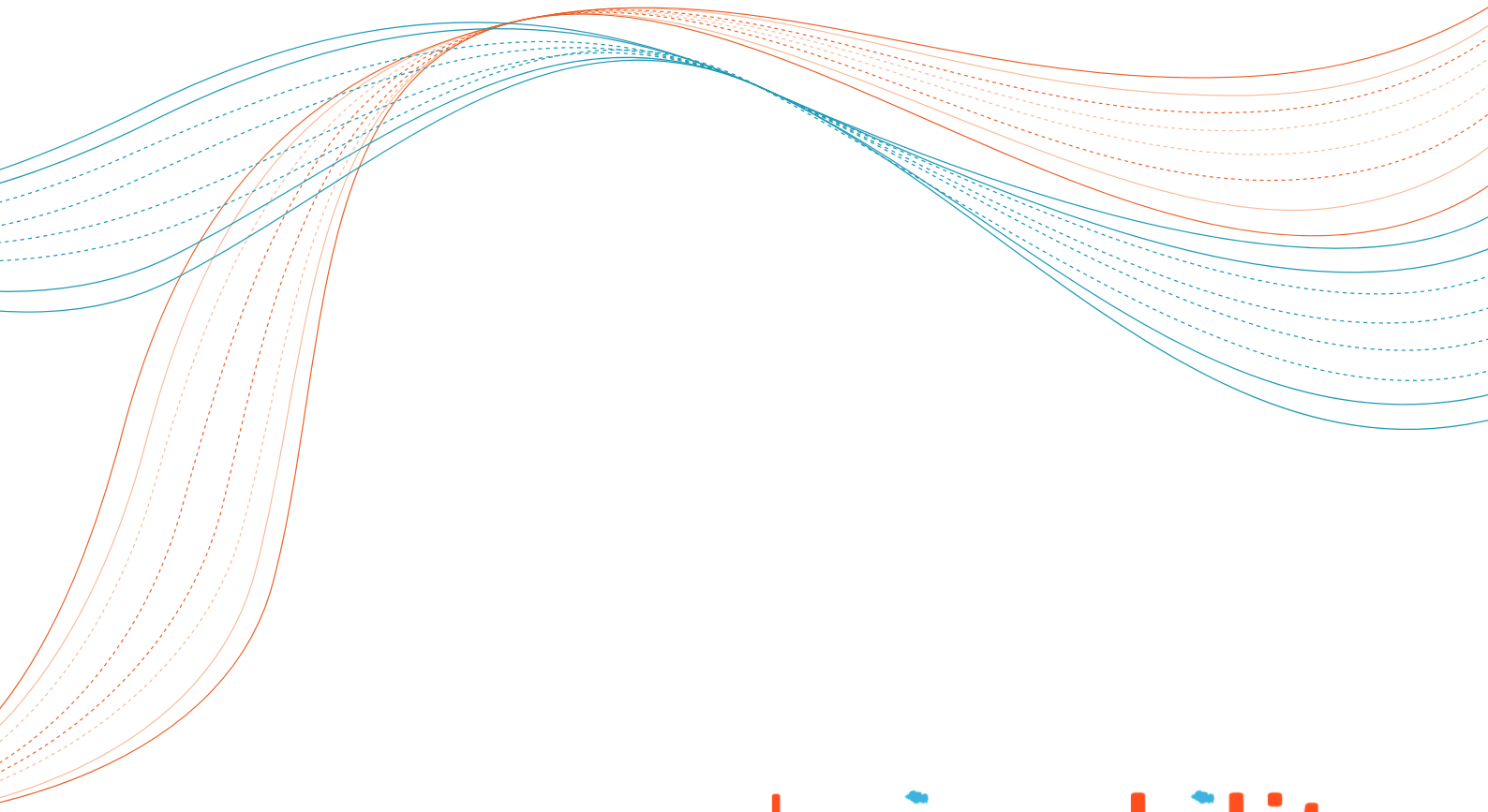
User Engagement Report

Accessible EV Charging

Motability the Charity



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Prepared by: Hazel Boyd, Keir Haines, Jess Ridgers
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Executive summary

The accessibility of public charging infrastructure for Electric Vehicles (EVs) has been identified by Motability, the national disability charity, as a priority area, to prevent disabled drivers, passengers, and pedestrians being disadvantaged as the UK phases out the sale of petrol and diesel vehicles. Designability, the disability and design charity, is working with Motability on their project aiming to make EV charging accessible.

This report describes the User Engagement work carried out by Designability to understand in detail from disabled users and the people close to them the topics raised in an earlier phase of Scoping and Discovery, about the future accessibility of electric vehicle charging. This report does not present design solutions for accessible public EV charging, nor is it an exhaustive review of the public charging market, but it describes the insights, experiences and views shared by disabled people and those close to them during the User Engagement research activities.

To source views from disabled people for this engagement, Designability contacted 10,000 Motability Scheme customers. Through the Motability Scheme, disabled people in receipt of particular mobility benefits in the UK can lease a vehicle, which can be adapted to suit their needs. 809 Motability Scheme customers subsequently demonstrated an interest in participating in the research, of which Designability then selected and invited 184 potential participants to take part in the User Engagement research activities.

Designability's researchers carried out four User Engagement activities to gather detailed insights from a total of **eighty-seven** Motability Scheme customers in the UK with a wide range of characteristics and vehicles.

The topic areas covered during the activities in different combinations were: experiences and views of the EV charging process and public charging provision; views about using an EV now or in the future; parking (including payment), fuelling and journeys.

The detailed findings from all users across all four activities were summarised under the headings of Built Environment, The Charging Process, Information About Charging Points and Other Topics. The built environment topic included the need for accessible parking (in general and charging-specific) as a significant aspect of accessible public charging. The charging process included physical and information provision aspects of the use of cables, connectors, sockets and charge point units.

Some challenges around public EV charging faced by disabled people related to the need for disability-specific provision, and other aspects related to issues that could be experienced by any user, such as reliability, availability, and the complexity of existing public charging solutions and the charging market (although these broader issues could have a disproportionately negative effect on disabled people).

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Purpose

This User Engagement Report describes the user engagement activities carried out by Designability's researchers in June and July 2021 with eighty-seven Motability scheme customers as part of the Accessible Electric Vehicle (EV) Charging Project, to understand in detail their views and experiences on topics relating to the accessibility of electric vehicle charging, to inform future accessible design and/or guidance for public charging infrastructure.

This report does not provide design guidance or suggested solutions, and is not an exhaustive review of current EV public charging infrastructure. It describes the issues raised from the perspective of disabled people and those who drive on their behalf who lease vehicles through the Motability Scheme.

Background

Motability Charity has identified a lack of attention paid to the accessibility of electric vehicle charging infrastructure, in the context of the planned ban on the sale of petrol, diesel and hybrid vehicles in the UK by 2030 (recently brought forward from 2035). The vision for this project is that EV charging infrastructure in the UK becomes accessible for disabled people so they are not disadvantaged in this future shift.

Designability's overall role in this project is to lead on User Engagement.

Designability carried out User Engagement over several weeks in June and July 2021 to inform in greater detail the issues identified in an earlier phase of Scoping and Discovery, with the intention of drawing together the findings from this phase and User Engagement into further work on concept design and guidance.

Objective

The objective of the user engagement work was practical engagement with disabled people and their carers (drivers and passengers) to gain first-hand insights into the challenges and opportunities for EV charging identified in the discovery phase, and to explore these through a mixture of both immersive (in person) and remote (phone/video interviews, focus groups) research methods.

The key research questions were:

- **What do issues associated with accessible EV charging look like in reality?** Gather problem statements that describe these, by understanding experiences, good and bad
- **How are people adapting to challenges they experience with EV charging?** What compensation strategies might people use, if any?
- **What are the key requirements for accessible solutions to be successful?** What are the broad elements of design requirements, e.g. space, visual content, grip design, user interface…that are needed to address the challenges that people experience?

Selecting potential participants

Contacting Motability Scheme customers

Designability securely received the details of approximately 10,000 Motability Scheme Customers who had agreed to be contacted in this way. The sample was specified by Motability Charity to be relevant to this user engagement research (e.g. including a significant proportion of electric vehicles users). The breakdown of vehicle type within this cohort of customers was as follows:

Vehicle type	**Number of customers**
Petrol or diesel Wheelchair Accessible Vehicle (WAV)	337
Any other petrol or diesel vehicle	6875
Total Internal Combustion Engine (ICE) vehicles	***7212***
Electric (EV)	1533
Petrol hybrid electric (PHEV)	1211
Total plug-in vehicles	***2744***
TOTAL	**9956**

Designability developed and sent a project-specific "Application Form" survey by email using Mailchimp to the whole sample of customers to invite them to express an interest in the project, and to ask them for relevant information about themselves and which activities they were interested in engaging in. The Application Form survey is reproduced in Appendix A.

In total, 808 Motability Scheme customers responded to the project application form survey, and a further customer from an under-represented group who was already known to Designability was also willing to participate and completed the application form, bringing the total to **809**.

Selecting participants for user engagement

Sets of spreadsheet filters were used to filter the details of the customers who completed the application form. Relevant specific groups of customers were then invited to take part in certain activities (only one activity invitation per customer, except for one participant who took part in a telephone interview then subsequently took part in one of the three in-person sessions on the project publicity day on 21st July 2021).

The aim of the filtering was to identify a diverse range of individuals, for example in terms of age, sex, vehicle, accessibility needs, use of walking aids, whether usually a driver or passenger, location (country), and amount of experience of using or charging an electric (or plug-in hybrid) vehicle, based initially on the groups identified in Scoping and Discovery. The potential participants' preferences about which activities to take part in, and when, were also taken into consideration. Large enough groups of people were invited to aim to fill activity sessions as far as possible (e.g. so that up to six people could attend an online group session while giving each

person a choice of two possible slots) while limiting the number and size of available sessions for resource reasons (e.g. restricting the number invited to individual interviews and in-person sessions).

