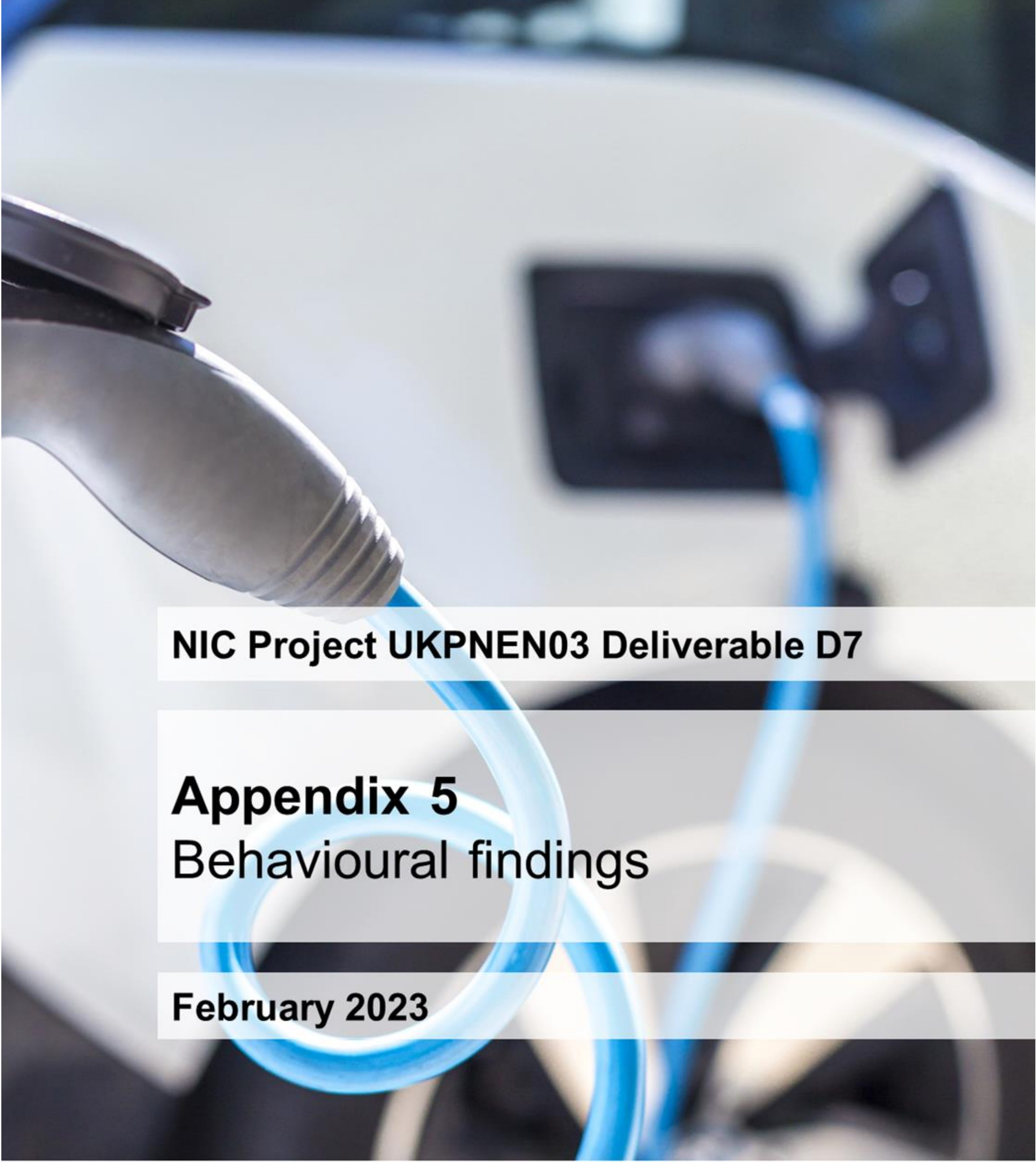


NIC Project UKPNEN03 Deliverable D7

Appendix 5
Behavioural findings

February 2023

Optimise Prime

Contents

1 Introduction

This appendix presents a detailed overview of the behavioural studies that were carried out as part of the Optimise Prime project, supplementing the summary given in Section 2.2.5 of the main Deliverable D7 Report.

In summary, drivers are overall very positive about EVs across all fleets, though the survey has identified some points which could be a barrier to adoption for some drivers:

- Lack of charging infrastructure is a growing concern across all fleets, this encompassed concerns about ability to install home charge points (CPs), ratios of CPs in depots and availability of public charging
- A significant proportion of drivers, especially those who are not able to charge at home or depot, believe that the long charging durations of EVs are impractical
- Range anxiety was found to be more common amongst drivers travelling the shortest distances. Those with more experience of travelling longer distances showed less concern.

Fleet managers presented a different set of concerns, with barriers to electrification including:

- Lack of availability of the right types of vehicles, potentially risking electrification targets
- High costs, both of vehicles and from the need to upgrade electrical connections
- Potential for operational disruption if charging infrastructure is not available to meet the needs of the business.

The following sections present the full details of the study's methodology and results.

2 Methodology

The purpose of the behavioural research is to understand the decision-making process for fleet electrification and the factors that play a role in the speed of adoption. Combined with the quantitative data from the vehicles and CPs, additional qualitative data on the behaviour of the various stakeholders can provide insights into future adoption across commercial fleets and the potential impact on distribution networks. The behavioural component of the Business Modelling workstream addresses research questions on:

- Adoption
- Barriers and enablers
- User experience
- The impact of power networks constraints
- The organisational decision-making processes.

A literature review and meta-review was conducted by Imperial College Consultants to develop a set of 10 factors that determine the behavioural intent to adopt an EV, including:

- Perceived risk
- Management involvement
- Performance expectations
- Environmental factors
- Organisational factors.

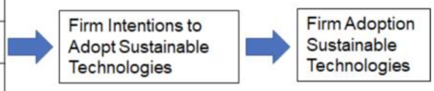
These were formalised in the Firm Adoption of Sustainable Technologies (FAST) framework[1], as shown in Figure 1. Respondents were asked to rate several statements and were evaluated on a seven-point Likert scale, from Entirely Agree to Entirely Disagree. The questionnaires

[1] Mohammed, L., Niesten, E., & Gagliardi, D. (2020). Adoption of alternative fuel vehicle fleets–a theoretical framework of barriers and enablers. *Transportation Research Part D: Transport and Environment*, *88*, 102558.

were designed with this framework in mind, building on earlier recommendations from Imperial College Consultants.

Figure 1 – Fast Adoption of Sustainable Technologies (FAST) Framework

Construct	Definition
Perceived Risk (PR)	Firm perception of uncertainty plus the seriousness of outcome involved.
Management Involvement (MI)	The ability of firm managers to convince and explore effective ways to engage employees in using a new sustainable technology.
Training for Innovation (TI)	Information, knowledge, and skills enhancing a firm's understanding and technical readiness for the adoption of a specific sustainable innovation.
Performance Expectancy (PE)	Factors affecting a firm's beliefs that using a new sustainable technology will help attain performance gains.
Effort Expectancy (EE)	Factors hindering a firm's ease of use of a new sustainable technology.
Social Influence (SI)	The degree to which a firm perceives that the social context influences it to use a particular sustainable technology.
Environmental Factors (EF)	Factors external to the firm, such as government regulations and the industry in which a firm conducts its business.
Organisational Factors (OF)	Characteristics and resources of the firm, such as firm size, managerial structure and organisational slack.
Attitude	Managers' and employees' positive or negative feelings about adopting a new sustainable technology.
Emotions	Managers' and employees' collective emotional reactions towards the adoption of a sustainable technology.



2.1 Questionnaire design

The FAST Framework is the foundation for the selection of questions that have been included in questionnaires intended for different stakeholder groups.

