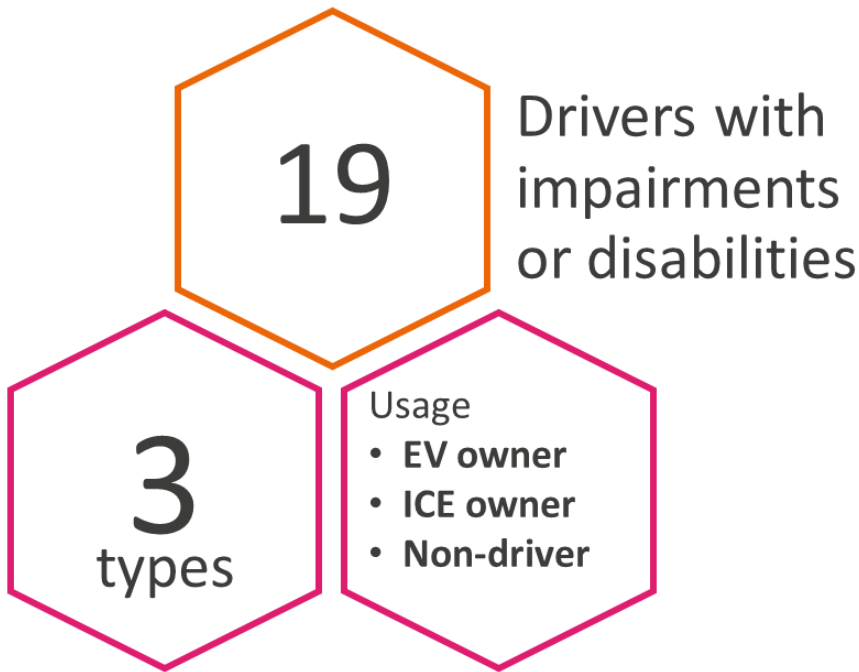
## 11.1 Stakeholder Research Methodology

This section outlines methodology used for this phase of the research programme conducted by Impact to understand the barriers and enablers to EV uptake among drivers with a mobility impairment from both an industry and customer perspective. We interviewed 15 different companies and organisations spread between local government, charities and independent start-ups leading the way in either accessibility, technology or electric vehicles.

From the industry experts we spoke to, eight were accessibility experts defined as those providing services or a voice for consumers with a disability/mobility impairment. Three were transport experts who were defined as having an influence on transport infrastructure either from local or central government and four technology experts who develop technology in the electric vehicle space associated with charging or customer facing platforms. When stakeholders have given permission for their companies to be named, we have referenced this. However, four stakeholders opted to remain anonymous, so we have referenced their feedback according to the broad sector they represent (for example 'government'). Interviews conducted were on average 45 minutes long, conducted over Zoom to show stimulus materials where relevant.



This was followed by customer interviews with drivers with a mobility impairment who either drove an EV, were interested in buying one or had a carer to drive their vehicle. These respondents were recruited by Disabled Motoring UK and based onto Impact to classify respondents into DNO region, age, impairment and EV usage and likelihood of take up. Interviews conducted were on average 45 minutes long, conducted either over Zoom or telephone with stimulus materials being emailed beforehand for telephone interviews or alternatively shown over Zoom in an online interview.



Physical Impairment	Counts
A physical disability or mobility impairment	19
A mental health condition	2
A chronic illness (mental or physical)	6
Reliance on essential medical equipment	2
A hearing impairment	2
Guardian of young children (up to 5 years old)	1

Likelihood of EV take up	Counts
Likely (Extremely, Very, Slightly, Moderate)	13
Unlikely (Not likely at all)	4
Non-driver	2

DNO	Counts
Scottish and Southern Electricity Networks (SSEN)	6
Scotland	3
South England	3
SP Energy Networks	2
Electricity North West	2



Northern Powergrid	2
UK Power Networks	3
Western Power Distribution	2
Don't Know	2

Age	Counts
18-24 years old	1
25-34 years old	0
35-44 years old	1
45-54 years old	1
55-64 years old	5
65-79 years old	9

Gender	Counts
Male	12
Female	6
Prefer not to say	1

Location	Counts
City Location	4
Other urban location	7
Semi-rural	6
Rural	2

## 11.2 List of Stakeholders

Below is a list of stakeholders who took part in the research and gave permission to be named in the report:

Name	Job Role	Organisation	Expert
David Livermore	Director	AccessAble	Accessibility
Chris Girling	Communications Assistant	Disabled Motoring UK	Accessibility
Hayley Ingram	Manufacturer Relations Manager	Motability	Accessibility
Richard Shakespeare	Former Chair and current member	SSEN's Inclusive Service Panels	Accessibility
Helen Dolphin MBE	Director	People's Parking	Accessibility
Caroline Jacobs	Head of Development	Research Institute for Disabled Consumers (RiDC)	Accessibility
Keith Johnston	Co-founder / Business Development	Urban Electric	Technology
Nick Sacke	Head of company Product Strategy, Development and Management	Comms365 Limited	Technology
Chris Pateman-Jones	CEO	Connected Kerb	Technology
Sophie Adams	Head of Consumer Experience	Department for Transport - Office for Zero Emission Vehicles	Transport
Colin McAllister	Group Training and Development Manager	John Clarke Motor Group	Transport

4 further stakeholders took part but wished to remain anonymous, this included 1 accessibility stakeholder, 1 technology stakeholder and 2 transport stakeholders.

### 11.3 Discussion Guide – Stakeholder focus group and in-depth interviews

w/c 25 <sup>th</sup> Jan – w/c Feb 8 <sup>th</sup> 2021 FG: Wednesday 3 <sup>rd</sup> Feb	SSEN	<b>Overall Objective</b> – Identify the enablers and barriers for EV adoption for drivers with disabilities, particularly around charging, along with recommending traditional and innovation solutions for making EV and EV infrastructure more accessible
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AREA OF DISCUSSION	TIME ALLOCATION
1. Moderator introduction	5 minutes
2. Warm up	5 minutes
3. Company journey	15 minutes
4. Defining relevant vulnerabilities	10 minutes
5. Enablers	10 minutes
6. Barriers	20 minutes
7. Power outages and resilience	10 minutes
8. Innovative solutions	10 minutes
9. Wrap up	5 minutes

**GROUP STRUCTURE (1½ HOURS):**

**1. Moderator Introduction (5 minutes):**

- Introduce yourself
- Explain that the research is being conducted on behalf of SSEN – who are the Distribution Network Operator (DNO) for Central Southern England and Northern Scotland. They are not your energy supplier, they do not send electricity bills or deal with billing or metering .
- Explain purpose of discussion (*SSEN are working in collaboration with DMUK, and Connected Kerb (a car Original Equipment Manufacturer (OEM)) to explore the requirements and the barriers for disabled and vulnerable motorists adopting electric vehicles (EVs).*)
- Confidentiality is guaranteed, no right/wrong answers, interested in everybody’s opinions, in as much detail as possible
- Explain moderator’s role and set out ‘rules’ (*speak loudly/clearly/not all together*)
- Explain audio and video recording and presence of observers (if appropriate)
- Any questions?