For some under-represented groups (e.g. WAV users), we invited all potential participants who expressed interest in a given activity, and for others we invited a selection of individuals to cover a range of characteristics as stated in their application form responses.

The filtering process was carried out using participant application form responses and allocated participant numbers, so that no identifying details were visible during the selection process. The exceptions to this were where we approached a small number of relevant, interested individuals who had indicated significant knowledge or experience and were initially considered for inclusion in individual activities on that basis.

Activities and participants

Designability's researchers carried out the following four types of activity during June and July 2021:

Activity	**Number of potential participants invited to take part in an activity**	**Number of participants who took part in an activity**
Online group sessions	84	41
Individual telephone or online interviews	20	9
In-person sessions at charge points	27	12
Online survey	54	26
Total	**184***	**87***

**One person took part in both a telephone interview and an in-person session*

Appendix B gives demographic information about the potential participants who responded to the application form, and about the participants who took part in the user engagement activities.

Written, informed consent was obtained from every participant before taking part in an activity, having provided them with information about the project and the activity. Consent was obtained using electronic signatures via AdobeSign, by returning a consent form via email, or by completing a paper consent form in person.

Where participants took part in any form of online or in-person session they were given the opportunity to tell the researchers anything that would make it easier for them to participate in the session, and were free to have someone with them to support their participation in the session.

Where participants and potential participants are described here as being disabled, they had selected in their application form response at least one disability or condition that affected their

mobility, stamina, strength, use of at least one upper limb or dexterity. These had previously been identified within the project as being particularly relevant to accessible EV charging.

1. Online group sessions

Each identified potential participant was invited by email to sign up to one of two relevant group session slots at their convenience. Emails went out via the Mailchimp platform and sessions were booked online using Ticket Tailor software.

Each group had clear shared experiences and/or characteristics (see table below), and the questions for each session were tailored according to the group. Two sessions with WAV users were planned but not carried out because of a lack of potential participants who were both willing and able to attend a scheduled group session, so these sessions were adapted to focus on the experiences of users of vehicles with stowage and access adaptations since these took space outside the vehicles' footprint and potentially included large vehicles.

Eight group sessions were carried out using Zoom online meeting software, with between three and six participants per group as follows:

"Independent disabled drivers of EVs": Disabled drivers currently leasing an EV or PHEV through the Motability Scheme, who typically drove alone, and had some experience of public charging.	2 sessions
"Disabled drivers of EVs": Disabled drivers currently leasing an EV through the Motability Scheme, with some experience of public charging (but not typically driving alone, unlike the group above).	2 sessions
"Drivers of (externally) adapted non-EVs": Drivers of petrol or diesel vehicles leased through the Motability Scheme with external (stowage or access) adaptations, who had no experience of public EV charging.	2 sessions
"Disabled users of EVs/PHEVs with walking or mobility aid(s)": Disabled people who used walking or mobility aids, were currently a driver or passenger of an EV or PHEV and had some experience of public EV charging.	2 sessions

Each group session was scheduled for up to 90 minutes and typically lasted for the full 90 minutes, including a ten-minute break.

Two researchers ran each semi-structured session, with one researcher mainly guiding the discussion and the other primarily taking notes. The participants were introduced to some basic Zoom functions and sound and vision were checked before the session began.

The sessions were not recorded, but detailed notes were taken by a researcher in writing and on virtual sticky notes via a pre-prepared Mural online whiteboard (as illustrated in an extract below) for part of each session, which was screen-shared with the participants, to provide a variety of visual interest during the session.

Some participants joined by mobile phone or tablet and others joined using a laptop. One participant was accompanied by someone to support them to take part in the session, one requested potential extra breaks and limited background noise, and one participant contributed only in writing via the chat function, for reasons relating to equipment availability rather than accessibility.

Each participant was sent a £30 shopping voucher by email after the session to thank them for their contribution.

2. Individual telephone or online (Zoom) interviews

For this activity we initially identified all individuals who had shown an interest in attending an individual interview and then reviewed their characteristics. We prioritised independent disabled drivers, individuals with larger vehicles, external vehicle adaptations (for access or stowage), those who used walking aids, and some who had indicated that they had significant experience of EV charging in public.

The chosen potential participants were invited by email to sign up (via Calendly online booking software) to one of several interview slots at their convenience and were contacted by telephone or using Zoom online meeting software (according to their preference) at their chosen time. Interviews were planned for up to 90 minutes and took between one hour and 90 minutes to complete, including an optional break. Most interviewees chose to continue the interview without a break.

One of Designability's researchers generated a range of relevant questions that reflected the questions asked in the group sessions. Each participant's application form information was reviewed before the interview, and a relevant subset of questions was selected to be asked by the researcher. A semi-structured interview was carried out and detailed handwritten notes were taken. The interviews were not recorded.

Participants were asked questions either (i) about their electric vehicle charging experiences and preferences (if they had experience of charging an EV/hybrid) or (ii) about parking, paying for parking, and fuelling (if they did not). Some participants were asked about both topic areas if their charging experience was limited.

Each participant was sent a £30 shopping voucher by email after the session to thank them for their contribution.

3. In-person sessions at charge points

For this activity, we travelled to meet the participants at charging points near to where they lived, so we invited individuals who lived within approximately 1.5 hours of Designability's offices in Bath. Their locations were identified by the first two letters of their postcodes, as provided in their application forms if they had expressed an interest in taking part in an in-person session.

We invited 27 people via email who had experience of using EVs, had a large vehicle, had exterior vehicle adaptations, or used a mobility or walking aid. We were successful in engaging nine people with a wide range of needs and experiences. We were not able to engage with a Wheelchair Accessible Vehicle (WAV) user with a ramp fitted to their vehicle, since no WAV users who had indicated they would like to take part this activity on their application form were also willing and available to meet during this period.

In addition to the nine people we met close to Bath, we arranged to meet three more participants at the Gridserve electric forecourt in Braintree, Essex (identified using their postcode information from the application form) as part of the project publicity day on 21st July 2021. These sessions were conducted in exactly the same way as the other in-person sessions with data recorded in the same way and contributing to the overall findings.

Each participant we met was contacted individually via telephone prior to our visit, to make specific arrangements for the session.

We visited people in the following areas;

- Wiltshire
- Bristol
- South Wales (x2)
- Devon (x3)
- Surrey
- Oxfordshire
- Braintree, Essex (x3)

Two of the twelve participants were supported during their sessions by a partner or spouse.

The participants' key characteristics relating to vehicles and mobility during the in-person sessions can be described as follows:

Vehicle	Adaptation	Mobility aid	Walking Aid	Notes*
Nissan Leaf EV	-	Wheelchair	-	-
Mitsubishi Outlander PHEV	-	-	Walking stick	Ambulatory
Kia Soul EV	Boot hoist	Mobility scooter	Walking stick	Ambulatory
MG ZS EV	-	Mobility scooter	Walking stick	Ambulatory
MG ZS EV	-	-	Walking stick	Ambulatory

Vehicle	Adaptation	Mobility aid	Walking Aid	Notes*
Hyundai Kona	Boot hoist	Mobility scooter	Walking frame	Supported
Nissan eNV200 EV	Boot hoist	Wheelchair/trike	Walking stick	Ambulatory
Mini Countryman PHEV	-	-	-	Ambulatory
Vauxhall Combo	Roof stowage	Wheelchair	-	-
Toyota RAV 4 Hybrid	-	Powered wheelchair	-	Ambulatory Supported
Hyundai Ioniq Hybrid	-	Wheelchair	-	-
Mercedes Vito (ICE)	Side lift	Wheelchair	-	-

Supported = travelled with partner or spouse; ***Ambulatory*** = able to move around without walking aid

Each session took between one hour and 90 minutes to complete. Two Designability researchers were present at every session, with one leading the questions and the other notetaking and capturing photos and videos.

The sessions included a mixture of practical activity, with participants demonstrating how they parked, moved around and charged their vehicle - and an opportunity to discuss their individual access needs, experiences of owning and using an EV (if applicable) and suggestions for how public charging could be improved.

Appropriate COVID-safe measures were in place and discussed with the participants in advance.

Each participant was sent a £30 shopping voucher by email after the session to thank them for their contribution, except for the three participants who took part in their sessions as part of a project publicity day who received their vouchers in person.

4. Online survey

This was the final activity that Designability planned and carried out, with the intention of filling any gaps in our knowledge of topic areas or demographics following the first three activities.

One key area that had not been explored in detail was the needs of disabled passengers and their drivers, especially while waiting for an EV to charge or while parking or charging in different settings.

A set of focussed questions was generated on this topic and emailed as a survey to potential participants who had not already taken part in another activity as part of this project, and who gave all of the following responses to the Application Form survey:

- Willing to take part in an online survey
- User of a vehicle leased through the Motability Scheme that had been provided to meet the needs of another person
- Usually the driver

The twenty-six participants who completed the survey drove a vehicle leased through the Motability Scheme that was provided for a child, parent, partner, spouse or sibling who had a range of conditions or disabilities that affected their mobility, strength, stamina, dexterity or the use of at least one upper limb, and some had ones that affected their cognition, learning, understanding, or breathing, or were autistic. The drivers themselves in some cases also had conditions that affected their mobility or strength.

Participants who completed the survey and agreed to provide their contact details were entered into a prize draw to receive a £30 shopping voucher. The winner was selected at random and sent the voucher by email.

5. Submission of recorded material

We had planned an optional activity to gather photos and videos from a wider number of participants (in addition to the 87 we engaged) to use if we had needed additional examples of issues around public EV charging. However, once the first three activities had been completed it was clear that we did not need to conduct this activity because of the richness of the data already gathered.

