



Electric Vehicle charging infrastructure for people living with disabilities

Report for Motability (the charity)

Final Report for Motability (the charity)

ED 14234 | Issue number 1 | Date 02/09/2020

Ricardo

Customer:

Motability (the charity)

Customer reference:

CN02094

Confidentiality, copyright and reproduction:

This report is the Copyright of Motability and has been prepared by Ricardo Energy & Environment, a trading name of Ricardo-AEA Ltd under contract "Consultancy Services to Motability", CN02094, dated 23/06/2020. The contents of this report may not be reproduced, in whole or in part, nor passed to any organisation or person without the specific prior written permission of Motability. Ricardo Energy & Environment accepts no liability whatsoever to any third party for any loss or damage arising from any interpretation or use of the information contained in this report, or reliance on any views expressed therein, other than the liability that is agreed in the said contract.

Contact:

Peter Weldon, Gemini Building, Fermi Avenue, Harwell, Didcot, OX11 0QR, UK

T: +44 (0) 1235 753 354

E: peter.weldon@ricardo.com

Author:

John Hekman, Peter Weldon

Approved by:

Sujith Kollamthodi

Signed



Date:

02/09/2020

Ref: ED 14234

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001

Executive summary

This research investigates the regulatory, market, infrastructure and technological aspects that may form barriers for disabled drivers to charge plug-in electric vehicles.

Motability (the charity) oversees the Motability Scheme, run on its behalf by the company Motability Operations (MO). Every year through the Scheme hundreds of thousands of disabled people and their families exchange some portion of their government-allocated mobility allowance (the enhanced rate) for a leased vehicle.

Motability (the charity) has commissioned this piece of research on possible barriers for disabled people with current and future electric vehicle charging infrastructure because the Government is consulting to bring forward the ban on new sales of new diesel and petrol vehicles from 2040 to 2035 at the latest, indicating that in the near future all drivers, including disabled drivers, would be making the switch to alternatively powered vehicles. At the beginning of this research, it was unclear to what extent accessibility for disabled users had been considered during the currently accelerating rollout of charging infrastructure, as well as what percentage of disabled drivers would be partially or wholly dependent on having universally accessible public chargers in 2035. The Research Institute for Disabled Consumers (RiDC) conducted user research in February 2020 (sponsored by Motability) with disabled drivers, which indicated that existing charge point infrastructure is not currently accessible for a large proportion of disabled people with mobility or dexterity impairments.

The findings in this report were drawn from desk research, expert interviews, and data analysis. Motability would like to understand what is needed to solve the already identified issues with the charging points so that disabled people can benefit, including which stakeholders (government and market) would need to be involved, whether there are international examples the UK can learn from, and which technologies and actions should be focussed on.

The main findings from this research are:

Looking forward to 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 charging infrastructure. Of that 1.35 million, 0.93 million of the total number of disabled drivers are unlikely to be able to charge their vehicle at home, with 0.54 million within that being dependent on on-street parking to park and charge, and the remaining 0.39 million unlikely to have adequate on-street charging either. It is therefore imperative that public charging infrastructure is made accessible to people with a disability so they may be able to charge their vehicle.

From a Government perspective, charging infrastructure is covered by the Automated and Electric Vehicles Act (AEVA), which has no specific regulations or definitions for access for disabled people. Current funding schemes for charging infrastructure do not consider disabled drivers. There may be scope to require the procurer of infrastructure to consider users with disabilities when funding schemes are used to purchase equipment, similar to existing AEVA legislation that mandates all charge points funded with public money to be smart-charging-enabled. There is an internal workstream starting up in the Office of Low Emissions Vehicles (OLEV) on improving accessibility for charging infrastructure, which is open to external input on these issues.

The right to reasonable adjustment via the Equality Act and/or reasonable accommodation via the UN Convention for the Rights of People with a Disability (UN CRPD) is underpinned by UK and international examples. This includes legal precedents for similar types of infrastructure to consider disabled users. The background EU legislation on alternative vehicle infrastructure (the Alternative Fuels Infrastructure Directive, AFID) is currently being updated and may include the principles of the UN CRPD.

The electric vehicle charging market is rapidly expanding, with a doubling of charge points between 2017 and 2019 to nearly 30,000 physical charging units. Yet, the market does not generally consider disability access when designing public charge points. The Equality Act's definition of 'reasonable adjustment' has been applied to fuel station forecourts, which means that charge point providers linked to petroleum companies have made the most progress and are thinking about the issue more than other companies. Of five market stakeholders interviewed, most stated that the lack of a UK or universal design standard, as well as lack of governmental push, meant that the issue had not appeared on their agenda.

Costs are also a major barrier, as the electric vehicle charging market is currently not profitable, and it would not be feasible for charge point operators to retrofit existing charge points. Therefore, there is urgency to address accessibility for disabled drivers now, especially for high energy charge points that have high investment costs and would be specifically needed by disabled drivers who might not have access to home-based charging.

Key considerations on disabled users and charging point technology:

Disabled users are not yet able to find information about which charge points are more accessible to them than others. No UK-based or international information service provides this information, though the UK market leader ZapMap has indicated it is interested in this issue. Crowdsourcing information would allow disabled users to log their experiences for the benefit of others, and comment and picture systems already exist in many services, which represents a potential "quick win" to ensure this information is available.

There are no universal design standards in the UK for electric vehicle charging infrastructure that ensure access for disabled users. In the UK, the most promising development is a Code of Practice from the Institute of Electrical Engineers (IET) that includes guidelines for ensuring wheelchair access for disabled users. IET already defines some standards for the British Standards institute (BSi), and it is possible similar standards could be developed with respect to disabled drivers and electric vehicles. This does not mean that the UK is behind other countries. Internationally, even market leaders such as Norway and the Netherlands have not come up with universal design standards, despite some interest in developing them. However, it is clear from stakeholder interviews and desk research that the USA has a long-standing history of addressing disabled user access from the very beginning of the rollout of EV technology, at least at the local level, and should be looked to for good practice examples of implementing disabled-friendly charge points.

Charging technology development is focusing mostly on high power chargers of 50 kW up to 350 kW, which uses heavier cables that disabled drivers may have trouble handling. It is not expected that this weight will be reduced, or that charging cables will become as easy to handle as fuel lines. Progress can be made when vehicles are able to accept higher voltage charging, but this is not expected to become commonplace outside of premium vehicles.

Wireless charging is expected to be a more promising solution for disabled drivers, as it may remove the need to interact with a charge point at all. That being said, this technology is not expected to become commonplace until at least three to five years from now, and there exists scepticism in the market about its commercial viability.

It is urgent for changes to happen now, as the rapidly expanding charge point market means that many operators may lock in designs and infrastructure for many years without considering accessibility for disabled users. If Government goes forward with mandating charge points in new building developments, it is key that design standards or guidelines with sufficient gravitas are in place to prevent developers from building facilities that only adhere to minimal standards.

Table of Contents

Executive summary	iii
Table of Contents	v
Table of Figures	vii
Table of Tables	vii
1 Introduction	1
1.1 Research methods.....	1
2 Projected future availability and accessibility of EV charge points to disabled drivers	3
2.1 Introduction.....	3
2.2 Datasets used and estimation methodology.....	4
2.3 Methodology.....	4
2.4 Home-based charging for disabled drivers in 2035.....	5
2.4.1 No available charging and on-street charging (34% of total).....	6
2.4.2 Off-street charging (66% of total).....	6
2.4.3 Charging for homeowners with off-street parking.....	6
2.4.4 Upper and lower scenario of charging access.....	7
2.5 Work-based charging.....	7
3 EV charging market outlook	8
3.1 Current market players.....	8
3.1.1 EV charging network overview.....	8
3.1.2 Views from market player stakeholders on disabled access.....	12
4 Relevant policies, initiatives, funding streams and design standards	14
4.1 Current UK policy and its potential relevance to the EV charging for disabled drivers.....	15
4.1.1 Automated & Electric Vehicles Act.....	15
4.1.2 Road to Zero Strategy.....	15
4.1.3 Alternative Fuels Infrastructure Directive (AFID) / Alternative Fuels Infrastructure Regulations (AFIR).....	16
4.1.4 Transport Decarbonisation Plan.....	16
4.1.5 Disability-focused legislation.....	17
4.1.6 Local policy.....	19
4.2 Existing electric vehicle initiatives and funding streams in the UK.....	19
4.3 Potential UK policy under consideration.....	21
4.3.1 Consulting on ending the sale of new petrol, diesel and hybrid cars and vans.....	21
4.3.2 Electric vehicle charge points in residential and non-residential buildings.....	21
4.3.3 Consultation on improving the consumer experience of electric vehicle chargers (forthcoming).....	22
4.4 International policies relevant to accessible EV charging for disabled drivers.....	22
4.4.1 Introduction.....	22

4.4.2	Transnational policy	22
4.4.3	Relevant policy examples from other countries	24
4.5	UK and international design standards for accessible EV charging infrastructure	28
4.5.1	British Standards and inclusive urban design	28
4.5.2	Other relevant UK standards and guidance	29
4.5.3	International design standards for electric vehicle charge points	30
4.6	Policy overview summary.....	31
5	Information provision on the accessibility of EV chargers.....	32
5.1	Introduction.....	32
5.2	Overview of information services	33
5.2.1	Leading provider.....	33
5.2.2	Other UK-based information services	33
5.3	Overview of information available from international examples.....	34
5.4	Potential for disability-specific information to be provided	34
6	Future technological developments in EV charging infrastructure	36
6.1	Current and near-term charging technology	37
6.1.1	Charge point technology development.	37
6.1.2	Price points for charge point technology.....	38
6.1.3	Charging technology in vehicles	38
6.2	Longer term charging technology.....	39
6.2.1	Static inductive charging	39
6.2.2	Assistive technology for EV charging.....	40
7	Conclusions and recommended changes	41
7.1	Summary of findings	41
7.2	Recommended changes	42
7.3	Addressing existing barriers to accessible EV charging	42
7.3.1	Barriers applicable to all types of public charging	42
7.3.2	Ensuring accessibility of on-street charging.....	43
7.3.3	Ensuring accessibility of off-street charging.....	44
7.3.4	Ensuring accessibility of rapid and higher-powered charging.....	44
7.3.5	Potential barriers to relevant technological developments	44
Appendices		45
A1 2035 estimation methodology		46
A1.1	2035 extrapolation methods.....	46
A1.1.1	Use of parking data to estimate EV charging need.....	46
A1.1.2	Estimating the number of disabled drivers in the UK.....	46

Table of Figures

Figure 2-1 Disabled drivers or passengers in 2035 and their likely access to charging infrastructure...	5
Figure 3-2 Number of charging points by speed (Source: Zap-Map)	9
Figure 3-1: Market Share of UK Charging Points by Network (Source: Zap-Map).....	10
Figure 4-1 Accessible EV parking signage from eTec guidelines.....	27
Figure 6-1 Typical recharging rate in km per hour, for > 400 km (> 250 mile) journey on a battery pack	37

Table of Tables

Table 1-1 Overview of stakeholders engaged in this study	2
Table 3-1: Key EV charging infrastructure market players in the UK and their near-term plans. The table provides information on the current market offering of each company.....	10
Table 4-1 Overview of electric vehicle initiatives and funding streams.	20
Table 6-1 Typical costs in capital expenditure (CAPEX) and operational costs (OPEX) for different types of charge points. Costs are for 2019.	38

1 Introduction

In February 2020 the UK Government announced plans for a potential 2035 ban (or earlier if feasible) on the sales of internal combustion engine (ICE) vehicles in favour of alternatively powered vehicles. Electric vehicles (EV) are expected to be the main technology that passenger cars and light duty vans will be shifting towards. As it stands the 2035 ban would apply to all drivers equally, which means that drivers with a disability would also have to transition to electric vehicles, and the accompanying EV charging infrastructure available to them. It is therefore imperative that charging infrastructure is made accessible to users with a disability. However, at the beginning of this research project it was unclear to what extent accessibility for disabled users is considered during the currently accelerating rollout of charging infrastructure, as well as what percentage of disabled drivers would be partially or wholly dependent on having universally accessible public chargers in 2035.

Motability (the charity) wishes to understand what needs to be done to help all disabled users in the transition from liquid refuelling to electric vehicle charging. This is because the charity oversees the Motability Scheme, which allows up to 1.7 million disabled people and their families to use their enhanced rate mobility allowance from the UK Government to lease a vehicle. 625,000 of these 1.7 million are currently customers of the Motability Scheme, provided by the company Motability Operations (MO), with some Motability customers having already started leasing an electric vehicle.

In 2020, EVs still only comprise less than 1 percent of the total fleet of cars in the UK. For drivers with a disability on the Motability Scheme, this percentage is even lower (of 625,000 vehicles leased, only 300 are fully electric models), which shows that not many drivers with a disability are among the early adopters of electric vehicles.

A market research study by Transport for London (TfL) showed that disabled drivers can be more apprehensive than non-disabled drivers about switching to electric vehicles¹, finding that:

- Many disabled drivers rely on their vehicle for their independence, which makes this group potentially more risk averse to vehicle change.
- Particular concerns and anxiety exist about the ability to use public charge points.
- Range anxiety is potentially higher in disabled people when considering the many practicalities behind people's lived experiences.

A survey by Motability Operations among Scheme users showed that in 2017 only 4% would definitely consider leasing an electric vehicle at that time. A 2020 study by Motability and RiDC surveyed the opinions of disabled drivers and field tested the experience of disabled drivers with electric vehicles, finding that existing charging infrastructure may not be accessible for a large proportion of disabled people, for example those with mobility or dexterity impairments. The report recommended a concerted effort to influence policy to be more proactive in accommodating the needs of disabled motorists².

This research studies all aspects of EV charging infrastructure and considers how many people in 2035 would be wholly or partially dependent on accessible public charging points. The report also explores the policy landscape, attitudes of market players, and state of charging technology, both in the UK and through international case studies, all of which influence whether existing barriers with EV charge points would be solved or not without intervention. The study examines if action is needed on any one or all of these issues, what action could be taken, and whether resolution of such topics is urgent.

1.1 Research methods

This report was informed by a combination of desk research, stakeholder consultation, and data analysis. Desk research covered all relevant existing and upcoming Government regulations (UK and

¹ Transport for London (2016), Electric Vehicles: Gauging interest among disabled and elderly drivers

² RiDC (2020), Going Electric – Plug-in cars

EU), funding schemes, initiatives and consultations, supplemented with targeted market research covering more than 60% of the 2020 charging market, and international examples. This was supplemented with stakeholder interviews with Government representatives, operators in the UK's EV charging market, and international contacts where relevant. The study also includes forecast estimates on how many drivers with a disability could be dependent on public charging infrastructure in 2035, estimated using data from the UK annual population survey, the English housing survey, the Blue Badge scheme, and the National Travel Survey.

The stakeholder consultation in this study was carried out with inputs from the following organisations:

Table 1-1 Overview of stakeholders engaged in this study

Group	Organisations
Government	Office for Low Emissions Vehicles (OLEV) Transport for London (TfL) Ministry of Housing, Communities and Local Government (MHCLG)
Charge point operators	Shell BP Chargemaster Ubitricity Pod Point Connected Kerb Anonymous Chinese charge point provider
Other	Motability Governor Dr Stephen Duckworth European Association of Service Providers for people with a Disability (EASPD) Society of Motor Manufacturers and Traders (SMMT) ZapMap Motability Motability Operations Ricardo colleagues in other countries focussed on electric vehicle technology

2 Projected future availability and accessibility of EV charge points to disabled drivers



Summary and highlights

- The number of disabled drivers or passengers is predicted to increase from 2.45 million to 2.72 million by 2035. All of this increase can be attributed to the ageing population, driven by the fact that 47% of over 65s identify as disabled.
- People with a disability are less likely to own their own home and more likely to rent (social) housing, which has less off-street parking availability, meaning that it is less likely that disabled people will be able to have a domestic residential electric vehicle charge point.
- By 2035, 34% of disabled drivers or passengers (0.93 million people) will not have access to off-street parking at their own home and will be dependent on on-street or public charging infrastructure. 14% of disabled drivers (0.39 million) are expected to be wholly dependent on public charging infrastructure.