**2. Warm-up (5 minutes):**

- Please each introduce yourself and briefly explain your job role

### 3. Company EV journey (15 minutes):

- Is your company involved in the motor or accessibility industry?  
Probe on: electric vehicles, is the company moving into the sector in the future?
- How did the company (or founder) become involved in this industry?  
Probe on:
  - Transport background
  - Environmental / low carbon background
  - Technology / innovation background
  - Personal experience
  - Expansion in current sector
- If different to the company, how did you personally become involved?
- **IF NO INVOLVEMENT IN EV SECTOR:** Are there any future plans to develop involvement in EV/motor sector in the company?
- Are there any organisations that you feel are particularly leading the way in helping the UK move towards a nation of EV drivers?
- Do you think all drivers have equal access to transition onto an EV?
- If no: which individuals come to mind when considering who is worse/better
  - Probe on: Accessibility, locality, household income, personal needs

### 4. Consideration of vulnerable drivers (10 minutes):

Utilities companies, regulated by Ofgem, are required to consider the support needs of customers with vulnerabilities in accessing energy. This also applies to ensuring they help customers with vulnerabilities to help overcome any barriers to switching to EVs.

- Does your organisation consider “vulnerable” customers? If so, what groups of people does your organisation consider “vulnerable”?
  - Probe on: difficulty using EVs and EV charging?
  - If no: are you looking to expand your offering/service to a broader range of customers?
- We are considering the following groups of people as drivers with vulnerabilities [SHOWCARD A]:
  - Physically disabled or mobility-impaired drivers
  - Older drivers (70+)

- Drivers with learning difficulties or who may have trouble adapting to new technology
- Drivers that don't speak functional English/experience barriers to effective engagement e.g. customers with learning difficulties
- Drivers living in remote rural locations
- **Difficult to identify e.g. customers with mental health issues**
- Do you agree with this list? Anything to add?
- What unique difficulties do you think these groups of drivers might have in switching to EVs and EV charging? (We will do into more detail on this later).

#### EV SPECIALISM:

- Are vulnerable drivers considered when developing EV strategy / innovation / product development/ schemes in your organisation?
  - If not, why not?
  - If yes, in what way? Who drives this?

#### ACCESSIBILITY SPECIALISM:

- What type of support, if any, does your organisation provide for customers with disabilities or vulnerabilities when it comes to driving?
  - Probe on: car modifications, schemes, public grants/funding, information
  - If non specific to driving: do you use any other sources to point customers towards
- What's your personal opinion of the importance of considering vulnerable and disabled drivers in an EV roll out strategy?
- Are there any organisations/international examples that you feel are particularly leading the way in enabling drivers with disabilities or vulnerabilities to access EVs?
- Is there anything missing in terms of what the UK is doing at the moment to enable these drivers?

#### 5. Enablers to EVs for drivers with vulnerabilities (10 minutes):

- What do you think are the benefits of switching to EVs for drivers who are in the categories we've identified?
  - Are these benefits equal for all EV drivers?
- Is this different for the different types of vulnerable driver [SHOWCARD A]?
  - Physically disabled or mobility-impaired drivers



- Older drivers (70+)
- Drivers with learning difficulties or who may have trouble adapting to new technology
- Drivers that don't speak functional English
- Drivers living in remote rural locations
- From a review of available literature we have identified the following four enablers [SHOWCARD B]

- Battery range of even smaller EVs should be sufficient for most drivers considering their typically low average mileage
- Once home charging is established (either on a private driveway or using residential street charging innovations), it is rare that most drivers would need to use en-route or destination charging which creates anxiety
- No longer needing to visit petrol stations which can be a physical, or social, challenge for many
- At the moment EVs work out cheaper than ICE cars overall when you take into account electricity costs vs petrol / diesel costs, and drivers can also benefit from a number of financial incentives to start driving EVs

- Do you agree with these? Have you / your organisation ever considered these enablers before?
- Any other enablers to add?

## 6. Barriers (20 minutes):

As we touched on before, there are specific issues that drivers with a disability or vulnerability face when they are switching to EVs and charging EVs.

- What problems or challenges do you think the different vulnerable driver groups might face?
  - For making the switch to EVs (including researching, choosing and driving)
  - For charging EVs (at home, at work, en-route etc)
  - Probe on: technology literacy and easy step by step guides for set up
- Can you think of specific barriers for any group in **SHOWCARD A?**
- We have identified the following list of barriers from the literature review conducted:

### [SHOWCARD C]

- What are your thoughts on list – agree/disagree/unsure?
- Anything to add/missing?

- Access to charge points
- Cost e.g. modifications, insurance
- Psychological barriers
- Lack of information on accessible charging

- EV range

- From your experience are these the key barriers?
  - Anything stand out which might be experienced more by particular drivers versus others?
- Have you considered any of these barriers before in your company/organisation's development of products and services?
  - Which do you think are the most important for your organisation to consider? Why?
- Have your customers / consumer groups you work with, ever mentioned any of these before?
  - Who? What did they say?
  - Did they expect your organisation to resolve them? Who do they see as being responsible?
- What do you think will happen as EVs become more widespread?
  - Do you think these barriers disappear? Or get worse?
  - Do you think new barriers emerge?

## 7. Power outages and customer resilience (10 minutes – if time available):

Amongst the barriers just mentioned above, experiencing a power cut could inflict significant disruption for the groups of customers mentioned in this discussion. Anxiety could be heightened for this group, if they experience a power outage and are then unable to either charge their vehicle or drive it all together due to no charge.

- What consideration have you/your organisation given to this scenario [of a power outage for individuals in vulnerable circumstances] in terms of the technology/service/products you provide?
  - Does this differ for a planned vs unplanned outage?

### **EV SPECIALISM:**

- Are there build in fail safes to ensure your produce/service aren't disrupted by a power cut?
  - Probe on: difference if short (0-2 hours) medium (2-6 hours), long (6+ hours) outage
  - If no: what impact would that have on the customer?
- Does your service/product offer information on steps to take in an event of a power outage?