Summary of research findings

All of the detailed notes from the online group sessions, individual interviews and in-person sessions were written up into a common theme-based template and compiled into a single "tidied raw data" spreadsheet, provided separately to Motability Charity. The responses generated by the online survey of people who drove a vehicle through the Motability Scheme for someone else were also added to the same spreadsheet.

Note: This findings summary is not intended to indicate priority, nor to give a finalised list of the aspects that must be addressed directly within the next phases of the project, but to describe the challenges raised by participants around public EV charging and related topics.

The findings from all four activities can be summarised as follows:

1. Built environment

Parking and manoeuvring around the vehicle

Parking in a suitable space and manoeuvring around the vehicle already presented significant issues or specific needs for many of the participants, even before considering additional aspects relating to charging, and are therefore a priority consideration in making future charging more accessible.

The need for sufficient space around the vehicle when **parking for any reason** was a significant issue. For some people, the space around the vehicle, described below, needed to be available, and ideally clearly marked to encourage this, on every occasion when they left or returned to the vehicle in order not to limit their independence.

It was very common for individuals to require space beside the vehicle when parking, for reasons such as: opening a side door fully to get themselves and/or passengers in and out of the vehicle safely and comfortably (or at all); using vehicle adaptations like transfer plates, side lifts or hoists; or manoeuvring along the side of the vehicle using walking aids such as wheelchairs, scooters or sticks. In some cases people needed to access both sides of the vehicle, e.g. to fully open the driver's door and manoeuvre along the passenger side. Many drivers who drove a vehicle for someone else described the need to help their passenger(s) in or out of the vehicle, to get walking or mobility aids in and out of the vehicle, and to manoeuvre around the vehicle all while keeping themselves and their passenger(s) (including children) with different needs safe from moving traffic.

One participant described that their local public chargers were next to verges, so they were unable to fit alongside the vehicle with their crutches or wheelchair, so always had to have someone with them when they charged, thereby removing their independence.

Some people also needed space at the rear of the vehicle to get a mobility aid in or out of the vehicle (either by hand or using a boot hoist) or for a driver or passenger to get in and out of the rear of the vehicle using a ramp or lift. The availability of this space was particularly at risk during on-street parking because of other drivers parking close to the rear of the vehicle, and the need for the greatest space here was for those who used rear ramps to get in and out of Wheelchair Accessible Vehicles (WAVs).

Stepping out of a vehicle directly onto a high kerb or transferring from a vehicle into a wheelchair that was on a high kerb, could be difficult or impossible compared with exiting the vehicle directly onto road level.

Restrictions to parking, such as time limits, parking charges or congestion zones, affected whether people felt they would confidently or willingly use certain parking spaces.

If payment were needed for accessible parking (as is the case in some locations in England, but described as not being the case in Scotland), parking payment machines could then pose further accessibility limitations, including:

- being able to reach up/down/horizontally far enough and be dexterous enough to use all parts of the payment machine (e.g. reaching coin slot and change dispenser, buttons, contactless payment pad, touchscreen, ticket insertion or removal, removal of a payment card from a narrow slot using a pinching action) from a seated position in a wheelchair or scooter, especially if the pay machine were set back and/or on high kerbs
- using the payment machine as above while standing using a stick(s), crutch(es) or a rollator/walking frame for balance
- poorly signed machines from the parking bays, and at some distance away across potholed or gravel surfaces

Some paid parking also required reaching a machine at the exit barrier to insert a ticket or token, or the validation of free parking at a venue reception some distance from the parking space which could require the user to reach a high screen to type in a vehicle registration number.

Alternatively, app payment for parking could be more accessible for some people than payment machines, although this relied on downloading and using an app on a smartphone and having mobile phone reception. One good example was the feature of some parking payment apps that reminded the user in advance of when parking was running out and gave the option of topping up the payment remotely without the effort of returning to the vehicle, as well as reducing the cognitive burden and concentration required to remember when the parking fee would expire.

The need **to charge, as well as to park**, introduced the following key additional need: that of simultaneous use of free space at the front and back of the vehicle. For example an independent disabled driver using a front-charging EV and having a boot hoist for their wheelchair would need, with the vehicle in a single position, to be able to safely unload their wheelchair from the rear of their vehicle without being near other moving vehicles, and also have enough space to manoeuvre their wheelchair between the front of the vehicle and the charging point to reach the charging point interface, cable and connectors.

The need to both charge and park also introduced potential conflicts between the following:

- Orientation of the vehicle to enable a person and/or walking aids to get in and out of the vehicle (e.g. a boot hoist at the rear of the vehicle, or parking with the chosen side of the vehicle alongside a kerb in an on-street space), and the chosen side for entering and exiting the vehicle varied between people depending on their situation
- Orientation of the vehicle to enable the charging socket on the vehicle to be close enough to the charging point for successful connection/charging

- Orientation of the vehicle to suit the driver and/or passenger's preferences (e.g. reversing into a space to enable safe driving away forwards, or parking a certain way around to enable e.g. people-watching while spending some time in the vehicle)

One person described what they saw as good practice from one provider: *"You can't park wrong in an InstaVolt bay"* – indicating that the charging cable could easily be moved around the vehicle to suit the charging socket locations on different vehicles.

It was important to have flat (non-sloping), smooth (without gravel, grass, mud, cobbles or potholes) parking spaces with level access (without kerbs or steps), or nearby available dropped kerb access, onto pedestrian areas and hence to nearby amenities and also to enable people to manoeuvre freely in the space around the vehicle. Examples of uneven ground around a vehicle and grass around a charge point unit are shown below.

This, along with many other findings, applied to kerbside charging points as well as those in side-by-side bays. Gridserve's electric forecourt at Braintree was described as a good example of space in terms of being spacious and having some level access areas, non-sloping ground and a disabled toilet.

One example of the difficulties presented by sloping parking bays was a participant who, if parking on a slope, would always park with his car bonnet facing downhill, so that when he assembled his manual wheelchair by his open car door while seated in the vehicle, his wheelchair was kept in place by the open door and did not roll away down the car park or road. Another was that a wheelchair hoist could not be deployed from the vehicle's boot on a steep slope.

Dropped kerbs may be provided but unavailable because they are blocked by other vehicles. Lack of sufficient nearby dropped kerbs caused inconvenience to people in car parks by causing them to travel further than necessary (which could have significant detrimental effects on those with limited strength or stamina) or danger to those in on-street parking if they were forced to travel along the road near moving traffic to reach the nearest dropped kerb. (Kerbs are also mentioned in other sections in other contexts.)

Additional obstacles such as bollards or (sometimes wet) foliage around parking spaces could limit the ease with which people could park in their preferred orientation and position, get themselves and their mobility aids in and out of the vehicle, and manoeuvre freely around the vehicle and onto pedestrian walkways.

Some charging bays contained a “wheel stop” bar on the ground to indicate where the vehicle’s wheels should stop in the space to be aligned with the charger. These ridged bars caused significant obstruction or trip hazards for some users e.g. those using wheelchairs, scooters or walking aids and could prevent access to the charging unit as well as obstructing manoeuvring space around the vehicle, as shown below:



Some people were wary about the ambiguity about being charged to park when charging an EV, with some examples given of receiving parking fines while using charge points.

People who drove vehicles through the Motability Scheme that met the needs of another person mostly anticipated being able to use, or already had used, public charging in at least some on-street or side-by-side parking bays. The stated limitations to their use related to both **parking and access** issues and **charging-specific** issues such as: concerns about charger cables being stolen; charging sockets being on the front of the vehicle; having to wait while charging if there were no nearby amenities; and lack of dedicated accessible EV-only bays and in the case of on-street charging, *“just too much hassle”*. Most of these drivers were not disabled, and mainly described limitations relating to the parking and access needs of their passengers rather than of their own use of parking or charging infrastructure.

Dedicated accessible parking

It was noted that very few dedicated accessible parking bays with EV charging points currently exist. One stated example of good accessible EV charging was at Rushden Lakes shopping centre in Northamptonshire, and which was described as having no kerbs, good signage and being located near the shops. In Nottingham it was anticipated that the new Broadmarsh Car Park would have 80 charging spaces, including 10 accessible ones. One participant described they chose to *“pay more per kW to park in a wider bay, but I shouldn’t have to”.*

There was no clear consensus on whether future additional charge points should be:

- Provided in accessible parking spaces with the option of encouraging/enforcing their use only by disabled people (*“Provide accessible charging bays - use Blue Badges as eligibility to use accessible charging bays”*), or
- Provided routinely in large spaces so that everyone could use any charging point (*“I don’t always want to have to display my blue badge – it shouts 'I am disabled'… I want to be equal with others - just design for all”*)

Comments were made that EV charging spaces for general use were sometimes being installed in place of accessible parking spaces, and *"They think you're either disabled or you are charging an electric car, but not both!"*.

Accessible parking spaces were, in some areas, often misused by those who were not disabled, including by van drivers loading and unloading, or even skips or portable toilets (with some expectation that this was because non-disabled parking spaces generate parking revenue for local councils whereas disabled spaces do not). In an equivalent EV example, electric vehicle charging bays were described as being "ICE'd" (taken up by an 'Internal Combustion Engine' vehicle that did not need to use the space for charging) or being taken up by EVs that had finished charging and were then simply blocking the space for others. At some charge points near fast food outlets it was common for non-EV delivery drivers to occupy EV charging spaces.

It was also noted that adequate parking provision for disabled people with the largest adapted vehicle (i.e. large Wheelchair Accessible Vehicles with rear ramps or side ramps) was not currently provided, so this would need to be addressed as a specific case when planning accessible charging infrastructure for those people.