2.1 Introduction

Home or work-based charging can increase the independence of a driver with a disability, as there would be no need to travel to a recharging station away from home. For those without off-street parking, this places emphasis on the availability of on-street residential charging infrastructure, although this will still not be possible for many households. Those without access to either off-street or on-street residential charging infrastructure will remain dependent on public charging infrastructure at other locations.

The analysis in the following sections assesses the number of drivers with a disability in the UK that are unlikely to have good access to home or work-based charging in 2035. Once sales of new ICE vehicles are banned, there may be a large number of disabled people that will become reliant on public charging infrastructure that is accessible to them. This factor underpins the need for addressing access for disabled users when designing charge points.

2.2 Datasets used and estimation methodology

The following public datasets produced by the UK Government have been combined to produce an upper and lower estimate of the share of disabled drivers unlikely to be able to charge at home:

1. **UK Annual population survey data (2008 – 2019)**, which includes information on the total number of persons with a disability, as well as their housing situation. For example, disabled people are far more likely to rent social housing than non-disabled people (24.7% of disabled people aged 16-64 compared to 8.2% of non-disabled people aged 16-64), and conversely are less likely to own their own home. Homeowners are more likely to have access to their own off-street parking (81%) than people who rent social housing (32%).
2. **English Housing Survey (EHS) data (2008 – 2017)**, including data on parking. This includes a breakdown of parking for people with and without a disability. It shows that 65% of disabled households (household with one or more disabled persons) have access to off-street parking versus 69% of non-disabled people. The Scottish, Northern Irish and Welsh equivalent surveys do not show parking availability by disability, though the data shows that there is no significant difference in the percentage of people with a disability. Therefore, the English housing survey proportions reported above are assumed for the whole of the UK.
3. **Transport for London data on the Blue Badge scheme (2009 – 2019)**, which releases statistics on the annual uptake of blue badges. This data is seen as a good proxy for the number of active drivers, or those who have another person drive for them, in the UK with a disability. In 2018, 2.35 million people were estimated to hold a blue badge.
4. **National Travel Survey (NTS) data (2018)**, via a secondary analysis that Motability (the charity) commissioned from the National Centre for Social Research (NatCen). This includes statistics on disability by type for people in England who hold a driving licence, are driving, or have someone else in their family drive for them, which has been used to understand the potential number of disabled users outside of the blue badge data.

2.3 Methodology

To estimate the number of disabled drivers who may become (partially) reliant on public charging infrastructure by 2035, we have used a combination of knowledge about the number of drivers and the availability of different types of parking (which can be more or less likely to have charging available) at or near their home or work. A detailed breakdown of how datasets have been used to develop these estimates is available in Appendix 1.

Projected number of disabled drivers in 2035

The projected number of disabled drivers in 2035 has been estimated based on the current number of blue badge holders and information about future changes in the UK's population. Over the next 15 years, due to the ageing population, the number of disabled drivers is expected to grow faster (+16%) than the population (+7%).

Parking availability for disabled drivers in 2035

Data from the English Housing Survey has been used here, which conveniently includes a data field where respondents can indicate whether or not they have a disability. This allows for cross-examination of parking types for people with and without a disability. The main parking types are:

- Off-street garage
- Off-street, without a garage
- Adequate on-street parking
- Inadequate on-street parking
- No parking

The most pressing needs are expected for those with either no parking or inadequate on-street parking. Those with adequate on-street parking will often still be reliant on whether a charge point can be installed in a parking space directly outside, or very near, their home, and this may not be possible for all people who park on-street. **For a discussion on how different parking types fit in the UK regulatory background, see section 4.5.**

For disabled drivers, a personal, off-street parking spot or a garage is a convenient way to charge a vehicle. However, in some cases there may still be obstacles to gaining a personal charger, for example if the driver is a tenant and thus dependent on the willingness of the landlord to install a charger, or if a tenant or homeowner in a centrally managed building. In this case, it depends on the willingness from the building managers to retrofit their parking spaces.

2.4 Home-based charging for disabled drivers in 2035

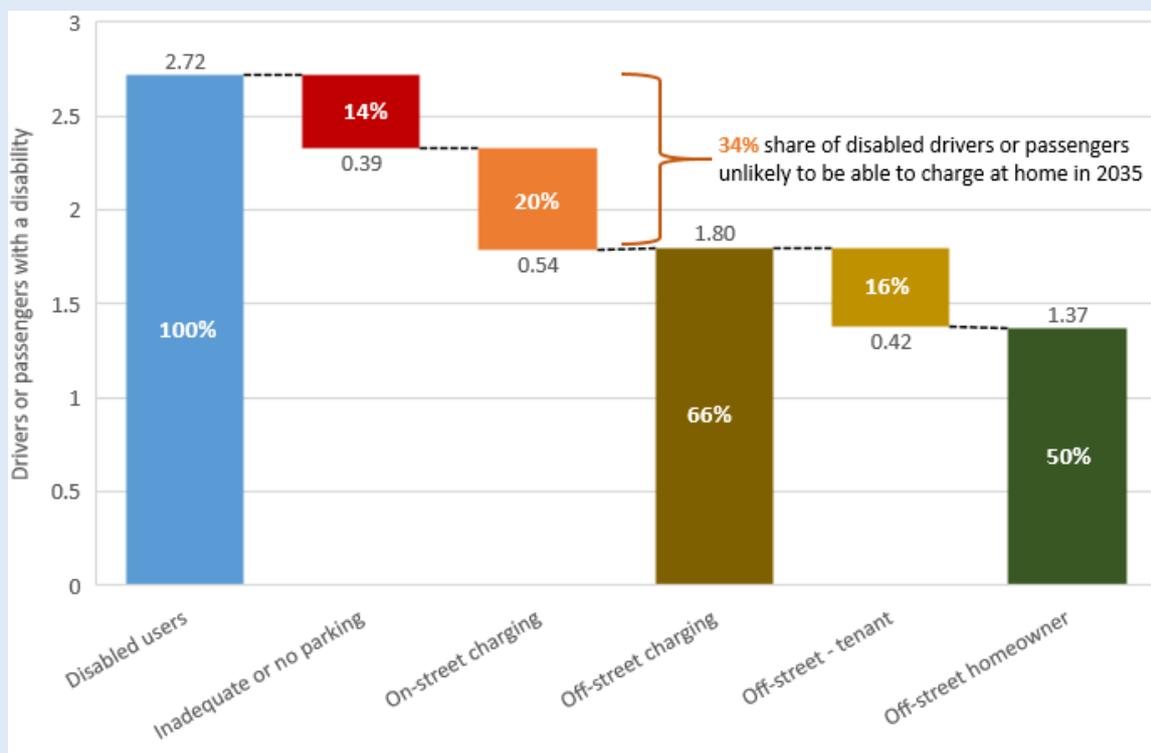
Of the estimated 2.7 million people in the UK in 2035 forecast to have a blue badge, a significant number may not have charging at or near home if the person is dependent on: (1) on-street parking or (2) off-street parking that is not under their control to modify. This is outlined in detail in Figure 2-1:

Figure 2-1 Disabled drivers or passengers in 2035 and their likely access to charging infrastructure

In the chart below, starting from the left, the total number of drivers or passengers with a disability is disaggregated according to likely access to different types of domestic parking in 2035. The left-most categories are those that are least likely to be able to charge at home, and most likely to require access to public charging infrastructure.

Of the forecast estimate of 2.7 million disabled drivers or passengers in 2035, 34% are unlikely to be able to charge their vehicle at home. Making up this total, **14%** are unlikely to have adequate on-street charging at all and would be wholly dependent on other public charging facilities away from home, while **20%** are dependent on on-street charging. This group includes both homeowners and tenants who do not have off-street parking.

66% of disabled drivers or passengers in 2035 are forecast to have off-street parking. The largest group making up this total are homeowners (**50%**). Homeowners with off-street parking are the least dependent on public charging infrastructure, and not considered in need of immediate action. The remaining **16%** - tenants with off-street parking - access to a domestic charge point may be more difficult due to reliance on landlords and building managers to obtain charge points.



The sections below provide a more detailed discussion of the ability to charge their car for each group in Figure 2-1.

2.4.1 No available charging and on-street charging (34% of total)

For on-street parking, of **2.7 million** expected disabled drivers or passengers in 2035, it is estimated that **0.93 million** (34%) would not have off-street parking and would be dependent on on-street parking facilities if they wished to charge at or near home. Making up this 0.93 million, **0.39 million** (14%) of the 2.7 million would only have inadequate parking available and would not have access to EV charging without changes to increase their ability to park a vehicle more reliably. The remaining **0.54 million** disabled drivers (20%) that park on-street would be dependent on the available public charging infrastructure at or near their home by 2035.

2.4.2 Off-street charging (66% of total)

In 2018, approximately 24% of the disabled population lived in social housing (vs. 8.2% of the non-disabled population). Of these 24%, nearly a third (equivalent to 7% of the total disabled population) had access to off-street parking (excluding personal garages). By 2035 it is expected that the vast majority (> 85%) of people with a disability who live in social housing will be in dwellings that were built in 2020 or earlier. Where this group has access to off-street parking, they will be dependent on EV charging equipment being retrofitted to existing off-street parking spaces. Without evidence to indicate otherwise, it is assumed that blue badge holders are equally represented across the population of disabled people, so it is assumed 7% of the blue badge holders in 2035 live in social housing with off-street parking, which is projected to be **190,000** people.

For this group, they will largely be dependent on the local council or housing association policy with respect to retrofitting existing parking spaces with EV charging infrastructure. For the **120,000** disabled drivers in 2035 who are likely to have off-street parking associated with private rented dwellings, the situation is similar, although they will be dependent on their landlords installing or arranging charging infrastructure for their off-road parking spaces.

Apartment buildings with shared parking facilities may not have the required infrastructure to associate the electricity used by a charge point in a specific parking space to individual dwellings/residents, if parking spots are not assigned to particular tenants or homeowners. Furthermore, the current financial incentive structure for installing a domestic EV charger is beneficial to homeowners, but not to private landlords³. For the anticipated small group of **110,000** drivers in 2035 who rent their home but have their own garage, it may be technically easier to install the appropriate infrastructure, though there may still be barriers through dependence on landlords.

2.4.3 Charging for homeowners with off-street parking

For disabled drivers who live in an owner-occupied property, a proportion will own an apartment in a centrally managed building, for which there may still be similar challenges for them to install or arrange for the installation of a charger at their off-street parking space. However, based on current data it is not possible to estimate the percentage of disabled drivers that may have this issue. To resolve this, building managers could work with charging infrastructure operators to grant concessions on their private car parks, enabling these operators to provide a charge point service to residents with electric vehicles. In this scenario, the charge point operator would be responsible for installing and maintaining charging infrastructure as well as recovering the cost of electricity from the residents.

³ Joseph Gurvitz (2020), UK property manager on enabling the electric vehicles transition; <https://medium.com/@josephgurvits/how-landlords-and-government-can-work-together-to-supercharge-the-electric-vehicle-revolution-716117374e8d>

2.4.4 Upper and lower scenario of charging access

At a baseline level, **390,000 disabled drivers in 2035 are unlikely to have access to home-based EV charging**, based on their lack of reliable access to parking. For a further **540,000** disabled drivers in 2035 who would have reliable on-street parking, charging may be dependent on the rollout of charging infrastructure on their street. Finally, in 2035 we estimate that approximately an additional **420,000 disabled drivers will rent their home and will have off-street parking**. This group will be dependent on the charging facilities provided by their landlords, councils or housing associations. In total, **potentially 1.35 million disabled drivers, or about 50% of the total, may be to some degree dependent on accessible public charging infrastructure**.

2.5 Work-based charging

To understand the ability of people with a disability to charge at work in 2035, an estimate would be required of how many parking spaces at workplaces in the UK are likely to be fitted with charging infrastructure by that point in time. However, at the moment workplace charging is still in its infancy, and it is therefore not possible to come up with any reasonable quantitative estimate for work-based charging in 2035 at this time. The expected prevalence of work-based charging infrastructure is estimated in a European study on the average charging behaviour of the European EV driver, which suggests that in 2020, 15% of charging happens at work, increasing to 24% in 2030⁴.

Stakeholders interviewed for this study indicated that they can envision a use-pattern for some people whereby the workplace charger would be their main charge point during the day. Employers may also see it as a benefit to their employees to be able to offer this type of charging, especially if those employees do not have easy access to charging at or near their home, and particularly if relying on on-street residential charging infrastructure, which may be less accessible.

However, **people with a disability in the UK are far less likely to be in work** than the non-disabled population. 7.7 million people, or 19% of the working-age population are defined as disabled and of this figure, 4.1 million (53.6%) are in employment, which is far less than the employment rate for non-disabled people (81.7%)⁵. This shows that disabled users are less likely to be able to rely on workplace charging schemes in general as their main source of vehicle charging.

This places further need on making public chargers, most notably rapid and ultrafast chargers, accessible to disabled users.

⁴ Transport and Environment (2020), Recharge EU: how many charge points will Europe and its Member States need in the 2020s.

⁵ House of Commons Library Briefing, August 2020; Disabled people in employment, available at <https://researchbriefings.files.parliament.uk/documents/CBP-7540/CBP-7540.pdf>

3 EV charging market outlook



Summary and highlights

- Few EV charging infrastructure providers have thus far considered disabled users of charging infrastructure in any great detail. Their current priority is deploying more charge points.
- The strongest consideration of disabled users comes from market players operating publicly accessible charge points on fuel forecourts, who are already subject to more standards and more familiar with implementing them.
- All market players interviewed showed a strong willingness to consider accessibility of charging infrastructure for disabled users in their product offerings.
- Due to the unprofitable business model that most charge point operators currently have, it is not considered economically viable to retrofit charge points to improve disabled access.
- Standards that define a disabled-accessible charge point are viewed as being extremely important.
- General feedback is that market players need the Government to lead the way to establish how charging infrastructure should be made accessible.
- Accessible on-street residential charging is potentially a difficult issue to resolve due to the additional complications of kerbs and a lack of space.

3.1 Current market players

3.1.1 EV charging network overview

There are numerous market players operating in the EV charging sector, with some companies focusing on the deployment of high-speed rapid chargers (typically located on the motorway / trunk road network or at hub locations), some focusing on destination chargers located in urban areas or other destinations that consumers and / or business users regularly visit (e.g. shopping centres, supermarkets, car parks, hotels, etc.), whilst other companies are focused on providing domestic EV

charging equipment to private consumers and/or residential on-street charge points for people with no access to off-street parking.

Charging infrastructure is referred to by its power, type or location, and there is currently no universally agreed terminology for charging infrastructure. In general, the following terms are used to describe the infrastructure:

- **Rapid (or high-speed, or high-powered) charging:** generally located in short-stay locations, with a power of 50 kilowatts (kW) or above, with chargers being developed up to 350 kW for light duty vehicles or higher-powered for larger vehicle categories;
- **Destination (or fast, standard or normal) charging:** generally located in longer-stay “destination” locations, where individuals would park their vehicles for a longer period of time and therefore lower-powered charging is satisfactory, ranging from approximately 7 kW to 22 kW of power;
- **Domestic or residential (or slow or normal) charging:** located in residential areas or domestic locations where vehicles are charged overnight, thereby necessitating far lower-powered chargers, typically between 3 kW and 7 kW for off-street or freestanding on-street chargers, or between 3 kW and approximately 5 kW for on-street lamp post charge points.

The UK’s EV charging infrastructure is constantly developing as new technologies evolve and come to market. The number of public charging points has been steadily increasing in the past 10 years. In 2011 there were approximately 1,500 public charging points, and this has increased to 33,600 in August 2020. The total number of public charge points almost doubled between 2017 (14,000) and 2019 (29,000). Operators list what type of chargers are part of their future plans and the power of cables is closely linked to the weight of it. The trend amongst operators and their desire to transition to faster rapid chargers – a trend reflected in Figure 3-1 using Zap-Map data. The data also shows that the development of slow chargers stalled between 2011 and 2018 but then grew again in 2019 and 2020 as local authorities introduced on-street charging facilities.