### **ACCESSIBILITY SPECIALISM:**

- Do you have any concerns when it comes to individuals with vulnerabilities or disabilities experiencing a power cut, whom drive/carer drives an EV?
  - How would a power cut impact the types of individuals your organisation represents?

- Probe on: difference if short (0-2 hours) medium (2-6 hours), long (6+ hours) outage
- Probe: unplanned vs planned
- Are there concerns usually mitigated/researched before purchase of an EV?
- Are you aware of resilience mechanisms these individuals have in place or organisations people with vulnerabilities/disabilities would turn to, to gain support?

## 8. Innovative solutions (10 minutes):

As charger and grid technology moves on, innovative solutions are being created to tackle a multitude of problems for all types of drivers. We are now going to focus on innovative solutions to barriers discussed earlier in this interview/discussion.

- How do you think barriers / challenges we have been discussing, can be resolved for disabled and other vulnerable drivers?
- What do you think about these examples? [SHOWCARD D]
  - Better communication of information
  - Financial incentives and support
  - Practical support
  - Design / technology innovation
  - Government / local authority action
  - DNO e.g. Priority Services Register
  - Electricity supplier activity e.g. ToU
  - Private company / non-profit organisation activity
- Who do you think is responsible for initiating these changes?
  - Probe: is this led by consumer/government/private sector?
  - Probe: relate back to examples in showcard D to specify which organisations should focus on which types of solutions
- Are you aware of any initiatives at the moment to help reduce barriers?
  - Probe on: From who? Details?
- What do you think should be happening to help resolve these challenges for vulnerable driver groups?
  - Why is this not happening already? What are the barriers? Who is responsible?

**ACTIVITY:** Please look at **showcard D**, could you rank these items in terms of which solutions you think would **help support customers the most** in terms of aiding transition to an EV, with number 1 top choice having the **most impact** to a person with vulnerability/disability and number 8 being **least impact** to customer.

[CHECK UNDERSTANDING OF EACH EXAMPLE, EXERCISE CAN INCLUDE ANY OTHER SOLUTIONS RESPONDENT HAS THOUGHT OF]

- Why have you ranked them in this order?
- Probe on role of DNO, Government, Supplier

The final thing I'd like to show you today is a list of innovations currently being used or trialed that may help remove barriers for vulnerable driver groups:

#### SHOWCARD E

- Charge point design innovations
- Innovation in EV charging management, payment and speed
- Inductive charging
- V2G

- Please tell me what, if anything you know about each of these?
  - Do you think they will help the vulnerable groups identified in showcard A to access EVs?
  - Which particular vulnerable groups? Any which we haven't considered today?
- Is there anything missing? What else would help?

**ACTIVITY:** Please look at **showcard E**, could you rank these items in terms of which solutions you think would **help support customers the most** when driving an EV, with number 1 top choice providing the **most support** to individuals with vulnerability/disability and number 8 providing the **least support**.

[CHECK UNDERSTANDING OF EACH EXAMPLE, EXERCISE CAN INCLUDE ANY OTHER INNOVATIONS RESPONDENT HAS THOUGHT OF]

- Why have you ranked them in this order?
- Which do you think should be prioritised in the next 5-10 years for mass roll out?
- Which companies / organisations do you think should be leading on implementing these innovations?

- What role do you think the government / Public sector should play in terms of encouraging this through regulation and funding vs private sector developing commercial propositions?
- Is there anything more you think your organisation could be doing to help remove barriers for vulnerable driver groups?
  - What would need to happen for this to be put into practice?
- What, if any, role should DNOs play in driving innovation and change to help remove barriers to EVs for vulnerable drivers?

#### 8. Wrap up (5 minutes):

- Thank you for your time today.
- Is there anything else you'd like to add to help us advise organisations on how best to enable drivers with disabilities or vulnerable driver groups in the EV transition?
- Have you learnt anything new today?
  - [QUAL GROUP] Either from each other or from the information I've provided?
- Is there anything that you have learnt today that your organisation do implement?
  - How likely would they be to do this?
  - What would stop them from doing this? (e.g. costs, time, lack of knowledge)

Thank and close.

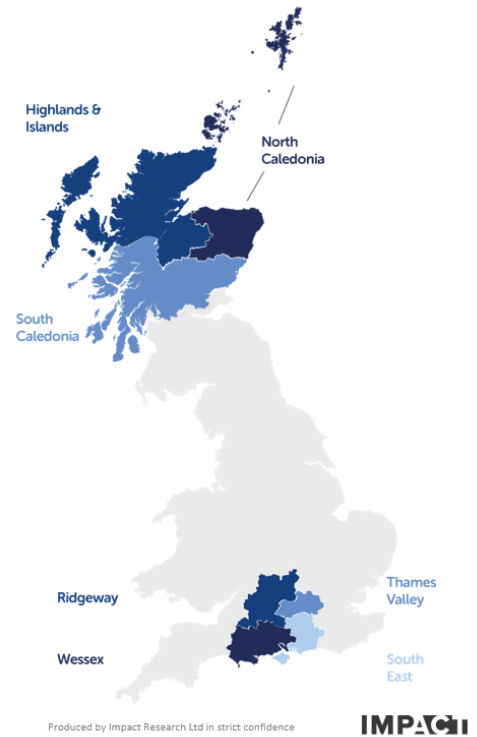


## 11.4 Stimulus – Stakeholder focus group and in-depth interviews



### Scottish & Southern Electricity Networks

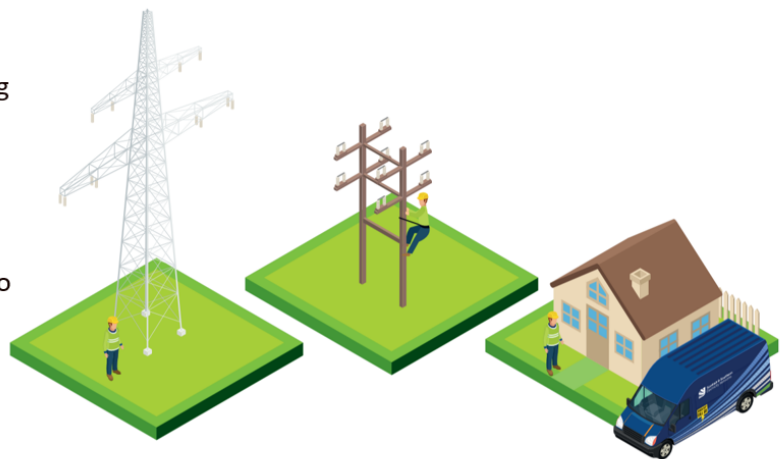
- Through SSEN's two licensed electricity distribution network areas, Scottish Hydro Electric Power Distribution and Southern Electric Power Distribution, SSEN operate and invest in an essential part of the UK's electricity system, delivering power to over 8m people in 3.8m homes and businesses.
- SSEN's core purpose is to deliver electricity that powers communities in a safe and reliable way. This is achieved through responsible stewardship of their networks, helping to keep the lights on and invest efficiently in new and existing network infrastructure for the benefit of their customers.
- SSEN Distribution is one of SSE Group's core businesses. They are a regional monopoly, funded through energy bills, with economically regulated returns set by Ofgem.