Charge point location and setting

Home charging was discussed in the context of whether participants typically charged at home or in public, to understand reasons for and against charging in public. Home charging itself was outside the scope of Designability's work on this project but the issues raised included the inability to have a home charger installed because of a lack of a suitable space and/or permission for the installation; the sometimes unpredictable cost of home charging where some charging smartphone apps failed to make use of the cheap overnight electricity tariff as intended; and issues with the reliability and speed of the process of home installation or fixing issues that arose with home chargers.

Existing public charge points were sometimes situated in far corners of car parks. This affected participants both in terms of lack of suitable lighting and the associated vulnerability that some people felt in the dark, as well as the need to travel further than necessary across car parks (sometimes for multiple trips, e.g. in supermarket car parks where shopping trolleys needed to be returned to the shop entrance while the charge points were a long way from the shop).

Suitable lighting was absent in some cases, making it difficult in dark conditions to see the charge point and its interfaces, charging socket(s) on the car and on the charge point, connectors, ground surface and kerbs, signage and instructions. One participant said, *"in the dark I use my 30-seconds of headlights that stay on after I get out of the car to rush to plug in the cable".*

A lack of shelter at the charge points caused issues in wet or hot conditions and could have a disproportionate effect on disabled people who could take longer to set up the charging process than other people or be more adversely affected than other people by heat or cold. This issue was compounded if the charge point was located a long way from amenities.

Signage

Some charge-points were not very visible and not well signposted and were therefore hard to find once at a given location. This included a lack of clarity about on which floor of multi-storey car parks charge points were located, and a desire to be able to look up the exact location of a given charge point. Clarity and consistency of signage, including the use of symbols and colours,

was important to people because of vision but also because of concentration, cognition and fatigue. Examples of varied signage are shown below.

Clear or consistent ground markings to indicate EV charging spaces were sometimes absent, making them harder to find or notice among other parking spaces.

Signage at the charge points was inconsistent and did not always give a clear enough indication that the bays were reserved for EV charging, or give clear information about charging type or speed in ways that were meaningful to the users in a format that was clear and easy to read from each charging bay by users at standing or seated height. Some low signage was too low for standing people to read, and some signage was dangerously positioned so that users could bang their heads on it. Few people had experience of accessible charging bay signage since these bays were currently rare.

2. The charging process

Setting up to connect and paying

Different providers required different processes to enable charging to take place, which was confusing or frustrating for some participants. There was a common preference for using familiar charging points and providers, to reduce setting up effort and uncertainty about the process. One participant in England described their preference of charging location as: *"…Tesco mainly, for the free Pod Point chargers, they are usually well maintained (and you can report in store if the charger is not working), I know how to use the app and the chargers".*

An example of a setting up process that was described as simple was for Pod Point, which was described as: *"Pod Point is easy because you just roll along, plug your vehicle in, type in the name of the charge point [into an app], the light comes on and off you go, you're charging - it only takes 2 or 3 minutes to set up."* Another was described as: *"I've got a ChargePoint Scotland card and the process is simple - I just put my card into the machine and plug in the [tethered] cable"*.

Others described that some setting-up processes on some smartphone apps "timed out" before the user had finished physically plugging in the cable, because of built-in time limits that did not accommodate how long they needed to do this, meaning they had to restart the process, unnecessarily taking further time and effort. One person said: *"I find it hard to use my phone quickly – I would rather not use phone to charge"*.

Different providers required different smartphone apps to access the charging infrastructure and/or to pay. Some people indicated that they did not want to have to download new apps

when at a charge point, for reasons of smartphone memory space and unreliability of mobile phone signal. Others indicated that they were not sure whether they were entitled to use a particular provider's charging points if they were not familiar with that brand.

There was a wide range of payment methods and models for public charging, which was felt to be confusing and complex. One frustration was that some providers took a minimum fee at the start of each charge, even if the charge was not subsequently successful, and the reimbursement of these fees could take several days. High fees (sometimes as much as £20), or repeated fees if several chargers had to be tried in succession, could have a detrimental effect on those on low or fixed incomes. One example of good practice was a provider's app which did not take a payment until charging was complete.

The payment format for EV charging was usually a smartphone app or contactless payment (by bank card or a charging provider's RFID card, or by e.g. Apple Pay or Google Pay).

Smartphone apps could be unreliable for payment because they relied on good mobile phone signal, although some charging bays (e.g. in underground car parks) had mobile phone hotspots to mitigate this.

Contactless payment methods could be more accessible than using an app in some cases, for example where the number of steps involved in charging was reduced by having a simple "plug in and pay with contactless" method. This simplicity was helpful for people with fatigue, cognitive issues, and physical impairments that made interacting with an app difficult or undesirable, and the retrofitting of contactless card readers to charge points in England in 2021 was generally well-received for accessibility and simplicity. One participant described how using Apple Pay on his smart watch enabled him to manage payment more easily as he could use his "good hand" to hold a walking stick and briefly raise the same hand to the contactless pad to pay using his smartwatch, thereby not needing to move his walking stick into his other hand or handle a payment card or smartphone.

Free-to-use charging was available in some locations, with examples of this given in Northern Ireland and England.

Instructions and labelling

Instructions on how to charge were very important for some users, particularly the first time they used a particular charge point unit, and in light of the huge variation of setting up and charging processes between different providers. In some cases printed or on-screen instructions and/or labels were completely absent, or were poorly formatted or poorly described. Some of the non-instruction information on charge point units was described as "unnecessary" while the lack of relevant instructions was described in one case as "appalling". This could particularly affect new users, those lacking in confidence, and those with cognitive or fatigue issues, as well as people with different levels of literacy or who did not have English as a first language.

Screens on charge point units needed to be clear and visible, and one good example given of a screen was at Polar charge points, which were described as having *"a lower unit with a big screen".* Conversely, another person described that bending down to look at a screen was not easy, indicating that lowered screens (or indeed other features) would not necessarily be a universally accessible solution. Some screens were difficult to see in bright conditions because of glare or fading, and could not always be seen if the user was forced to be view them from some distance away, e.g. because of kerbs or bollards.

Clear feedback was important during charging and in some cases it was not easy to tell if the vehicle was successfully charging, e.g. if charging status indicator lights were hard to see in bright conditions. One stated example of good visual feedback was of InstaVolt chargers, which were *"… easy to find at a site, as they have illuminated, coloured words high on the top to indicate: green = available, blue = in use, red = out of service so you can see that from a distance"*, thereby helping with identifying available chargers as well as giving feedback about successful charging. One person described listening for the "beeps" at a charge point as they could not always see the screen to know what was happening, and another mentioned be reassured by the "click" of positive feedback as the cable was securely located in the vehicle's charging socket.

Feedback about the current speed of charging, time to full charge, expected total cost and miles added were appealing to some users and were sometimes lacking or unclear. This mattered to those who wanted to know when to return to their vehicle (and in some cases the speed varied where more than one charger was based in one charging unit) and to those on low or fixed incomes. Stating the price per kWh was not meaningful to some users.

Charger orientation and position

Some charge point units were positioned on kerbs, and in some cases set far back and/or with the some or all features positioned on the side, not the front, of the unit. This made interacting with the different parts of the unit (screen, connectors, sockets) difficult or impossible for some standing or seated people, particularly when combined with obstacles such as kerbs or bollards. Interaction was difficult because of reach and/or line of sight. This was, in some ways, like the issues presented by kerbs around petrol pumps (which, similarly, are often provided to protect the infrastructure from damage): "*The kerb that the petrol pump sits on is … in the way of reaching the petrol pump."* One person described how reaching out was risky because they had limited balance so they did not feel confident doing this. Cables that were stored in a high or far-back holder on the charge point unit could be difficult to reach comfortably or safely: *"I hold onto my walking frame with one hand while lifting the cable from the holder in other hand – I don't want to reach too far as it affects my balance"*. Some examples of the issue of horizontal reach are shown in the images below.

Where charge points were on-street and positioned up on kerbs, or in car parks with a kerb alongside (e.g. at the end of a row of side-by-side bays), some users needed to leave a significant space between their vehicle and the kerb, as they did when parking at a traditional fuel pump, in order to get themselves and/or a mobility aid out into the space between the vehicle and the kerb as shown in the image below.

Some participants described that they had to step up onto a kerb to get close enough to use a charge point unit, and the ground surface was sometimes wet grass, muddy ground or bark chippings which were not good for people with reduced balance.

The most serious safety issue relating to positioning the units on a kerb was that several people reported having fallen off kerbs and in some cases being injured, both from stepping off the kerb unexpectedly with their foot or e.g. a walking frame or rollator, or having the wheel of their wheelchair or scooter unexpectedly drop off the edge of the kerb by the charging unit.

An example of a charge point on a raised kerb with grassy ground is shown below.

Using and handling cables, connectors and sockets

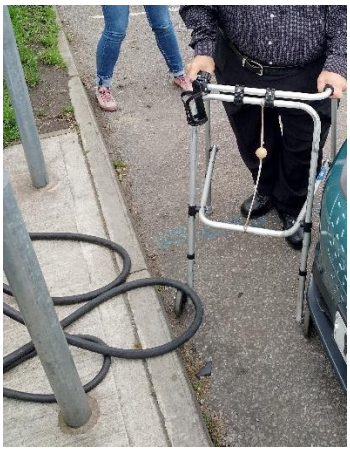
Portable cables (“untethered”) could be less accessible than charge points with built-in (“tethered”) cables, since users had to purchase, handle and carry a cable that could be wet, dirty and heavy. Users described carrying portable cables on their laps while moving from the car boot (where the cable was stored) to the charger and then having to plug in both ends of the cable; the cable sometimes began to unravel on their laps while they used both hands to propel a manual wheelchair, so some chose to carry the cable over a shoulder, putting the cable in contact with their clothing as well as their hands. Examples of carrying a portable cable and using a manual wheelchair are shown below.

