Enable
Final report

UK Power Networks in collaboration with Ricardo

18 January 2022

About this report

This report is prepared by Ricardo for UK Power Networks, under the Ofgem Network Innovation Allowance (NIA) Programme.

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Stakeholder	Role	Approval
Denis Naberezhnykh	Project Director	Review of first draft and approval for release to client

About UK Power Networks

UK Power Networks is the UK's biggest distribution network operator, delivering power to 8.3 million homes and businesses across London, the East and South East of England. UK Power Networks manages three licensed distribution networks, responsible for 28% of Great Britain's total electricity distribution. Through the NIA, UK Power Networks delivers innovation projects which aim to make our services more reliable, affordable, clean and safe. Within our overall innovation portfolio, we work extensively on facilitating the Net Zero transition.

About Motability

Motability is a charity with the purpose of enhancing the lives of disabled people with transportation solutions and charitable grant programmes. Motability oversees the Motability Scheme, which helps disabled people to get mobile by exchanging their qualifying mobility allowance to lease a new affordable car, Wheelchair Accessible Vehicle, scooter or powered wheelchair. Motability is working with Government, industry, charities and most importantly, disabled people, to ensure that disabled people are not left behind as the UK transitions to electric vehicles.

About Ricardo

Ricardo is a global strategic consultancy, recognised for its breadth of capability and technical excellence in the fields of sustainable transport, energy and climate change. Ricardo's team of consultants support the private sector, government bodies, non-governmental organisations and associations, through the provision of in-depth technical analysis. Under the Enable project, Ricardo brings together specialists in transport electrification and energy networks, with experience in the accessibility of electric vehicle charging infrastructure.

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1 Introduction

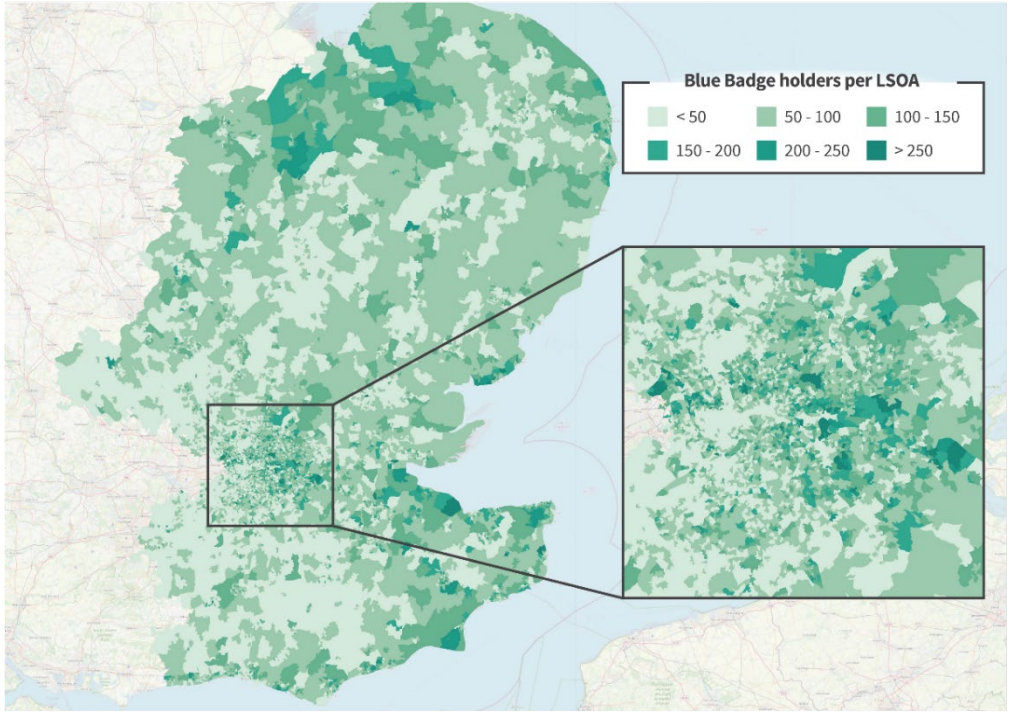
Disabled customers (disabled motorists, disabled passengers, and carers) who do not have access to off-street parking will require on-street charging solutions as they transition to electric vehicles. Prior research[1] has shown that disabled customers, known as Blue Badge holders, have specific needs when it comes to on-street charging infrastructure, and also have limited flexibility on where to park. Of the 2.72 million disabled customers predicted in the UK by 2035, it is estimated that 1.35 million will be partially or wholly reliant on on-street charging infrastructure.

There will be an estimated 745,000 Blue Badge holders in the UK Power Networks licence area by 2030, 395,000 of which will be partially or wholly reliant on on-street charging infrastructure. As displayed in Figure 1, the concentration of Blue Badge holders varies across the UK Power Networks licence areas, with the highest estimates present in the Eastern Power Networks (EPN) licence area. However, the London Boroughs of Islington, Newham and Hackney are also in the top 10 local authorities for both the estimated number of Blue Badge holders and on-street disabled parking bays per Lower Layer Super Output Area (LSOA).

The Enable project aimed to understand the role of the distribution network operator in supporting disabled customers reliant on on-street parking in their transition to electric vehicles, and to assess the impact of the electrification of disabled parking bays on our networks. UK Power Networks partnered with Motability on the Enable project, a national charity that actively seeks to assess and develop new solutions to meet the evolving mobility needs of disabled customers. This report provides a summary of the key findings, which were developed in three phases:

- **Phase One** produced a literature review of the barriers to on-street charging for disabled customers. It also developed an initial market sizing analysis for disabled customers in the UK Power Networks area, alongside an initial understanding of UK Power Networks' role in assisting disabled customers in their electric vehicle transition.
- **Phase Two** developed a more comprehensive understanding of the issues facing disabled customers reliant on on-street charging through stakeholder engagement activities. More granular market sizing analysis and a network impact analysis were carried out, and the role of the distribution network operator was developed further.
- **Phase Three** fully developed the roles of the distribution network operator in terms of facilitating the uptake of electric vehicles amongst disabled customers reliant on on-street parking and charging, as well as developing recommendations for further trials.

Figure 1: Estimated Blue Badge holders per LSOA in 2030



[1] Motability (2020), Electric vehicle charging infrastructure for people living with disabilities.

2 Methodology

The Enable project delivered five key tasks, to facilitate the development of the recommended roles of the distribution network operator in supporting disabled customers reliant on on-street charging in their transition to electric vehicles:

- A **desk-based literature review** explored developments in the electric vehicle charging market in the UK, relevant policy measures and funding streams, and barriers and opportunities for on-street charging for disabled customers.
- A **survey** was released to disabled customers in the UK Power Networks licence areas, gathering 1,000 responses. The survey responses provided insights into the needs of disabled customers in relation to on-street parking and charging, as well as typical parking behaviours and perspectives on electric vehicle adoption. Box 1 provides a summary of the survey respondent characteristics.

Box 1: Overview of survey respondents

- 98% of survey respondents are Blue Badge holders or regularly drive a Blue Badge holder.
- More than 50% of survey respondents have a mobility impairment, 20% have a non-visible impairment, 12% have a visual impairment and 11% have a hearing impairment.
- 31% of survey respondents are current electric vehicle users.

- An **interview programme** captured the perspectives of 20 local authorities in the UK Power Networks licence area, the Office for Zero Emission Vehicles (OZEV), Transport for London (TfL) and five charge point operators. The interviews collected insights into the processes for requesting disabled parking bays and on-street charge points, the business models for supporting the rollout of on-street charge points for disabled customers, and perspectives on the role of the distribution network operator in supporting disabled customers in the shift to electric vehicles.
- The **market sizing analysis** provided a granular assessment of the market of disabled customers in the UK Power Networks licence area, analysing the distribution of disabled parking bays and disabled customers in the UK Power Networks area, to help understand where the associated on-street charging demand may occur from electric vehicles used by disabled customers.
- The **network impact assessment** provided analysis of the electrification of on-street disabled parking bays, using the results of the survey to produce likely charging profiles for disabled customers, and analysis of the suitability of disabled customers to existing flexibility/smart solutions.

Theory of Change analysis was carried out, to identify the key problem areas which need to be addressed to assist disabled customers reliant on on-street charging in the transition to electric vehicles. Following the identification of these problem areas, an initial set of potential roles for the distribution network operator was developed, which aimed to positively influence the problem areas.

Through the interview programme, stakeholders provided feedback on these potential roles and the actions which UK Power Networks could take to implement the roles. The roles were developed further and a final set of roles were established following assessment of and consensus on the implementation feasibility of the roles and actions through an internal UK Power Networks workshop.

Building upon the recommended roles and actions, a coordinated approach for local authorities was developed and two recommendations were proposed for further trials which UK Power Networks could lead.

3 On-street charging needs of disabled customers

Electric vehicle transition timelines for disabled customers

In 2020, the UK Government announced its plans to end the sale of new petrol and diesel cars by 2030. The upcoming phase out date is expected to lead to a rapid increase in electric vehicle adoption, and with respect to disabled customers, this will be partially driven by easy access to new electric vehicles via the Motability Scheme. With a predicted 2.72 million disabled motorists and disabled passengers in the UK by 2035, it is essential that the factors which have the potential to limit or encourage the adoption of electric vehicles are fully understood.