Figure 3-1 Number of charging points by speed (Source: Zap-Map)

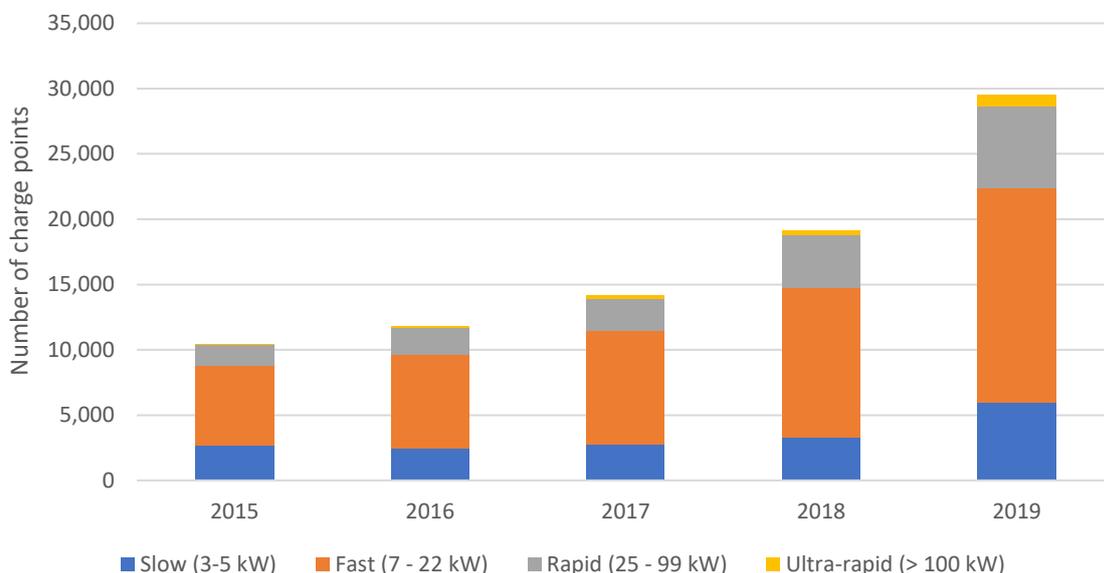
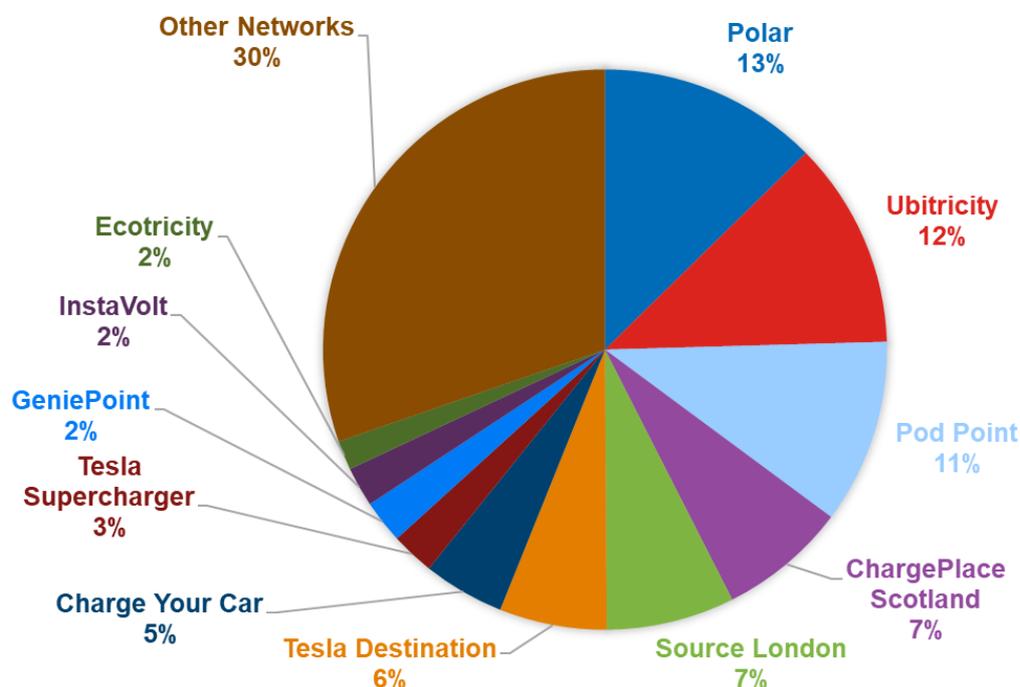


Figure 3-2 shows the market share of the major players in the UK charging market, highlighting the fragmentation of the market and the large number of differently designed chargers that users can encounter, using data from Zap Map⁶.

Figure 3-2: Market Share of UK Charging Points by Network (Source: Zap-Map)



The evolution of service, near term plans, and whether their current or future plans include specific infrastructure designed for ease of use by people with a disability is outlined in Table 3-1. Across the types of charging technologies, there are different dominant market players. To help understand which market players to target when assessing accessibility for disabled users for different types of chargers, the table provides information on their current focus and recent evolution of service.

Table 3-1: Key EV charging infrastructure market players in the UK and their near-term plans. The table provides information on the current market offering of each company.

Market player (and types of charging provided)	Has accessibility for disabled people been considered?	Overview and evolution of service	Near term plans in 2020
Tesla (Rapid/ Fast/ Slow)	No information found.	Offers Tesla Supercharger (120 – 250 kW) network in 61 locations in the UK, that is only accessible to Tesla cars. Also offers Tesla destination chargers usable by more EV brands.	26 more Supercharger locations are planned or currently being built ⁱ . Tesla's focus is on their V3 high power chargers. No information on plans for destination chargers.
Pod Point (Rapid/ Fast/ Slow)	No, as main market is not public infrastructure.	Pod Point has a portfolio of 3,000+ public charging bays, through its network of home, workplace and public charging points. However, their main focus is on the large market for off-street chargers, as sceptical about on-street business model.	In February 2020, EDF acquired a majority stake in Pod Point and is looking to accelerate national rollout of EV charge points, but focus will remain on off-street chargers.

⁶ <https://www.zap-map.com/statistics/#charger-type>

Market player (and types of charging provided)	Has accessibility for disabled people been considered?	Overview and evolution of service	Near term plans in 2020
BP Chargemaster (Polar) (Slow/Rapid/Fast)	Some consideration; has added 1 larger bay in some charging hubs.	BP Chargemaster is one of the main UK market players and operates over 7,000 public charging points via their Polar network. Their charging portfolio covers all speeds and modes of charging.	BP Chargemaster's main strategic focus is to continue rolling out 150 kW rapid charging points at BP forecourts, and lower-powered city-based hubs.
Connected Kerb (Fast/ Slow)	No, although there is a strong focus on inclusivity, adding chargers to poorer areas and promoting coverage.	Connected Kerb manufactures chargers from recycled vehicle tyres. They offer 3 main chargers: Armadillo (low to the ground, for car parks), Gecko (higher up, for streets) and Limpet (wall-mounted).	Spent the last 6-12 months developing relationships with various customers including local authorities – aiming to increase accelerate roll out of charge points in the next 18-24 months.
Shell (Rapid/Fast)	Yes, following guidelines for fuel pumps, and starting to follow Institution of Engineering and Technology (IET) standards, and has international pilots with wheelchair accessible chargers.	Shell has over 300 150 kW and 50 kW rapid Charging points. These are only found at Shell forecourts. Shell is offering disabled drivers assistance when refuelling ⁷ . This does not yet officially apply to their rechargers, but company has the ambition to train all staff on this.	Shell's near-term plan is to have rapid and ultrafast chargers on all of their forecourts and expand further into destination charging.
Ubitricity (Slow, Fast)	No, but would consider charge points near disabled bays if lamp post is present.	Operates on-street residential charge points often installed in lampposts and bollards. Ubitricity has a portfolio of over 2000 chargers in the UK, the majority in London and Oxfordshire.	Ubitricity is aiming to increase the number of charge points to 6000 by the end of 2020. Started in London but is planning on expanding to other areas of the UK. Moving away from the heavy proprietary cable, any Type 2 cable can be used now.
Ecotricity (Rapid/Fast)	No information found.	Operates Electric Highway Network with over 300 charging locations. Operates with long-term exclusive contracts with motorway service groups The company also has a limited number of off-highway locations, for example at IKEA stores.	As an early player in the market, Ecotricity is now looking to update its charging infrastructure and replace with faster, more reliable chargers.
Instavolt (Rapid/Fast/ Slow)	No information found.	Supplies England, Scotland and Wales with over 400 charging locations. Has contracts with forecourt operators, service stations, retail and leisure outlets, and local authorities. Installation of DC chargers is at no cost to landowner.	Is looking for contracts with commercial companies to install rapid chargers, including (for example) a 2020 partnership with McDonalds to install Rapid chargers at drive through restaurants.

⁷ Web page, available here <https://www.shell.co.uk/motorist/services/disable-driver-service.html>

Market player (and types of charging provided)	Has accessibility for disabled people been considered?	Overview and evolution of service	Near term plans in 2020
Source (Fast)	No information found.	Operates on-street chargers in London covering over 23 boroughs. Source London offers a monthly subscription or PAYG tariff. Their current portfolio includes approximately 1,300 charge points.	Source have an ambitious goal to operate 2,000 EV charging points by the end of 2020. Currently, they own around 1,300.
ChargePlace Scotland (Rapid/ Fast/ Slow)	No information found.	ChargePlace Scotland is Scotland's national EV charging network. They provide over 1,000 public charge points across Scotland.	Plans announced in 2020, company is hoping to install 800 new public charge points.

3.1.2 Views from market player stakeholders on disabled access

Interviews conducted with selected market players have provided key insights into the views and commitments of these market players towards enabling access to EV charging for disabled users. **In general, accessibility for disabled users has not been implemented**, although some market players operating on refuelling forecourts are implementing examples of wheelchair accessible charge points and are also looking at what standards should be applied to make charge points accessible. The main findings from the consultation are as follows:

- Ensuring accessibility for charging infrastructure was said to be lower down the list of priorities, after compatibility of the charger with all vehicles, standardisation of connectors, building out the network, and optimising the payment experience.
- Inductive charging was highlighted by most market players as being particularly suitable for disabled users, due to its lack of cabling and kerb requirements.

On how to ensure accessibility of on-street charge points:

- Accessibility of **on-street infrastructure is a particularly difficult issue to solve**, and that universal accessibility is not feasible due to street space and cost limitations.
 - Deploying disability-specific solutions where the space is available, similar to how disabled parking is handled, was suggested by one stakeholder as the best solution.
- One stakeholder highlighted that 'social accessibility' is important, to ensure charge points are also placed in lower income areas, but that it is up to the procuring local governments to ensure this can happen.

On accessible charge points in fuel station forecourts:

- The existing model of having trained staff should be extended ensure help is available for disabled people when operating EV chargers, but this requires more cooperation between charge point operators and those that employ staff at the refuelling/recharging forecourt.
- Wheelchair accessibility is already ensured for many petrol and diesel refuelling stations, and stakeholders operating on forecourts are looking to ensure the same level of access for EV chargers, although this is not universally applied.
- A charge point provider operating on motorway forecourts indicated that they source their designs from subcontractors, and a willingness to communicate experiences from disabled drivers to help their subcontractors improve their designs.

For destination chargers, such as those located in shopping centre car parks:

- Charge points could be installed in disabled bays, as these would already be located in convenient locations with larger parking bays.
- It will however be up to the procurer, which is often a commercial entity, to install these charge points, and they may not have the incentive to do so.

On applying the Equality Act:

- Market players are ensuring that the Equality Act is observed for the minimum height of charge points and their sockets (one industry player).
- In some cases when deploying charging stations with multiple units, ensuring one is larger and more accessible to bigger vehicles.

On the role of Government versus the market:

- A common observation is that any changes need to be Government-led.
- The main need is Government-backed definitions of standards for “accessibility” when considering different categories of charging infrastructure.
- Some stakeholders noted that the legislative processes may be too slow to keep up with technological developments, and they prefer to use standards developed by industry bodies.

On the cost of infrastructure, and the cost of potential adjustments:

- All market players agree that it would be not be economically viable for them to have to change or retrofit existing charging units based on accessibility standards.
- Many stakeholders mention that selling electricity itself does not cover the cost of deploying the infrastructure, and that they are therefore dependent on public investment or are operating at a deficit. Hence, adjustments to enable disabled access may be difficult to justify without an external “push” factor in the form of a standard.

From desk-based research and information obtained via interviews with market players, limited attention has so far been given to ensuring charge point access for disabled users. With regards to near-term plans, some market players do have activities to make charge points accessible, notably those who operate on refuelling forecourts, following industry-led standards on accessibility. Section 4.2 provides information on current and forthcoming funding streams that will help increase the provision of public charging infrastructure.

Government policy and Government backing on design standards are highlighted by all stakeholders as key for them to be able to adjust their charge points. This is especially important to establish the requirements, which can vary between universal design standards for all charge points of a particular type, or a more measured approach based on ‘reasonable adjustment’, based on the Equality Act. Section 4 provides an overview of all current relevant policy, and examples of international implementations.

4 Relevant policies, initiatives, funding streams and design standards



Summary and Highlights:

- The Automated and Electric Vehicles Act (AEVA – primary legislation that gives Government powers to intervene in areas of market failure via secondary legislation) could be the ideal lever to ensure users with disabilities are considered, though other legislative measures could be used based on Government preferences. The AEVA mentions accessibility, though not specifically for disabled drivers.
- Current funding schemes for charging infrastructure do not consider users with disabilities; the procurer of the infrastructure could stipulate requirements for users with disabilities when the funding schemes are used.
- There are two funding streams that are expected to greatly increase provision of charging infrastructure across the UK; the Charging Infrastructure Investment Fund and the forthcoming Rapid Charging Fund.
- There is a forthcoming Government consultation on consumer experience of using charging infrastructure (focused on issues such as payment mechanisms and data availability). The Government has showed a willingness to include questions related to ensuring accessibility of infrastructure for users with disabilities within this consultation.
- Of countries considered further ahead in the rollout of charging infrastructure, only the United States and Canada have implemented (local-level) guidelines and standards to address disabled access that go beyond the progress made in the UK. Norway has progressed further on laws that ensure charging infrastructure is available to people dependent on landlords and building managers.
- There are no universal standards that ensure disabled access when designing charge points, although there are guidelines and proprietary standards that cover (wheelchair) access.

This section provides an overview of the relevant policies, initiatives, funding streams and design standards that affect the charging infrastructure market in the UK. Whilst the main focus is on UK policies and initiatives, additional consideration is given to policies and initiatives in other countries (including EU legislation), as well as some local examples. Information is provided on consideration of, and relevance to, EV users with disabilities where appropriate.

4.1 Current UK policy and its potential relevance to the EV charging for disabled drivers

4.1.1 Automated & Electric Vehicles Act

The Automated & Electric Vehicles Act (AEVA) is an important piece of UK legislation that has the potential to help improve the accessibility of EV charging infrastructure for disabled users⁸. The Act was passed through Parliament on 19 July 2018 to become law. The AEVA is primary legislation that gives the UK Government powers to intervene in areas of market failures with respect to automated and electric vehicles via the implementation of secondary legislation. The Government intends on monitoring the market and only using powers if the market fails, or takes too long, to deliver further improvements. Some areas of focus of the AEVA include:

- Mandating a minimum method of access to charging infrastructure (e.g. contactless payment);
- Ensuring availability of dynamic data (e.g. whether charge points are occupied or in working order when a user wants to utilise a charge point);
- Enforcing reliability and maintenance standards;
- Ensuring all charge points are enabled with smart charging technology;
- Mandating installation of charge points at key strategic locations;
- Enabling Metro Mayors to designate charge point provision at fuel retailers

Government has committed to report on the AEVA after two years in operation. Referring to the list above, Government has begun to act in the area of smart charging, and is planning a consultation to improve the consumer experience of using the infrastructure – this is described further in Section 4.3.

In consideration of users with disabilities, the Act is an important piece of legislation in that it can potentially be the method by which legislative measures aimed at improving the accessibility of charging infrastructure for disabled users can be introduced. Within the Act, there is a mention of accessibility in terms of a minimum method of access – this refers to the method of access for payment; however, the definition of accessibility is not well-defined, and as such could be amended to consider accessibility for disabled users. As such, **the Act gives the Government powers to intervene if the market is failing to act in the area of ensuring accessibility**, though again noting that accessibility is currently not defined as accessibility for disabled users. This would follow a consultation process to determine exactly in which areas the market is failing, and to assess what is defined by “accessibility”, potentially in both a home-based and public charging infrastructure context.