Coiling up a portable cable and putting into its bag to stow in the boot of the vehicle was also challenging to people with reduced energy, strength or use of an upper limb. Portable cables were also expensive to purchase, so excluded some people and caused others to worry about dropping them because of the cost of replacing a damaged cable, as well as the difficulty of picking up a dropped cable from ground level. It was also not obvious to some users which end of the portable cable was which.

Tethered cables attached to charge points could cause usability issues because of their weight, length and stiffness:

- The stiffness of some cables caused issues because of the strength and dexterity required to manipulate them into the required position(s), sometimes in confined spaces.
- The weight of the cables particularly affected people who had fatigue or reduced strength or dexterity, or seated users who had reach to lift cables into positions a long way up or across from their bodies. One example of good practice described by users was InstaVolt chargers that supported the weight and position of the cable using an overhead arm.
- Cables that were long enough to reach vehicle charging sockets sometimes trailed along the ground, causing obstructions for wheelchair users and trip hazards others who had reduced balance (as well as creating obstructions or trip hazards for passing pedestrians), as well as the need to pick up cables from ground level if they had been left in or around charging bays by previous users or if the cables had been dropped by the current or previous user (see images below). Some users described supporting the weight of long tethered cables by draping them over their shoulders, bringing the potentially wet or dirty cable into contact with their clothes. One person described their experience as, *"I'm not very strong and it's hard to drag the long cable to plug it in."* and another said, *"When I am using walking sticks, it's possible to fall over the cable".* Another said about a long heavy cable: *"…it's tempting to just leave the cable on the floor rather than struggle"*. Cables could also be harder to handle if they became twisted.

- Cables that were too short constrained the position and orientation of the vehicle (depending on the vehicle socket location), thereby reducing choice and flexibility for the user to park and manoeuvre around in the space according to their preference or needs. For example, a short cable could require a rear socket on the vehicle to be positioned very close to the charge point, and this could prevent the users, particularly those with walking aids, having enough space to safely or comfortably fit between the vehicle and the charge point (as shown below) to interact with the features of the charge point (e.g. screen, connector, socket).



- Plugged in cables of any length could obstruct access into or around the vehicle, for example if they ran across a door.
- Cables could be hard to handle for reasons such as texture and finish, and a lack of features that enabled the cable to be gripped easily. One good example was given as Ecotricity cables, which were provided with handles to help to hold the cables.

Some confusion and inconvenience were caused by the lack of a universal charging connector type and a lack of clear labelling about which of the multiple connectors and sockets was appropriate for a user's vehicle at a given charge point unit. One participant said, *"When I first got my vehicle, I had to physically look closely at each charging connector [at tethered charge points] to work out which one I could use for my vehicle."* For some people, having to move from one charging space to another more suitable one (and similarly if a charging point was not working) took a great deal of effort, since they would park at the first charging point, get a mobility aid from their vehicle, move to the charging point unit to check the charger type only to find that it was not suitable for their vehicle, then get back in the vehicle and move it to another charge point, which meant using a significant amount of unnecessary time and energy.

The action of plugging in an EV connector was described by one person as being *"easier than holding and squeezing a petrol pump nozzle"* and by another as "*physically hard work".* Others could manage the connectors comfortably.

Sockets on **charge points** (where users provided their own cables) were sometimes positioned so that people using walking aids (while seated or standing) found it difficult to position the connector in the required orientation to put it into the socket. This was a particular issue when sockets were on the side, rather than the front, of a charge point, and in some cases socket flaps on the charge point sockets also had to be opened before inserting the connector.

Charging sockets **on vehicles** are located in a range of heights and positions around different vehicles, and could require different angles of connector insertion, and therefore suit different users.

- A low socket on the front of a vehicle may be easy to reach by someone seated in a wheelchair or scooter but could be painful for a tall or inflexible person to bend down to, as shown below.

- Conversely, a socket high up on the side of a tall vehicle (like a van or an SUV) could be comfortable to use by a standing person but hard to manage at arm's length by a seated person.
- The socket's position around the footprint of the vehicle could also influence the required vehicle orientation when charging (as described in the Built Environment section), which could conflict with the orientation required for accessibility reasons.
- Being able to open the socket flap, remove the socket's dust caps, and have a good line of sight (including lighting) past the socket flap into the socket, were also important, for example, *"I managed to locate the socket by touch/feel but it felt like clutching in the dark - is it actually connected?"*
- Open socket flaps and plugged-in connectors could reduce or block the available space around the vehicle, particularly in narrow parking spaces, for example: *"I am plugged in, but now the cable is between me and the driver's door"* as shown in the image below.

Vehicle design falls outside the direct scope of Designability's work, but knowledge about these details could help disabled people to choose EVs to suit their needs.

It was not always easy to manage cables, connectors and socket flaps with the use of only one hand, which was important for people with limited use of either or both hands, as well as for those using one or both hands for walking aids such as sticks, to propel a manual wheelchair, or otherwise to balance by leaning on nearby objects. One person said: *"I only have the use of one hand, and it's only because I have years of experience that I can manage things like lifting up the socket flap on the vehicle and plugging in the cable [reaching high up] with one hand."* And another said: *"I use the end of the connector to flick up the cover and then plug it in"*.

Several people described that when charging or fuelling a vehicle they leaned against the vehicle or petrol pump/charge point unit for support to maintain their balance and use their hands as needed.

Waiting while the vehicle is being charged

Charging an EV inherently requires the vehicle user(s) to wait for charging to occur (for at least twenty minutes to several hours, with these times reducing with the availability of ever-increasing charging speeds) in a way that that is not needed when fuelling petrol and diesel vehicles.

More than one participant described leaving their vehicle to charge and then using another vehicle, or getting a lift, to their home or to a coffee shop to wait while the vehicle charged, with one saying, *"There are not usually buses between the charge point and home!"*. Some described that their vehicle had to be switched off and locked during charging, so they did not want to wait in the vehicle since they could not access any in-vehicle climate controls or entertainment.

Having amenities close to charge points was important for many people, so that they could shop, eat (including healthy options), drink, use an accessible toilet or changing facilities (e.g. to change between work and going out), or work during charging, or at least use these amenities and then return to their vehicle to wait for the rest of the charging time. For some disabled people these amenities were essential (e.g. being able to address medical or related needs) and for others they were desirable. The close proximity of chargers to amenities was very important for some users who had limited energy.

Some people chose to wait in the vehicle, either by choice: *"I wait in the vehicle (because I only use fast charging and there is sometimes nothing to do - you don't want to spend hours at a supermarket, do you?)"* or because leaving the vehicle was difficult or undesirable.

Drivers of vehicles through the Motability Scheme that were provided to meet the needs of another person described that they might wait in the vehicle with their passenger(s) during charging, either by choice or by necessity. Where people chose to wait in the vehicle, they would talk, listen to music or radio or watch TV or films on a tablet computer, use the internet, support the needs of their disabled passenger(s), or eat. Where they stayed in the vehicle by necessity this was because: getting in and out of the vehicle took a lot of time and effort; moving around with passenger(s) outside the vehicle was difficult; the weather was poor; or there were no nearby amenities. If they left the vehicle during charging this was because: the person who the vehicle was provided for could not safely or comfortably wait in the vehicle (e.g. an autistic child trying to leave the vehicle and becoming frustrated or a person finding it uncomfortable to sit still for long periods of time); the vehicle had to be locked and switched off during charging; or because they wanted or needed to use local amenities.

Finishing charging

Cables were still heavy and difficult to manage at the end of charging, as described earlier in this section and in some cases needed to be returned to a holder high up on a charge point unit which was difficult for some people, particularly seated users or those with reduced strength.

Some participants had experienced problems with the charging connector remaining “locked” into the vehicle’s charging socket after charging had finished, sometimes for unclear reasons. Suggested reasons included not having successfully pressed a release button inside the vehicle, uncertainty about whether the two ends of a portable cable had to be unplugged in a specific order, or lack of feedback on the charge point unit or vehicle about whether charging was still ongoing.

Releasing the cable after charging is achieved in some vehicles by using a release button or lever inside the car, but the feedback for this control was not always clear, for example, *“I have to press a little lever on the dashboard to unplug the cable but it doesn’t always work (or it’s not clear enough if it has engaged) so sometimes I have to come all the way back into the car to press it again”*. The disconnecting process could also time out if a person needed to take a long time to physically unplug the cable: *“The time-out of the disconnecting process is too short for me sometimes - I’d love to be able to press "disconnect" while I am close to the socket.”* For others, the cable failed to be released when requested, or took a long time to be released.

Pulling out the cable was difficult for some people, for example when using two crutches to walk and balance, or if they had limited strength or dexterity. In some instances, people thought that the connector was hard to pull out but then realised the connector was locked in place.

The feature that allowed the cable to be locked in place during charging was however seen as important, as some people reported that other people had tried to remove a charging cable while their vehicle was being charged, or were concerned that this could happen.

For others, the position of the socket and limited strength could make unplugging the connector difficult: *“When unplugging while sitting in a wheelchair you are reaching from a difficult angle (so you cannot use your full strength) and you have to reach up (and I can't hold my hand up for long)”.*

Handling a portable cable and putting it back into the car boot was difficult for some people, and one person described that they would put the portable cable in the boot without coiling it up and instead tidy it once they arrived home.

Seeking assistance

Several examples were given of public EV chargers not working. These included being broken on arrival, failing to set up (including payment) or charge successfully, or failing to release the charging cable at the end of charging.

Using a provider's phone number to seek help was routinely described as taking a very long time, with the expectation of waiting a long time for a call to be answered: *"It is standard to be on hold for twenty minutes now before you get through"* and *"I once was on hold … at motorway services for twenty minutes when my payment wouldn't work, it was very stressful and I still then had to wait for the car to charge after that – that's not good for anyone but more unfair for disabled people".* One good example of assistance was given as Geniepoint: *"Geniepoint's 24/7 support is very good – they have helpful and patient call handlers".* Telephone assistance relied on mobile phone reception and the person having the time and ability to make a long voice call. There was a desire for a built-in help button on charge point units, to avoid the need to make a phone call.