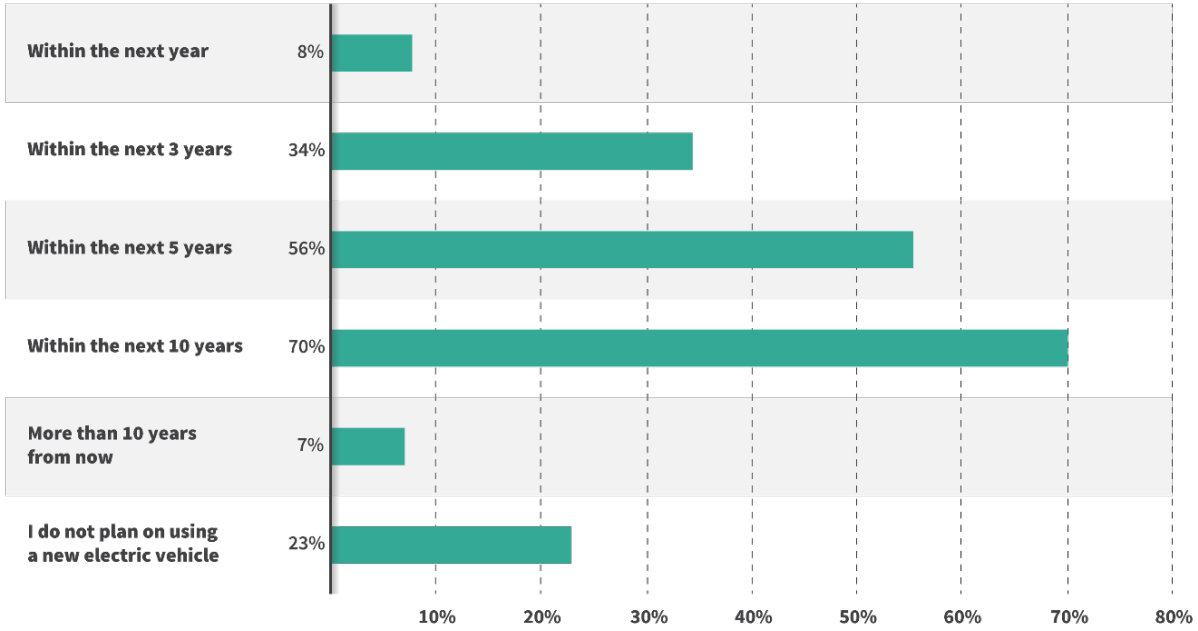
The survey of 1,000 disabled customers gathered views on electric vehicle adoption and the barriers faced with respect to on-street charging infrastructure, as well as collecting information on typical parking and charging behaviours.

The survey results show a high level of interest from disabled customers in the switch to electric vehicles, with 31% of respondents already electric vehicle users. Of the respondents that do not use an electric vehicle currently, 70% indicated their plans to switch to an electric vehicle within the next 10 years (see Figure 2).

There is some variation across UK Power Networks licence areas, with a greater proportion of individuals in EPN (58%) and London Power Networks (LPN) (62%) licence areas indicating their plans to use an electric vehicle within the next five years, compared to individuals in the South Eastern Power Networks (SPN) licence area (52%). In addition, a greater proportion of respondents in the SPN licence area (27%) do not plan on using an electric vehicle, compared to the EPN licence area (20%) and LPN licence area (14%).

To support this transition, disabled customers indicated their expectations for electric vehicle charging infrastructure, with 76% of disabled customers stating that they would expect their disabled parking bay to have an electric vehicle charge point installed beside it. This reinforces the need to ensure that on-street charging is accessible for disabled customers.

Figure 2: Electric vehicle transition timelines for disabled customers



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3 On-street charging needs of disabled customers

Policy and strategy developments

Of approximately 745,000 disabled customers in the UK Power Networks area, 395,000 disabled motorists or disabled passengers (53%) may struggle to charge their electric vehicles at home in 2030 (see Figure 3). As such, it is essential that these disabled customers are not left behind in the transition to electric vehicles. The current consideration of the needs of disabled customers with respect to on-street charging by key government and industry stakeholders is presented below, building upon the findings from the interviews conducted as part of the project.

Department for Transport (DfT)

- DfT recently **consulted on measures to support the electric vehicle rollout**[2], including the potential to introduce a statutory obligation for delivering charging infrastructure, as well as proposals to ensure that inclusively designed charge points are available for all.

OZEV

- OZEV has kicked off its **internal accessibility work stream** and is jointly **sponsoring (along with Motability) the development of accessible charging infrastructure standards,** produced via the British Standards Institution (BSI). These standards are due for completion in 2022.

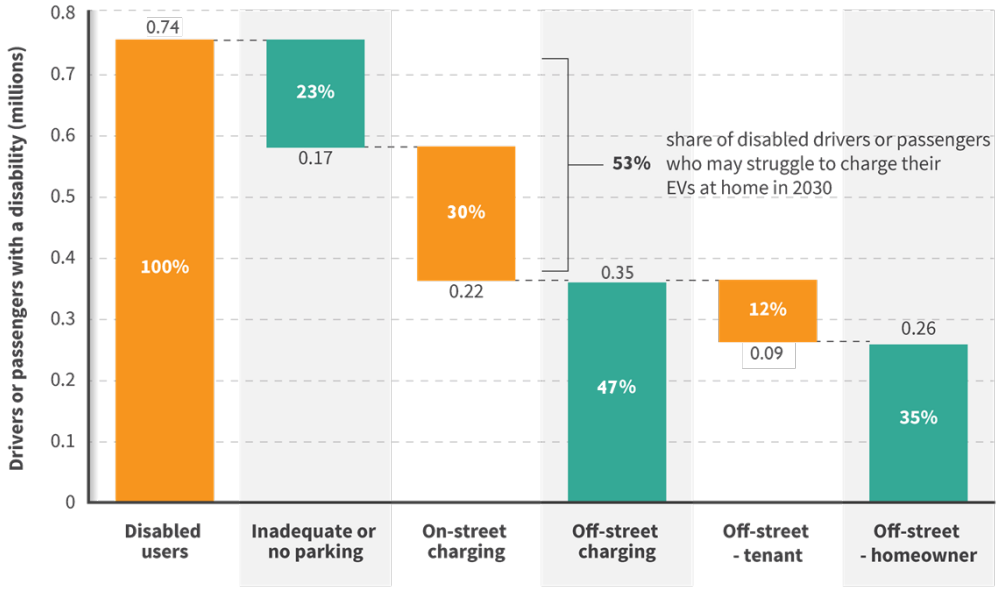
Charge point operators

- The majority of charge point operators do not currently tailor their services to the needs of disabled users. For example, hardware and software are not typically designed with accessibility in mind.

TfL

- As charging infrastructure provision and electric vehicle uptake in London increases, TfL is beginning to address charge point accessibility and recently published **London's 2030 electric vehicle infrastructure strategy**, which acknowledges accessibility issues and commits to update its installation guidance.
- As a transport authority, TfL sees its role as facilitating and coordinating electric vehicle infrastructure delivery across London, seeking to make it consistent and accessible. TfL has developed design principles as part of its electric vehicle charge point installation guidance.

Figure 3: Breakdown of disabled motorists and passengers in the UK Power Networks licence area by parking provisions



[2] DfT (2021), Future of Transport Regulatory Review: Zero Emission Vehicles.

3 On-street charging needs of disabled customers

Barriers to electric vehicle adoption for disabled customers

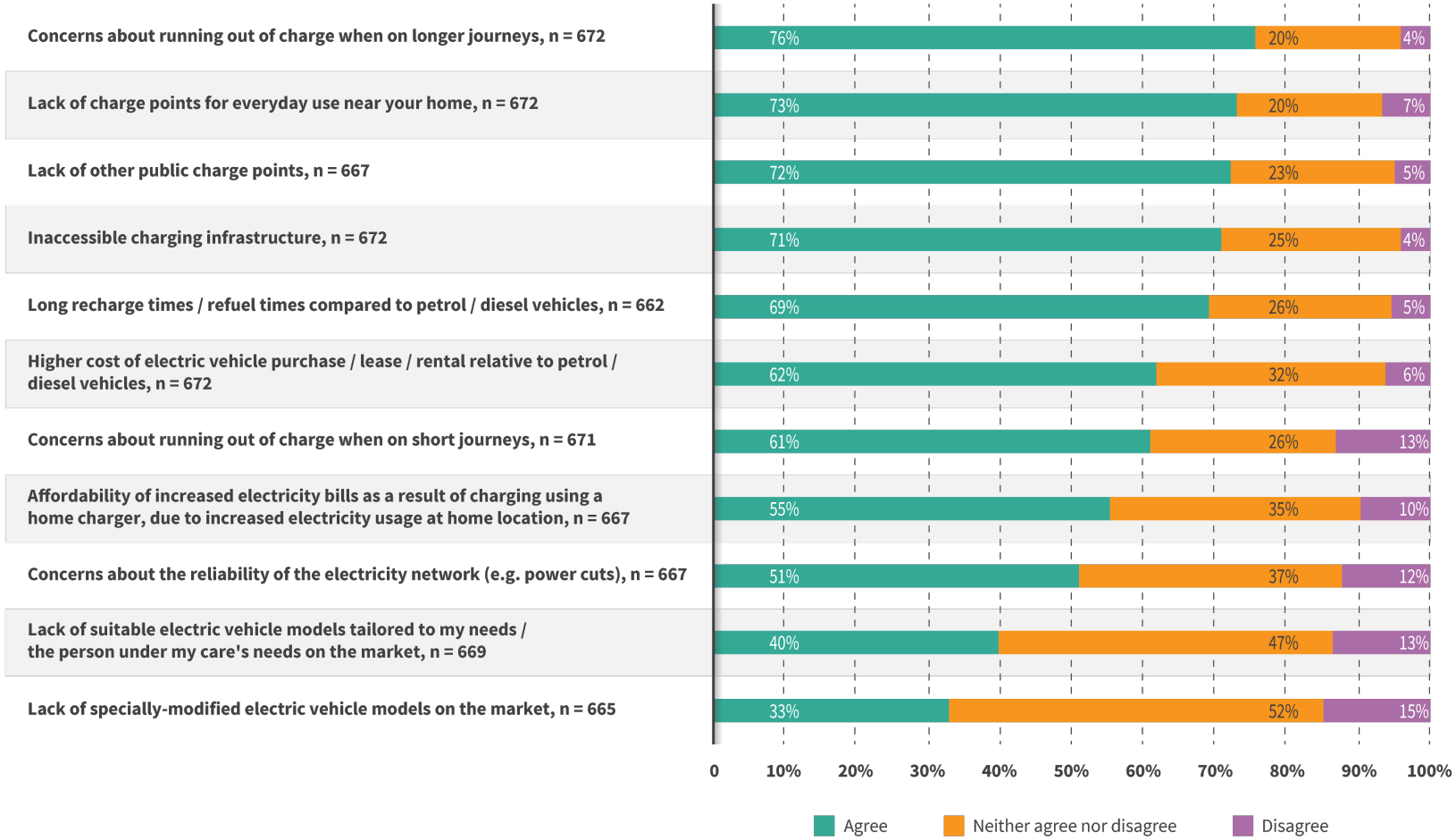
Disabled motorists, disabled passengers and carers were also asked to identify the key factors which might limit their use of an electric vehicle. The most significant limiting factor (76%) is concern around battery capacity when carrying out longer journeys. The next three most commonly selected factors are all related to a perceived lack of charging infrastructure, and the accessibility of charging infrastructure.