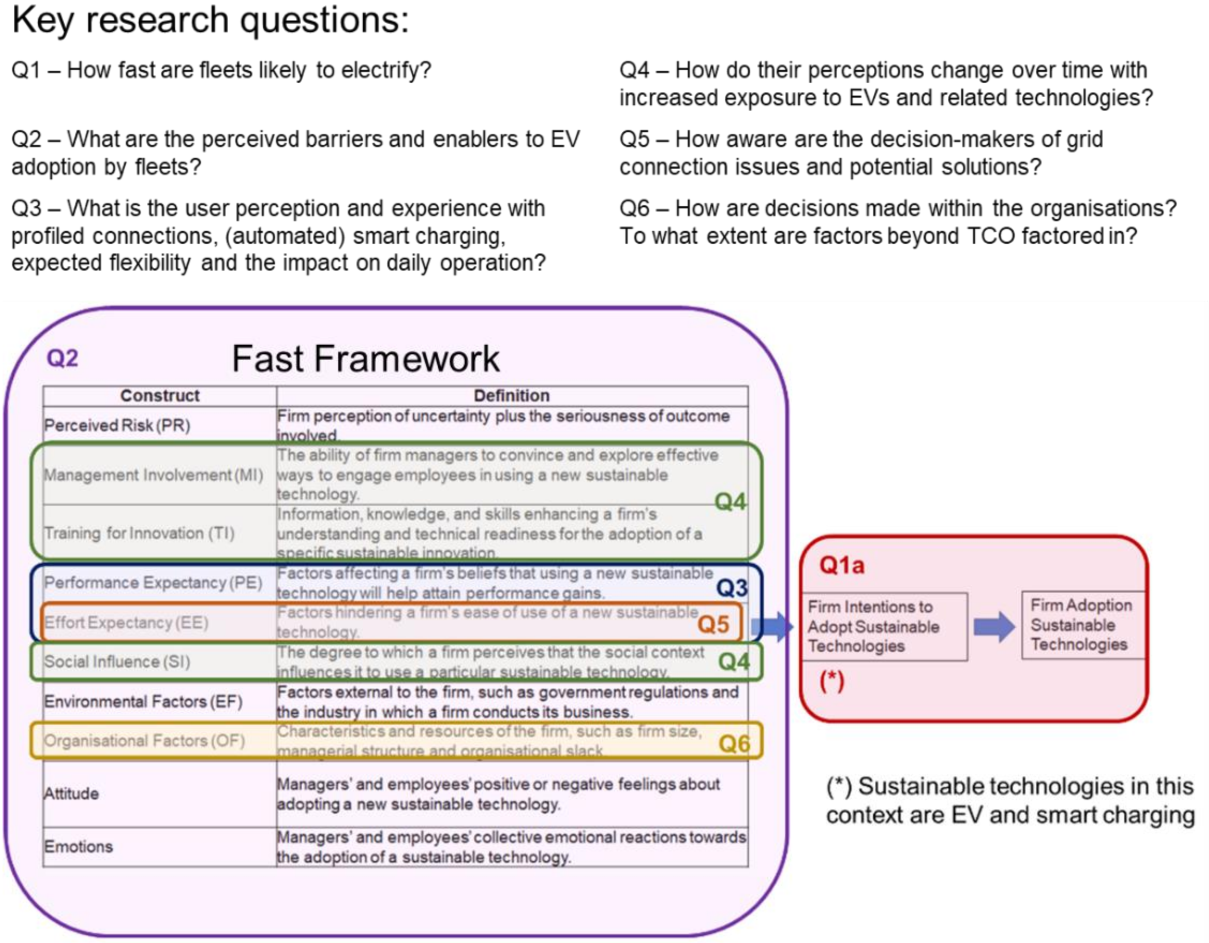
The questionnaires vary between partners, due to sponsor discretion, and after considering previous findings. They also vary depending on the subject's seniority level. The aim was to collect data from EV drivers, fleet managers, senior managers, and other key stakeholders, to understand their experiences and attitudes, and the impact of these on the decision to electrify their fleets.

The aim of this behavioural component was to support answering the following questions:

- How fast are fleets likely to electrify?
- What are the perceived barriers and enablers to EV adoption by fleets? This could relate to vehicles, charging infrastructure and software (charging controls, optimisation), as well as business strategies and (internal) communication.
- What is the user perception and experiences with smart charging, expected flexibility, and the impact on their daily operation?
- How do their perceptions change over time with increased exposure to EVs and related technologies?
- How aware are the decision-makers of network connection issues and potential solutions?
- How are decisions made within these organisations? To what extent are factors beyond total-cost-of-ownership factored in?

Figure 2 shows the mapping of FAST Framework's constructs onto the key research questions.

Figure 2 – Key research questions mapped onto the FAST Framework



The surveys included:

- 30 statements for Centrica,
- 26 statements for Uber
- 19 statements for Royal Mail.

Table 1 shows the link between the statement presented during the survey, which the respondents shared their opinion on, and the theoretical FAST Framework. For example, the electric vehicle performance factor is not tested directly, but respondents share their views on statements PE1-PE6. The survey was designed on the hypothesis that these are relevant factors, based on academic literature and previous research projects. The factor analysis presented in Section 3 was carried out by Imperial Consultants and aims to identify and explore further the factors influencing attitudes.

Table 1 – FAST framework constructs and survey statements, with item identifiers

FAST Framework	Item	Statements
Management involvement and training	MI1	Our shift to electric vehicles is supported by sufficient information and training provided by our organisation
	MI2	Our managers are implementing strategies and technologies to ensure that the switch to electric vehicles has minimal impact on our tasks
	MI3	Uber's efforts to encourage the switch to electric vehicles is well received
Organisational structure	OF1	Drivers' inputs are considered when new vehicles, navigation technologies or other technological changes to are adopted by our organisation

FAST Framework	Item	Statements
	OF2	Drivers are consulted when new vehicles, navigation technologies or other technological changes are adopted by our organisation
Electric vehicle performance	PE1	Driving an electric vehicle is more pleasant as it is less noisy than a conventional vehicle
	PE2	The acceleration performance of the electric vehicles is very good
	PE3	The fact that the electric vehicle can be charged overnight saves working time, as it avoids fuel station trips
	PE4	On balance, an EV will be cheaper for me to drive over its lifespan
	PE5	Driving an EV will reduce my impact on the environment and air quality
	PE6	Overall, EV has/would improve my performance at work
Effort related to EV adoption	EA1	The limited range of electric vehicles makes/ would make it more difficult to fulfil my daily work tasks
	EA2	Long charging durations for electric vehicles are very impractical
	EA3	The limited availability of charging facilities at and around my home makes it more problematic to use an electric vehicle than a conventional vehicle for the fulfilment of my daily work tasks
	EA4	It is difficult to remember to plug-in the electric vehicle at the end of the shift
	EA5	Smart charging is risky - there may not be enough charge when the driver needs it
Attitudes/emotions & social influence	AI1	I am interested in electric vehicles
	AI2	I think electric vehicles would be beneficial to the environment in the long term
	AI3	I think that electric vehicles would eventually result in cost savings in my industry
	AI4	I think that electric vehicles are generally cool and pleasant to drive
	AI5	I think that electric vehicles are only a temporary phenomenon
	AI6	The range of electric vehicles is sufficient for most daily trips
	AI7	Free parking would make it easier to use electric vehicles
	AI8	It is advantageous to use electric vehicles because of the low energy cost
	AI9	Companies who have electric vehicles have good public image
	AI10	Companies within my industry are considering electric vehicles
	AI11	Electric vehicles are viewed favourably within my industry
	AI12	Business leaders in my industry are talking about switching to electric vehicles
	AI13	Policy makers expect companies in my industry to switch to electric vehicles
	AI14	Customers expect organisations in my industry to switch to electric vehicles
	AI15	I know fleet managers who are considering electric vehicles
	AI16	My customers prefer electric vehicles
	AI17	Smart charging saves British Gas money
	AI18	Overall, I support the rollout of smart charging across our electric fleet

2.2 Execution approach

To collect longitudinal data and observe how attitudes change over time as more EVs are rolled out, the questionnaires were repeated at different stages of the project (see Table 2).