4.1.2 Road to Zero Strategy

In July 2018 the Department for Transport (DfT) published the Road to Zero Strategy, outlining Government ambitions for cleaner road transport⁹. One of the key ambitions in the Strategy is for at least 50% (and as many as 70%) of new car sales and 40% of new van sales to be Ultra Low Emission Vehicles (ULEVs) by 2030. The ultimate aim for the Strategy is to have zero emission road transport by 2050. The Strategy includes a number of actions for the Government and industry to take

⁸ Automated & Electric Vehicles Act (AEVA), available at: <https://www.legislation.gov.uk/ukpga/2018/18/contents/enacted>

⁹ UK Road to Zero strategy, available at: <https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy>

to achieve these targets. The Strategy has now led to more ambitious measures in the form of proposals to bring forward banning the sale of new internal combustion engine cars and vans by 2035, and the Transport Decarbonisation Plan (outlined below).

With respect to charging infrastructure, some actions within the Road to Zero Strategy include consultations on smart charging requirements and regulations for ensuring new build residential developments include provision of charging infrastructure – these are described in greater detail in Section 4.3. A progress review of the Strategy is due to occur in 2025 or sooner – it is a certainty that Government’s next strategy will be more ambitious in light of the recent policy focus on climate change and air quality.

In consideration of users with disabilities, the Road to Zero Strategy includes very little on accessibility of charging infrastructure or of road transport in general. The Road to Zero Strategy references accessibility via the AEVA, although as with the AEVA, it does not go into detail on the definition of “accessibility”.

4.1.3 Alternative Fuels Infrastructure Directive (AFID) / Alternative Fuels Infrastructure Regulations (AFIR)

The European Union’s Directive 2014/94/EU on deployment of alternative fuels infrastructure creates a common framework of measures for the deployment of alternative fuels infrastructure in the EU¹⁰. All EU Member States transposed this Directive into national legislation, and given that the UK was part of the EU when the Directive was introduced, UK-specific legislation derived from the Alternative Fuels Infrastructure Directive (AFID) is already in place in the form of the Alternative Fuels Infrastructure Regulations 2017 (AFIR)¹¹. These regulations address the standardisation of charging technology, mandate some data to be made publicly available (such as location), and ensure ad hoc access to public charging infrastructure (i.e. access without the need for a membership).

In consideration of users with disabilities, the existing AFID, and the resulting UK implementation in AFIR, has very few references to accessibility of alternative fuels infrastructure in the context of users with disabilities. Some European disability-focused stakeholders have been critical of the AFID for its lack of consideration of users with disabilities both in terms of accessibility of the infrastructure and the implementation of technical standards. This is an area of active consideration for the update of the AFID, though existing EU directives already address accessibility in different ways (outlined further in Section 4.4.2).

4.1.4 Transport Decarbonisation Plan

In May 2019, the Committee on Climate Change released its Net Zero report (CCC, 2019), which responded to a request from the Governments of UK, Wales and Scotland to reassess the UK’s long-term emissions targets. The CCC recommended that the new emissions targets for the UK should be net-zero greenhouse gas emissions by 2050, with targets of net-zero for Scotland by 2045 and a 95% reduction in GHG emissions in Wales by 2050. These targets have since been incorporated into legislation via an amendment to the Climate Change Act¹². Achieving net zero emissions means that more actions will be required to decarbonise each sector of the economy more quickly than previously assumed.

In late March 2020 the DfT launched a policy paper called “Decarbonising Transport: Setting the Challenge”¹³. The document outlines the challenge of reducing emissions from all modes of transport to achieve net-zero emissions by 2050, and reviews existing climate policy in transport. The policy

¹⁰ EU Directive 2014/94/EU (2014), available at: <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094>

¹¹ Alternative Fuel Infrastructure Regulations (AFIR) (2017), available at: <https://www.legislation.gov.uk/uksi/2017/897/contents/made>

¹² Target amendments to the Climate Change Act, available at: <https://www.legislation.gov.uk/ukdsi/2019/9780111187654>

¹³ Department for Transport (2018), Decarbonising Transport; Setting the Challenge

paper is quite high-level and has been referred to as “a plan for a plan”. The Government is currently consulting with a wide range of stakeholders on what the plan may include. The intention is to publish the Transport Decarbonisation Plan before the end of 2020.

In consideration of users with disabilities, there is no mention of accessibility for disabled users in the “Decarbonising Transport: Setting the Challenge” position paper. The Transport Decarbonisation Plan covers all modes of transport and as such is considered too broad and high-level to consider accessibility of charging infrastructure at this time. The engagement channel provided by the development of the Transport Decarbonisation Plan may be useful to ensure users with disabilities are included in the eventual Plan.

4.1.5 Disability-focused legislation

Equality Act (2010)

The 2010 Equality Act is the basis of UK anti-discrimination laws and includes a provision on “Anticipatory Reasonable Adjustment Duty”. It includes a duty to anticipate in which ways disabled people (or anyone with a mobility impairment) are placed at a substantial disadvantage in accessing services, and to therefore take reasonable steps to avoid this happening. This can be done by:

- (1) Altering provisions, criteria and practices;
- (2) Changing physical features;
- (3) Providing additional aids and services.

In consideration of users with disabilities, the qualifier of ‘reasonableness’ is the main enforceable element, and beyond the legal text has been defined further by the courts in two transport-related conflicts between service providers and disabled users, on accessibility of train stations (Roads vs Central Trains on platform access, 2004) and airports (Ross vs. Ryanair on payment for wheelchair access, 2012). In Roads vs. Central Trains the judge ruled in favour of the disabled user, and interpreted the law now included in the Equalities Act (Disability Discrimination Act) as such¹⁴:

“The policy of the Act is not a minimalist policy of simply ensuring that some access is available to disabled people; it is, so far as is reasonably practicable, to approximate the access enjoyed by disabled people to that enjoyed by the rest of the public. The purpose of the duty to make reasonable adjustments is to provide access to a service as close as it is reasonably possible to get to the standard normally offered to the public at large.”

It is likely that in the future, if a disabled driver becomes dependent on charging infrastructure when petrol or diesel vehicle sales are banned, that they would appeal to this law in the situation where their needs are not catered for, wielding the interpretation of the law as quoted during Roads vs. Central Trains.

Government stakeholders engaged with during this project also see the Equality Act as a main driver for potential legislative action to ensure charge point accessibility for disabled drivers. One stakeholder noted that it may require significant work including a consultation with disabled users in order to understand the variety of disabilities that drivers can have and identify the best way to ensure a majority of these disabilities are catered for in a cost-effective way. A representative from the Ministry of Housing, Communities and Local Government (MHCLG) noted that an approach on accessibility of buildings is to work with percentiles for accessibility, and to do any reasonable anticipatory work to ensure the maximum percentile of citizens is able to access a service (for example, 99% of all people can use all building services). This approach could also be considered for EV charging stations.

With respect to policies related to EV charging, **accessibility of a charge point** is still interpreted as ‘how to find it, how to get to it, are you able to pay for it’ and does not generally mean access for

¹⁴ EWCA Civ 1541 (2004), available at <http://www.bailii.org/ew/cases/EWCA/Civ/2004/1541.html>

disabled users. This is changing however, as our engagement with the Office for Low Emission Vehicles (OLEV) revealed a new internal work stream that looks specifically at this issue. However, this was delayed in early 2020 due to Covid-19 resourcing issues. OLEV showed interest in using this current project report to contribute to their understanding of the issues facing disabled drivers, including the determination of any consultation questions that could be featured in upcoming consultations on consumer experiences of utilising charging infrastructure.

Implementation of reasonable adjustments for EV charging

The level of adjustment required to ensure accessible EV charging for disabled users could be defined in two ways; maximum technical accessibility of charge points (**fully inclusive solution**), and a less demanding type of design or service that ensures independence without requiring adjustments to all charge points, or even any technical adjustments at all (**reasonable adjustment solution**).

The fully inclusive solution implies setting and enforcing technical accessibility standards for all charge points, for example on the presence of kerbs, space around the charge point, etc. This would go beyond the way the law is interpreted at the moment for parking, and in many space-constrained situations (narrow city streets, parking garages) may not be considered reasonable or even physically possible. That said, there are stakeholders engaged in this study who have called for at least the minimum reasonable adjustments to be made wherever those are physically feasible.

The reasonable adjustment solution would ensure that there is generally always an option for a disabled user in their local area or in their own street to find a charge point, or there would be the ability for the driver to call for help, as is currently the approach for refuelling at fuel service stations. In the case of EV chargers, this could mean ensuring that for a series of chargers placed in a residential street, at least one is adjusted with an accessible kerb and space to mean a wheelchair user can access it. Section 5.4 details some international examples on this issue from Norway and the Netherlands.

There was no unanimous agreement from stakeholders with respect to which option would be most beneficial. Some stakeholders referenced “Design for All” standards, noting that all charging infrastructure, where possible, should be fully accessible to all users, whilst others believe the so-called “silver-plated” solution would suffice, particularly for public charging infrastructure in locations such as motorway service areas. For the latter, stakeholders pointed towards a need to ensure that this is enforceable, such that a disabled user would not be left waiting for a long period of time until the assistance arrived to make use of the charge point, thereby adding considerable time to their refuelling process.

Of particular note, it is highly likely that the fully inclusive and reasonable adjustment solutions would **differ dependent on the category of infrastructure**, as different categories of charging infrastructure would necessitate different adjustments to be made.

DfT Inclusive Transport Strategy (2018)

This strategy document’s aim is to set out the Government’s plans to make the transport system more inclusive, and to make travel easier for disabled people. It includes a passage on electric vehicle charge points, noting that concerns have been raised by disabled users on the accessibility of charge points. Direct mention is made of the Equality Act and how the reasonable adjustment duty applies also the electric vehicle charge points.

National Planning Policy Framework (NPPF), MHCLG (2019)

The NPPF is the national guidance on planning policy for local authorities in England, upon which local authorities can build their own distinctive plans. It states that all developments should be designed to be inclusive. Specific to new development proposals, it states in provision 110 that applications for development should “address the needs of people with disabilities and reduced mobility in relation to all modes of transport”.

Disabled Persons Transport Advisory Committee (DPTAC) access principles

The DPTAC is a government advisory committee, whose guiding principle is that disabled people should have the same access to transport as everybody else, to be able to go where everyone else goes and to do so easily, confidently and without extra cost. DPTAC routinely provides advice to DfT on issues that are relevant to people with a disability. The committee has not yet provided advice on electric vehicle charging infrastructure, but could do so either on policy requirements or design standards.

4.1.6 Local policy

Policy developed by local councils or transport authorities on charging infrastructure provision can also influence the inclusion of considerations for users with disabilities. Many local councils in the UK have developed policies related to infrastructure provision for residential and public charging points, with varying levels of ambition. These policies are implemented via the development of Local Plans for each local authority, where the local authority sets the planning policy for charging infrastructure provision in residential and other locations.

Within these Local Plans, local authorities are able to include stipulations related to users with disabilities, such as ensuring charging infrastructure deployed in public locations is deployed in a manner that guarantees some degree of accessibility. This could include a minimum provision of infrastructure in disabled parking spaces for shared car parks in residential areas. To date, this has not been a priority for infrastructure provision included in local plans, similar to the way in which accessibility of infrastructure has not been considered by many market players due to the priority for getting the infrastructure in the ground.

It is worth highlighting that any national policy on charging infrastructure may supersede charging infrastructure policies in Local Plans, if the national policy is more ambitious than the Local Plans – a consultation on provision of EV charge points in residential and non-residential developments is outlined in Section 4.3.2.

In terms of strategy from a transport authority perspective, Transport for London (TfL) released its *“London electric vehicle infrastructure delivery plan”*, which set a London-wide strategy for delivery of charging infrastructure¹⁵. As part of this delivery plan, TfL held a series of workshops with stakeholders to define the direction of the plan – the issue of addressing users with disabilities was raised during these workshops, with the issue said to be particularly pronounced for on-street residential charging (particularly prominent in London). Whilst these issues were not addressed within the delivery plan, TfL is actively considering users with disabilities and the issues they may face with charging infrastructure.

4.2 Existing electric vehicle initiatives and funding streams in the UK

Table 4-1 contains a list of existing initiatives and funding streams in the areas of electric vehicle and charging infrastructure deployment in the UK. The table provides information on the budget, timeline and target group for each initiative / funding stream, and relevant details and future plans for the initiative / funding stream.

In consideration of users with disabilities, none of the current initiatives and funding streams have specific considerations in place that consider disabled users. There are future initiatives, policy proposals and consultations that may lead to funding streams with specific consideration for users with disabilities, which are explored in the following section after the table.

¹⁵ Transport for London (2019) London Electric Vehicle Infrastructure Delivery Plan, available at <http://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf>

Table 4-1 Overview of electric vehicle initiatives and funding streams.

Initiative / funding stream	Budget, timeline, target group	Relevant details and future plans
On-Street Residential Chargepoint Scheme (ORCS)	<p>£20 million of funding available to local authorities for on-street residential charging points in 2020/21</p> <p>Maximum of £6,500 per charge point (£7,500 in special circumstances)</p>	<p>ORCS funding can be used to help fund the installation of on-street EV charge point infrastructure. 2,000 on-street charge points have been installed by over 60 local authorities via the scheme to-date. No plans for post-2021.</p>
Electric Vehicle Homecharge Scheme (EVHS)	<p>The EVHS is providing £20m of funding in 2020/21 for charging infrastructure in residential locations with off-street parking. Individual EV users apply for this funding. The maximum grant rate is £350 per charge point (recently reduced from £500).</p>	<p>EVHS funding can be used to assist in funding EV charging infrastructure for new or second-hand EV users, lessening the purchase price for the infrastructure. The funding has been used for over 120,000 charger installations to-date. No plans have been announced for post-2021.</p>
Workplace Charging Scheme (WCS)	<p>The WCS has the same grant rate as for the EVHS, with a maximum grant rate of £350 per charge point socket (reduced from £500 in April 2020). No public information is provided on the budget for the WCS, though it was recently confirmed to be continued until 2020/21, similar to EVHS.</p>	<p>Employers installing infrastructure apply for the funding via a voucher-based scheme from OLEV. The limit for the number of sockets per employer was recently increased from 20 to 40 sockets. The funding has been used for charging sockets in over 6,500 locations to-date. No plans have been announced for post-2021.</p>
Charging Infrastructure Investment Fund (CIIF)	<p>The CIIF is intended to develop charging infrastructure in the UK. The fund does not specify the type of charging it is focusing on. The Government is investing £200m, to be matched with £200m in private funding.</p>	<p>£75m of private funding has already been committed by investment funds. £125m of private funding needs to be raised to achieve the CIIF target. The fund has a 10-year life up until 2030.</p>
Plug-in Car Grant (PiCG)	<p>The PiCG subsidises the upfront purchase cost of an EV. Only pure battery EVs can access the funding. £403m was announced for the PiCG in April 2020, with a maximum of £3,000 grant funding per vehicle.</p>	<p>Government has recently committed to continuing the PiCG up until at least 2022/23, but this was not accompanied by a guarantee of maintaining the same grant rate for vehicle purchase.</p>
Plug-in Van Grant (PiVG)	<p>The PiVG subsidises the upfront purchase cost of an electric van, similar to the PiCG as outlined above. £129.5m was announced for the PiVG (coupled with the Plug-in Taxi Grant and the Plug-in Motorcycle Grant) in April 2020, with a maximum grant level of £8,000 for an electric van. It was recently announced funding will continue until at least 2022/23</p>	<p>The take-up of the PiVG is far less than for the PiCG to-date, due to the smaller number of plug-in vans available on the market. The Government recently announced the extension of the PiVG until at least 2022/23, but there was no guarantee that the grant level would continue at this rate, and it is expected to gradually reduce.</p>
Project Rapid	<p>'Project Rapid' is a Government-led project seeking to define the requirements for rapid charging on the UK strategic road network. A Rapid Charging Fund of £500m was announced in March 2020 to fund "rapid charging hubs" at motorway service areas and other locations along the strategic road network. It is likely to address grid reinforcement costs that are proving a barrier to provision of these chargers at sufficient scale for the high-powered charging requirements of modern EVs</p>	<p>In a policy paper published in May 2020, the UK Government detailed its vision for a rapid charging network in England. By 2023, the aim is to have at least six high-powered, open access charge points (150-350kW) at MSAs in England, with some larger sites having 10-12 charge points. The main advantage of these charge points is it can enable vehicles to charge up to three times faster than most currently available charge points; however, this is dependent on a vehicle's ability to accept these levels of charge.</p>

4.3 Potential UK policy under consideration

4.3.1 Consulting on ending the sale of new petrol, diesel and hybrid cars and vans

In February 2020 the UK Government announced the beginning of a consultation on ending the sale of petrol, diesel and hybrid cars and vans. The Government is proposing to bring forward the current 2040 ban (as outlined in the Road to Zero Strategy) to 2035 or earlier if feasible. The announcement also included hybrid-electric and plug-in hybrid-electric vehicles in the ban for the first time. These policy changes, if / when confirmed, are expected to help accelerate EV uptake in the UK.