People also wanted to be able to report broken chargers, which they could do by phoning a provider or via apps such as Zap Map or the apps of individual providers.

The idea of using an emergency stop button on a charge point unit was also mentioned, including an ongoing issue with a non-card contactless payment provider (Apple Pay) which routinely caused a transaction issue. This meant that the charging process could only be successfully stopped by using the emergency stop button.

One example of past good practice was that *"The old Ecotricity chargers used to go to 'free-vend' if there was a comms issue"*, thereby minimising disruption to customers if they needed to charge but could not successfully connect to the charging point via the app because of a connectivity issue.

The idea of seeking in-person assistance to charge an electric vehicle was not discussed directly, but aspects of petrol station assistance were considered because they were potentially relevant to the context of public EV charging. Users of petrol and diesel vehicles described examples of using or seeking (in-person) assistance to fuel their vehicles at petrol stations. The availability of convenient, reliable fuelling assistance varied, for example between large (e.g. supermarket) and small forecourts with more or fewer available staff, and in some cases the provision switched overnight to pay-at-pump only, so assistance was not available. People spoke about choosing to use local petrol stations where they knew that staff would recognise them and/or respond reliably to requests for assistance.

Attracting the attention of assistance staff at petrol stations ranged from using a vehicle's horn or lights and waving a Blue Badge to asking another person, including members of the public, to ask staff in the shop to come out and assist with fuelling. Using the horn was effective but not desirable, since it drew the attention of other drivers. The time needed to wait for assistance also concerned some drivers: *"Other drivers hoot at me as I am apparently doing nothing at the petrol pump"*. Some used the assistance button on a petrol pump or a petrol assistance apps or fob to call for assistance, and others indicated that the success of being assisted was reliant on the willingness and training of individual members of staff.

Making payments at petrol stations could be complex if users did not pay with cash at their vehicle, since customers who did not leave their vehicle to fuel could need to leave their vehicle to enter the shop and pay. "Drive-through" payment kiosks on exit were considered to be more

accessible, and pay-at-pump features could be inaccessibly high to reach even from outside the vehicle, so some people had to leave their vehicles, including managing mobility or walking aids, in order to travel to and from the shop to pay. In some cases this would mean moving the vehicle, since parking right next to the pump to fuel meant that they and/or their mobility aids could not fit or manoeuvre in the space between the vehicle and the petrol pump, particularly in smaller forecourts. Some participants described in the past being asked to provide their payment card and PIN to a member of staff to pay, which was a financial security issue.

3. Information about charging points

Finding information about public EV charging points was a widely raised topic, in addition to the more obvious aspects of charge point accessibility during charging.

The need to plan ahead for journeys of any length was a common theme, and "range anxiety" was mentioned by some participants. The lack of reliable, accessible public charging infrastructure left many feeling that they had no choice but to build significant contingency into their travel plans (e.g. keeping their battery well-charged, or planning several possible charge points for a single charging occasion). The use of the vehicle battery to operate hoists, lifts, aircon and heating (for medical or comfort reasons) could also have a disproportionate effect on the available travel range for disabled people.

In related discussions about fuelling with petrol or diesel, different participants said: *"I don't let the fuel go below half way, partly to save having the expense of paying for a whole tank in one go, and because I don't like the worry of running low on fuel"* and, conversely, *"I try to avoid fuelling as often as possible, so I go for as long as I can before filling, as it's such an inconvenience"*, showing the different approaches taken to the same underlying idea.

Some participants identified suitable charge points by only or mainly using familiar local ones, or using familiar providers at new locations (e.g. other branches of the same supermarket chain) where they could expect a similar experience. Some used one or more smartphone apps to find suitable chargers - the maximum number mentioned by one person was fifteen apps (including apps for finding charge points and also apps for accessing charging provision) - noting that there were many different apps available, some covering many charge points (e.g. Zap Map or ABRP (A Better Route Planner) or the ChargePoint Scotland app) and others covering just one provider. Others used built-in apps in their EVs to find and navigate to charge points.

The idea of using unfamiliar charging points was concerning for some (but not all) users, describing their feelings as: *"Very anxious", "Nervous but OK", "Apprehensive", "New places make me nervous"* for reasons including uncertainty about how to use a charger, cost, accessibility and whether it would be available and working.

The need to refer to different apps was frustrating for some people. **Zap Map** was commonly used, and was described as "the bible of charging" by one participant, as it covered all of the charge points in the UK and Ireland, and contained detailed information about charge points including whether they were working and available (although this was not always up to date) and some of the information was crowdsourced. Accessibility information about charge points was generally lacking in smartphone apps, and it was noted that "accessible" meant different things to different people.

Choosing charge points was influenced by charging type and speed, charging cost, availability, location, accessibility (although this was hard to determine in advance for unfamiliar chargers), nearby amenities and any costs or restrictions around parking, and whether the charge point was described as working.

The EV sector was frequently described as complex and confusing, with customers typically feeling like they had to carry out a significant amount of research to find out what they needed to know about choosing an appropriate EV (both to meet the customers' general and accessibility needs and preferences), as well as about the charging aspects of EVs.

4. Other topics

Cost of charging

The cost per unit for electricity was confusing for some people, as it varied between countries and by area, as well as by type of location (kerbside, car park, motorway services) and provider type (local authority, commercial provider) and was changing over time as different schemes stopped or started requiring payment for charging. Paying fixed monthly subscriptions for public charging, although simple, had not been good value in the past year for some participants due to reduced travel because of COVID.

Some charging was free in some countries and some areas, but this was also changing over time. Free-to-use chargers were often occupied and/or slow.

Availability and reliability

In addition to issues directly relating to the accessibility of public infrastructure in a disability context, a lack of availability of charging points was a significant issue that disproportionately affected disabled people.

This lack of availability was caused by limited provision of any public charging in some areas, increasing use of chargers by the increasing number of EV drivers, limited provision of charging points of particular types and speeds, and chargers that were either occupied (by charging or non-charging EVs or by non-electric vehicles) or not working. The BP Pulse app was described as useful in that it indicated when an occupied charge point was expected to become free, allowing the next potential user to plan to use it at that time.

Charge points that were not working (because of hardware or apps) were a commonly mentioned problem which caused inconvenience and anxiety.

Journeys

A wide range of examples of journey types arose during the user engagement activities. It was noted that some people routinely took journeys of several hundred miles (often or occasionally) to visit family, go on holiday or for work. Long journeys required not only planning of where to stop but planning (how) to spend time while waiting for the vehicle to charge (as discussed elsewhere in this report) which further increased the journey time. Some people felt restricted by electric charging (of an EV or PHEV) to local-only journeys because of the inconvenience or anxiety that was caused by concern about public charging. Others took regular short journeys such as school runs several times a day or commuted regularly for work.

People travelling together

Some of the user engagement research focussed on the needs of disabled drivers who travelled alone, since their individual accessibility needs away from home would always need to be met by public charging infrastructure to maintain their independence. One disabled driver described that going into a petrol station to pay was complicated because of the need to look after more than one child, including carrying a young baby into the petrol station to pay for fuel. Other disabled drivers described that they needed large vehicles not because of their access needs but to accommodate their family members.

Other engagement focussed on drivers of vehicles leased through the Motability Scheme that were provided to meet the needs of another person, and who therefore had experience of travelling with disabled passenger(s). These drivers reported in a small number of cases that they typically travelled with up to four passengers (children and/or adults), and in some cases with more than one of those passengers being disabled. Some of the drivers were disabled, even though the vehicle had been provided to meet the needs of another person.

PHEVs

Some participants described that their choice of a PHEV over an EV was to increase the convenience of fuelling the vehicle or to reduce range anxiety, and some spoke of wanting an EV but being reluctant to choose one until the availability of suitable public charging infrastructure had improved. Others mentioned that they had a PHEV while waiting for a suitable EV to become available on the Motability Scheme. Some chose to use their PHEVs as electric vehicles as much as possible, including in some cases only ever using home (not public) charging, but in some cases choosing petrol for long journeys.

Views about having an EV (currently or in the future)

Those who currently used EVs or PHEVs were generally positive about the principle of having one, and pleased with their driving experience and performance, but in some cases this was offset by the inconvenience or stress caused by difficulties with charging.

The participants who did not have an EV or PHEV generally expressed being excited about or interested in having an EV for reasons including modern, quiet technology and design, as well as the commonly given reason of environmental benefits including for future generations, and aspired to having an EV that would enhance their independence.

Those who did not currently have an EV or PHEV had concerns including: how they would manage public charging if they could not get a home charger installed; perceived inefficiency of PHEVs; the extra costs associated with adaptations and buying charging cables; being able to access an otherwise suitable vehicle for their (and their family's) needs; range; battery capacity of operating adaptations such as hoists; the safety of charging an EV in the rain; a lack of information or understanding about the EV market, costs and charging: *"How will I know which charging points are compatible with my vehicle?"*; the weight of charging cables; and the availability, reliability and accessibility of public charging infrastructure: *"I want to wait until it's mainstream - I'll wait until it has improved"* and *"It would worry me that I would get stuck [without charge]"*.

Limitations

This User Engagement phase about public EV charging infrastructure, while detailed and wide-ranging, was not exhaustive and had some limitations.

Most of the participants were from England, although the work covered the whole of the UK with some participants from Scotland, Wales and Northern Ireland being involved. The in-person session locations were limited by participants' proximity to Designability's location in Bath.