Table 2 – Number of responses by questionnaire iteration

	1st questionnaire iteration			2nd questionnaire iteration		
Organisation	Date	Total no. of responses	No. of responses from EV drivers	Date	Total no. of responses	No. of responses from EV drivers
Royal Mail	Jun-21	312	234	Feb-22	256	195
Centrica	Mar-21	108	19	Oct-21	230	86
Uber	May-21	798	71	Dec-21	952	388
Total		1,218	324		1,408	644

Both EV and non-EV drivers were surveyed, and the execution methods varied by stakeholder group and project partner, as outline below.

Royal Mail

- **Drivers:** paper printouts of questionnaires were distributed to drivers and questionnaires were conducted face-to-face. Questionnaires were anonymous, and so it was not possible to track individual opinion changes over time (although it is possible to analyse data per depot).
- **Depot Managers:** online questionnaire distributed via a Microsoft Forms link.
- **Corporate Management:** online questionnaire distributed via a Microsoft Forms link.

Centrica

- **Drivers:** online questionnaire distributed via a Microsoft Forms link posted on an internal message board. No incentives were offered in the first iteration, while £10 Amazon vouchers were awarded to all respondents in the second iteration.
- **Senior Management:** online questionnaire provided via a Microsoft Forms link distributed by e-mail to relevant stakeholders, as well as interviews with the Fleet Manager.

Uber

- **Drivers:** online questionnaire provided via a Microsoft Forms link and distributed via an internal newsletter. £10 Amazon vouchers were offered to selected respondents (those who were first to respond in the first iteration and randomly selected respondents in the second iteration). In the second iteration, EV drivers were targeted via a separate e-mail reminder to increase the response rate from this group.

The Uber drivers are the key decision makers in the context of EV adoption. While Uber offers incentives to transition to EV, it is the individual drivers who decide whether switching to EV is appropriate for them. The views of Uber's management were sought to help formulate the questionnaire questions and to interpret the results.

Online questionnaires were conducted with selected customers of Novuna (formerly Hitachi Capital Vehicle Solutions) to confirm applicability of the survey findings to a wider range of fleets. Questionnaires followed a similar structure and explored the same questions as those provided to other fleets, to ensure consistency and reliability of results. Questionnaires were sent to drivers since management varied among Novuna customers. The results of this complementary analysis are presented in Section 5.

A seven-point Likert scale was used in questions that asked the respondents to rate their agreement with presented statements. For presentation purposes, a five-point scale is used, with the categories mapped as shown in Table 3. Also, graphs often show the impartial respondents on the disagreement side, and so the respondents who are presented as agreeing with the statement expressly stated a level of agreement.

Table 3 – Seven-point agreement/disagreement Likert scale mapping onto a five-point scale

Questionnaire scale	Presentation scale
Entirely Disagree	Entirely Disagree
Mostly Disagree	Disagree
Somewhat Disagree	Disagree
Neither Agree nor Disagree	Impartial
Somewhat Agree	Agree
Mostly Agree	Agree
Entirely Agree	Entirely Agree

3 Fleet-specific learnings from behavioural study

3.1 Royal Mail

3.1.1 Overview and context

In the first iteration of the Royal Mail questionnaire, 333 participants responded to the questionnaire (312 drivers, 15 depot managers and six corporate managers). Drivers' responses were collected from nine London depots: Dartford, Whitechapel, Camden, Victoria, Premier Park, Orpington, Islington, Bexleyheath, and Mount Pleasant. In the second iteration of the Royal Mail questionnaire, 231 participants responded to the survey (226 drivers and five depot managers). Drivers' responses were collected from eight depots: Dartford, Whitechapel, Victoria, Premier Park, Orpington, Islington, Bexleyheath, and Mount Pleasant. Table 4 below shows the numbers of EVs and CPs in each depot at the time of data collection, as well as the overall number of vehicles.

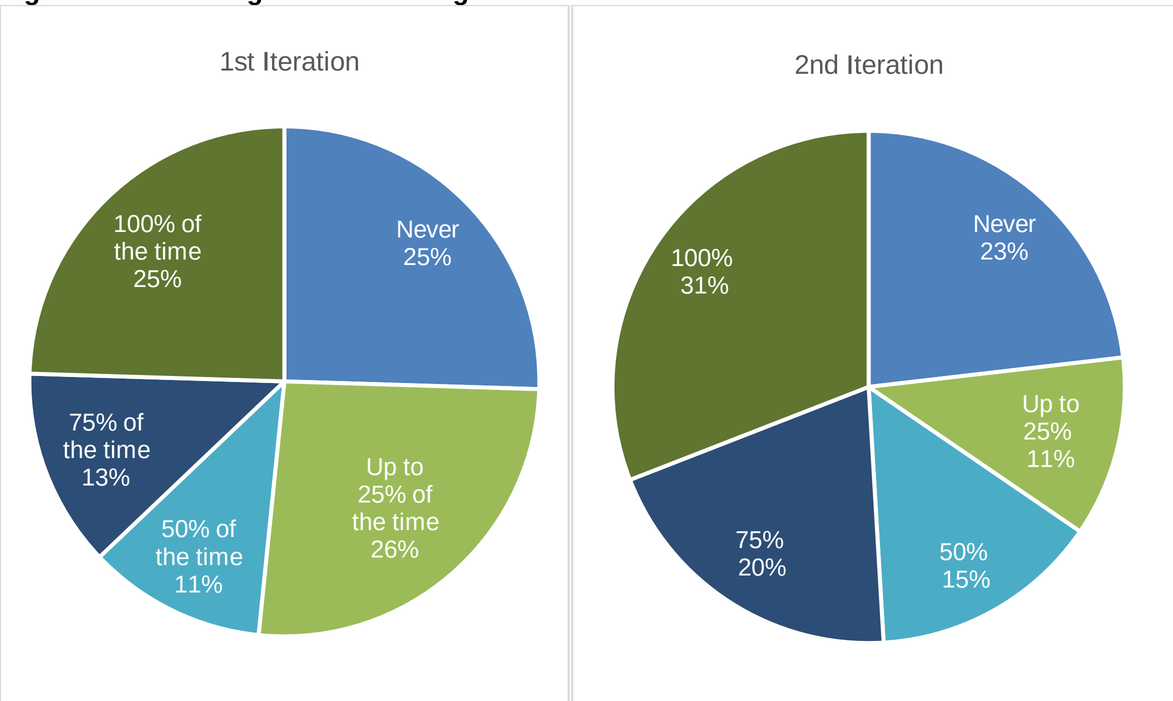
Table 4 – EVs and CPs at each depot at the time of the surveys

	June 2021 (1st iteration)		February 2022 (2nd iteration)		Total number of vehicles (EV & ICEV)
Depot	No. of EVs	No. of CPs	No. of EVs	No. of CPs	
Camden	6	3	12	3	37
Victoria	6	3	22	3	22
Orpington	9	3	18	3	28
Dartford	15	12	35	12	128
Bexleyheath	12	3	18	3	23
Islington	24	14	24	14	38
Mount Pleasant	87	47	125	47	192
Premier Park	47	27	49	27	111
Whitechapel	32	18	37	18	37
Total	**238**	**130**	**340**	**130**	**616**

3.1.2 Drivers' questionnaire results

EV use behaviour: Royal Mail does not assign vehicles to drivers, and so a driver may drive an ICEV on some of the days and an EV on others. Vehicles are often allocated on a first come, first served basis, with some drivers choosing ICEV or EV based on personal preference. At the time of the first and second questionnaire not all drivers had been trained to drive an EV. However, the majority of respondents (75%), during both rounds of the questionnaires, had some experience with EVs – a quarter of drivers exclusively drove an EV during first iteration, which increased to 31% during the second iteration (see Figure 3).