In consideration of users with disabilities, the outcomes from this consultation could lead to a rapid increase in EV adoption, meaning that drivers with disabilities will need to be able to utilise accessible charging infrastructure sooner than previously envisaged. Hence, it is of paramount importance that the outcomes of the consultation do not disadvantage those with disabilities.

4.3.2 Electric vehicle charge points in residential and non-residential buildings

The UK Government released a consultation between July 2019 and October 2019 seeking to alter existing residential and non-residential buildings regulations to include EV infrastructure requirements. The consultation forms part of the UK's transposition of the European Commission's Energy Performance of Buildings Directive (EPBD), where the UK consulted on going further than the charging infrastructure requirements mentioned in the EPBD, i.e. the installation of cable routes for charging infrastructure in all parking spaces for new residential buildings and those undergoing major renovations. A summary of the Government's policy position, as outlined in the consultation documentation, is as follows:

- Residential buildings: The Government has proposed that every new residential building with an associated car parking space should have a charge point – the requirement also applies to buildings undergoing a material change of use to create a dwelling. The Government also proposes requiring every residential building undergoing major renovation with more than 10 car parking spaces to have cable routes for electric vehicle charge points in every car parking space.
- New non-residential buildings: The Government proposes that every new non-residential building and every existing non-residential building undergoing a major renovation with more than 10 car parking spaces should have one charge point and cable routes for an electric vehicle charge point for one in every five spaces.
- Existing non-residential buildings: The Government proposes a requirement of at least one charge point in existing non-residential buildings with more than 20 car parking spaces, applicable from 2025.

The outcomes of the consultation are expected to be announced in late 2020.

In consideration of users with disabilities, if the Government's preferred policy option is implemented, this will result in a greatly increased provision of home-based charging infrastructure. This can benefit disabled users of EVs by providing ready access to the most convenient charging model; however, there is an increased urgency to ensure that the infrastructure is accessible, both in terms of positioning and the technology. There will also be an increase in charging infrastructure in non-residential buildings, which also adds to the urgency to define "accessible" for different categories of charging infrastructure.

The engagement with Government representatives undertaken during this project noted that some responses to this consultation referenced users with disabilities. It was also noted that the cost concerns seemed to be driving most of the business opposition, and that there would be a risk of a 'minimum viable solution' implemented (which would likely not meet accessibility requirements for disabled users) for new buildings to meet regulations, unless design standards for these residential charge points are defined.

4.3.3 Consultation on improving the consumer experience of electric vehicle chargers (forthcoming)

In May 2020, the Government announced its intention to consult on the consumer experience of using EV chargers – this consultation is forthcoming. Within this intention, four high-level focus areas were announced as part of the consultation:

- Ensuring users can pay for using public EV charging infrastructure using credit/debit cards
- Data availability – open data for new apps for both static and dynamic data.
- Reliability – enforce reliability standards on public charge point operators.
- Pricing transparency – standardise the pricing of EV charging to p/kWh.

Many of these focus areas relate to potential secondary legislation associated with the AEVA, as outlined in Section 4. It appears that the Government intends on assessing whether they should take powers via secondary legislation to intervene in areas of market failure. The engagement with OLEV undertaken as part of this study revealed that the Government is currently in the process of engaging with stakeholders to assess the exact questions that should be asked via the consultation.

In consideration of users with disabilities, this consultation may be very important due to the mention of “accessibility” within the AEVA, and the possibility to ask questions related to accessibility within the consultation – OLEV showed a willingness to include questions related to accessibility for disabled users within the consultation, and to define what questions should be asked in consultation with stakeholders. In line with how such Government consultations work, this could take the form of an opinion by informed stakeholders or the public on the usability for disabled users of charge points (in general and per charge point type), and an open question on what could be done to meet the needs of disabled users when considering the issues experienced by disabled users – such questions are defined in consultation with stakeholders.

The consumer experience consultation could serve as an important first step in defining what needs to be addressed to ensure different categories of charging infrastructure are accessible, and to obtain feedback from stakeholders on accessibility. Indeed, Citizens Advice has already indicated in an initial high-level response to the consultation that public bays can be inaccessible for disabled people¹⁶.

4.4 International policies relevant to accessible EV charging for disabled drivers

4.4.1 Introduction

There are many countries in the world currently experiencing a large expansion of electric vehicle charging infrastructure. Internationally, there may also be policy frameworks, conventions and guidelines in places that can help inform and guide future developments in the UK with respect to ensuring that charge points are accessible to disabled people.

It is also valuable to benchmark current progress in the UK compared to other countries who may be further ahead in the transition to EVs. Successful initiatives for enabling disabled access to EV charge points in other countries can potentially be used as best-practice examples to support and stimulate action in the UK.

4.4.2 Transnational policy

Transnational policy covers international policy frameworks and regulations that the UK is either subject to, or is likely to, align itself with.

¹⁶ Citizens advice consultation response, [available here](#)

United Nations Convention on the Rights of Persons with Disabilities (UN CRPD)

The UN CRPD is a convention ratified by the UK since its acceptance by the EU in 2011. Under the Convention, States' parties would guarantee that persons with disabilities enjoyed their inherent right to life on an equal basis with others¹⁷. Appendix 1 contains a collection of the articles of the convention that are most relevant to the issues of accessibility in transportation.

In summary, the UN CRPD is based on the principle of "Reasonable accommodation" which is similar to the definition of "Reasonable adjustment" as implemented in the Equalities Act, and is defined in Article 2. This article also contains a provision on **universal design of products, environments, programmes and services to be usable by all people**, to the greatest extent possible, without the need for adaptation or specialized design.

Article 9 concerns the ability of people with a disability to live independently, and specifically mentions access on an equal basis to transportation, including services "open or provided to the public", which could include electric vehicle charging stations. Further, section b) of this Article defines that parties to the convention should **implement minimum standards and guidelines for the accessibility of such services open or provided to the public**, and ensure that private entities (such as private charge point operators) take into account "all aspects of accessibility for persons with disabilities". Finally, Article 9 section h reads: "Promote the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost". This supports the early consideration of accessibility in the design of electric vehicle charge points, even if the technology is still young and evolving.

As a final highlight, Article 20 of the CRPD concerns personal mobility, and promotes Parties to **take effective measures to ensure personal mobility** with the greatest possible independence for persons with disabilities. Below is a relevant example on how transnational policy frameworks for accessibility like the UN CRPD could conflict with the current approach to public electric vehicle charging¹⁸.

Spanish example on interpreting the UN CRPD and EU Charter of Fundamental Rights for unmanned fuel service stations

The Spanish Committee of Representatives of People with Disabilities (CERMI) produced a study which shows that in their view, the proliferation of unmanned fuel service stations directly violates both the Charter of Fundamental Rights of the European Union, and the UN CRPD. This study also refers to the 'European Strategy on Disability 2010-2020: a renewed commitment to a Europe without barriers', whose main objective is to train people with disabilities so that they can enjoy all their rights, ensuring the implementation of effective practice of the Convention on the Rights of Persons with Disabilities. CERMI considers unmanned service stations to be in violation of fundamental rights for disabled people.

As electric vehicle charging stations are generally unmanned, unless charging at an existing fuel supplier or motorway service area, the interpretation of the international legal background by this study is relevant for understanding the rights of people with a disability. It is unlikely that a demand for staff availability at electric charging points is considered a 'reasonable adjustment' or 'reasonable accommodation', although an argument could be made that certain centralised, large charging hubs may become subject to such legislation to give disabled drivers who need a public charging station an option to get help when needed.

¹⁷ UN CRPD highlight, available at <https://www.un.org/press/en/2006/ga10554.doc.htm>

¹⁸ News article (2018), available at <https://www.pressreader.com/spain/costa-levante-news/20180921/282759177585572>

Revision of the Alternative Fuels Infrastructure Directive

EU Directive 2014/94/EU on deployment of alternative fuels infrastructure is being updated during 2020/21 to address the areas where it is deemed to have not succeeded in achieving its objectives, and to account for any updated market developments since the original Directive came into force in 2014. Numerous disability-focused European representatives, such as the European Disability Forum (EDF), have been critical of the initial Directive's lack of focus on users with disabilities, and other stakeholders have called for the update to the Directive to include requirements focused on users with disabilities – this is an area of active consideration.

Requirements focused on users with disabilities would have to be devised – for example, the high-level policy may stipulate that charge points (or a proportion of charge points) would have to be accessible, but standardisation bodies may be responsible for developing the standard for defining what comprises “accessible”, and the requirements may be at the EU-level or devolved to Member States.

Of note, requirements related to accessibility of charging infrastructure may not end up in the AFID and may instead end up in complementary EU legislation. Whilst the UK is no longer obliged to follow the stipulations within the AFID, it has nevertheless shown a willingness to be at least as ambitious as the EU when it comes to alternative fuels infrastructure. This is evidenced by the Government workstream previously mentioned that is looking into accessibility of charging infrastructure.

EU Directives on accessibility requirements for products, services and digital services

Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 covers the accessibility requirements for products and services. This Directive defines persons with disabilities in line with the UN CRPD, and further highlights and interprets several sections of the UN CRPD and how they apply to accessible products and services. It is meant to harmonise provisions on disability access among EU Countries and applies to products only from June 2025¹⁹. A second relevant legislation is Directive (EU) 2016/2102 on the accessibility of websites and mobile apps of public sector bodies.

It is of interest that the Directive **did not consider self-service terminals as part of electric vehicle charging stations in scope**. It is said to apply to “self-service terminals” but specifies strictly that this only applies to elements of air, bus, rail and waterborne passenger transport services, or that the terminals covered have a communications or audio-visual media purpose. UK alignment with this Directive post-Brexit would therefore not guarantee enforcement of the UN CRPD provisions that this Directive is based on. An international policy stakeholder representing the rights of disabled people was also engaged in this study. They mentioned that this EU legislation has adopted a very limited scope, as only the digital service stations are covered by Directive 2019/882, not the surrounding environment. This contrasts with the US approach (see section 4.4.3) which covers not just the accessibility of the service station, but also access to and from it from the surrounding amenities.

If the UK continues its pledge to align with this particular EU legislation in terms of ambition, then the inclusion of EV charge points could be addressed at the formation of policy to ensure there is a wider scope that includes them under the definition of self-service terminals in the transport sector, which would then allow the requirements from this directive to apply to EV charge points.

4.4.3 Relevant policy examples from other countries

From the desk research carried out as part of this study, there are no examples of **national or local-scale policy implementations that set accessibility standards for EV charging stations directly**. Our research covered a small sample of countries that are considered to be ahead in the electric vehicle transition; Norway, the Netherlands, China and the United States.

¹⁹ EU Directive 2019/882, available at <https://eur-lex.europa.eu/eli/dir/2019/882/oj>

There are however examples of policy implementations, nationally or locally relevant guidance documents, and examples where existing policy addressed the needs of disabled users in combination with electric vehicle charging. Where the UK is behind on implementing relevant policy, or implementation of disabled accessibility at charge points, these examples of best practice may help in designing solutions and provide further evidence for implementing changes.

Netherlands

As of 2019, the Netherlands has the highest density of EV chargers in the world, with approximately 1.2 charge points per square km, comprising nearly 41,000 public charge points²⁰. In 2019, 11% of all new cars sold were fully electric²¹. The Dutch government has a plan to ban the sale of petrol and diesel vehicles by 2030, and have 1.9 million EVs on the road by 2030 supported by 1.7 million charge points²².

Policy for the deployment and rollout is largely devolved to local councils. Councils have made agreements with a partly government-owned charge point operator (Allego), which facilitates the requests for residential on-street chargers. Drivers of electric vehicles can petition the council via Allego. The company judges the viability of the request, and if they decide the request is viable, will start the process to install a charge point.

Dutch planning policy also allows for individuals to request their own disabled bay to be installed in on-street parking zones (which will ban other vehicles from parking on it, even if they have a blue badge). In one example, a permit was requested and approved by a disabled driver combining both a request for an individual disabled bay, and a public electric charge point near the bay. Local policy on electric vehicle charge points mandates that each charger should at least cover two parking bays. Therefore, planning permission was given on the condition that the charge point could service two vehicles at the same time, so that a public charging bay for non-disabled people was also created. The secondary parking bay next to the disabled bay was converted so it can only be used by electric vehicles²³.

In the Netherlands, the general policy is to reserve parking spaces near charge points for electric vehicles only, and updated planning permission is required in order to enact this legal access to the parking bay. **For disabled drivers who have their own on-street disabled parking bay, it is easier to get a charger installed than in open, non-disabled parking bays**, because in this situation, no change in the planning permission for the parking bay is required to ban petrol vehicles from it, as it is already exclusively used by one person assigned to the parking bay²⁴.

Outside of this specific advantage to disabled drivers who have their own assigned on-street parking bay, no specific local or national policy was found in the Netherlands that addresses the issue of accessibility for charge points for disabled drivers.

Norway

Norway is considered to be the world leader when it comes to the market share of electric vehicles. Aided by central government policy which has a mission to make sure buying and running an EV should never be more expensive than the internal combustion engine equivalent, the market share of pure battery EV sales in 2019 rose to 42% of all new car sales. Norway also has nearly 14,000 public charge points as of 2020. As a result, Norway has the most EV drivers per capita of any country in the

²⁰ Statistics on EVs in the Netherlands (2019), available at <https://www.statista.com/statistics/658043/number-of-charging-stations-for-electric-vehicles-in-the-netherlands/>

²¹ News article, available at <https://cleantechnica.com/2019/12/16/dutch-electric-vehicle-sales-explosion-market-will-not-return-to-normal/>

²² Central government information provision on electric vehicles (Dutch)
<https://www.rijksoverheid.nl/onderwerpen/auto/overheid-stimuleert-milieuvriendelijker-rijden>

²³ Council of Pijnacker-Nootdorp, 2019 planning permission for charge point enabled disabled bay, available at <https://zoek.officielebekendmakingen.nl/stcrt-2019-53416.pdf>

²⁴ Local policy notice, available at <https://decentrale.regelgeving.overheid.nl/cvdr/XHTMLoutput/Actueel/Woerden/CVDR484301.html>

world²⁵. By 2025, the country aims to have all new cars sold to be zero emission vehicles, significantly earlier than the current UK proposals for 2035 or 2032.

Norway has not made direct efforts to make public charging facilities specifically accessible for disabled drivers. However, the deputy-chairman of the Norwegian Electric Car Association has called for universal charge point standards by 2025, to ensure all charge points are able to be used by disabled drivers as well. The Norwegian equivalent of Motability (Nav) is currently considering options for suitable electric vehicles for disabled drives who require a minivan with a wheelchair lift. However, their contacts with major vehicle manufacturers, including Volkswagen and Mercedes-Benz, indicate that the technology has not progressed far enough on wheelchair accessible electric vehicles. Nav expects that availability of wheelchair accessible electric vehicles will start in 2022^{26 27}.

In Norway, regulation has been implemented for housing associations, which means the board of a housing association can no longer refuse the installation of charge points at off-street charging locations unless strong reasons can be documented, which can only be based on insurance cost, a proven fire hazard, or lack of suitable space²⁸. Lack of available power is no longer a valid reason, as smart charging solutions are seen as a solution to these potential problems²⁹.