## Who are SSEN?

The company that is responsible for getting the electricity people need to their homes or businesses via their network of cables and poles.

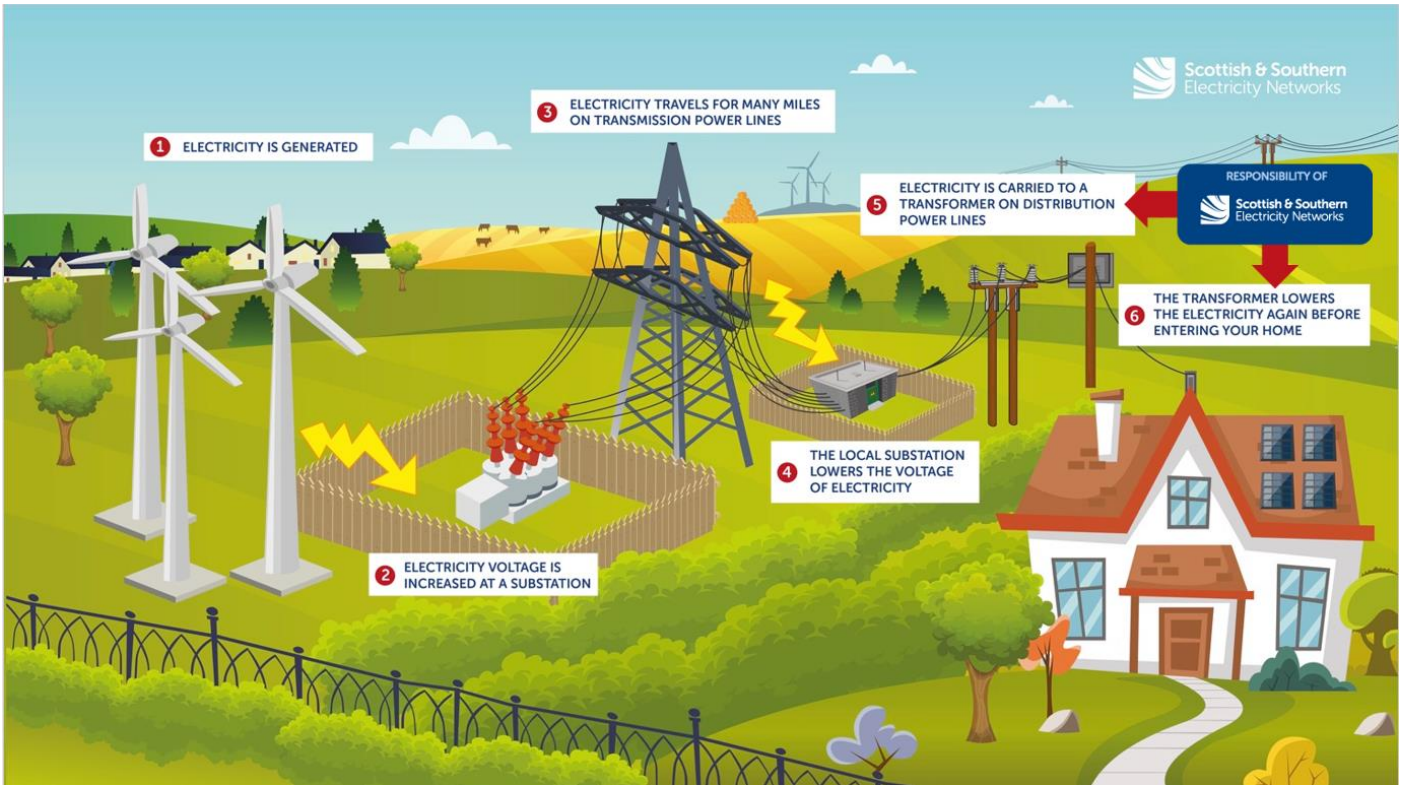
They provide this service for every home and business in the North of Scotland and central southern England regardless of who your energy supplier is (i.e. who you pay your energy bill to).



2

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SHOWCARD A

List of vulnerabilities

Drivers with a physical disability or mobility-impairment



Drivers that don't speak functional English/ experience barriers to effective engagement e.g. customers with learning difficulties



Drivers living in remote rural locations



Drivers who are elderly



Drivers with learning difficulties that may find using new technology difficult



Difficult to identify e.g. customers with mental health issues

## Enablers for vulnerable drivers



Battery range of even smaller EVs should be sufficient for most drivers considering their typically low average mileage



Once home charging is established (either on a private driveway or using residential street charging innovations), it is rare that most drivers would need to use en-route or destination charging which creates anxiety