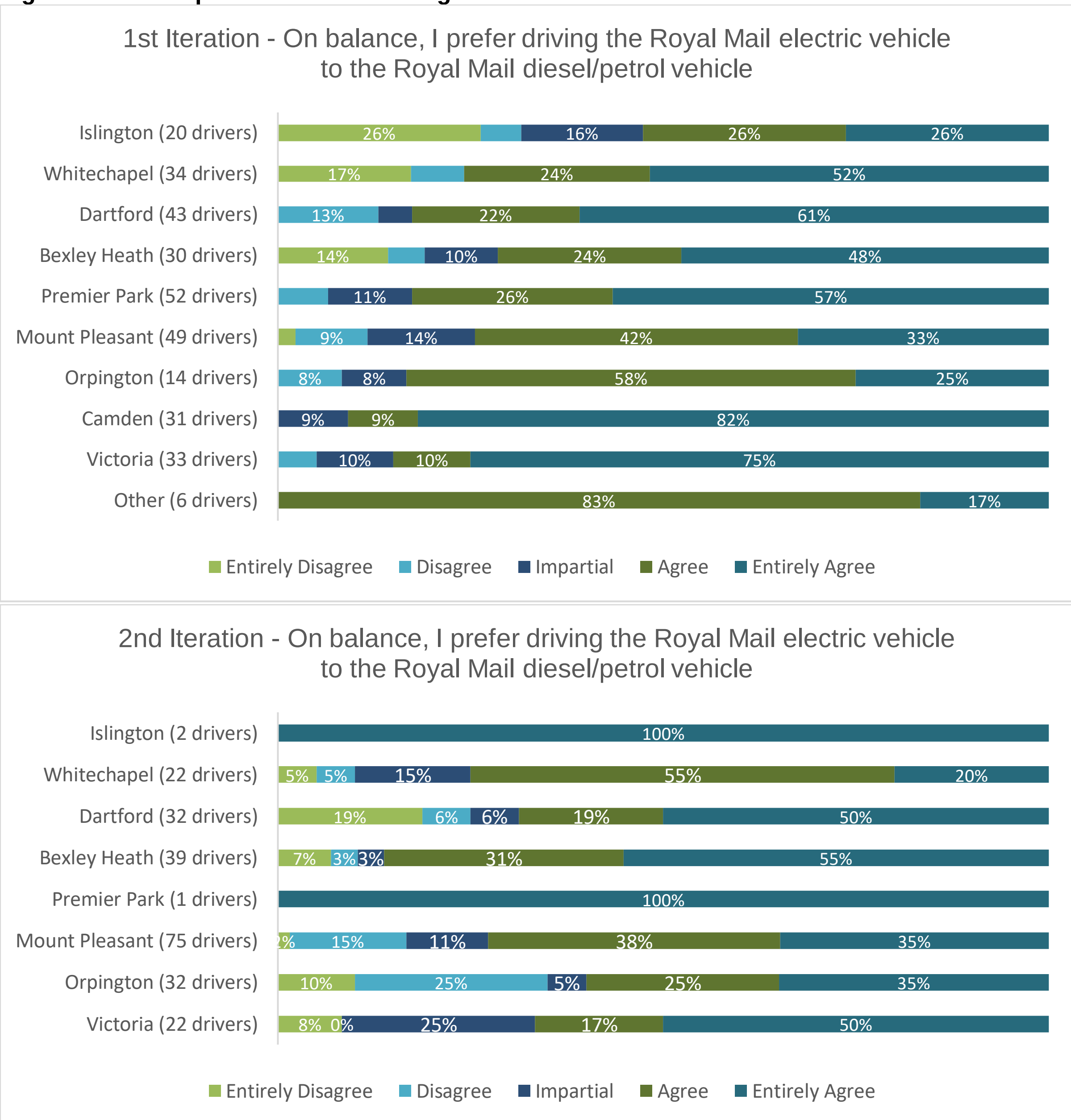
Figure 3 – Percentage of time driving an EV



As shown in Figure 4, below, drivers across all depots, in both iterations, preferred driving the EVs to ICEVs. However, in the first iteration, Islington stands out as an outlier with 26% entirely disagreeing with the statement "On balance, I prefer driving the Royal Mail electric vehicle to the Royal Mail diesel/petrol vehicle" and only 52% preferring to drive an EV. It is not clear why the views at Islington were different from the others, although concerns around impractical charging durations discussed in Section 3.1.2.4 offer a likely explanation.

Results from the second iteration were less aligned: both Dartford and Orpington depot present higher levels of disagreement with the statement, indicating that drivers became less favourable towards EVs. For Dartford this is at 25%, of which 19% entirely disagree, whilst for Orpington it is 35% of which 10% entirely disagree. This highlights the variation among depots, some of which may have experienced more issues with their EVs leading to a more negative outlook.

Figure 4 – Driver preferences on driving an ICEV vs. an EV van



EV drivers and non-EV drivers reported similar distances driven during the first and second round of the survey. The majority of drivers drive between 10-15 miles on a typical shift (Figure 5) with most driving less than 20 miles on a given shift (Figure 6). Telematics data (24/02/21 – 22/05/21) from seven of the nine Royal Mail depots shows that EV drivers typically drive 12.1 miles, compared with non-EV drivers at 18 miles per shift. The telematics data may include delivery and collection, explaining why it is higher than the typical distance reported by the drivers. The consistency in distances travelled among EV drivers rules out this factor as having played a significant role in the shift in attitudes seen between survey iterations.