An interesting observation from the survey is that a significant proportion of respondents (61%) had concerns about running out of charge, even on short journeys (see Figure 4).

This suggests that many people may not have accurate or up-to-date information about the range of modern electric vehicles. Furthermore, a large proportion of respondents expressed concerns around the reliability of the electricity network (51%), which may suggest the existence of a perceived risk rather than an actual risk, as significant power cuts that last long enough to impact charging, are very rare in the UK.

A small proportion of respondents disagreed with the barriers presented. Only 33% of respondents agreed that there is a lack of electric vehicle models tailored to the needs of disabled customers.

Figure 4: Barriers to using an electric vehicle identified by non-electric vehicle users



3 On-street charging needs of disabled customers

Drivers to electric vehicle adoption for disabled customers

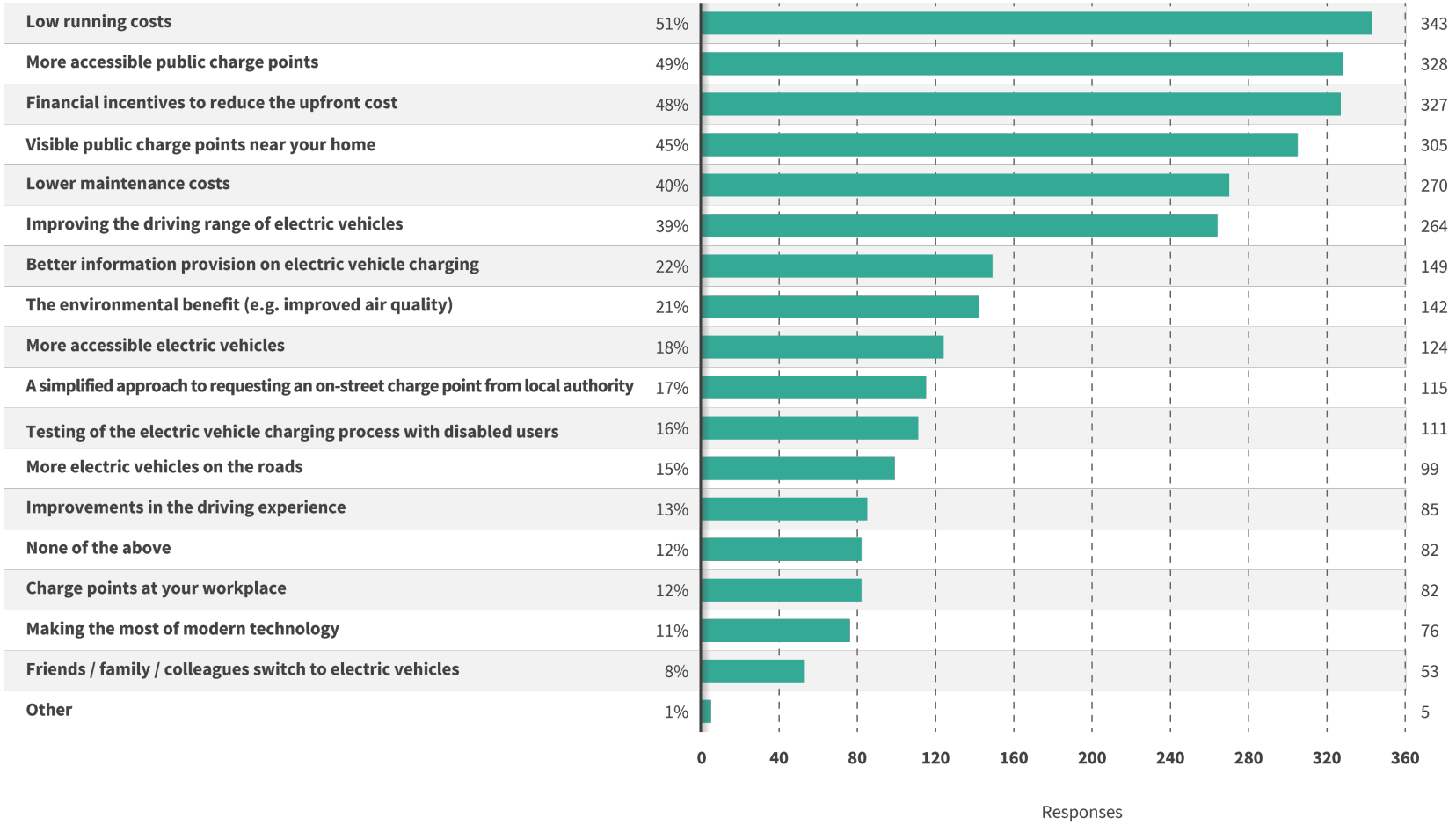
When asked what would encourage greater electric vehicle adoption, the factors that received the highest level of support from non-electric vehicle users relate to additional financial benefits or incentives, more accessible charging infrastructure and greater electric vehicle range (see Figure 5).

Interestingly, when asking current electric vehicle users about the benefits of switching to an electric vehicle, lower running costs and financial incentives are recognised as some of the key realised benefits.

This suggests that non-electric vehicle users would benefit from information sharing about the financial benefits associated with electric vehicle use, as well as the available incentivisation schemes which support electric vehicle use.

It is also important to note that an improved driving experience is the non-financial benefit which received the highest level of support from existing electric vehicle users, a realised benefit which could also be highlighted through information sharing activities.

Figure 5: Drivers to using an electric vehicle identified by non-electric vehicle users



3 On-street charging needs of disabled customers

Barriers to on-street charging for disabled customers

Through the literature review, survey and interviews conducted as part of this project, a number of key barriers were identified and categorised, as displayed in Table 1. Although these barriers focus on on-street charging, they are equally relevant to all charging bay types. Through addressing these barriers, UK Power Networks can help to ensure that disabled users are able to participate in the transition to electric vehicles and use on-street charging infrastructure.

From direct engagement with disabled customers through the survey, the key barriers identified are a lack of consideration of the required proximity to charge points, with just under half of survey respondents indicating that a residential on-street charge point would need to be a maximum of 50 metres from home; lack of consideration of the differing needs of disabled customers in charge point design; lack of level access; and lack of comprehensive data on parking and charging availability for disabled customers.

Table 1: Key barriers relating to the accessibility of on-street charge points for disabled users

Variety of users	• Lack of consideration of users with **varying mobility and visual impairments**. • Lack of consideration of the need to account for **disabled motorists, disabled passengers and pedestrians in infrastructure design**. • Lack of consideration of the requirements of individuals with respect to the **minimum proximity to charge points**.
Suitability of charge points	• Lack of **visibility of charging units**. • Lack of consideration of **space required for wheelchair users around the charge point**. • Lack of consideration of the potential for charge points to **block car door access**. • Lack of consideration of the **difficulty lining up, retrieving and returning connectors**. • Lack of consideration of the **weight and length of cables**.
Built environment and infrastructural barriers	• Lack of consideration of the need for **cover from weather**. • **Lack of drop kerb** for wheelchair users or those with visual impairments.
Informational barriers	• Lack of **clarity and consistency in regard to language** used in payment interface. • Lack of **clear labelling/signage**. • Lack of **apps which collate information on parking and charging availability for disabled customers**.