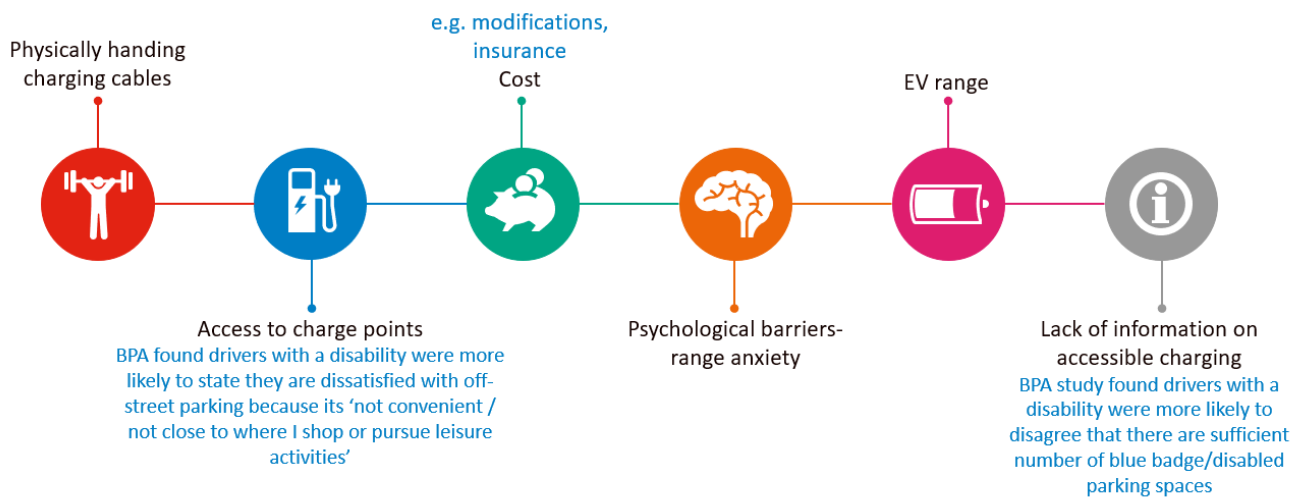


No longer needing to visit petrol stations which can be a physical challenge for many

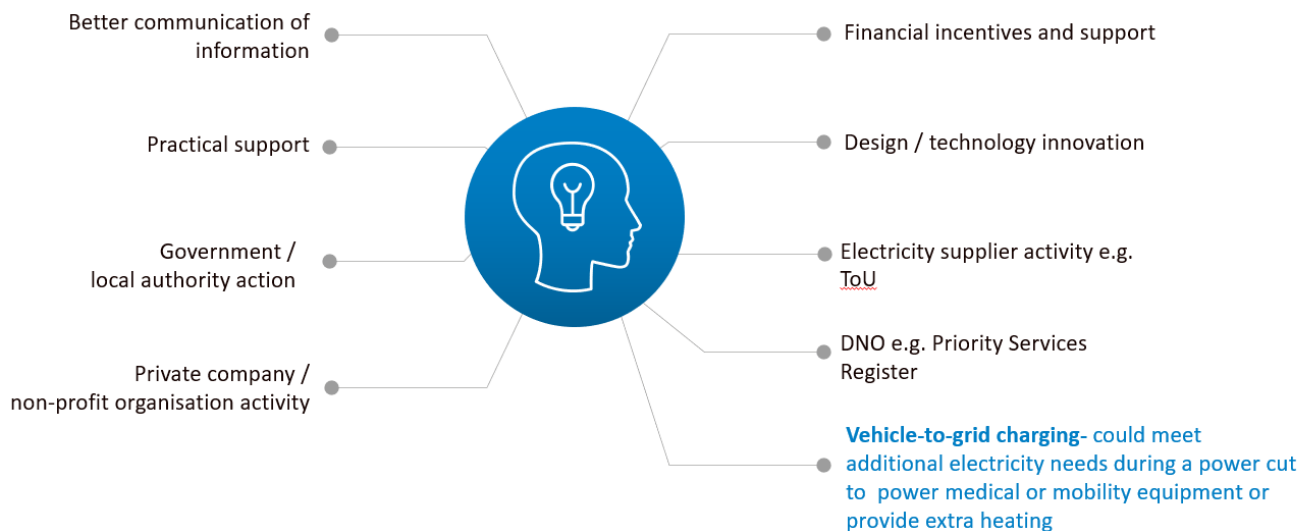


EVs work out cheaper than ICE cars overall when you take into account electricity costs vs petrol / diesel costs, and drivers can also benefit from a number of financial incentives to start driving EVs

## Barriers to transition to EV

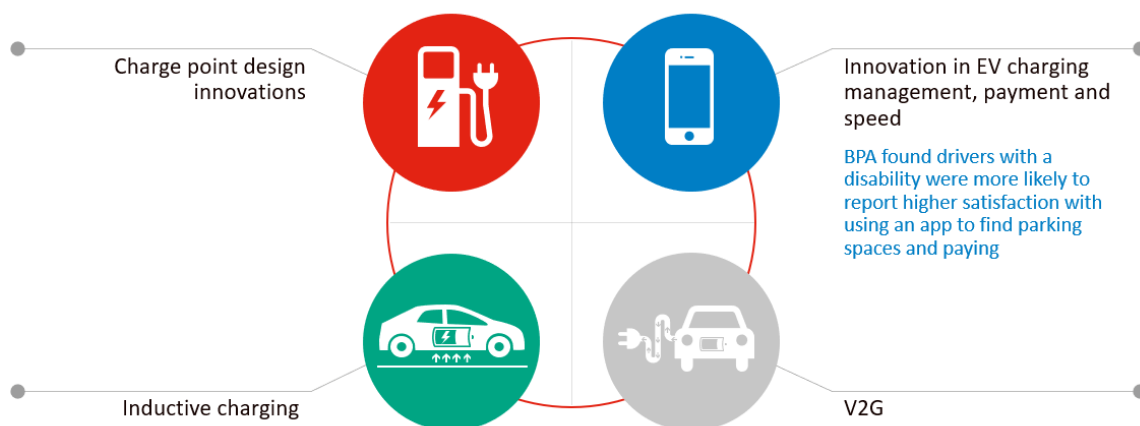


## Resolution of barriers



Produced by Impact Research Ltd in strict confidence 7 **IMPACT**

## Innovation to resolve barriers



Produced by Impact Research Ltd in strict confidence 8 **IMPACT**

## 11.5 Discussion Guide – Customers with vulnerabilities in-depth interviews

w/c 1 <sup>st</sup> March	SSEN	<b>Overall Objective</b> – Identify the enablers and barriers for EV adoption for drivers with disabilities, particularly around charging, along with recommending traditional and innovation solutions for making EV and EV infrastructure more accessible
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### INTERVIEW STRUCTURE (1 HOUR):

AREA OF DISCUSSION	TIME ALLOCATION
1. Moderator introduction	5 minutes
2. Warm up	5 minutes
3. Current driving experience	15 minutes
4. Electric Vehicle uptake	20 minutes
5. Innovative solutions	10 minutes
6. Wrap up	5 minutes

#### 1. Moderator Introduction (5 minutes):

- Introduce yourself
- Explain that the research is being conducted on behalf of Scottish and Southern Electricity Networks (if respondent is from Scotland may be more familiar with ‘Scottish Hydro Electric Power Distribution) (SSEN) – who are the Distribution Network Operator (DNO) for Central Southern England and Northern Scotland. They are not your energy supplier, they do not send electricity bills or deal with billing or metering.
- Explain purpose of discussion (*SSEN are working in collaboration with DMUK, and Connected Kerb (an EV charge point owner and operator) to explore the requirements and the barriers for motorists with disabilities or vulnerabilities adopting electric vehicles (EVs).*)
- Confidentiality is guaranteed, no right/wrong answers, interested in everybody’s opinions, in as much detail as possible
- Explain audio and video recording
- Any questions?