Figure 5 – Mileage distribution during given shift

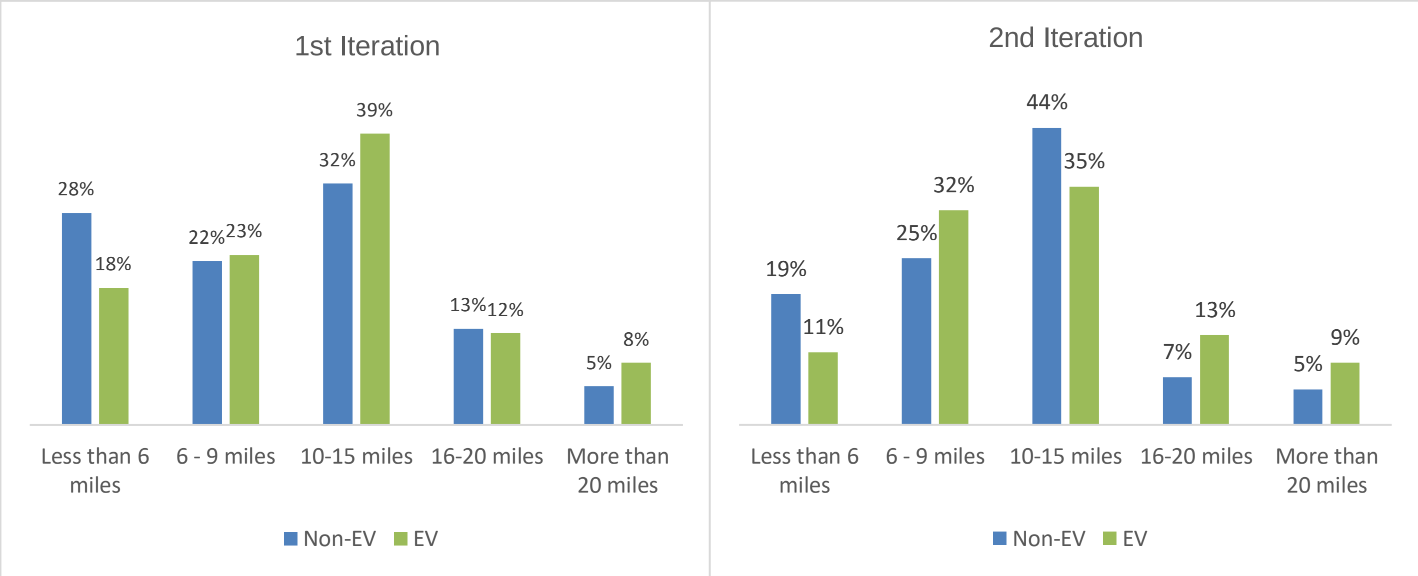
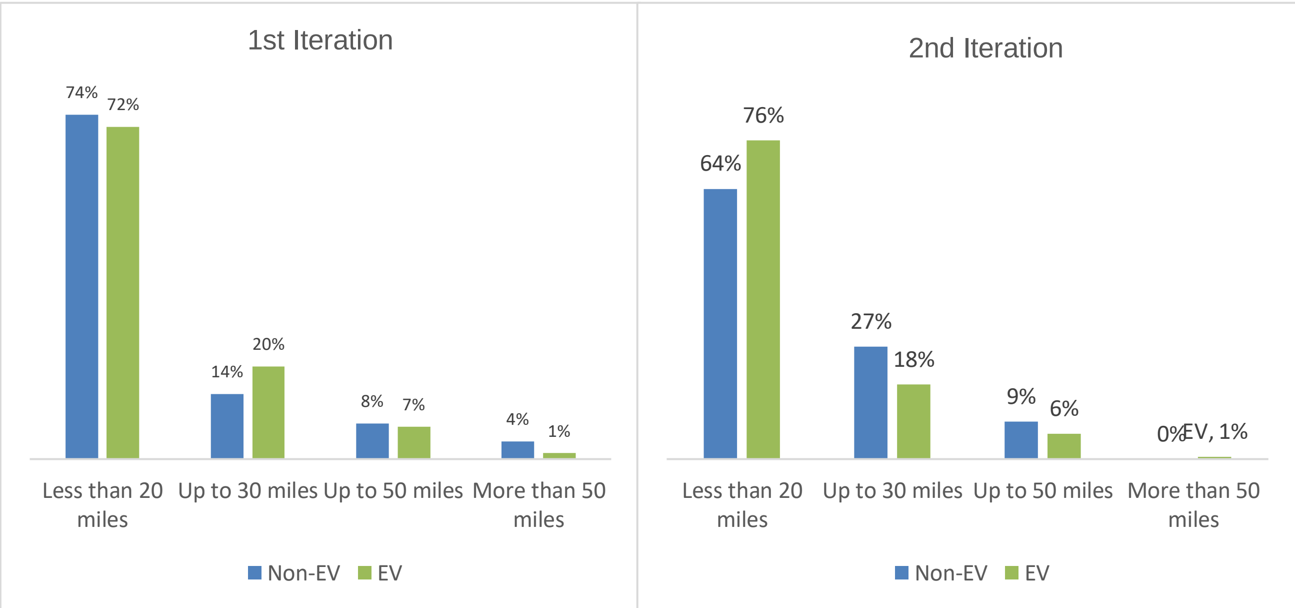
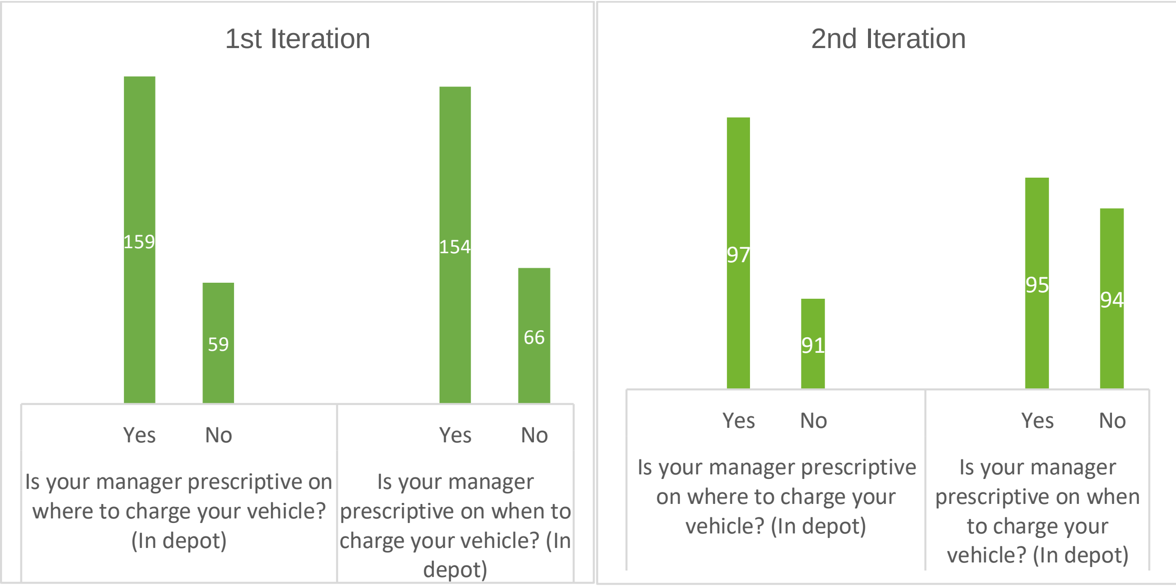


Figure 6 – Maximum distance during given shift



EV charging: The first iteration showed that 73% of EV drivers believe that their managers are prescriptive on where to charge and 70% for when to charge (Figure 7). At some depots, the number of vehicles was higher than the number of CPs, and drivers were plugging their vans in every other day. Royal Mail's strategy is to move to a 2:1 vehicle to socket ratio, which will require coordination regarding plug-in times and locations. It is expected that depot managers will issue clear instructions to drivers (or on the dashboard of each vehicle). In the second iteration of the survey there was no clear tendency towards a yes or no answer to either question – 50% of the drivers responded that their manager is not prescriptive on where to charge and 52% for when to charge (Figure 7). The decrease in management direction may be linked to increased experience with EVs among drivers who in turn require less direction.

Figure 7 – Drivers' view on management charging instructions



3.1.2.1 Opinions on Management Involvement

Royal Mail drivers and depot managers are not involved in decision making regarding vehicle technologies and were not directly consulted on the decision to switch to EVs. Their focus was instead on providing information and training and ensuring that impacts of EVs on daily tasks are minimised. Therefore, questions related to drivers' being consulted in the decision-making process were not asked.

Management involvement was seen very positively by the drivers in the first iteration, with 94% of EV and 91% of non-EV drivers agreeing that information and training was sufficient, and 91% of EV and 95% of non-EV drivers agreeing that management ensured that electrification had minimal impact on their tasks (Figure 8). Whilst management involvement continued to be perceived as positive by most non-EV drivers in the second iteration, those who agreed or strongly agreed that sufficient information and training was provided dropped significantly from 91% to 60%. Similarly, those agreeing that managers ensured the switch to EVs had minimal impact on their tasks fell from 95% to 46% - although the surge in those that were impartial accounts for this.

Ultimately, the second iterations show that non-EV drivers in particular felt a reduced level of support from management on the switch to EVs, which likely contributes to a lack of confidence and assurance among non-EV drivers on the transition.