United States and Canada

The Americans with Disabilities Act (ADA) is a US federal civil rights law that prohibits discrimination in public places against individuals with disabilities. Employers installing workplace EV charging stations need to follow special design guidelines to accommodate people with disabilities, as required by the ADA. Although the ADA does not provide design standards for charging station-equipped parking spots, several industry studies and EV planning guides do.

More recently in 2017, the state of California published California Building Code (CBC) regulations for commercial car parks, that specify if a facility provides electric vehicle charging stations, then a certain number of them also need to be made accessible to individuals with disabilities. In most cases, this will mean at least one charging bay needs to be accessible and adhere to technical requirements on the size of the bay, design of the charger, required signage, and also access requirements on the surrounding environment, whereby 'paths of travel' to other public services from the charge point (such as restrooms) also should be accessible³⁰.

The US approach is very much led by state and city-level implementation and interpretation of the ADA in the electric vehicle space, expressed as guidance documents to follow to ensure compliance with the ADA. See section 4.5.3 for more information on such design guidelines, most notably those published in 2009 by the company eTec. These guidelines were also adapted by the Canadian province of British Columbia (BC). Canada, like the US, does not have any national policy on accessibility, so progress in this space is very much led by the local government of BC.

²⁵ <https://www.statista.com/statistics/1028302/public-charging-points-for-electric-vehicles-in-norway-by-county/>

²⁶ News article, available at <https://www.handikapnytt.no/elbilforeningen-ladestasjonene-ma-vaere-universelt-utformet/>

²⁷ News article, available at <https://www.handikapnytt.no/bilparken-i-norge-skal-bli-utslippsfri-men-nav-kjorer-fortsatt-fossilt&usg=ALkJrhfhJeL4fdZTX94xfnSapCy7Vu8rg>

²⁸ News article, available at <https://elbil.no/na-far-beboere-i-borettslag-laderett&usg=ALkJrhRoKhfSq0LsQnlSFAC14ajFqmCXw>

²⁹ News article, available at <https://elbil.no/lav-stromkapasitet-er-ikke-saklig-grunn-for-a-nekte-beboere-elbil-lading&usg=ALkJrhgrg2zX2jJs725KLMQOre0SVZmL6w>

³⁰ M. Wender (2018), Accessibility and EV Charging Stations, the Green Standard: <https://www.parking-mobility.org/wp-content/uploads/2019/03/18-02-Green-standard.pdf>

Relevant provisions from the eTec guidelines as adapted by Canada's British Columbia

In this guideline, disabled access is a separate section and there are several provisions that place strong emphasis on ensuring accessibility, similar to common requirements for accessible parking spaces. US and Canadian states and cities have adapted these sections to fit their policy background, with US entities referring to the American ADA act, whereas in Canada the Building Code is used as legal background, which applies to all privately owned car parks that offer EV charging. Some relevant citations from the provisions are:

“parking should be provided in premium locations similar to accessible locations. Because stalls containing EVSE (Electric Vehicle Supply Equipment) should be for EVs only, the accessible parking stalls should be in addition to those required by the BC Building Code for parking.”

“The BC Building Code requires where parking is provided that contains more than 50 parking stalls, parking stalls for persons with disabilities shall be provided in the ration of 1 for every 100 or part thereof. Where there are EV charging stations included in the parking area, for every 25 parking stalls with EVSE, one should be accessible. For every 10 accessible stalls, one should be van accessible.”

Figure 4-1 Accessible EV parking signage from eTec guidelines



China

China has a long history of active promotion of electric vehicles through policy measures. The country has a strong domestic electric car industry that focuses primarily on sales within China. To support this, in 2020 alone the Chinese government is investing the equivalent of over £1 billion in charging infrastructure³¹.

The stakeholder consultation carried out to support this study included a charge point provider from China. This company indicated that they are following the national design standards, and could customise facilities upon request, but did not consider access for disabled people by default due to low demand.

The findings from the literature review and stakeholder interview showed that there are no specific national policies on EV charging facilities for disabled drivers. Facilities are designed to comply with a national standard that covers location, power and minimum quality of the parts. The location standards cover only that chargers should be placed where there is enough space on the road for a vehicle to turn into the charging bay (at least 9 metres) and placing the charging facility at least 20 cm above the ground.

³¹ News article, available at: <https://technode.com/2020/04/10/china-is-investing-rmb-10-billion-in-ev-charging-infrastructure/>

From desk research, there are examples of local policy in Guangzhou mandating 100% of new residential parking spaces and 30% of new public parking spaces to be “EV-ready”³².

4.5 UK and international design standards for accessible EV charging infrastructure

In the UK, there are currently no design standards that apply to electric vehicle charging infrastructure that focus on accessibility and inclusivity. There are design standards and guidelines already in place that consider, or are indirectly relevant to, charging infrastructure accessibility for disabled drivers.

This section differentiates between standards and guidance as many materials have been produced that could be used as ways to standardise design, but not all of them are promoted as standards that provide certification and are referred to as guidance. Several policy stakeholders in this study indicated their preferred method would be to produce guidance, rather than lock down requirements via legal requirements. Policy processes to enforce standards can be too slow moving to be relevant to a technologically fast-moving market. On the other hand, it was perceived that the lack of widely accepted standards on accessibility means that market players have less incentive to design charging infrastructure to be more accessible.

From a legal perspective, not a single Government body can legislate the adoption of standards that would apply to all types of public chargers at once. This is because the different locations of public charging infrastructure on streets, at commercial developments, residential car parks, etc are governed by different rules that come from different parts of Government. For example, on-street infrastructure is governed by DfT, but also heavily influenced by local authority planning policy, where different requirements exist depending on council planning preferences. Off-street infrastructure in car parks is not governed by DfT, and often also not governed by the UK Building Regulations as maintained by MHCLG. Government stakeholders interviewed have recognised that there is a gap in regulation with respect to accessibility, with no clear responsibility between Government branches.

4.5.1 British Standards and inclusive urban design

The relevant design standards in the UK are managed by the **British Standards Institution (BSI)**. The relevant applicable standard is *BS 8300-1:2018 Design of an accessible and inclusive built environment. External environment - code of practice*³³.

The BSI is updating its standards, using some of the principles from its 2013 guidance on *Inclusive Urban Design*³⁴. Inclusive design is defined in the guidance (..) *to remove the barriers that create undue effort and separation. It enables everyone to participate equally, confidently and independently in everyday activities*. The most relevant takeaways from this guidance are:

- Inclusivity for the widest number of people, and maximising independence;
- Consulting with people who represent a wide range of disabilities, early on in the design process.

Specifically focusing on electric vehicle charging near disabled bays, the guidance mentioned that consideration needs to be given to the future potential increase in electric vehicles, and provision of on- and off-street charge points. The 2018 update of BS 8300-1 moved away from focusing solely on separate accessible facilities and towards inclusive design, implemented in provision 7.9:

“7.9 Electric vehicle charging; Where charging points for electric vehicles are provided, equivalent provision should also be made for designated accessible spaces.”

³² ICCT (2020) Electric vehicle charging Guide for cities

³³ BS 8300-1:2018 Design of an accessible and inclusive built environment. External environment - code of practice, available at: <https://www.thenbs.com/PublicationIndex/documents/details?Pub=BSI&DocID=320519>

³⁴ BSI (2018), Inclusive Urban Design (not available via direct link online)

Lastly, concerning British Standards, *BS 12414:2020 Vehicle parking control equipment* could be indirectly relevant, as it contains very detailed design requirements for parking terminals, including interoperability and wheelchair access. This standard could be used as an inspiration for ensuring similar access is provided to (a subset of) terminals for EV charging. At the moment, electric vehicle charge points are mentioned to ‘consider’ for accessibility, but no actual design requirements are placed on them in a similar fashion as is done for parking terminals³⁵.

There are plans for a wireless charging standard under the series BS EN 61980, although it is likely that this standard will focus on the technical requirements; such a standard could help accelerate the adoption of this technology³⁶.

Policy stakeholders highlighted that the British Standards for accessibility are very relevant and adhered to when designing accessible buildings and related public spaces. Multiple stakeholders noted that without a design standard on the charge points themselves, in response to any mandatory requirements of charge points in new developments, **there is a risk that minimum viable solutions that do not satisfy accessibility requirements** will be implemented by property developers.

4.5.2 Other relevant UK standards and guidance

The Institution of Engineering and Technology (IET) is a UK-based, international professional body, that is involved in standardisation for the BSI and are providing codes of practice. The 2020 release of their **Code of Practice for Electric Vehicle Charging Equipment Installation** (which is not freely available but requires purchase), which includes specific ‘**good practice for accessibility and wheelchair access**’³⁷. This code of practice has been promoted since 2018, but as the standard is proprietary was not accessible for review during this study.

BEAMA (British Electrotechnical and Allied Manufacturers Association) is an association of electrical equipment manufacturers in the UK, which in 2015 produced a guide to implementing electrical vehicle infrastructure³⁸. On accessibility, the only mention is focused on general accessibility for cars, with nothing specific to disabled users. More recently in 2020, BEAMA was tasked by the Mayor of London’s 2019 EV Infrastructure Taskforce, to produce a guidance document on ‘future proofing’ electric vehicle infrastructure. This document mentions that: “*placement 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.*” The guide also mentions that bays should be wide, long and high enough for use by vans, but does not make any mention of the cable weights³⁹.

In 2016, the EV Association Scotland released their Electric Vehicle Charging Infrastructure design guide. A highlight is that this discusses the issue of EV chargers and disabled bays. A specific recommendation is made not to turn existing disabled parking spaces into shared EV spaces. Combining both of 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 spaces⁴⁰.

³⁵ BSi vehicle parking control equipment, available at <https://shop.bsigroup.com/ProductDetail?pid=000000000030370333>

³⁶ BSi wireless standard development, available at <https://standardsdevelopment.bsigroup.com/projects/2016-03538#/section>

³⁷ IET Code of Practice on EV Charging Equipment Installation (2020), available at <https://electrical.theiet.org/guidance-codes-of-practice/publications-by-category/electric-vehicles/>

³⁸ BEAMA guide to electric vehicle charging infrastructure (2015), available at <https://www.beama.org.uk/resourceLibrary/beama-guide-to-electric-vehicle-infrastructure.html>

³⁹ BEAMA best practice for future proofing EV infrastructure (2019), available at: <https://www.beama.org.uk/resourceLibrary/best-practice-for-future-proofing-electric-vehicle-infrastructure.html>

⁴⁰ EV Association Scotland, EV Charging Infrastructure Design Guide (2016), available at: <http://www.oref.co.uk/wp-content/uploads/2016/07/20160726-Charging-Infrastructure-Design-Guide-V1.3.3.pdf>

Disability-specific guidance from London policy

The **Transport for London “streetscape” guidance** on kerbside activity has street design principles, but they are not targeted to specifically ensure accessibility of the charge points. The streetscape guidance includes a focus on ‘considering all users’, through for example an ‘Equality Impact Assessment’. It should be noted that these equality impact assessments are a standard procedure, and not very demanding and not likely to improve accessibility on their own. The guidance also includes street design principles, such as a specific height requirement for on-street infrastructure which was invoked to refuse developments of low-to-the-ground charge points. Beyond this, the design principles do not specifically mention people with a disability or how to make the charge points more accessible ⁴¹.

TfL also published **London’s electric vehicle charge point installation guidance** in 2019 ⁴². This document includes design principles, including the principle of **inclusivity**, aimed specifically at ease of use for disabled persons and wheelchair users, as well as orderly installation to ensure blind persons can navigate around the equipment. It also mentioned that for larger ‘charging hubs’, additional facilities should be provided, such as seating for disabled users while waiting for a charge. The guide further specifies this with implementation examples and designs, including:

- Design schematics for combined disabled and electric vehicle bays that combine requirements from the BS-8300-1:2018 on disabled bays, with optimal locations for electric vehicle charge points around the bays.
- For on-street chargers, the guide mentions that existing disabled bays should also “be retained and incorporate chargers”.

4.5.3 International design standards for electric vehicle charge points

As highlighted in section 4.4.3, the topic of EV charging accessibility for disabled users has been on the agenda in the USA and Canada since the beginning of the rollout of charging infrastructure. As early as 2009, the ‘Electric Vehicle Charging Infrastructure Deployment Guidelines’ was published. US cities that have released a form of this guidance under their own umbrella include San Diego, Houston and Washington; it has also been adopted outside of the USA by the Canadian state of British Columbia⁴³.

In 2012, several local stakeholders in the US states of Ohio and Virginia produced guidance on EV Charging for disabled people. This guide references the Americans with Disabilities Act (ADA) as the legal basis for this guidance, and noted several challenges related to the weight of cables included in rapid charging stations. **The focus of the report is on accessibility for wheelchair users**, and it cites a minimum and maximum height that the relevant cable and service screens should be at to be accessible. In 2014, the US Department of Energy published a short summary and highlight of this guide to make it available nationwide.

A market player interviewed during this study highlighted that in 2020, Canadian lawmakers are still very much ahead on this topic, having commissioned a highway network of up to 20 chargers where every forecourt was required to have all charge points accessible to disabled users.

In the European countries researched for this study, no specific design standards that mention disabled access for EV-chargers could be identified from the literature. The recent advances in guidelines produced by UK stakeholders such as the IET and TfL appear to be at the forefront of this space in Europe. One element which is repeatedly highlighted in American policy is the accessibility not just of the charge point, but also access to and from relevant amenities around

⁴¹ Transport for London (2019), Streetscape guidance, available at: <http://content.tfl.gov.uk/streetscape-guidance-pdf>

⁴² Transport for London (2019), London’s electric vehicle charge point installation guidance, available at <http://ruc.content.tfl.gov.uk/london-electric-vehicle-charge-point-installation-guidance-december-2019.pdf>

⁴³ eTec & British Columbia (2009), Electric Vehicle Charging Infrastructure Deployment Guidelines

the charge point. This is not included in any UK guidance, standard, or policy document, nor is this a key element of relevant transnational policy.

4.6 Policy overview summary

In summary, there are many different relevant national and local regulations and relevant proposals that could tie in disabled access. The lack of universal design standards as highlighted by the market players is also recognised by government as potentially slowing down any needed policy development here. The EU policy background is also only just starting to include the issue, and therefore it is not likely to be implemented in regulation very soon. Government regulation is most likely to evolve based on requirements from the Equality Act on reasonable adjustment and may further be based on promoting and releasing guidance on design standards that enjoy support from both government and market stakeholders.

The UK is not behind most other countries in implementing policies and/or design standards for disabled users, even compared to market leaders such as Norway and the Netherlands. However, it is clear from stakeholder interviews and desk research that the USA has a long-standing history of addressing disabled user access from the very beginning of the rollout of EV technology and should be looked to for good practice examples of implementing disabled-friendly charge points.

5 Information provision on the accessibility of EV chargers



Summary and Highlights:

- The UK's leading provider ZapMap, which covers 97% of charge points and is used by >90% of EV drivers monthly, does not yet include specific information on the accessibility of public charge points to disabled drivers.
- Other information providers active in the UK or in other countries also do not provide disability-specific information for their charge points.
- Crowdsourced information that leads to reviews and photographs uploaded by users is currently the best way to ascertain the accessibility of a charge point.

5.1 Introduction

Various web-based information services are available to help drivers find publicly accessible charge points, such as those en-route or near their destination, or charge points of a particular type such as rapid charge points. They can also show whether the charger is currently available, or whether it is faulty and should not be used, if the information service is enabled to present dynamic rather than static data.

For users with disabilities who may not be able to use all charge points or may have difficulty with certain types of charge points, information services and their coverage of disability-specific needs (such as lowered kerbs, lack of bollards, wheelchair accessibility etc.) may be critical to their ability to find suitable, accessible public charge points. This section explores if information providers have already considered the information needs of disabled users, and if not, what could be done to best enable drivers with a disability to find suitable public charge points.

5.2 Overview of information services

5.2.1 Leading provider

The main provider of information in the UK in 2020 is ZapMap⁴⁴, whose coverage of charge points is much greater than any competitors. ZapMap was interviewed during this study to identify whether it provides information services to aid disabled drivers. According to ZapMap, its service covers 97% of the UK's public charge points, and has 120,000 active users per month in 2020, out of an estimated 130,000 plug-in vehicle drivers in the UK, 94% of which use public charging infrastructure⁴⁵.