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4 Network impact analysis of electrification of on-street disabled parking spaces

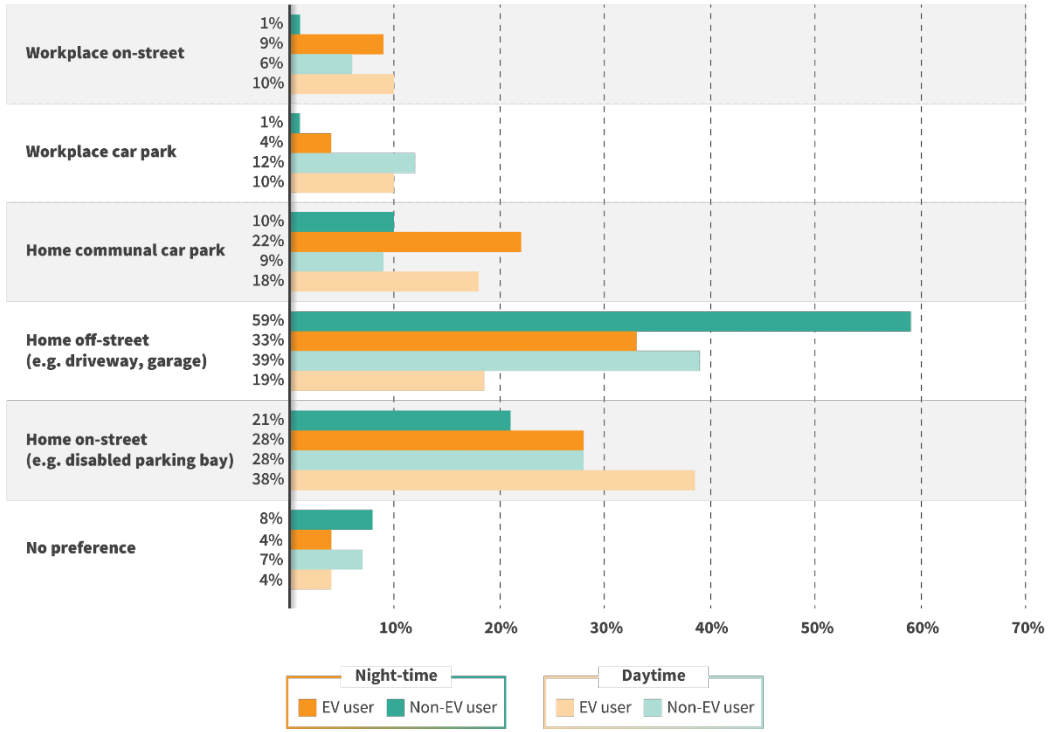
Parking behaviours of disabled customers

The charging behaviours of disabled customers, along with the locations of disabled parking bays, may have an impact on the electricity distribution network. Prior to the Enable project, the parking and charging behaviours of disabled customers were relatively unknown to UK Power Networks. To address this, the survey carried out as part of the project assessed the daytime and night-time parking behaviours of disabled customers for home off-street, home on-street, home communal car park, workplace car park and workplace on-street locations. The survey found that 47% of respondents typically park at home on-street during the daytime, night-time or both, whilst 62% of respondents park at home off-street either during the daytime, night-time or both.

The majority of respondents tend to park at home locations during the daytime, either off-street, on-street or in a communal car park (80%). **In the night-time, an even greater proportion of respondents park at home locations (93%)**. These results indicate that vehicles used by disabled customers are likely to be stationary during the day and overnight at domestic locations, and are therefore **well-suited to daytime and overnight charging utilising off-peak energy demand**. The results for parking locations were analysed further to assess whether there are differences between types of user (e.g. disabled motorists, disabled passengers, and carers), licence area and current vehicle use of disabled customers (e.g. electric or non-electric vehicle).

- Although no significant differences emerge between types of user, passengers with a disability park slightly less often at home off-street locations, and slightly more often at home communal car park locations during the daytime, compared with disabled motorists and carers of someone with a disability.
- **During the daytime, the use of home on-street parking was roughly equal across all licence areas. This was reflected in the night-time, where home off-street was the most common parking behaviour across all licence areas,** but with a slightly greater proportion of respondents in the LPN licence area parking in a communal car park.
- A higher proportion of current electric vehicle users, relative to non-electric vehicle users, park at home on-street (38% compared to 28%) and communal car park (18% compared to 9%) locations. A higher proportion of non-electric vehicle users park at home off-street (39% compared to 18%) locations during the daytime, relative to electric vehicle users.

Figure 6: Breakdown of current parking location by time of day and type of vehicle



These parking segments were selected to facilitate the development of a charging profile for the network impact analysis.

4 Network impact analysis of electrification of on-street disabled parking spaces

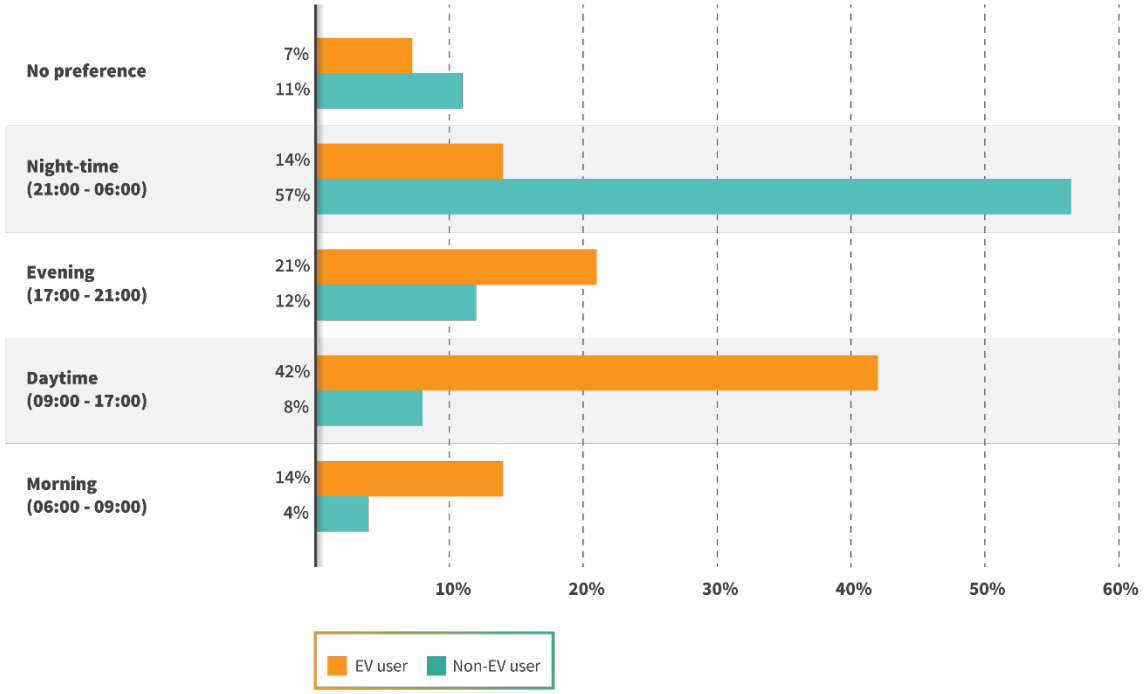
Charging patterns of disabled customers

The survey gathered information on the average daily mileage of respondents, as well as the actual charging behaviours of current electric vehicle users and the intended charging behaviours of non-electric vehicle users. The survey results indicate that **a significant majority (>98%) of disabled customers travel less than 50 miles per day**. With current electric vehicle battery ranges and the typical power of charge points in domestic locations in mind, the survey results indicate that a vast majority of disabled motorists, disabled passengers and carers would be able to **comfortably charge overnight at domestic locations using standard 3-7kW (or lamp post) charge points,** and daily charging would not be required for most users.

There is a clear preference for night-time charging amongst those that do not currently use an electric vehicle, with 57% of non-electric vehicle users indicating a preference for night-time charging (see Figure 7). Interestingly, the preferences of electric vehicle users differ greatly, with a large proportion (42%) of electric vehicle users stating that they tend to charge their vehicles during the daytime, thereby potentially having a greater impact on the electrical grid. This may be linked to the large proportion of electric vehicle user survey respondents that tend to park their vehicle at home during the daytime, and therefore, may typically plug in their vehicles during this time. This indicates the possibility for the provision of flexibility services, and importantly, **81% of electric vehicle users indicated that they would be flexible with the time of day that they charge their electric vehicle**.

The survey results show that there are **no major differences between the charging behaviours of the disabled customers who responded to the survey and the charging behaviours of other UK Power Networks customers.** There is a similarly large proportion of home charging and the average daily mileages for disabled customers and other UK Power Networks customers are both within the capacity of current electric vehicle batteries, with the Charge Collective[3] study concluding that only 1% of all drivers in the UK Power Networks licence area travel more than 55 miles per day on average. However, it is important to note that the Enable survey respondents display a slightly greater preference for home-based parking during the daytime.

Figure 7: Breakdown of expected charging times for electric vehicle and non-electric vehicle users



[3] UK Power Networks (2021), Charge Collective.