Figure 8 – Management involvement first iteration

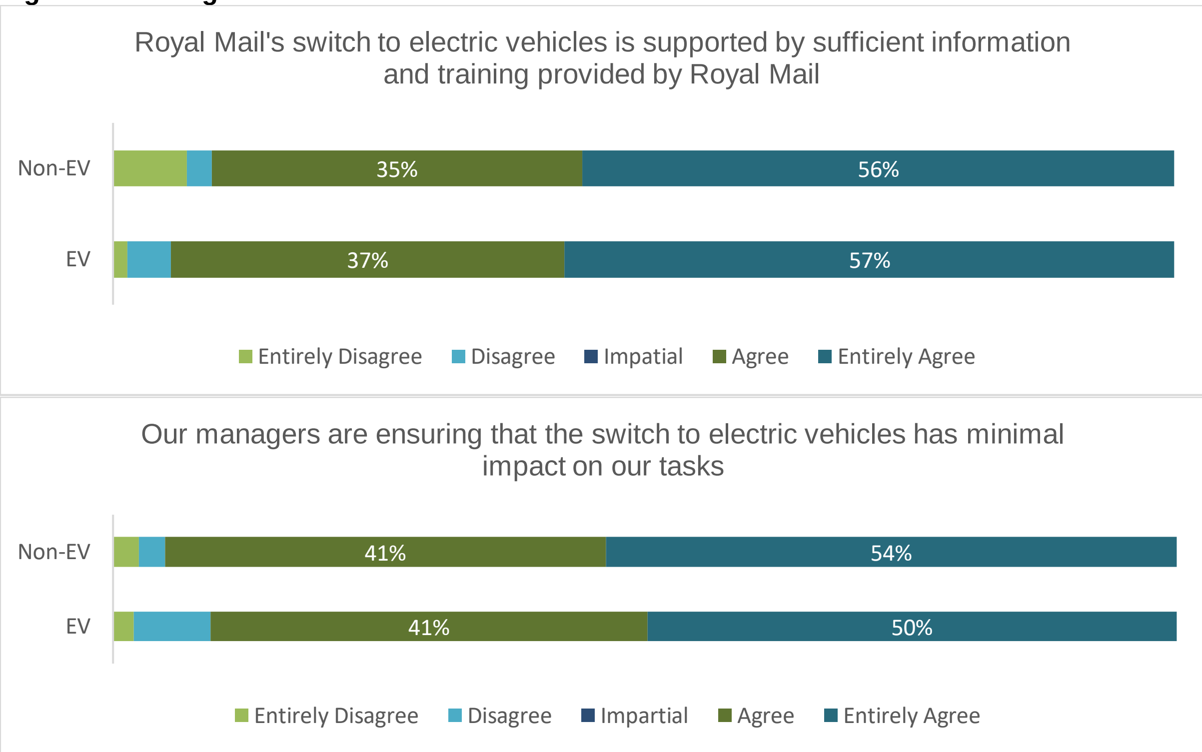
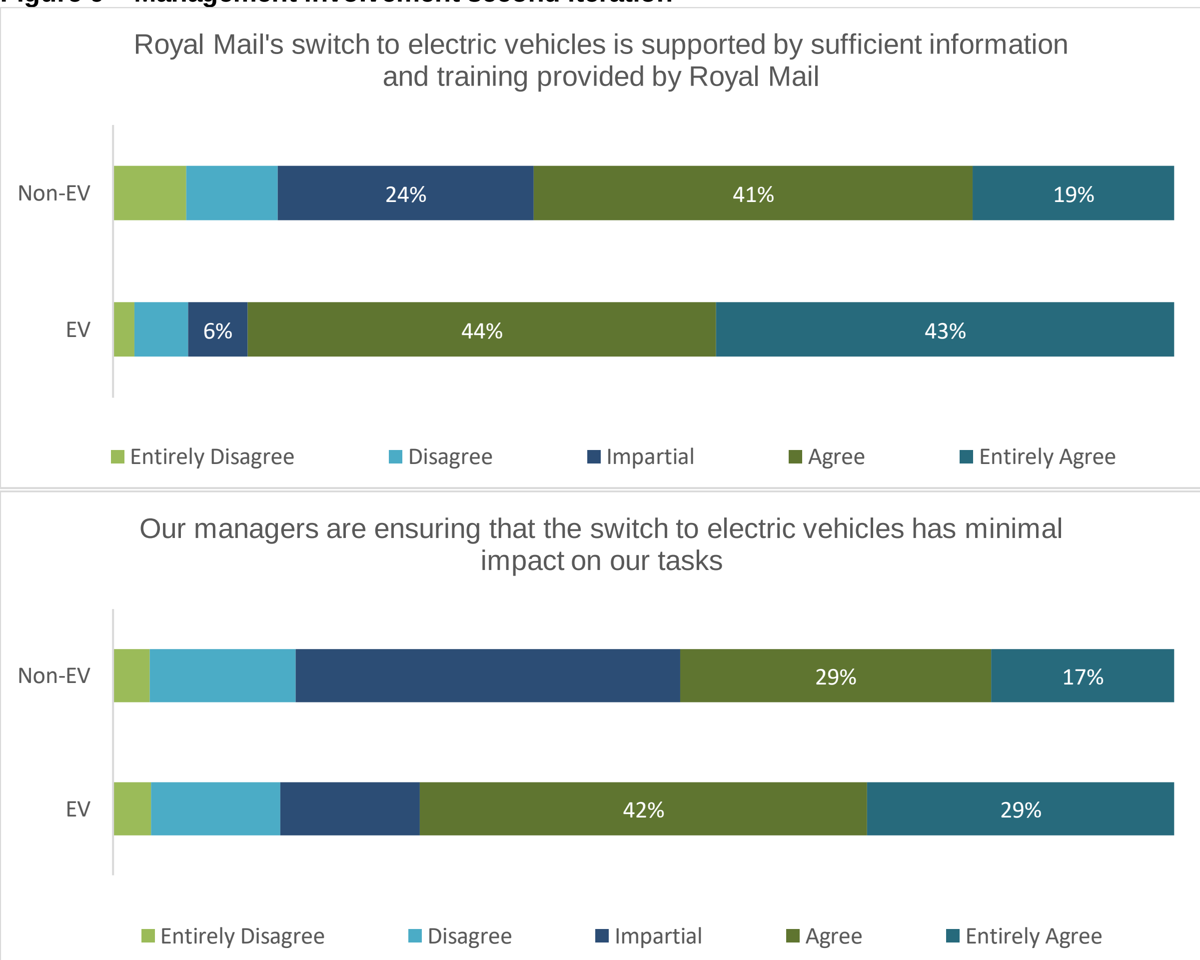


Figure 9 – Management involvement second iteration



3.1.2.2 *Performance Expectancy*

Performance of EVs (acceleration and noise) was regarded very positively by most drivers during first and second iteration of the survey (Figure 10 and Figure 11). However, during the first round of questionnaires, some drivers noted that the lack of noise was a potential problem for pedestrians. The drivers stated their preference for a reversing sound to make pedestrians aware of the EV. This has now been introduced by Royal Mail. During the second iteration, the positive responses slightly declined. Some drivers reported that although acceleration is very good, it appears to drop significantly once the battery level goes below 50%.