## 2. Warm-up (5 minutes):

- Please each introduce yourself and explain your [carer: the person you are supporting's] living situation. If the participant is comfortable doing so, probe briefly on: their disability/chronic condition/vulnerability and how this affects their everyday life
- What is your main method of transport? Do you drive a car? If so, is it petrol, diesel or electric/hybrid?
- How long have you had this car?
  - Has it been adjusted in any way to enable you to drive? How did you find that experience?
  - Do you currently or have you ever used the Motability scheme or any other support schemes? How did you find out about these schemes?
  - Do you own or lease your current vehicle?

## 3. Current driving experience (10 minutes):

- Thinking about a typical week for you before the COVID-19 pandemic began:  
Probe on:
  - How many trips outside of your house you make in a typical week? How far?
  - How many times do you use your car to travel to these locations?
  - **Carer:** specific caring duties?
- Do you normally plan your journey before making it?  
Probe on:
  - What types of journey would you plan for?
  - What types of things do you do to plan?
  - PROBE ON Car parking spaces? Look up accessibility of venue travelling to? Distance?
  - Guides/websites?
  - Anything else?

## CAR SPECIFICS

- Why did you/the person you support decide to purchase/lease your current vehicle?  
Probe on:



- Enablers of a petrol/electric car which they couldn't do before in their everyday life when owning previous vehicle
- Compatible with Motability scheme or modifications
- Petrol: Familiarity of a car, had driven similar model before
- Recommendation – from friend/relative/forum/magazine/review
- Cost
- EV: friend/relative/support organisation had provided information on switching to EV
- What are the positive experiences when it comes to driving?
- Have you had to overcome any challenges when you first drove this car specifically?
  - Probe on:
    - Instances when you're visiting friends/relatives vs public venues, or new versus familiar places
    - Any issues with medical equipment when driving?
    - Petrol– fuelling and paying
    - Getting used to driving with modifications
    - Carer: learning how to get the person you are support into/out of the vehicle
    - **EV:** finding and accessing charging points (especially if you live in a rural area), payment for charging
- What would help make driving a smoother experience for you?

#### 4. Electric vehicle uptake (20 minutes):

##### PETROL /DIESEL USER

- Have you ever considered purchasing an electric vehicle?
  - If yes, what stopped you purchasing an EV?
    - Probe on:
      - Cost to purchase and modifications (if needed)
      - Access to home charging or public chargers (especially if you live in a rural area)
      - Potential difficulties with charging, e.g. heavy cables, bollards preventing access, no dropped curb. Any concern about lack of assistance at EV chargers (unlike at petrol stations)?
      - Added anxiety of learning how to use/park/charge EV
      - Range of car – distance could travel (if this is a concern, probe on how long their average journey would be and if they think an EV could do that)

**NOTE:** A typical journey distance for blue badge vehicles is less than 20 miles per day.

- Insurance cost and limited options

- Hard to understand information provided about EVs and lack of information available specific to their needs
  - Difficultly using new technology, e.g. apps for finding and paying for chargers.
  - Necessary adaptations – probe: on issues with the car battery being underneath the car.
- If no, why not?
  - Probe on (*above list as well as new prompt below*):
  - ‘Myths’ associated with EV such as poor range, higher cost associated with day-to-day use, not enough charging points, unable to drive in rain
- Have you ever had the opportunity to test drive an EV?
  - Yes, how did you find this experience? How was this offered to you?
  - No, would you like to? What has stopped you in the past?
- If you did switch to an EV which type would you most likely purchase?
  - Probe on:
  - Hybrid plug in/full EV/ self-charging hybrid
  - Do you know the difference between these?
  - Do you think a Hybrid plug in, a full EV or a self-charging hybrid would best meet your transport needs? Why?
- Where would you start to look, if you wanted to start researching into buying an EV?
  - Probe on:
  - Trusted organisations – Motability Scheme
  - Google search
  - Car dealerships
  - Friend/family recommendations
- What things would you consider most important when finding out about EVs?
  - Probe on: car milage, adaptations
  - Friends/relative recommendations
  - Suitability for the journeys they make
  - Charge point availability in my area

## ELECTRIC VEHICLE USER

- What prompted you to purchase an electric vehicle?
  - Do you know the difference between the types of EVs: Hybrid plug in/full EV/ self-charging hybrid? What type of EV do you drive?
  - Why did you choose X car over hybrid/fully electric (dependent on car they have)?
    - Probe on: whether anxiety with range (lower if driving hybrid?), and charging logistics (petrol station for self-charging hybrid vs EV charger for hybrid plug in or full EV) played a role
- What was your main motivation for transitioning from petrol/diesel to EV?
  - How did you find this transition?
  - How has this transition affected your car costs? Probe on initial purchase/lease, insurance, charging, getting the car serviced
  - Any challenges when going through the process of deciding to buy an EV?
  - How did you research it? Probe on:
    - Trusted organisations – Motability Scheme
    - Google search
    - Car dealerships
    - Friend/family recommendations
  - Did you test drive before you bought? How was that experience?
- Have you experienced any challenges with using your EV?
  - If yes, what were they and have they been resolved/ behaviour adjusted?
    - Probe on:
      - Access to home charging (especially if you live in a rural area) or public chargers– disabled blue badge vs chargers for public
      - Accessibility of using charge points – e.g. heavy cable, having to have the cable on your lap (if participant uses a wheelchair), bollards preventing access to charger, no dropped curb, lack of choice over using apps at some chargers, size of parking space (if not a disabled park place).  
**Any concern about lack of assistance at EV chargers (unlike at petrol stations)?**
      - Waiting for the car to charge – could have to wait in car (possibly at night in an unknown area, feeling unsafe?), access to accessible toilets and cafes nearby.
        - Do they opt for rapid chargers where possible? If so, why?
        - Been stuck in an unfamiliar place and not found a usable charger?
      - Any support provided to them by friends/relative/parking attendant?