4 Network impact analysis of electrification of on-street disabled parking spaces

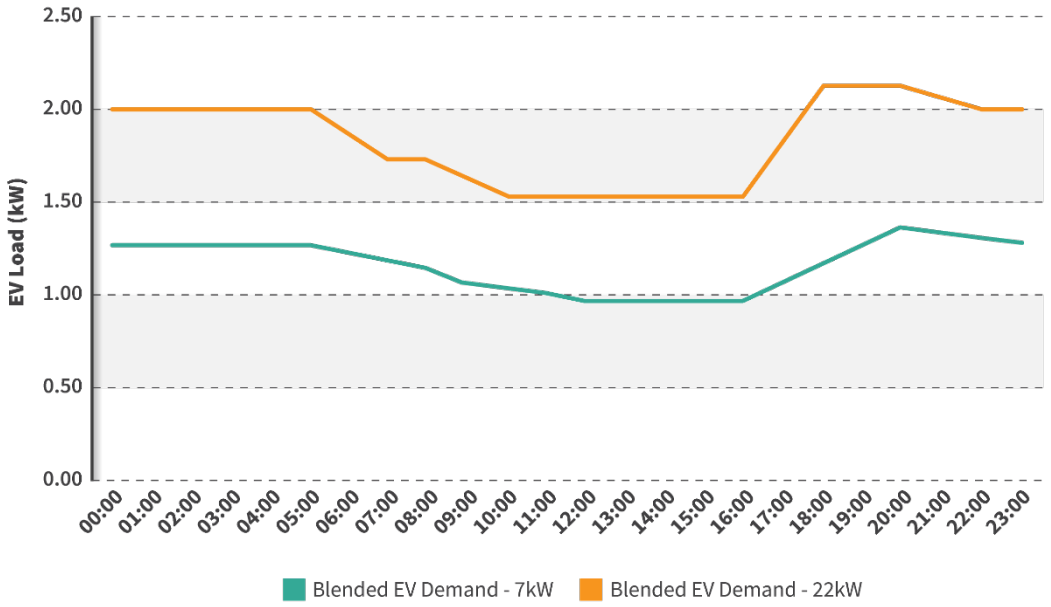
After Demand Maximum Diversity (ADMD) electric vehicle charging profile

The survey results from current electric vehicle and non-electric vehicle users were used to account for actual and intended future charging behaviours in the development of a 24-hour load profile. The difference between the charging behaviours of disabled customers who use or do not use an electric vehicle demonstrates a **potential for flexibility to shift charging demand away from peak demand periods**. Using the results of current electric vehicle and non-electric vehicle users, a mixed profile was estimated to take account of current and future charging events. This resulted in combining the results from both types of survey respondents, to create a 50/50 blend between current and future charging behaviours.

Published data on electric vehicle user charging behaviour was used to estimate charging duration and energy recovered during each charge event. A charging trial was undertaken in the Netherlands, which looked at approximately 17,000 electric vehicle drivers and over 1 million charge events[4]. The trial concluded that for an average 75kWh electric vehicle battery, the average State of Charge change was 30%, resulting in an energy consumption gained per charging cycle of 22.5kWh. This results in each electric vehicle requiring 3.21 hours (rounded up to 4 hours) for a 7kW charger and 1.02 hours (rounded up to 2 hours) for a 22kW charger. For example, a 7kW charger that starts a charge event at 06:00, will taking 4 hours to charge, finishing at 10:00. An **electric vehicle load profile was generated that considers the ADMD** to reflect the number of electric vehicles that are connected to the local network (see Figure 8).

The average ADMD seen by the local network for a single electric vehicle charge point rated at either 7kW or 22kW is approximately 1.36kW or 2.14kW, respectively. It is important to note that it is unlikely that 22kW chargers would be used in the residential on-street charging use case. However, these chargers have been included in the analysis to illustrate the potential impact. The electric vehicle load profiles were then used to undertake a network impact assessment, to predict areas in the UK Power Networks' distribution network where there is a high probability of encountering network constraints in the future. The London Borough of Islington and London Borough of Camden were selected for the network impact assessment, given the high proportion of disabled parking bays in these boroughs, and therefore, the potential impact of the electrification of these bays on the distribution network.

Figure 8: Daily ADMD electric vehicle load profile using a standard residential 7kW or 22kW charger



ADMD accounts for the peak load a network is likely to experience over its lifetime, which is important to consider with respect to electric vehicle charging and the levels of diversity of electric vehicle charging profiles in the future.

[4] Wolbertus, R and van den Hoed, R. (2020). Fast Charging Systems for Passenger Electric Vehicles.

4 Network impact analysis of electrification of on-street disabled parking spaces

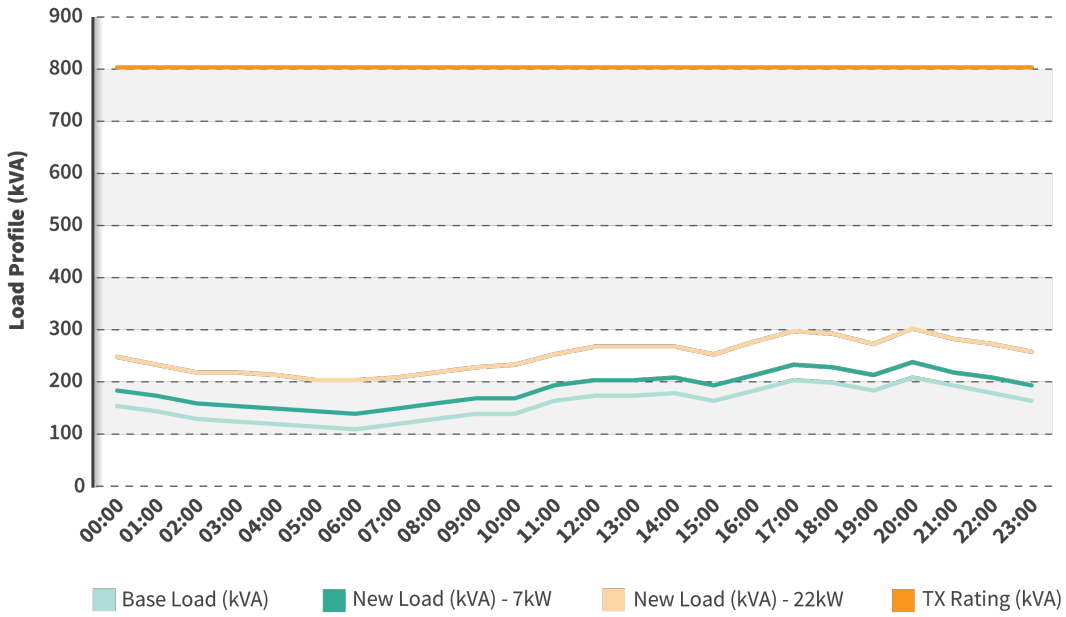
Case study: Islington

Islington has approximately 654 on-street disabled parking bays, the third highest in the LPN licence area. This means that **654 additional electric vehicle charge points could be installed in the future in this area**, thereby increasing network demand in the area. The Holloway 11 kV primary substation is in the centre of Islington and likely to supply the majority of electrified parking bays in the Islington area. For this assessment, the Holloway 11 kV primary substation was assumed to supply all 654 disabled parking bays.

The option of charging electric vehicles from either a standard 7kW charge point or 22kW charge point, and assuming a diversity factor across all 654 disabled parking bays, generates a small increase in network demand that has **little to no impact on the thermal performance** of the high voltage (HV) feeder groups. Approximately four electric vehicle charge points are supplied per low voltage (LV) substation by assuming an event split of electric vehicle chargers, based on the number of disabled parking bays in the area and the number of LV substations being supplied by Holloway primary. Therefore, in a worst-case scenario, 7kW and 22kW charge points would add an additional 28kW and 88kW to the load, respectively. This was modelled as the worst-case scenario, as the degree of diversity on the low voltage network is low. Overall, the impact on thermal performance at low voltage is low. It is important to note that an N-1 assessment was not considered at the HV primary substation for this study, due to the expected low impact of additional electric vehicle load. However, an N-1 assessment should be considered for any future network connection studies.

A voltage assessment was undertaken to understand if any voltage constraints would be encountered on the network due to the increase in network demand from electric vehicle chargers. Two types of voltage constraints common on the network are a) where the voltage decreases below the minimum statutory requirement and b) voltage fluctuations, where the change in voltage, with and without load, exceeds 3% in accordance with Engineering Recommendation (EREC) P28. The voltage assessment was applied to one 11 kV HV feeder supplying an LV substation. A worst-case scenario was used, which assumed that all four chargers per LV substation in the Islington area were used at the same time. The results are shown in Table 2. The decrease in voltage seen on the other side of the HV feeder is minimal, and is therefore compliant. Similarly, the change in voltage with and without electric vehicle load is less than 3%, and is therefore compliant with P28.

Figure 9: Base load increase from new 7kW or 22kW electric vehicle chargers against LV substation capacity



Source: UK Power Networks

Table 2: Voltage Assessment at HV level for one feeder from Holloway HV substation

Load (with or without electric vehicle chargers)	3 – phase HV Voltage	Voltage change (with and without electric vehicle charging load)
Without electric vehicle chargers	10.95 kV	0 kV
With 7kW chargers added (28kW of new load)	10.95 kV	0.004 kV
With 22kW chargers added (88kW of new load)	10.94 kV	0.012 kV

4 Network impact analysis of electrification of on-street disabled parking spaces

Case study: Camden

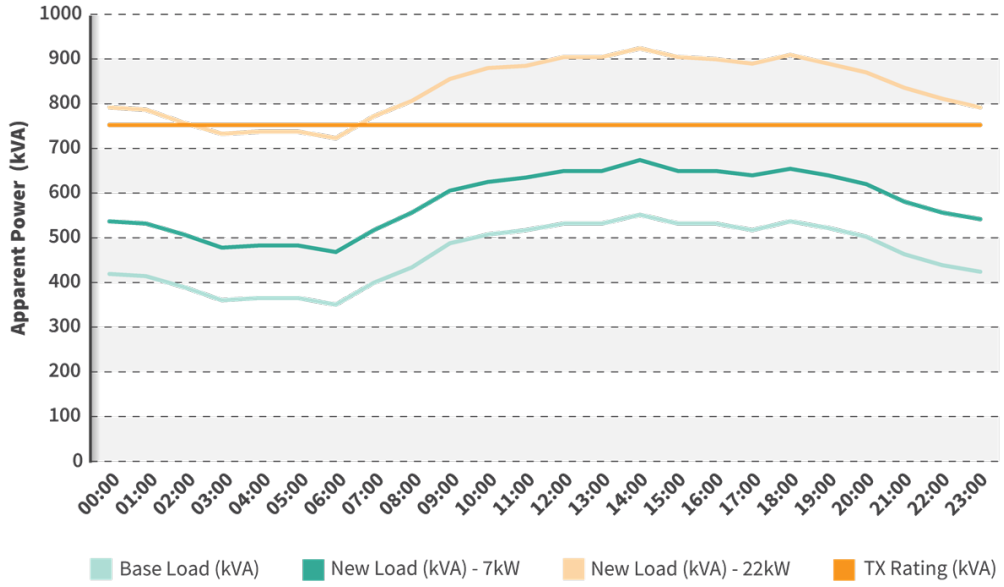
Camden has approximately 837 on-street disabled parking bays, the second highest number in the LPN area. This means that **837 electric vehicle charging points could be installed in the future in the area**, thereby increasing network demand in the area. The high voltage primary substation assumed to be the likely 11kV substation that will supply the electric vehicle chargers via the high voltage network is Georgiana St substation. There were no thermal constraints identified at the primary substation on the 11 kV HV network.