Figure 10 – Performance Expectancy first iteration

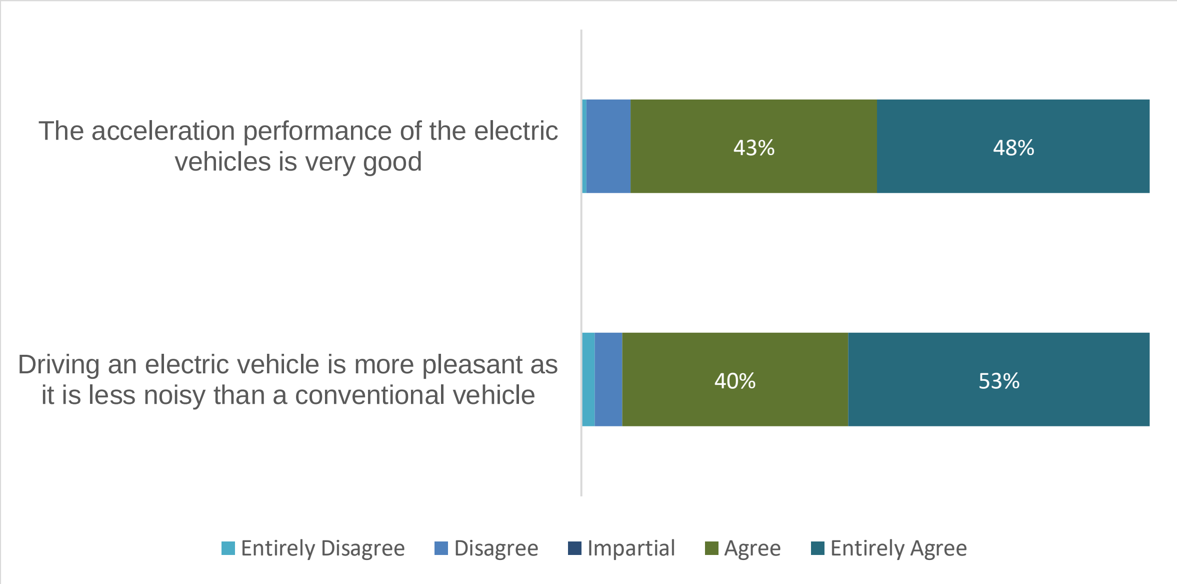
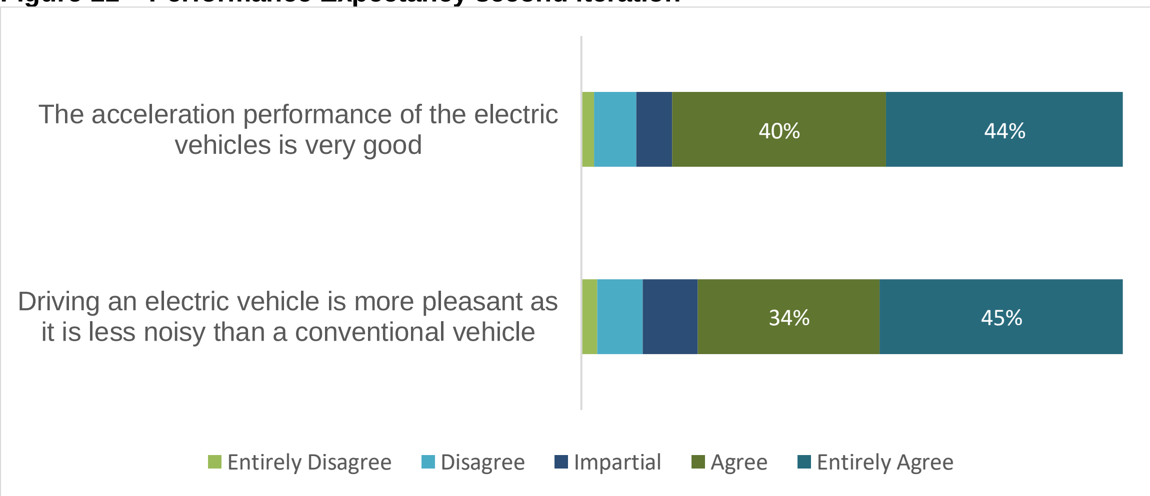


Figure 11 – Performance Expectancy second iteration



3.1.2.3 *Effort Expectancy*

Charging facilities: During the first iteration, availability of charging facilities was a concern among some EV drivers, 38% of which felt this was an issue compared to just 12% of non-EV drivers (Figure 64). This was more pronounced at some depots, including at Bexleyheath, where 60% of drivers felt that limited charging facilities made their daily work more problematic. During the first iteration the Bexleyheath depot had the highest vehicle to CP ratio and limited parking space, which required the vehicles to be moved around for charging, explaining their concern. Yet, 50% of drivers at Orpington also found that limited charging facilities hindered their daily work whilst many drivers noted that the pace of EV vehicles arriving at depots was not matched by the pace of CP installation.

In the second iteration of the surveys, undertaken eight months later, this problem became even more severe. Some drivers reported being unable to charge their vehicles due to lack of CP availability and no guarantee that their vehicle would be charged before their next shift. This is reflected in Figure 65, with 72% of EV drivers and 79% of non-EV drivers agreeing that limited charging point facilities makes it problematic to use an EV to fulfil daily tasks – up by 34% and 67% from the first iteration. Charging facilities in Royal Mail's depots present a huge barrier to non-EV drivers from making the switch, and for existing EV drivers, who find that using an EV is a hinderance to completing their tasks.

Figure 12 – Drivers' view on the impact of charging facilities on their daily tasks first iteration

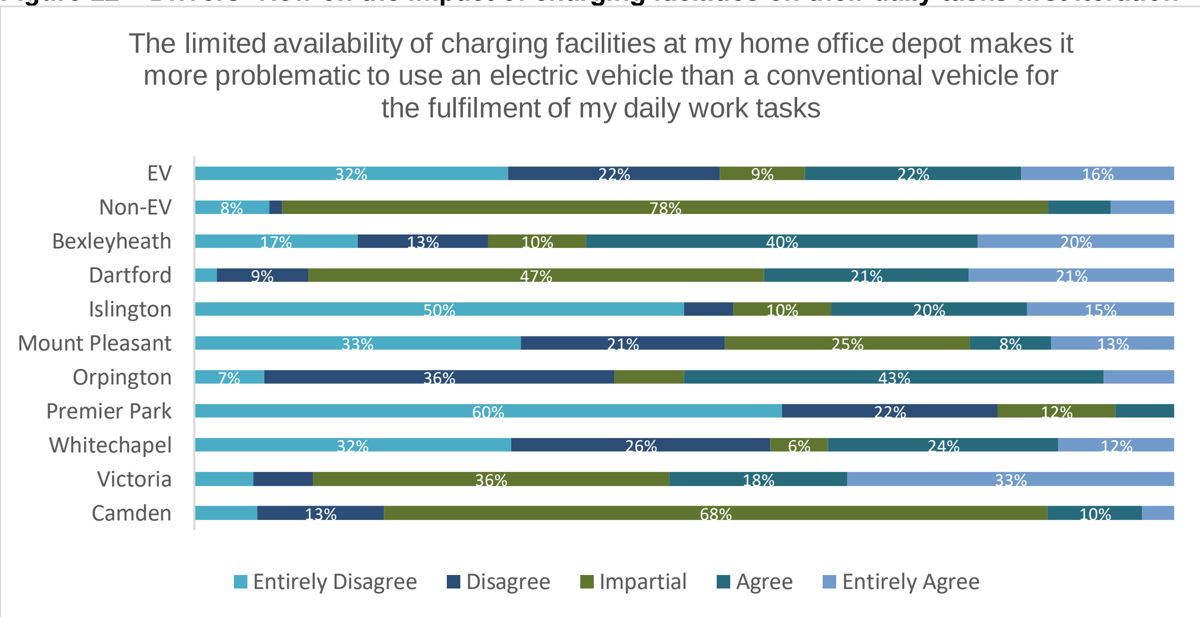
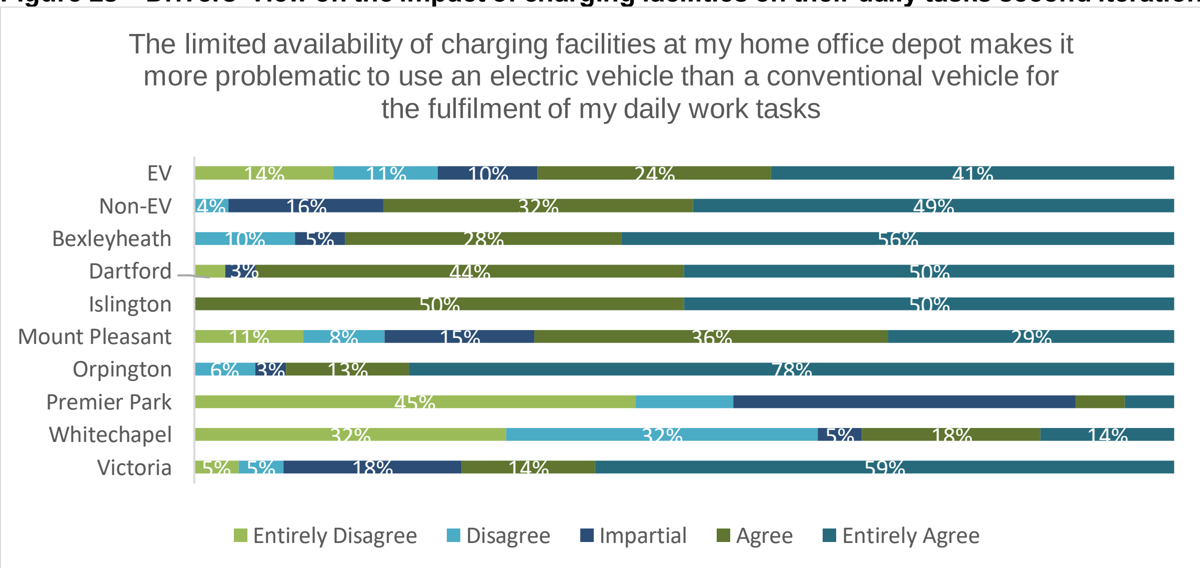