While ZapMap does not specifically include information on how accessible individual public charge points are for disabled drivers, there are some functions that are indirectly helpful, such as integration with the Google voice assistant in the app, and the ability for users to provide direct feedback (in a free-form text field) on individual charge points in the form of comments, such as whether the charge point is in good working order, or how accessible it is.

ZapMap also indicated a willingness to add accessibility-related details to this information source, as this question had not been asked of the company before, but the company recognises its role as the leading provider of charge point information in providing a universal service that is suitable to the largest possible group of people. The company also indicated it could be a fast mover in this space, for example by including an icon or similar recognition for charge points that are deemed wheelchair accessible and enable users to search for them. This would be a first step but would not be based on a rigorous measurement on the accessibility of the charge point until the Government creates or backs a standard.

5.2.2 Other UK-based information services

For the purpose of this report we have conducted research on the following other information providers established in the UK or in other countries, to assess whether any information service provide disability specific information.

Other information services considered:

- National Chargepoint Registry
- A Better Route Planner
- Open Charge Map
- Plugsurfing
- Charge your Car
- Pod Point
- Electric Highway

The scope of coverage of UK charge points varies between the other providers, though none of them has as good a coverage as ZapMap currently does.

All of the apps are very similar in design, features and usability. They all offer maps and search filters including price, charger types, models of car, connection type, speed, availability, accessibility (private/public). As users move across the map, local facilities appear - clicking on specific charge points opens up more details on the facility. Like ZapMap, none of the information services provide information on the accessibility of charge points for disabled drivers. Some do provide the ability to add comments and pictures.

Crowd-sourcing information on disability access

Additional information is offered in some of the apps; this comes in the form of crowdsourced data. Two of the apps that utilise this are Open Charge Map and PlugShare. The user community regularly adds photos and reviews which could offer good insights into whether a certain charge point is

⁴⁴ <https://www.zap-map.com/live/>

⁴⁵ ZapMap internal presentation

accessible for disabled users or not. Plugshare (which operates in multiple regions around the world) has over 2 million crowd-sourced reviews and over 375,000 driver contributed photos.

Zap Map also has a feature to allow for crowd-sourced information in Zap Chat, and the company has seen examples of users posting reviews of charge points, noting when they were not accessible to them or difficult to use considering their disability.

5.3 Overview of information available from international examples

The information services available in the UK were compared to a set of international leading examples to understand if there is any disability-specific information provided.

- **Netherlands:** Oplaadpalen.nl, provided by Eco-Movement®, a dedicated information service like ZapMap⁴⁶.
- **Norway:** Ladestasjoner, provided by the Norwegian power company Fjordkraft⁴⁷
- **USA:** PlugShare, which was developed by an energy technology company, but is now owned by the German power company Innogy⁴⁸. It operates internationally but is a major player in the USA.

Like the available providers in the UK, there is **no disability-specific information available from these information providers**. Their services do not differ significantly from that offered by Zap Map. The Dutch example “oplaadpalen.nl” allows for users to provide direct comments, which is not available in “Ladestasjoner”, though the Norwegian app does allow for the charge point provider to add specific comments. Plugshare offers the most comprehensive ‘crowdsourcing’, where users can both add photos and comments to any charger. It is however not possible to sort chargers by those who have a picture.

From reviewing these providers, it does not appear that the UK providers, led by Zap Map, are behind in providing information relevant to disabled people. No information service researched in the UK or internationally currently appears to provide relevant information for disabled drivers.

5.4 Potential for disability-specific information to be provided

With respect to disability-specific information, none of the web-based information services researched in the UK or internationally currently provide such information. Some did provide a direct link to Google Maps Street View® so the directly surrounding environment can be viewed, but this often provided little use, as the photos may be from before the charge point was installed, or the location is not precise enough for the user to view the charge point surroundings.

Many of these apps only use directly available information through the OCPI (Open Charge Point Interface), which is an in-development standardisation protocol that defines how charge point operators should make information about their charge points publicly accessible. The OCPI is focused on the technical and operational status of the charge point, and therefore is not likely to include any disability-specific information service in the near-future.

To improve the information provision for disabled drivers, the following could be considered:

- Further promote and enable crowdsourcing of information, to obtain a high coverage of photographs and comments on charge points, thereby gradually allowing disabled users (and other users) to build up an information resource for themselves.
- A good way to enable this would be to allow disabled users, such as wheelchair users, to verify whether individual charge points are accessible to those people with their specific

⁴⁶ <https://oplaadpalen.nl/>

⁴⁷ <https://www.ladestasjoner.no/kart/>

⁴⁸ <https://www.plugshare.com/>

disability, which could then be filtered for in the information service. This requires more active support from the web application developers, which ZapMap was open to providing.

6 Future technological developments in EV charging infrastructure



Summary and Highlights:

- Rapid (50 kW and above) and ultrafast (up to 350 kW) charging technologies are being more widely deployed in order to simulate the fast petrol/diesel refuelling experience at a refuelling forecourt.
- It is unlikely that the weight of charging cables for rapid and ultrafast chargers is will decrease until a large proportion of vehicles are available with the capability for higher voltage charging.
- On-street residential chargers are not expected to increase in charging speed or reduce significantly in costs. On-street charging is likely to remain tied to the availability and feasibility of consistent, accessible, long-term parking near the charge points.
- Vehicle batteries are no longer considered a bottleneck by market players (with ranges of up to 250-300 miles now possible from mainstream EVs on the market today). The focus is now on reducing costs to make electric vehicles more generally available. Larger batteries are expected to be reserved for premium vehicles.
- Wireless charging via inductive technologies is the most promising development for disabled users in the medium to long-term, as it may remove the requirement to interact with inadequately designed charge points completely.

As outlined in section 2.4.4, from 2035 up to 1.35 million drivers with a disability (50% of all disabled drivers in 2035) may become partially or fully reliant on public charging infrastructure. The type of technology available by then may change from what is available now. This section outlines the most relevant technological developments in the short-term, as well as an outlook into the long term, post 2025 developments that are most relevant for disabled users.

6.1 Current and near-term charging technology

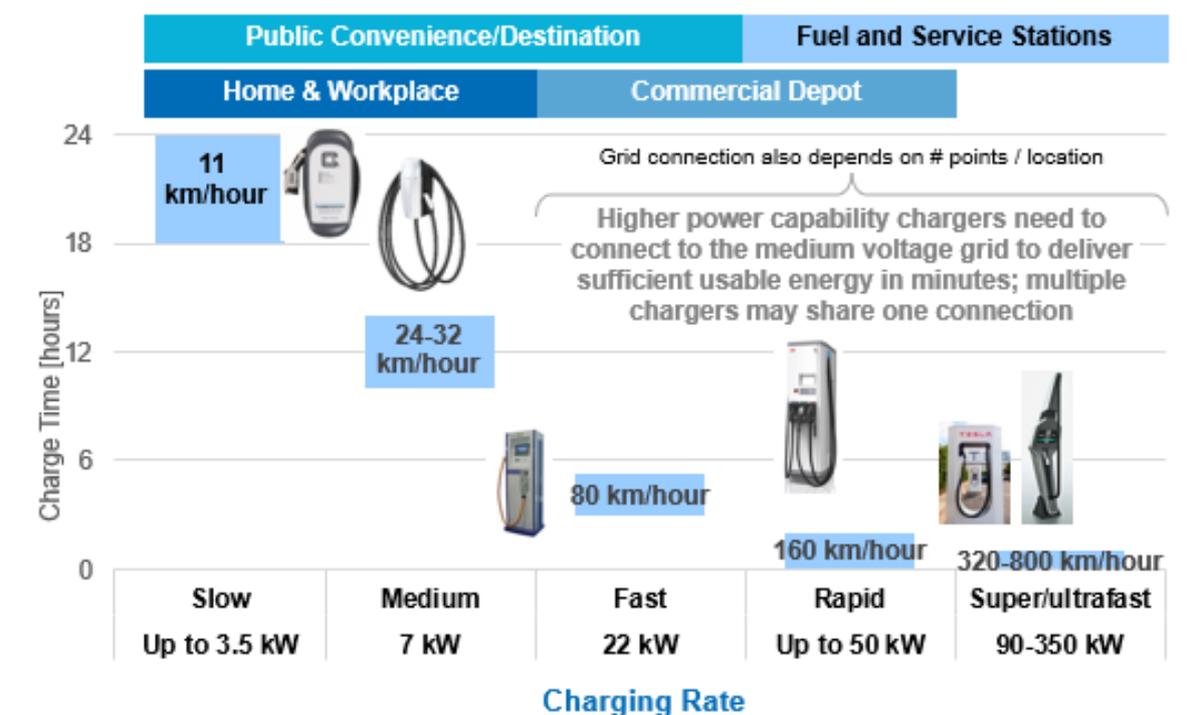
6.1.1 Charge point technology development.

Figure 6-1 provides an overview of how long it typically takes to recharge a modern EV to enable a range of 250 miles, and in which locations these types of chargers are typically found. Range isn't likely to increase substantially beyond 250 to 300 miles for most vehicles.

Rapid and ultrafast chargers

In order to encourage more widespread adoption of electric vehicles among disabled drivers (but also the general population), there may be a need to substantially reduce the length of time it takes to charge an electric vehicle en-route when using a rapid charger (e.g. to bring the experience closer to the time taken to refuel and petrol or diesel car). The vast majority of public rapid chargers in the UK are currently limited to a maximum power output of 50 kW, enabling recharge times of approximately 40 minutes to 1 hour or more, depending on the size of the vehicle's battery and the state of charge (SoC) of the battery at the time of plug-in. Ultrafast, high-power chargers with outputs of between 150 kW and 350 kW potentially enable vehicle recharging to take as little as 10 to 15 minutes.

Figure 6-1 Typical recharging rate in km per hour, for > 400 km (> 250 mile) journey on a battery pack



For disabled users, rapid and ultrafast chargers will retain the issue of heavy weight cables, an issue highlighted by the RiDC field test. This will remain an issue for the next 5 years, as there is a physical requirement to have a thicker, heavier cable to enable the fast charge times from the chargers. These cables may also require active cooling, which makes them not necessarily heavier, but less flexible and harder to move into position.

As mentioned in section 2, for the large group of people with a disability who may not have access to home or work-based charging, they may become very dependent on rapid and ultrafast chargers, so it is key that a solution is found for those who are not able to handle heavy cable weights.

Residential and work-based on-street chargers

Several stakeholders in this field have indicated that the business model for such charge points may be even more challenging than for rapid and ultrafast chargers, as less of a premium can be asked for

the electricity itself. Therefore, the cost-cutting measure of lamp-post chargers is an attractive option, but this has very limited scope for modification to ensure accessibility for disabled users.

Most notably, for both residential on-street and rapid/ultrafast chargers, they are all designed for people to use when standing up. Any design standard applying to any charge point would need to address this issue, perhaps at least at a 'reasonable accommodation' level, but also at a street-level if entire streets are to be fitted with chargers.

6.1.2 Price points for charge point technology

The **price points for these different types of charging infrastructure** is visible in Table 6-1. Market stakeholders do not envision the price for the most expensive equipment (50 kW rapid chargers) to reduce significantly, though Ricardo analysis has shown that higher power (100 kW and above) rapid charger cost could still come down to around £425/kW per installation. As mentioned in section 3 on the cost of infrastructure, due to the currently unviable business model of most charge point technologies, charge point operators are unlikely to be able to retrofit charge points, and **there is a definite need to incorporate disability-specific design standards that do not increase the costs significantly.**

Table 6-1 Typical costs in capital expenditure (CAPEX) and operational costs (OPEX) for different types of charge points. Costs are for 2019.

	Fast (11 kW)		Rapid (50 kW)		Residential –lamp posts (3 kW)		Residential dedicated (7 kW)	
	CAPEX	OPEX	CAPEX	OPEX	CAPEX	OPEX	CAPEX	OPEX
Unit Cost	£1,900	-	£20,000	-	£750	-	£1,500	-
Network connection	£1,500	-	£5,000	-	£1,000	-	£1,500	-
Installation	£3,000	-	£6,000	-	£220	-	£3,000	-
Signing / lining	£2,000	-	£2,000	-	N/A	-	N/A	-
Maintenance per year	-	£350	-	£750	-	£250	-	£250
Back office per year	-	£150	-	£240	-	£150	-	£150

Source: 2019 Ricardo analysis

6.1.3 Charging technology in vehicles

The technology used in vehicles influences the ability to charge at slow or high speeds, and what charging equipment can be used. There is one significant barrier in vehicle technology, which influences cable weight, namely the **charging voltage**.

Almost all electric vehicles in 2020 operate at a charging voltage of 400V. This means that to receive more charge, the charging cables need to carry a higher current and need to be thicker and heavier or actively cooled. Some OEMs are working on moving vehicles to a voltage of up to 1000V, which reduces the required current and in return, the required weight of rapid charging cables. More vehicles with a higher voltage capacity may enter the market in the next 5 years, though they are likely to be at a premium segment.

Stakeholder consultation with the Society for Motor Manufacturers and Traders (SMMT) has shown a strong willingness to discuss technical topics such as voltage and how they relate to accessibility.

6.2 Longer term charging technology

There are a number of innovative technologies that are currently in development or being researched that could have very significant benefits for disabled drivers. These include static or dynamic wireless charging and robotised charging infrastructure. As the technology is developed quickly, assessing what happens beyond 2025 is difficult. Thus, this section focuses on two main technology fields that may be especially helpful to disabled drivers.

6.2.1 Static inductive charging

Static inductive vehicle charging is achieved by transfer of electric energy through a method of near field wireless power transfer. Instead of a physical coupling using an electric cable/wire, this method relies on magnetic/electric field coupling between plates/coils that are separated⁴⁹. For people with a disability, wireless charging technology may be an attractive option that relies only on the ability of the user to park the vehicle over a flat-surfaced charge point embedded in the surface of the ground (i.e. under a parking space). Once parked over the charge point, the vehicle will start charging without any need to leave the vehicle and physically connect it to the charger.

The absence of a direct connection between the vehicle and the charger using cables means that wireless charging is much less energy efficient than a conventional cable-based charge point. Connected Kerb, a UK-based company developing this technology, quoted a maximum efficiency range of 90% to 93%, though realistically without optimal alignment of charger and vehicle, and other environmental factors, an average efficiency of around 80 to 85% is more likely. This can be an acceptable loss for specific use cases where the benefits of wireless charging outweigh this efficiency loss.

The technology is already being tested for 'opportunity charging', which involves charging of vehicle batteries at the transit points (e.g. bus stops) whilst the vehicles (in this case, buses) wait for passengers to board / alight the vehicle. A test in Wenatchee, Washington used opportunity charging and high-power wireless charging with capacities as high as 300kW, to enable a bus to run a 14-hour scheduled route and maintained its charge above 90% throughout the journey⁵⁰. For cars, Nottingham City Council is testing opportunity charging on some of their taxis, which enables them to charge while waiting in line for customers. Further, the US company WiTricity is pioneering the technology with a pilot programme launched by BMW in California, consisting of 200 examples of BMW's 530e plug-in hybrid car fitted with wireless chargers with a power capacity of 3.2 kW⁵¹. Static inductive charging could be made even more straightforward with automated vehicle technologies, such as the already available ability of some electric vehicles like the Tesla Model 3 to park themselves, and WiTricity's Chinese partner Anjie recently demonstrated this combination of technologies⁵².

It is expected by various industry stakeholders that heavy vehicles such as buses will be the main short-term application of static inductive charging, until electric vehicle OEMs include the technology in their cars. At the moment, all wireless charging tests for cars are carried out using expensive, retrofitted systems on the vehicles typically costing up to £5,000 per vehicle). Stakeholders estimate a time-to-market of 2023 (optimistically, depending on available vehicles) to post 2025 (considered a more realistic estimate) for new electric cars that have integrated wireless charging technology. There is an estimate from stakeholders that cars with inductive charging enabled will cost more, but are only commercially viable if the additional cost is brought down from a current £5,000 to retrofit, to approximately £1,000 for an additional wireless charging option.