At LV level, the secondary substation selected for investigation was Camden Rd 27, which has a transformer with a nominal rating of 750 kVA. It is assumed that approximately 16 electric vehicle chargers are supplied per LV substation, based on the number of disabled parking bays and LV substations in the area. The addition of multiple electric vehicle chargers rated at 22kW will produce a new load profile, which will **exceed the nameplate rating of the secondary transformer** if all 16 chargers are operating at the same time. As the distribution transformer is estimated to be overloaded if all of the disabled parking bays are connected with a 22kW electric vehicle charger, there is a potential need for the transformer to be replaced by a 1000 kVA transformer. However, it should be noted that 22kW electric vehicle charge points were considered as part of a sensitivity analysis of the Enable project, and it is unlikely that these charge point types will be used in this residential on-street charging use case.

It is important to note that an N-1 assessment was not considered at the HV primary substation for this study, due to the expected low impact of additional electric vehicle load. However, an N-1 assessment should be considered for any future network connection studies.

A voltage assessment was also undertaken at an 11 kV HV feeder in the Camden area, applying the same approach as the Islington case study. In this case, it was assumed that 16 electric vehicle chargers per LV substation would charge at the same time, applying a worst-case scenario. The results are shown in Table 3. The decrease in voltage seen on the other side of the HV feeder is minimal, and is therefore compliant. Similarly, the change in voltage with and without electric vehicle load is less than 3%, and is therefore compliant with P28.

Figure 10: Base load increase from new 7kW or 22kW electric vehicle chargers against LV substation capacity



Source: UK Power Networks

Table 3: Voltage Assessment at HV level for one feeder from Georgiana St HV substation

Load (with or without electric vehicle chargers)	3 – phase HV Voltage	Voltage change (with and without electric vehicle charging load)
Without electric vehicle chargers	10.95 kV	0 kV
With 7kW chargers added (112kW of new load)	10.94 kV	0.0085 kV
With 22kW chargers added (352kW of new load)	10.92 kV	0.0255 kV

4 Network impact analysis of electrification of on-street disabled parking spaces

Case study: Camden (Smart Charging)

Smart solutions can be deployed to reduce the overall impact that electric vehicles have on the network, by shifting vehicle charging patterns away from peak demand in the evening. The potential to add to the existing evening peak could put additional pressure and strain on network assets and increase electricity costs.

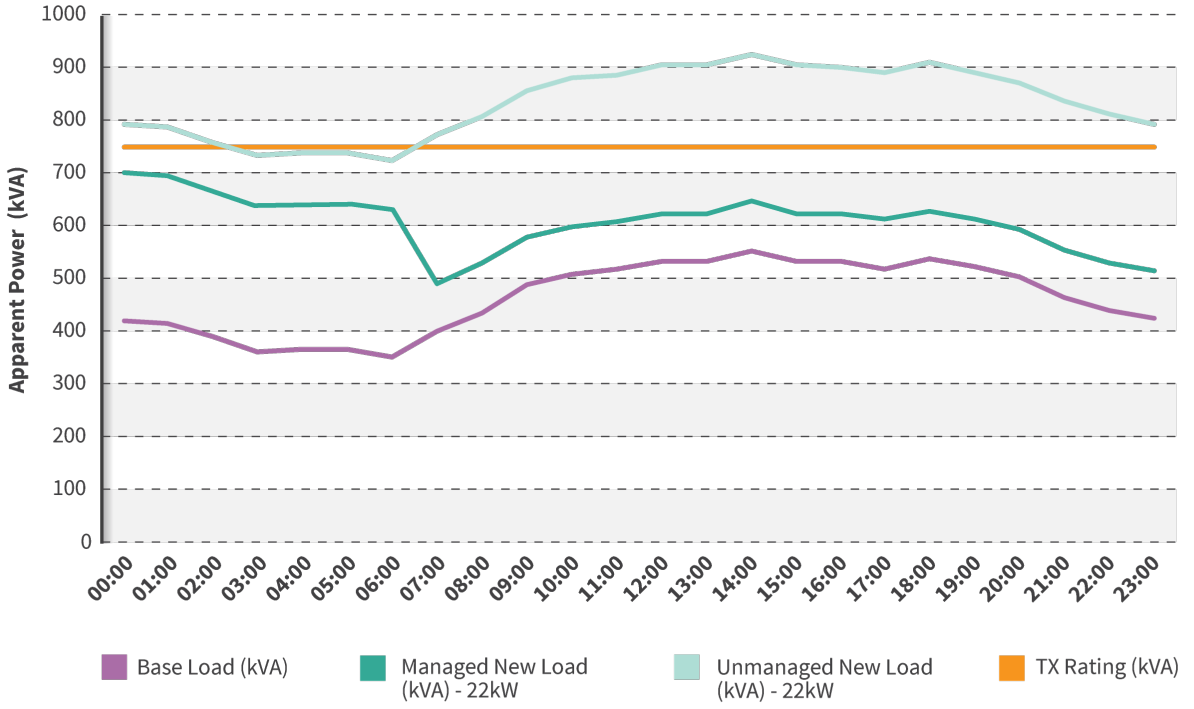
The survey results for **non-electric vehicle users represent a typical smart charging profile**, where most of the respondents indicated a preference for charging during the night-time, away from the peak demand hours to reduce charging costs. For this reason, the survey responses were used to model a smart charging profile.

The smart charging profile was applied to the low voltage network for the Camden case study, where unmanaged electric vehicle chargers rated at 22kW cause the total demand to exceed the nameplate rating of the transformer (see Figure 11). This was estimated by assuming a worst-case scenario, where all electric vehicle chargers supplied by an LV substation charge at the same time. A smart charging profile was estimated by assuming that an electric vehicle would charge for 75% of the time at night, and 25% of the time during the day. The addition of smart charging reduces the impact on the load by moving the demand away from the transformer rating, compared to adopting unmanaged electric vehicle load.

The analysis above highlights the need to undertake **additional network trials to understand the levels of diversity of an electric vehicle charging profile**, an important consideration for investment plans going forwards.

There is potential for UK Power Networks, charge point operators or energy suppliers to incentivise disabled electric vehicle users to charge away from the network peak and charge at times when there is capacity available on the network. This could be achieved by offering disabled electric vehicle users a smart tariff.

Figure 11: LV substation capacity for 22kW electric vehicle along with smart charging



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4 Network impact analysis of electrification of on-street disabled parking spaces

Investment plan for UK Power Networks

The network impact assessment investigation identified that electrified disabled parking bays will produce an increase in thermal constraints on existing high voltage and low voltage networks with a high demand. The London Borough of Camden was identified as a potential area of impact, given its cluster of disabled parking bays. Within the sensitivity analysis conducted as part of the project, additional load brought about by installing multiple electric vehicle chargers rated at 22kW exceeded the nameplate rating of the low voltage transformer.

However, it is unlikely that 22kW electric vehicle chargers will be installed at a home-based location, and it is more representative to only consider 7kW electric vehicle chargers when assessing the impact of electric vehicle charging from home-based locations. Overall, network demand will increase following the expected increase in the uptake of electric vehicles, as well as heat pumps and distributed generation between now and 2030. However, the impact on network demand is expected to be low and can be managed when the uptake is in small numbers.

Issues will be encountered within the UK Power Networks area, when there is a high proportion of electric vehicles, as well as heat pumps, connected in areas where the distribution network is already constrained and close to being overloaded.

As such, gathering additional information on the low voltage network is essential for maintaining the reliable, safe and cost-effective operation of the network. Investment in substation monitoring, as well as technology and smart meter data, which provide a more granular view of the network will offer better insights into the performance of the network. Identifying clusters of disabled parking bays in the UK Power Networks area, through working with local authorities, will help to model where the demand from disabled customers will emerge.

Table 5 provides a summary of the key areas of investment planning activities with respect to the network.

Table 5: Summary of investment planning activities to account for disabled customers

Model	• Understand where the **demand from disabled customers will appear.**
Monitor	• Identify the **locations of constrained feeders.**
Market-led solutions	• Incentivise electric vehicle users to **reduce peak charging time to reduce demand in constrained areas.**
Reinforcement	• **Apply reinforcement** where market-led products are not able to solve the distribution network constraints.

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5 Local authority processes and progress towards supporting disabled customers in their transition to electric vehicles

Processes for installing on-street charging for disabled customers

As part of the project, 20 local authorities in the UK Power Networks area were interviewed, to gain insights into their processes for requesting disabled parking bays and on-street charge points, and their views on the role of the distribution network operator in facilitating the transition to electric vehicles for disabled customers.