- Hard to understand information provided about EVs and lack of information available specific to their needs
- Difficultly using new technology, e.g. apps for finding and paying for chargers.
- Necessary adaptations – probe: on issues with the car battery being underneath the car.
- Insurance cost and limited options
- Which do you feel is more convenient for you as a driver – filling up a petrol/diesel tank at a petrol station or charging at an EV charger (at home or on street). Why?
- How often do you find you need to charge your EV on-route to a destination?
- Are there any particularly good apps or websites you use on a regular basis to help with your journeys?
  - Probe on: Zap map, AccessAble guides
  - Is digital engagement a concern for you? I.e. would you be worried about using different phone apps to find / pay for your charger?

## ALL

- What do you think are the benefits of switching to EVs for drivers who need extra support in their day-to-day life?
  - Probe on: how the lack of a gear box (all automatic) might affect those needing adaptations.
  - If can't think of benefits – what issues which need to be resolved before they consider purchasing an EV?

## 5. Innovative solutions (10 minutes):

As technology moves on, new and innovative solutions are being created to tackle a multitude of problems for all types of drivers. We are now going to focus on innovative solutions to some of the issues discussed earlier with driving an electric vehicle.

- Who do you think should be responsible for providing advice and guidance and ensuring that new technology such as EVs are accessible to all?
  - Probe: is this currently led by consumer/government/private sector? Who should be leading this?
  - Probe: Local vs national government led? Is a national strategy needed, or is it better for local authorities to work on this based on the level of demand in the area?
- Which companies / organisations do you think are leading the way in implementing solutions to support access to Electric Vehicles for all drivers, including those drivers with additional support needs.
- Looking at the examples do you know of any companies/individuals who are really good at the following **[SHOWCARD A]**. This can include private companies and not for profit organisations

- Communication of information to suit your specific needs
- Providing financial incentives and support
- Providing practical support and advice

## SHOWCARD B

**Inductive charging** – you park your car on top of a plate buried underground which will power the car wirelessly. Inductive charging offers an attractive alternative for motorists as it does not require a connector cable between the vehicle and charge point. This reduces the poor aesthetic and safety concerns of charging cables protruding from both vehicle and charge point.

- What do you think about this charging solution?
  - Would it resolve any issues with charge points/accessing cables?
  - Would this improve your charging experience?
- Would you trust it to charge your car?
- What reassurances would you need using this charging method?
- What information would you like to see about this method being advertised?

**Vehicle –to- Home** – this allows you to use your car battery as a source of power in a power cut

## SHOWCARD C

- What do you think about this solution if you were to experience a power cut?
- Do you like the idea of providing power to your house via your car?
  - PROBE – Do you have any medical equipment that requires electricity?
    - If so, do you see vehicle-to-home resolving any worries or issues with medical equipment?
  - Does electricity power other essential items in their house? E.g. stair lift, hoists, heating, fridge, wheel chair, If so, would this service provide them with more reassurance regarding using these items?
- Would you trust your car to provide your house with energy? What concerns would you have?
  - PROBE ON: Do you think it would damage your battery?
  - Would you be concerned about the charge of the vehicle if a power cut had just occurred?
- What reassurances would you need about using this back-up power method?
  - Probe on: needing information such as how much power their car could provide them for X amount of time, ability to attain warning if car battery level gets to a certain point
- How would you like to be made aware of the vehicle-to-home capability?
  - Probe on: car manufacturer/dealership, energy supplier, support organisations like Mobility Scheme

- What information would you like to see about this method being advertised?

#### 8. Final thoughts (5 minutes):

- Thank you for your time today.
- Is there anything else you'd like to add about your general driving experience or areas you think we haven't been identified which would help support individuals in similar circumstances?
- Anything else to help us advise organisations on how best to enable drivers like yourselves to transition to having an EV?

**Separate Note – PSR:** Are they aware of the priority services register? SSEN has offers free priority services for any customers who would benefit from adapted services or additional help during a power cut, including advance notice of planned power cuts. Is that something you'd like to register for? If yes, please follow the relevant information below to sign up to ensure they are prioritised in an event of a power cut:

Website: [www.ssen.co.uk/psr](http://www.ssen.co.uk/psr)

The phone number to join is 0800 294 3259 and the form to register is here: [www.ssen.co.uk/PSRform](http://www.ssen.co.uk/PSRform)

#### IF PARTICIPANT LIVES OUTSIDE OF SSEN:

Contact your supplier – you'll find contact details on your latest bill or by searching online. If you use different suppliers for gas and electricity, you'll need to register with both companies. When you speak to your supplier, be sure to mention if you're dependent on a consistent energy supply due to a medical condition. Suppliers will be able to pass on your details to the network operator.

Thank and close.

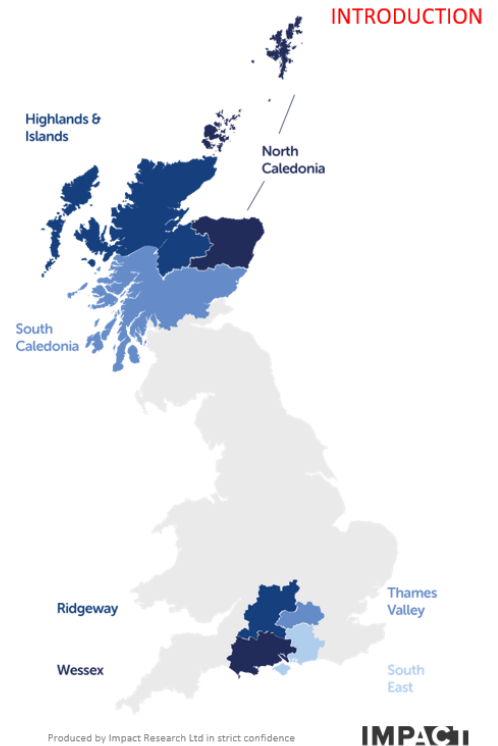


## 11.6 Stimulus – Customers with vulnerabilities in-depth interviews



### Scottish & Southern Electricity Networks

- Through SSEN’s two licensed electricity distribution network areas, Scottish Hydro Electric Power Distribution and Southern Electric Power Distribution, SSEN operate and invest in an essential part of the UK’s electricity system, delivering power to over 8m people in 3.8m homes and businesses.
- SSEN’s core purpose is to deliver electricity that powers communities in a safe and reliable way. This is achieved through responsible stewardship of their networks, helping to keep the lights on and invest efficiently in new and existing network infrastructure for the benefit of their customers.
- SSEN Distribution is one of SSE Group’s core businesses. They are a regional monopoly, funded through energy bills, with economically regulated returns set by Ofgem.