For users with a disability, this technology could be very beneficial in eliminating the need to leave the vehicle at inopportune times, especially for wheelchair users or others with specific mobility impairments. It may still remain more expensive than traditional charging even if vehicles and charge

⁴⁹ Khurram Afridi, National Academy of Engineers (2018). [Wireless Charging of Electric Vehicles](#).

⁵⁰ Green Car Congress (2020). <https://www.greencarcongress.com/2020/05/20200520-link.html>.

⁵¹ Electrek (2018). [BMW launches wireless electric car charging system touted as convenient but inefficient](#).

⁵² WiTricity, product page: <https://witricity.com/anjie-wireless-make-life-wire-free/>

points become available, but a static inductive charger could in the future be considered part of assistive technologies that can be retrofitted to vehicles. That said, it is too early to know whether there should be a role for the Government in promoting static inductive charging to help disabled drivers.

6.2.2 Assistive technology for EV charging

A potential technology that could be beneficial for disabled drivers are automated systems that do the plug-in handling for the user. Such mobile charging robots would contain a high-capacity battery (to be used for charging a vehicle's on-board battery) and the robot would navigate itself to the vehicle and locate the charging port using its onboard sensors and wireless equipment. The robot would then connect its onboard battery to the vehicle's charging port using an onboard cable, thereby enabling the vehicle to be charged without the driver having to handle any cables at all.

At this point in time, this is just a concept that has been illustrated by one of the major car manufacturers and no examples of actual working prototypes have been found in the literature. It would be able to enable certain car parks to have charging infrastructure without having to install cabling at every bay, and would be inherently smart-enabled, removing the need for interacting with a charge point⁵³. However, these technologies are likely to be very expensive, and are not expected to become commonplace until robotics technology is more affordable and developed.

⁵³ Volkswagen. [Volkswagen lets its charging robots loose](#). Dec 2019.

7 Conclusions and recommended changes

7.1 Summary of findings

Ensuring that electric vehicle charging infrastructure is accessible for different types of disabled users is unlikely to be achieved through policy changes, market developments, or technological innovation alone – rather, it is more likely that a combination of the three will be required. It is clear that there is very little in the way of policy measures to ensure that public charging infrastructure is accessible for disabled people. From 2035, in the worst-case scenario up to 50% of disabled drivers (14% in the best-case scenario) will be either wholly or partially reliant on public charging infrastructure.

There is an opportunity for the Government to use the Automated and Electric Vehicles Act (AEVA) to change this situation via secondary legislation. The Government may not decide to mandate minimum design standards to ensure that all public charge points are accessible by disabled people, but legislation could be used to ensure that a minimum number of public EV charging stations meet accessibility requirements for disabled people, in particular for critically important rapid and ultrafast charging hubs. Any change initiated by the AEVA would depend on the definition of “accessibility” and a specification of the exact challenges with charging infrastructure that need to be overcome, which would be subject to consultation.

Furthermore, new technologies such as static inductive charging are likely to be very important for some disabled drivers in the future, particularly for those with more severe mobility issues, and measures to promote the adoption of this technology may be helpful for these users. This technology is unlikely to be widely available until the mid- to late-2020s, with stakeholder opinions differing on exactly when the technology will be widely available.

From engagement with charge point operators, key market players were willing to consider changes in favour of accessibility, but none of the operators had thus far done so of their own free will. Some stakeholders only began to think of this issue whilst engaging with this project. The Government has initiated an internal workstream on the topic of improving accessibility for charging infrastructure within the Office of Low Emissions Vehicles but does not have the evidence to make informed decisions at this point in time. This will require coordination and consultation with industry and engagement with representatives of users with disabilities, and this is likely to be a long process that begins with understanding the issues via consultation before any actions can be taken, culminating in policy changes if necessary.

Some industry-led guidance exists, although it is focused on wheelchair accessibility and is unlikely to address many other types of disability, such as dexterity focused impairments. Government stakeholders agreed that developing comprehensive guidance may require direct involvement in working groups and evidence from the experience of disabled drivers, to ensure optimal design and placement of charge points that are accessible by the largest group of people. Moreover, the UK does not appear to be behind in this space in comparison to international examples, with other countries considered to be leaders in the space of rolling out EVs and implementing charging infrastructure also lacking universal design standards.

Regarding the **urgency of any required changes**, this varies based on the category of infrastructure – off-street residential charging infrastructure is considered to already be relatively accessible. There are funding streams that will greatly expand the amount of infrastructure in the coming years – this could point towards an urgency for accessible public rapid charging at fuel station forecourts. These rapid chargers are also much more costly, and there will be less of them per EV driver, so it is key that this infrastructure is well-designed. For on-street residential charging infrastructure, despite the myriad of issues facing disabled drivers for this infrastructure category, it is nevertheless considered less urgent, as initial adopters of EVs are unlikely to not have access to off-street parking, and other options may be more suitable for disabled drivers.

At the moment, the provision and operation of EV charging infrastructure is not a profitable business model for most (if not all) companies active in this space, due to the initial investment costs being significantly higher than current and near-term expected revenues from the sale of electricity to EV drivers. This makes it economically unviable to retrofit chargers to improve access for disabled

people. As industry and governmental stakeholders around the world have started to think about this issue, it is key to accelerate these conversations where necessary to ensure adequate design standards and guidelines are produced and used at the point of installation.

7.2 Recommended changes

The analysis undertaken during this research project indicates the following **recommended changes** that are needed to ensure disabled users are supported in the transition to electric vehicles:

1. **Develop legislation, possibly via the Automated and Electric Vehicles Act (AEVA) or through other means**, regarding accessibility of charging infrastructure for disabled users, as at present there are no specific regulations or definitions concerning accessibility for disabled people. There is scope to require a procurer of infrastructure to consider users with disabilities when funding schemes are used to purchase equipment, similar to existing AEVA legislation that mandates all charge points funded with public money to be smart-charging-enabled. Input into the Office of Low Emissions Vehicles (OLEV) workstream on improving disabled access to charging infrastructure is a key starting point for this to be achieved.
2. **Create universally-backed design standards or guidelines** for accessible charging infrastructure. In order to this, it will be necessary to convene a wide range of actors, including different Government departments and agencies, market players, standardisation bodies, and disabled groups. Expertise drawn from actors in other countries might also be useful. Standards or guidelines will likely need to differ based on category of charging infrastructure. Government has indicated the need to have greater input from the voice of users included in their workstream on charging infrastructure for disabled users. The forthcoming consultation focused on the consumer experience of using electric vehicle charging infrastructure is an ideal first step.
3. **Support disabled users of electric vehicles** with respect to information services and providing feedback. Ensure disabled users are properly apprised of their charging infrastructure options with respect to public and private charging, and make it easy to access information on possible charging solutions tailored to individual users. Use crowdsourcing to gather insight on the user experiences of disabled drivers, particularly the issues they experience with electric vehicle charging infrastructure, whilst also providing collective information on accessibility of public charge points. UK market player ZapMap has already indicated interest in this issue.
4. **Promote the on-going development of wireless charging infrastructure** and other electric vehicle technological developments that might positively affect disabled users in the future. These technologies may require additional public support to ensure users with particularly severe mobility issues are not disadvantaged by charging infrastructure offerings and have sufficient access to infrastructure at an affordable price. Ensuring accessibility will not be achieved by a one-time focus; rather, it is a factor that needs to be considered for the long-term.

7.3 Addressing existing barriers to accessible EV charging

The main barriers to accessible EV charging are in the sub-sections below, split into different categories of charging infrastructure.

7.3.1 Barriers applicable to all types of public charging

Regardless of charger type, speed, or location, the following barriers that need to be overcome have been identified, in descending order of urgency.

- A. There are no universal design standards or guidelines that **define what an accessible charge point** looks like, and both the Government and market stakeholders have indicated that work needs to be done to understand accessibility for disabled users.
 - Stakeholders have noted a need to directly engage with disabled users, as otherwise any policy or definition of accessibility may not be fit-for-purpose.
 - There are relevant international examples and best practice but they mainly exist at the local level or are specific to one type of disability.
- B. Currently, a lot of responsibility to ensure accessibility lies with those who are procuring EV charge points, such as the local council or the commercial owner of a car park, through the stipulation of requirements in procurement documentation, rather than with the operator or designer of the charge point.
 - For Government-led procurement, having national secondary legislation focused on users with disabilities (similar to the already-implemented policy that all charge points procured with Government grants need to be smart-enabled) would mean all entities procuring charge points with public money could be subject to similar rules on ensuring accessibility of (a subset of) charge points, particularly if procuring on behalf of a user with disabilities. This can also be implemented via procurement policies for local authorities.
- C. Many UK or applicable EU regulations and design standards that cover accessibility of self-service terminals are either very specific to that type of terminal (such as parking ticketing machines), or do not explicitly cover electric vehicle charging stations.
 - The EU regulatory process is very slow, and current EU accessibility regulations are focused on ensuring current market players all adhere to the same standards rather than pushing the boundaries, so they are currently not a good example of best practice.
- D. Most charging operators currently have non-profitable business operations, whereby the sale of electricity to EV users does not cover the infrastructure installation costs, so costs incurred to make all charge point more accessible may reduce incentives to place them.
 - To address this issue, national standards that ensure accessibility should also emphasise affordability, in order to not hamper the growth of EV charge points.
 - There is currently no information available on what it would cost to make charge points minimally accessible, and for which types of disability, as this would depend on the definition of accessibility which is yet to be developed.

7.3.2 Ensuring accessibility of on-street charging

In 2035, it is estimated that up to 34% of disabled drivers would not have access to off-street parking. On-street charging may be a solution for some of these users, but these chargers are likely to be the most challenging of all charger types to make accessible due to issues with kerbside space and existing street furniture.

- E. Where design standards are developed that would ensure wheelchair accessibility, the lack of space on the kerb may make application of such standards challenging.
 - Similar to barrier C, this would be another reason why proposing universal design standards may encounter opposition. It may be better to promote a minimum number of these chargers in an area, and per charging hub, to be made accessible.
- F. Lamp-post chargers offer many general advantages such as being minimally invasive on the street, and lower installation costs. That said, these advantages (no need for civil engineering works in the majority of circumstances) reduce the ability to design the surrounding space for accessibility.
 - Lamp post chargers are relatively affordable, but lamp posts next to disabled bays may not be chosen for charger installations.

- On-street charging may prove to be too unviable a solution for disabled drivers due to the above-mentioned issues, dependent on technological developments.

7.3.3 Ensuring accessibility of off-street charging

- G. Drivers with off-street parking in centrally managed buildings may be refused installation of charge points due to cost concerns, and in general, housing associations or councils may not be proactive in retrofitting charge points to these buildings, where a disproportionate number of people with a disability live.
 - The Norwegian model of regulations on council housing and housing associations places more agency in the hands of tenants in centrally managed buildings, by ensuring that charge points cannot be refused except on very strong grounds. This ensures that disabled drivers in rented properties can use their off-street parking space to charge their vehicle.
- H. If a mandatory provision of charging infrastructure in parking spaces in new residential buildings becomes regulation, there is a risk for minimum viable solutions to be implemented by property developers in new builds, unless standards on minimum accessibility and usability are defined and legally enforced. Currently, there are no such standards.

7.3.4 Ensuring accessibility of rapid and higher-powered charging

- I. For rapid and higher-powered chargers, the cable weight can become an issue for users with dexterity problems, and this is unlikely to be resolved due to the nature of the technology requiring heavy copper cables
 - Where chargers are situated in staffed forecourts, regulation could ensure that there are obligations for staff to understand and provide aid where necessary as a minimum.
- J. Almost all charge points are designed for people to use standing up.
 - This needs to be addressed when communicating design standards. It is unlikely that this can be addressed for all charge points, but there should be reasonable accommodation.
- K. Current rapid and higher-powered charging is limited by the ability of vehicles to accept charge, and cable weight is in part determined by the vehicle's maximum charging voltage. Higher voltage charging reduces the need for thicker cables but is not expected to become widely available for many years, and it is uncertain if it will become mainstream.

7.3.5 Potential barriers to relevant technological developments

- L. The market and most stakeholders interviewed are sceptical about static inductive charging for reasons of price and efficiency, but all universally agree that it could be a potentially extremely effective solution for those who have difficulty handling cables, but would not become commonplace until at least 2025
- M. Information services for charge points such as ZapMap do not currently provide information that specifies the accessibility of a charge point for disabled drivers.
 - Crowdsourcing this information could represent a "quick win" to ensure it is collected, in the absence of any Government-led data requirement.

Appendices

- Appendix A1: 2035 estimation methodology

A1 2035 estimation methodology

A1.1 2035 extrapolation methods

To understand the change in the number of people with a disability from current year data to 2035, official population projections are the main source. We considered whether the share of disability by age group should change (for example, the estimate that 44% of over 65s have a disability), but there is no strong evidence to assume a different ratio in 2035 than for 2020. While the UK population is set to grow by 5.5% between 2020 and 2035, the number of people over 65 will grow by 30%, and the population growth in the UK is accounted for entirely by an increase in over 65s.

To extrapolate other data, such as share of blue badge holders and housing/parking data from 2020 to 2035, historic time series data was used to provide an indication of any trends that can or should be extended. For all required data sources, reliable information was available from the period 2008 – 2017. If no discernible trend was observed in the time series, then the latest reliable figure is used and assumed to stay constant up until 2035. A conservative approach was taken, where unless a clear trend is visible in recent years, the most recent data or an average across multiple recent years is taken forward to 2035.

A1.1.1 Use of parking data to estimate EV charging need

In 2017, 15.4% of respondents to the EHS with a disability indicated having either no parking provision (1.4%) or 'inadequate' parking (14%), which is self-selected from the survey indicating the respondent is not satisfied with their available parking provision. This figure has remained constant over the period of 2008 – 2015, and therefore extrapolated to stay constant across 2020 – 2035. An additional 19.6% of people have access to adequate on-street parking. 65% of respondents with a disability had either a garage or other off-street parking.

The starting point for analysis is the number of disabled drivers that do not have any off-street parking, but off-street parking at housing estates is also considered to be potentially not meeting demands in 2035, if councils or housing associations are not willing to retrofit existing parking facilities with domestic EV charging equipment. Where people own their own home with off-street parking, installing a home-based charging facility is not expected to be a problem by 2035.

A1.1.2 Estimating the number of disabled drivers in the UK

Across 2015 – 2018, on average 20% of people with a disability that were of a legal and likely able driving age (between 18 and 84) carried a blue badge. It should be noted that not all blue badge holders are drivers, they may also have another person drive for them. Even if not a driver but having someone drive for them, similar demands may apply with respect to accessible charging near a disabled person's home, as this would help them avoid having to walk distances they may not be able to easily to get to a parked vehicle.

People with a disability above 85 are considered unlikely to be drivers on average and have been excluded from this estimate. While 32% of all over 85s do hold a valid driving licence, the number of active blue badges is the current best estimate for the number of disabled drivers in the UK. As the number of blue badge holders, when controlled for population, stayed relatively constant over 2015 – 2018, it is not assumed that the share of blue badge holders among the disabled population will deviate from this 20% in 2035. This means that by 2035, we estimate that 2.7 million people with a disability could hold an active blue badge, when controlling for population growth and the ageing population.

The period 2015 – 2018 is chosen, as across this period the DVLA's measurement method for the number of active blue badges stayed constant, and the most recent 2019 estimate was a likely underestimate according to the footnotes of the data publication. It was also observed that the relative

number of blue badge holders as a proportion of all people with a disability decreased significantly over the period 2008 – 2015 (from 25.5% down to 20.6% in 2015). The exact reasons for this are unclear, but it may be a combination of both an increased share of disabled people in the population due to increased recognition of additional disabilities, and a decrease in the absolute number of blue badges awarded. The last effect could be attributed to increased enforcement of fraud over the same period⁵⁴. Note that a change in measurement methods for estimating active blue badges is also likely to play a role, as the DVLA has previously used a dedicated survey to devolved administrations, and the number of badges is generally higher for years where this survey is used.

⁵⁴ A 2011 publication by Imtac (The inclusive mobility and transport advisory committee) addressed blue badge fraud, and asserted that data from DfT indicates a 4-6% fraudulent use of the blue badge scheme



T: +44 (0) 1235 753000

E: enquiry@ricardo.com

W: ee.ricardo.com