Only one local authority in the UK Power Networks licence area does not have a formal process in place for requesting a residential on-street disabled parking bay. From the survey of disabled motorists, disabled passengers and carers, 26% of respondents indicate that they have completed the process for requesting a residential on-street disabled parking bay, with a significantly larger proportion of electric vehicle users completing this process than non-electric vehicle users.

A clear difference was found between local authorities in the LPN, EPN and SPN areas with respect to the processes in place for requesting on-street charge points outside of homes (see Table 6). Local authorities in the LPN area have established formal processes, while half of the local authorities in the EPN area have yet to establish any process. Other local authorities have adopted an informal process, through which residents can express their interest in an on-street charge point via an online form, yet there is no commitment from the local authority to provide this charge point. At the moment, these informal processes are largely a data collection exercise used to inform an understanding of demand in the area, rather than a means to deploy charging infrastructure for particular individuals.

Table 6: Processes for requesting on-street charge points for local authorities

Licence area	Formal process	Informal process	No process
SPN	2	1	1
EPN	0	3	3
LPN	9	0	0

The local authorities in the LPN area expressed support for combining the processes for requesting disabled parking bays and on-street charge points at home. However, none of the local authorities in the UK Power Networks area have implemented a combined approach as of yet. In fact, some local authorities in the EPN and SPN areas do not plan to allow individuals to request an on-street charge point outside of their home, and are instead prioritising other charging locations (e.g. car parks). It is essential that local authorities build upon existing good practice, to ensure that processes are in place to support the expected growth in demand for residential on-street electric vehicle charging from disabled customers over the next 10 years. Box 2 provides an example of good practice adopted by Surrey County Council.

Box 2: Surrey County Council's on-street 'easy access bay'

Surrey County Council is in the process of delivering its first on-street charge points, and is deploying 80 residential on-street charge points across four boroughs. To account for accessibility requirements, where possible, Surrey County Council is making at least **one in every four bays an "easy access bay"**, which are longer in length (at least 1.4 metres), to enable wheelchair users to disembark safely and to ensure that there are no obstructions on the pathway. This can also benefit other electric vehicle users, such as those with children that need to use a pram. The Council has been able to achieve this in at least 80% of locations. These 'easy access' bays are not reserved for Blue Badge holders for the duration of the two-year pilot. However, once the level of electric vehicle uptake has reached a significant level in comparison to internal combustion engine vehicles, the Council's intention is to update the appropriate Traffic Regulation Orders to enforce Blue Badge only parking, to prioritise those with mobility impairments. Surrey County Council is also assessing whether it could formalise this as a policy following the implementation on a trial basis. The Council consulted with the Surrey Coalition of Disabled People on this matter, to ensure that their views were accounted for.

5 Local authority processes and progress towards supporting disabled customers in their transition to electric vehicles

Business model for the rollout of on-street charging for disabled customers

Given the upcoming 2030 phase out date for the sale of new petrol and diesel vehicles, it is essential that the rollout of charging infrastructure supports the uptake of electric vehicles for disabled customers. As on-street charge points for disabled customers are currently being deployed on a case-by-case basis, there is **a need to consider the business model which will enhance the pace of rollout**. As part of this project, charge point operators, local authorities and TfL were asked to provide their views on the requirements for a business model which will enhance the rollout of charging infrastructure for disabled customers.

The low utilisation of on-street charge points for disabled customers to date, the lack of statutory requirement to deploy these charging bays, and the potential for on-street charge points for disabled customers to engender additional one-off costs, were identified as key reasons for the limited rollout of accessible on-street charge points.

Charge point operators indicate that the **low utilisation of on-street charge points for disabled customers** limits the commercial viability for the widespread installation of accessible charge points, due to the lack of guaranteed return on investment. To enhance the commercial viability of on-street charge points for disabled customers, one charge point operator suggested that deployment at scale, in a similar fashion to the aforementioned Charge Collective project being delivered by UK Power Networks, could prove more attractive to charge point operators.

From TfL's perspective, the optimum business model for the rollout of charging infrastructure is a demand-led strategic approach, which prioritises the locations with the highest demand but also ensures a good coverage. Therefore, there is potential for UK Power Networks to deliver further trials to test the business case for deploying on-street charging for entire streets, which include disabled parking bays.

Drawing comparisons to the Charge Collective model, TfL and London Councils support the "dig-once approach", where charge point locations in close proximity are installed at the same time, to avoid digging up the ground more than once.

From the perspective of local authorities, the current lack of deployment of on-street charging for disabled customers partially links to the **absence of a statutory requirement for the rollout of on-street charging infrastructure**. Therefore, it is likely that legislation could drive the installation of on-street charging infrastructure for disabled customers.

As noted previously, DfT has recently consulted on **measures to support the rollout of electric vehicles**, including the potential to introduce a statutory obligation for planning and delivering charging infrastructure. OZEV also highlighted the Government's extensive work with local authorities to support the deployment of on-street charging infrastructure, both through grant schemes and other forms of engagement. The Government will shortly publish an infrastructure strategy, which will set out its vision for infrastructure rollout.

Charge point operators indicate that, if a dropped kerb is required, if any adjustments to the built environment (including additional signage) need to be made, or if charge point software interfaces need to be made more accessible, **additional one-off costs could accrue for tailoring the design of on-street charge points for disabled customers**. Local authorities across the UK Power Networks licence areas also suggest that additional one-off costs are likely to accrue with respect to adjustments to the built environment (e.g. dropped kerbs, larger bays). They add the potential need to develop apps to support the identification of accessible on-street parking bays.

It is likely that financial support will be required to deliver wider scale deployment of on-street charge points for disabled customers and to address the financial challenges which charge point operators and local authorities have raised, with respect to current funding support mechanisms.

5 Local authority processes and progress towards supporting disabled customers in their transition to electric vehicles

Coordinated approach for local authorities

Despite the ongoing collaboration within and between local authorities, and with distribution network operators, there is an absence of a coordinated approach to the provision of on-street charge points for disabled customers.

- Local authorities suggest that greater **knowledge sharing** with respect to the likely costs and timescales for getting connections could support the development of a more coordinated approach to the deployment of on-street charge points for disabled customers.
- Local authorities also suggest that UK Power Networks could indicate more clearly the **key experts** which should be contacted for queries relating to on-street charging, especially in consideration of on-street charge points for disabled customers.
- Local authorities also note that UK Power Networks could engage more proactively with local authorities on their **plans and policies** relating to on-street charging, to ensure that these are accounted for in future demand modelling.

To address the emerging themes from engagement with local authorities, a proposed coordinated approach for UK Power Networks and local authorities was developed, which outlines actions which UK Power Networks could take with respect to knowledge sharing and engagement, dedicated in-house experts, and planning and monitoring (see Table 7). This is aligned with the proposed roles which the distribution network operator could play, as presented in the following slides.

Table 7: Proposed coordinated approach for UK Power Networks and local authorities, in response to local authority perspectives

Knowledge sharing and engagement	UK Power Networks could **proactively share the results of the Enable project with local authorities** in the UK Power Networks licence area, to inform their planning processes prior to the procurement phase. UK Power Networks could actively engage with local authorities through workshops, to **enable local authorities to share best practice examples** of on-street charging provision processes for disabled customers, and to allow UK Power Networks to **share information and guidance** on the impact of the future demand for on-street charging for disabled customers, potential network connection challenges, and the timelines for infrastructure provision.
Dedicated in-house experts	UK Power Networks can **ensure that dedicated support teams are available to offer guidance to local authorities** on on-street charging for disabled customers in the short-term, and in the longer-term under ED2 from 2023. This will address the lack of clarity raised by local authorities with respect to the key points of contact at UK Power Networks for on-street charging. In-house experts can be supported by a **dedicated mailbox for local authorities** to engage with, as a first point of contact.
Planning and monitoring	UK Power Networks can seek to **proactively understand and monitor different local authority plans and policies** on on-street charging provision, through setting up a monitoring database. UK Power Networks can **encourage the standardisation of local authority data** on current charge point installation and future plans, and **assess the impact of changes of plans and policies on future demand modelling**, bringing greater clarity to local authorities.

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6 The role of the distribution network operator in facilitating the uptake of electric vehicles amongst disabled customers

The project collated evidence from the market sizing analysis, network impact assessment and stakeholder engagement activities to identify six roles which the distribution network operator can play in facilitating the uptake of electric vehicles amongst disabled customers. These roles and their associations actions are presented below.

Role	Action plan	
	What?	How?
1. UK Power Networks can host the learnings of the Enable project online on a dedicated accessibility portal, tailoring the content where appropriate to different audiences, such as local authorities, charge point operators and disabled customers, to ensure it is easily accessible	• Assess how dissemination materials from the Enable project could be effectively hosted online to reach the target audiences.	• Set up a dedicated online portal to host the dissemination materials from the Enable project. • Identify the target audiences and promote the dissemination materials via key channels to ensure that the resources are effectively disseminated (e.g. share the dissemination materials with disabled customers via Motability).
	• Promote the online resources during educational engagement with local authorities.	• Share the online portal with local authorities during workshops and signpost to other key resources (e.g. best practice local authority processes for on-street charge point provision for disabled customers).
2. UK Power Networks can use its position as a trusted stakeholder in power networks to advocate for the on-street charging needs of disabled customers and ensure that the accessibility of charging is featured prominently within the electric vehicle industry stakeholder landscape	• Advocate for the consideration of the charging needs of disabled users in terms of the accessibility of charging infrastructure provision.	• Proactively share a list of the top barriers facing disabled customers with charge point operators and other key stakeholders active in the UK Power Networks licence area. • Ask charge point operators and other key stakeholders about the accessibility of future charge points and any special requirements for connection.
	• Convene with other distribution network operators in the UK to share learnings from the Enable project.	• Share the recommended roles from the project with other distribution network operators, and aim to develop a set of standardised roles that all distribution network operators can agree to follow as best practice.
	• Start to collect data on which on-street charge points being connected to the network are for disabled users.	• Include mandatory questions/data fields in the request to connect and ‘connect and notify’ processes to identify which charge points are being deployed in disabled bays.