The work did not assess all the chargers on the market (and wireless charging was not discussed in detail), because the research was led by the experiences of users. More detailed examples were gathered of charging in side-by-side bay parking than in on-street charging, but rich data was gathered about both settings.

One notable case that was not explored but that will need to be addressed specifically in the future design of accessible charging is that of large WAVs, particularly those with ramps. These require the greatest space when parking for any reason (including charging) and although we did not engage with the users of such WAVs, we did gather relevant information about accessible parking and charging for a wide range of related situations.

All the participants who showed an interest in the work were a self-selecting cohort who were approached by email and were willing and able to respond by completing an online survey, so were not necessarily representative of all users of the Motability Scheme, and all the user engagement work was conducted in English.

Not all types of disability, impairment or condition were explored, since there was a deliberate focus on the physical impairments identified as being relevant in the previous Scoping and Discovery phase of the project. However, in the course of the work we did engage with, or find out about, drivers or passengers with some varying or hidden disabilities, anxiety, autism, learning difficulties such as dyslexia, and learning disabilities.

Conclusions

Designability engaged with 87 individuals who were users of vehicles leased through the Motability Scheme during four types of engagement activity: group online sessions, individual interviews by telephone or video call, in-person sessions at charge points and a focussed survey.

The participants were asked for their views and experiences about EV charging and related topics such as fuelling and using payment machines, and their experiences and views were captured in detailed notes.

Some of the challenges around EV charging related to the reliability and availability of public EV charging infrastructure and the complexity of the market in general (all of which could affect all users but could affect disabled users disproportionately), and others caused specific issues relating to accessibility for disabled people.

The accessibility needs of disabled people were wide ranging, and occasionally conflicting, and the needs of apparently similar people in similar circumstances could be quite different. A wide range of walking aids and mobility aids was discussed in the context of EV charging, with users describing accessibility issues around EV charging when using one or two walking sticks or

crutches, walking frames and rollators, manual and powered wheelchairs, scooters, and in some cases more than one of those options on the same day or on different occasions. Some disabled drivers who intended to be able to charge an EV independently had significant vehicle adaptations including driving controls, and their needs must be considered in design of future accessible vehicle charging.

Accessibility issues were grouped into three key areas: built environment, the charging process and information about charging points. Accessible parking was an ongoing issue experienced by EV users and non-EV users alike and was therefore one of the key requirements that would be needed to underpin the accessibility of public EV charging infrastructure.

Attitudes to EVs (either as current or future EV users) were generally positive in principle, but there were a variety of concerns about the reality of the accessibility of public EV charging, as well as other EV concerns that any user might have, such as complexity, cost, range, availability and reliability.

Users of large WAVs with rear or side ramp access were not included in this work because of their availability, and must be considered carefully in later work so that their access needs for charging (and particularly parking), which may be more significant than for the participants we engaged with, are not overlooked.

Next steps

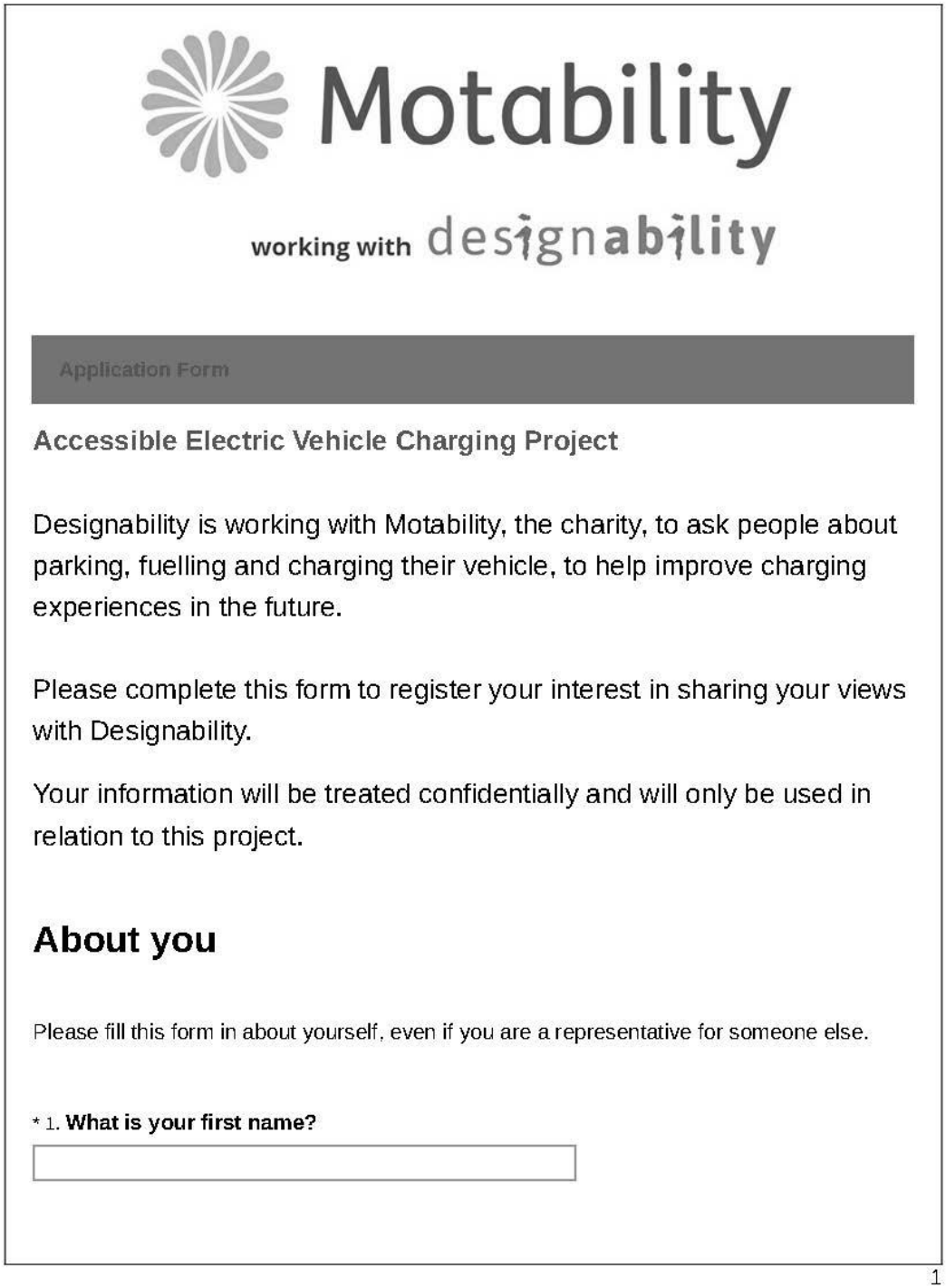
Designability has completed the planned User Engagement activities which will be used to inform the design of and guidance for accessible public electric vehicle charging in the future, to improve the accessibility of charging for disabled people.

Acknowledgements

Designability would like to thank all the participants for being so willing to share their views and experiences in detail to contribute to future improvements in accessible public charging.

We are also grateful to ChargePoint UK, GridServe, and Blenheim Palace for the use of their sites.

Appendix A: “Application Form” survey questions



Motability

working with designability

Application Form

Accessible Electric Vehicle Charging Project

Designability is working with Motability, the charity, to ask people about parking, fuelling and charging their vehicle, to help improve charging experiences in the future.

Please complete this form to register your interest in sharing your views with Designability.

Your information will be treated confidentially and will only be used in relation to this project.

About you

Please fill this form in about yourself, even if you are a representative for someone else.

* 1. **What is your first name?**

1

* 2. **What is your last name?**

* 3. **What is your email address?**

* 4. **What is your telephone number?**

* 5. **What is your sex?**

- Male
- Female
- Prefer not to say

* 6. **How old are you?**

We are only able to work with people over 18 years old.

- 18-24 years
- 25-34 years
- 35-44 years
- 45-54 years
- 55-64 years
- 65-74 years
- 75+ years

* 7. **Where do you live?**

- England
- Wales
- Scotland
- Northern Ireland

* 8. **Do you consider yourself to be disabled?**

- Yes
- No

* 9. **Do you have a condition or disability that affects your...**

Please tick all that apply.

- [ ] Mobility
- [ ] Stamina
- [ ] Strength
- [ ] Use of at least one upper limb
- [ ] Dexterity
- [ ] None of the above

These are of particular interest because we know they are not well accommodated by current electric vehicle charging design. If we invite you to take part, you will have the opportunity to share information about any other condition or disability which may be relevant.

* 10. **Have you ever charged, or seen someone else, charge any electric or hybrid vehicle on the street, in a car park, at a service station or at work?**

Please tick all that apply.

- [ ] No
- [ ] Yes - I have charged one myself in at least one of these places
- [ ] Yes - I have seen someone else charge one in at least one of these places

About the Motability vehicle you use

* 11. **What is the make of the vehicle?**

For example: Ford

* 12. **What is the model of the vehicle?**

For example: Fiesta

* 13. **How can the vehicle be fuelled or charged?**

- ○ **Diesel or petrol only**
  The vehicle can only be fuelled using petrol or diesel - this includes self-charging hybrids
- ○ **Plug-in electric hybrid**
  The vehicle can be plugged in and can use petrol or diesel
- ○ **Electric-only**
  The vehicle can only be charged by plugging it in
- ○ **I'm not sure**

* 14. **Are you the person the vehicle was provided for?**

- ○ Yes - the vehicle was provided to meet my mobility needs
- ○ No - the vehicle meets the mobility needs of another person

* 15. **Are you usually the driver or a passenger?**

- ○ Usually the driver
- ○ Usually a passenger

16. **If you are a disabled driver, when do you travel in this vehicle on your own?**

- ○ Always
- ○ Often
- ○ Sometimes
- ○ Rarely
- ○ Never

* 17. **Do you, or anyone else, usually bring walking aids with you when travelling in this vehicle?**

Please tick all that apply.