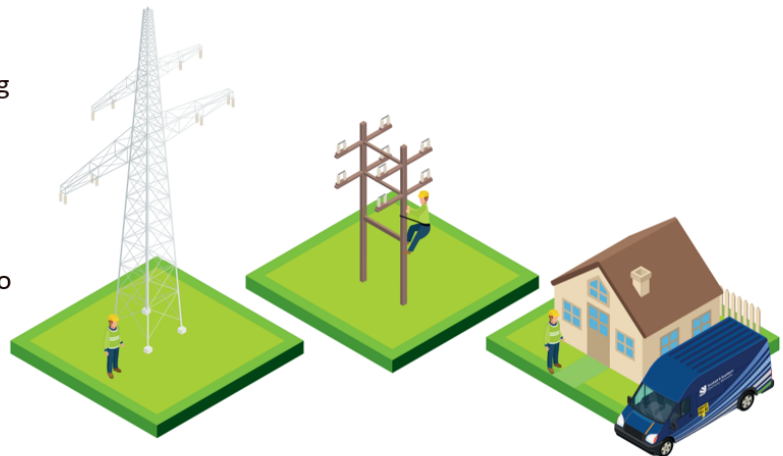


INTRODUCTION

## Who are SSEN?

The company that is responsible for getting the electricity people need to their homes or businesses via their network of cables and poles.

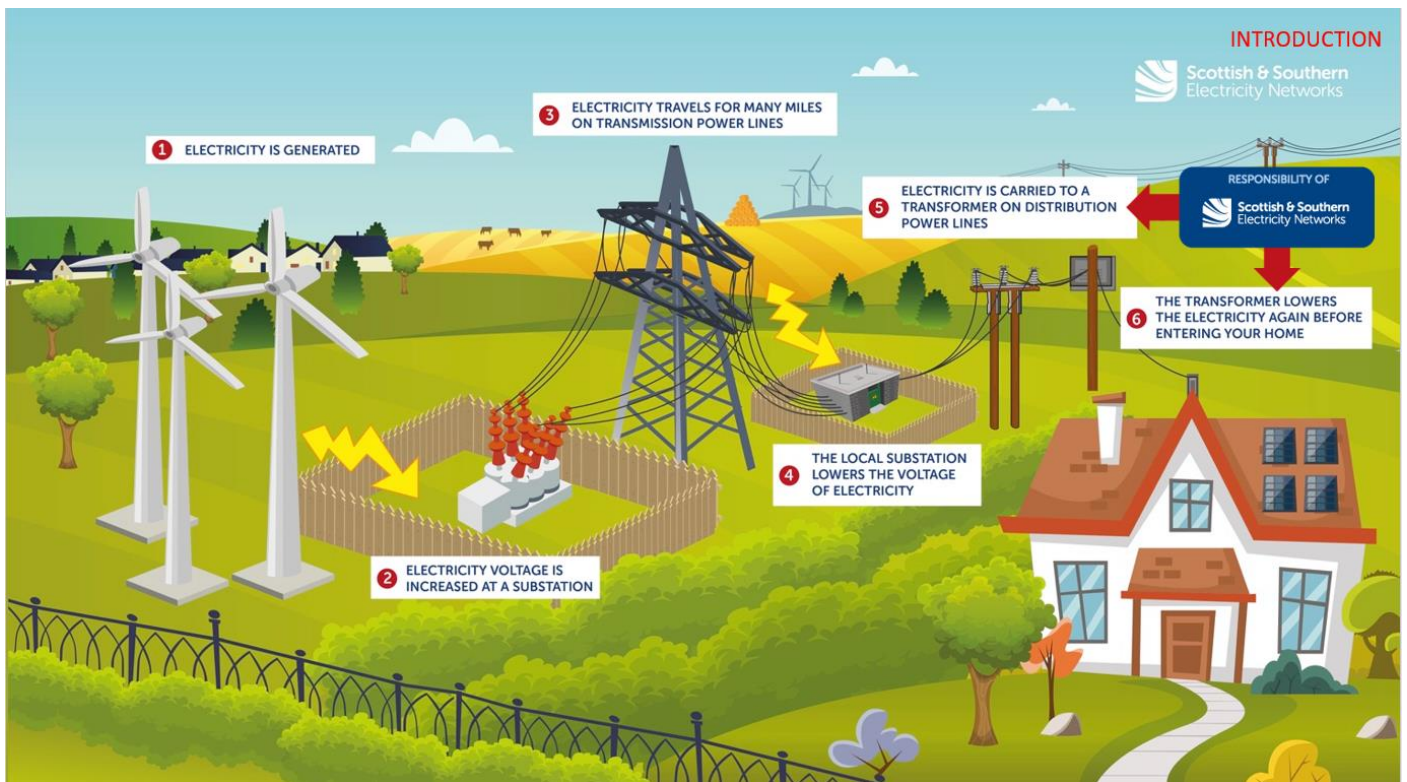
They provide this service for every home and business in the North of Scotland and central southern England regardless of who your energy supplier is (i.e. who you pay your energy bill to).



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SHOWCARD A

Best Practice – Companies/Organisations providing support for below:



Communication of information to suit your needs



Providing practical support and advice

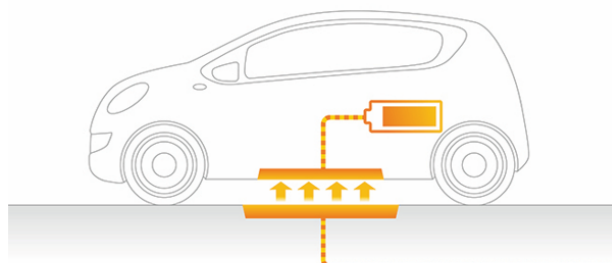


Providing financial incentives and support

## Inductive Charging

- Idea is **similar** to how **wireless phone charging** works with **placing phone onto a round plate** to charge the battery.
- **Park** your car **on top of a charging plate** buried underground which will **power the car wirelessly**.
- **Does not** require a **connector cable** between the **vehicle and charge point**. Ease of driving over charging plate markers without having to pick up anything.
- **Reduces safety concerns** of charging cables lying on the floor and connecting from **both vehicle and charge point**.

## Wireless Charging



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## Vehicle-to-Home

- This allows you to use **your car battery** as a source of power in a power cut
- This means you can use your **car battery** for anything powered by electricity e.g. stairlifts, lighting, cooking, heating, charging electric wheelchair, hoists, fridge
- Once the **power has been restored** to your property your vehicle will **continue to charge** the battery, ready for your next drive



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