6 The role of the distribution network operator in facilitating the uptake of electric vehicles amongst disabled customers

Role	Action plan	
	What?	How?
3. UK Power Networks can proactively encourage third party service aggregators (such as smart charging providers) to consider the inclusion of disabled on-street charging bays in their flexibility services, and ensure that services that do include disabled users are designed with their accessibility in mind	• Consider whether UK Power Networks could build upon existing trials, or launch new trials, to consider the needs of disabled customers.	• Assess the market appetite from industry stakeholders (e.g. third party service aggregators) to support the deployment of further trials which build upon the Charge Collective 'buy a street' approach and trials which specifically focus on flexibility services, to consider the needs of disabled customers.
	• Ensure that accessibility is on the agenda for any future engagement with third party service aggregators.	• During discussions with third party service aggregators, proactively share parking and charging data for disabled customers to make the case for consideration of this charging demand.
	• Consider the potential for UK Power Networks to prioritise accessible charge points in its procurement of third-party aggregators providing flexibility services.	• Assess the potential to adjust the scoring criteria to prioritise third party service aggregators which consider the needs of disabled customers in the provision of their services.
4. UK Power Networks can undertake proactive data sharing and engagement with local authorities on the demand for on-street charging for disabled customers, potential network connection challenges, on-street charging needs of disabled customers, and the timelines for infrastructure provision	• Assess how the locational and charging demand results from the Enable project can be included within UK Power Networks existing forecasting systems.	• Assess the potential to overlay the Enable network impact analysis and findings from the Charge Collective project with the Strategic Forecasting System (SFS), rather than viewing forecasting results in isolation.
	• Periodically update the analysis to keep forecasting up to date and to reflect any new developments.	• Assess the potential for the local area energy planning (LAEP) teams to source further data or commission network impact modelling to ensure that forecasting is as up to date as possible.
	• Proactively share results of the Enable project with local authorities in the UK Power Networks area to inform their tender specifications for charge point operators prior to the procurement phase.	• Share key information on the parking behaviours of disabled customers and requirements for accessible charge point design to allow local authorities to include these key considerations in tender specifications.
	• Develop a programme of educational engagement with local authorities, to allow local authorities to engage in knowledge-sharing, and to apprise them on costs and timelines of charging provision for disabled customers.	• Host workshops with local authorities and share UK Power Networks expertise on the lowest cost options, smart solutions, and guidance for electrical infrastructure and metering.

6 The role of the distribution network operator in facilitating the uptake of electric vehicles amongst disabled customers

Role	Action plan	
	What?	How?
5. UK Power Networks can ensure that support teams are available to offer guidance to local authorities on issues related to on-street charging provision for disabled customers and consider the creation of a dedicated mailbox to offer a first point of contact	• Assess which internal UK Power Networks team is most appropriate to take on the guidance support role and management of the dedicated mailbox.	• Assess whether the connections service delivery team are the most suitable support team to provide guidance and oversee the dedicated mailbox in the short-term. • Assess whether the LAEP teams, which will be implemented under ED2 in 2023, will be the most suitable support team to provide guidance and oversee the dedicated mailbox in the long-term.
	• Ensure that the short-term and long-term support teams are fully trained up on the issues facing disabled customers reliant on on-street charging.	• Develop and deliver a training module which covers the key findings of the Enable project and local authority best practice, to build internal knowhow of the challenges faced by disabled customers and accessibility requirements for on-street charge points.
	• Actively encourage local authorities in the UK Power Networks area to use the dedicated mailbox as a first point of contact for issues related to on-street charging provision for disabled customers.	• Set up the dedicated mailbox and share the contact information with local authorities during workshops, as well as clearly promoting the contact information through the dedicated accessibility portal.
6. UK Power Networks can seek to proactively understand different local authority plans and policies on on-street charging provision, including for disabled customers, to include in future demand modelling	• Assess the potential for the LAEP team to set up and take ownership of a data and information platform that will enable local authorities to share their data for current installation and future plans in a standardised form.	• Identify a sponsor at each local authority, who is responsible for engaging with UK Power Networks on plans/policies for on-street charging provision. • Assess the capacity for the upcoming LAEP teams to support local authorities in uploading their data to the platform. • Share best practice examples of installation data with local authorities to encourage a standardised approach.
	• Monitor the emergence of new local authority plans and policies.	• Build on the information gathered under the Enable project to engage with local authorities to gather information on new plans or policies. • Set up a monitoring database to track updates to plans and policies.
	• Assess the impact of changes of policy on future demand modelling.	• Assess the potential for policy changes relating to on-street charging provision for disabled customers to impact future demand modelling. • Proactively communicate any impacts on future demand modelling to local authorities to encourage the sharing of data.

7 Areas for further investigation or trials

To facilitate the implementation of the roles of the distribution network operator, and to support the need to test approaches for on-street charging provision which cater to all, the project identifies two key areas where UK Power Networks could add value by initiating or contributing to further trials.

Trial 1: UK Power Networks can seek to develop a trial of flexibility services using on-street charge points for disabled customers, to understand whether there is a viable business case for further future deployment of these charge points

To date, there have been no trials which focus on the provision of flexibility services for on-street disabled charge points. UK Power Networks could lead the way, by investigating the deployment of smart electric vehicle charge points in disabled bays and working with third parties to demonstrate the level of flexibility and value which could be delivered, likely through an aggregator.

The more complex business case for on-street disabled bay charge points (due to higher costs and lower utilisation) is considered an issue by all stakeholders engaged with as part of the project. UK Power Networks' role in demonstrating and trialling network services is also strongly referenced by stakeholders. It is commonly mentioned that UK Power Networks and other stakeholders should aim to provide a consistent customer experience to all customers, ensuring that disabled customers can benefit from potential cost savings. The results of the survey show that the parking and charging behaviours of disabled customers have the potential to be well-suited to existing network flexibility solutions. The on-street flexibility market is still in its early stages and remains unproven, and would therefore require funding, along with appropriate appetite from key stakeholders for trial. As such, UK Power Networks could deliver the following actions:

- Assess the demand for undertaking a trial with a small group of local authorities engaged with on-street charging, along with Motability and third-party aggregators.
- Consider whether learnings from Charge Collective could facilitate this trial.

Trial 2: UK Power Networks can explore a project electrifying a whole street with on-street charging, including disabled parking bays, to consider the potential benefits this may have on the business case for accessible charging

Charge point operators express that the business case for a single charge point in a disabled bay is challenging. However, the business case may be improved if the disabled bay charge point is installed in a "bank" of chargers on a street, buoyed by the utilisation of other chargers. UK Power Networks could collaborate with charge point operators and local authorities to electrify a whole street, including disabled bays, to assess whether this could improve the business case.

Stakeholders interviewed as part of the project are unanimous in their view that the business case for disabled bay charge points is likely to be more complex than for charge points for other customer segments. Charge point operators highlight a strong likelihood of improving the business case of disabled bay on-street charging if all other parking spaces on a street could also be electrified, thereby spreading the costs for civil works and electricity network connections. This trial could also be used to develop best practice for the "dig once" approach to charging with the inclusion of disabled charging bays, which is desirable to all stakeholders in the electric vehicle landscape.

Charge point operators highlight that local authorities are likely to face implementation barriers for the delivery of this type of project, including constraints relating to planning permissions. Therefore, appetite from industry players and local authorities is likely to be required to facilitate this trial. A trial delivered by UK Power Networks could involve building upon the Charge Collective project to:

- Use data from the Enable project and engagement with local authorities to understand where a street with sufficient existing demand could be fully electrified.
- Assess the appetite for undertaking such a project with local authorities and charge point operators, along with accessibility experts such as Motability and Designability.

8 Dissemination workshop

The key findings, recommended action plan for UK Power Networks and potential for further trials were presented to local authorities, charge point operators and other interested stakeholders during a workshop in December 2021. Prior to the workshop, 47% of workshop attendees indicated that the accessibility of public charging is either 'not important and not urgent' or 'important but not urgent' and that their organisation has no action planned to tackle accessibility.

Following the workshop, 63% of workshop attendees indicated that the accessibility of public charging is 'important and urgent', and 34% of workshop attendees felt that the accessibility of public charging is 'important' yet still lack the urgency for action. This highlights the impact of sharing the barriers facing disabled customers in the use of on-street charge points with key industry and government stakeholders.

Contact details

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The recommended roles for UK Power Networks were tested with the workshop attendees, to understand the importance of each of the roles for the stakeholders. Stakeholders were asked to select the two most important roles and the results are presented in Figure 12. Each of the roles gained support, yet the roles which involve UK Power Networks using its position to encourage third party providers and wider industry stakeholders to advocate for the on-street charging needs of disabled customers received the highest level of support, with 28% and 19% of the votes respectively. These findings will be considered as UK Power Networks considers its plan for implementation.

Figure 12: Results of the dissemination workshop