- ☐ No
- ☐ Yes - single walking stick or crutch
- ☐ Yes - pair of walking sticks or crutches
- ☐ Yes - manual wheelchair
- ☐ Yes - powered wheelchair
- ☐ Yes - mobility scooter
- ☐ Yes - other (please state)

* 18. **Do you or another person enter the vehicle while seated in a wheelchair or scooter (in other words, is it a Wheelchair Accessible Vehicle)?**

- ○ No
- ○ Yes - using a ramp at the back
- ○ Yes - using a ramp at the side
- ○ Yes - using a tail-lift at the back
- ○ Yes - using a lift at the side
- ○ Yes - other (please state)

* 19. **Does the vehicle have any adaptations that help lift an empty wheelchair or scooter into or onto the vehicle?**

Please tick all that apply.

- ☐ No
- ☐ Yes - hoist into car boot
- ☐ Yes - hoist onto rooftop
- ☐ Yes - other (please state)

* 20. **Does the vehicle have any adaptations that help a person enter the vehicle when they are not seated in a wheelchair or scooter?**

Please tick all that apply.

- ☐ No
- ☐ Yes - transfer plate
- ☐ Yes - electric person hoist
- ☐ Yes - swivel seat
- ☐ Yes - other (please state)

* 21. **Does the vehicle have any driving adaptations, for example for speed control, steering or signalling?**

- ○ Yes
- ○ No

Tell us how you would like to be involved in this project

- We will not be able to invite everyone to take part in the project.
- We expect to carry out this research during June and July this year.
- If we invite you to take part, we will ask you about your access needs, so that we can support you to take part.
- If we meet with you online or in person, or if you send us any recordings, you will receive a shopping voucher.
- If you complete an online survey or questionnaire you can choose to be entered into a prize draw to win a shopping voucher.
- We will be following all relevant COVID-secure guidance when conducting in-person activities outdoors.

* 22. **Please tick all the activities that you might be interested in**

- ☐ **a. Online video call or phone call for up to 90 minutes**
  Individually or as a pair with someone over 18 years old who travels with you
- ☐ **b. Online group video call for up to 90 minutes**
  With a small group of other Motability Scheme customers, usually using Zoom
- ☐ **c. In-person outdoor session for up to 90 minutes**
  Using or commenting on an electric vehicle charging point near where you live
- ☐ **d. Send us audio or video recordings or photos**
  Short recordings of your experiences charging electric vehicles
- ☐ **e. Online survey or questionnaire**

23. **If you selected an in-person outdoor session for the previous question, please give the first two letters of your postcode.**

This helps us to know if we could realistically travel to meet you.

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24. **If you selected an online or in-person session, please indicate all of the parts of the week that might be possible for you.**

Different days of the week will be offered.

- [ ] Weekday morning
- [ ] Weekday afternoon
- [ ] Weekday evening
- [ ] None of these

Consent

* 25. The information you provide will be used by Designability to select people with a range of different experiences for this project. Your contact details will only be used to contact you about this project.

Designability will store and use the information you provide safely in accordance with our privacy notice.

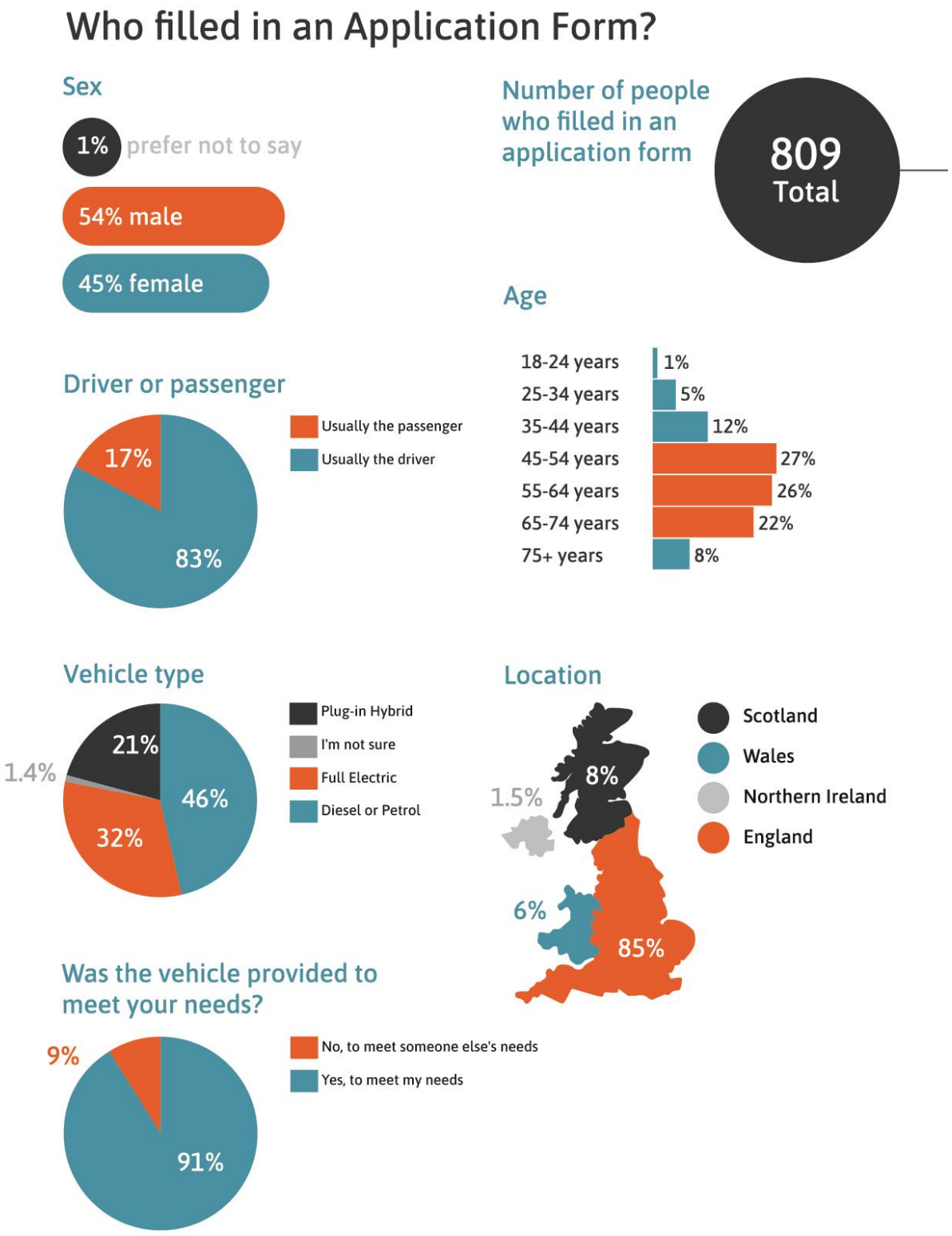
You may withdraw your application at any time without giving a reason, at which point all data you have provided to Designability in this form will be permanently deleted from our records. To withdraw your application please email: evcharging@designability.org.uk

Do you consent for Designability to use the information you have provided in this way?

- [ ] Yes, I consent

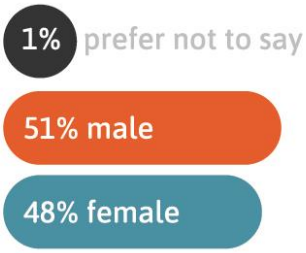
Please press the Submit button below to send us your completed form.

Appendix B: Participant demographics

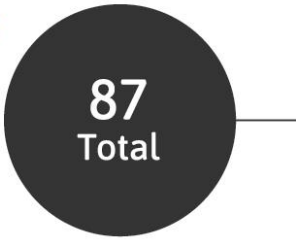


Who took part in our research?

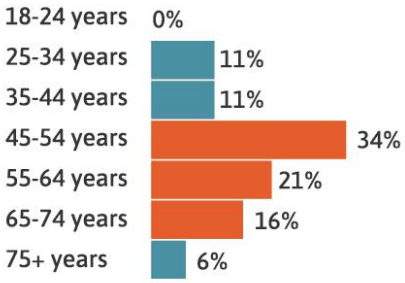
Sex



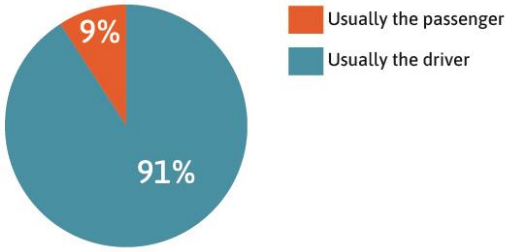
Number of people who filled in an application form



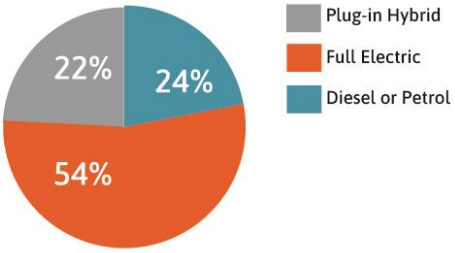
Age



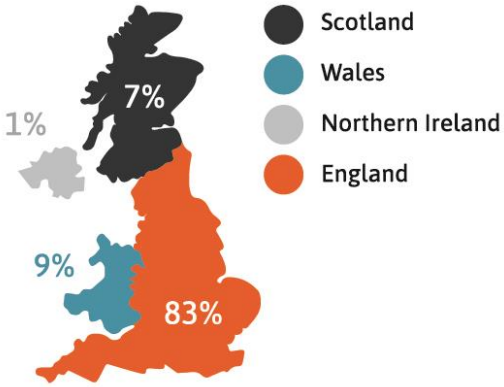
Driver or passenger



Vehicle type



Location



Was the vehicle provided to meet your needs?