Figure 13 – Drivers' view on the impact of charging facilities on their daily tasks second iteration



Range: During the first iteration, EV drivers were positive about the range of EVs with 74% disagreeing that limited range of EVs makes daily work more difficult, which was expected given the short distances driven (Figure 14). During the second iteration, there were only 53% disagreeing with that statement. It is highly likely that this is partly caused by the second round of interviews being conducted during wintertime, since many drivers reported that range drops significantly when the heating is on (Figure 15).

Charging durations: During the first iteration only 28% of EV drivers agreed that long charging durations were impractical, but this increased by 12% by the second iteration, even though most vehicles charge overnight.

Interestingly, the EV Effort results from the Islington depot in the first iteration align with the overall EV Effort second iteration results, in that EV drivers based in Islington were already experiencing a higher effort required. 61% of the Islington drivers agreed that long charging durations of the vehicle are very impractical. This finding might explain why only 52% of Islington depot drivers answered that they prefer an EV to an ICEV in the first iteration – which was considerably lower than drivers in all other depots.

Figure 14 – EV Effort first iteration

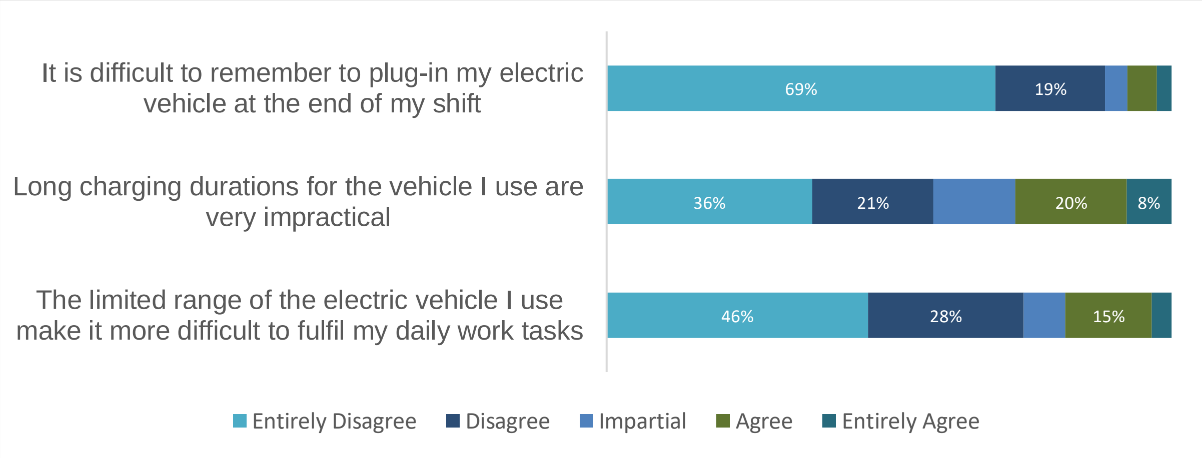
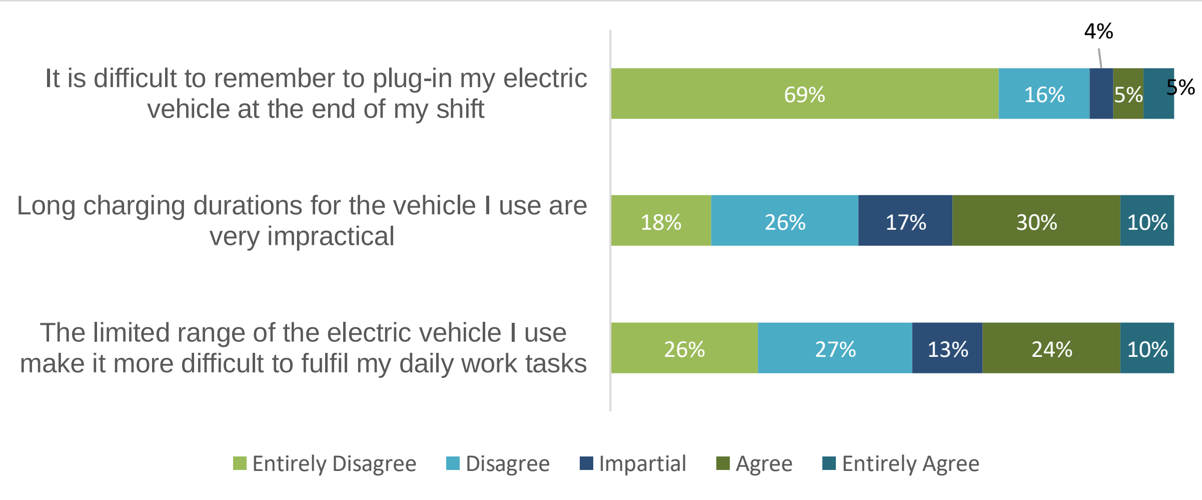


Figure 15 – EV Effort second iteration



3.1.2.4 Attitudes, Emotions and Social Influence

Drivers are positive overall about EVs, and this is relatively consistent across EV drivers and non-EV drivers and between depots. The only significant discrepancy between EV and non-EV drivers can be seen in Question AI4 (*I think that electric vehicles are generally cool and pleasant to drive*) in both iterations (Figure 16 and Figure 17). More EV Drivers agreed with that statement than non-EV drivers, who were more impartial. In the first iteration 86% of EV drivers replied positively compared to 52% of non-EV drivers. In the second iteration, 78% of EV drivers agreed with that statement compared to 48% from non-EV drivers. Question AI2 which states that EVs would be beneficial to the environment in the long term, scored the highest agreement number from EV and non-EV drivers across both iterations.

Figure 16 – Mean responses to Attitudes/Emotions & Social Influence questions – first iteration

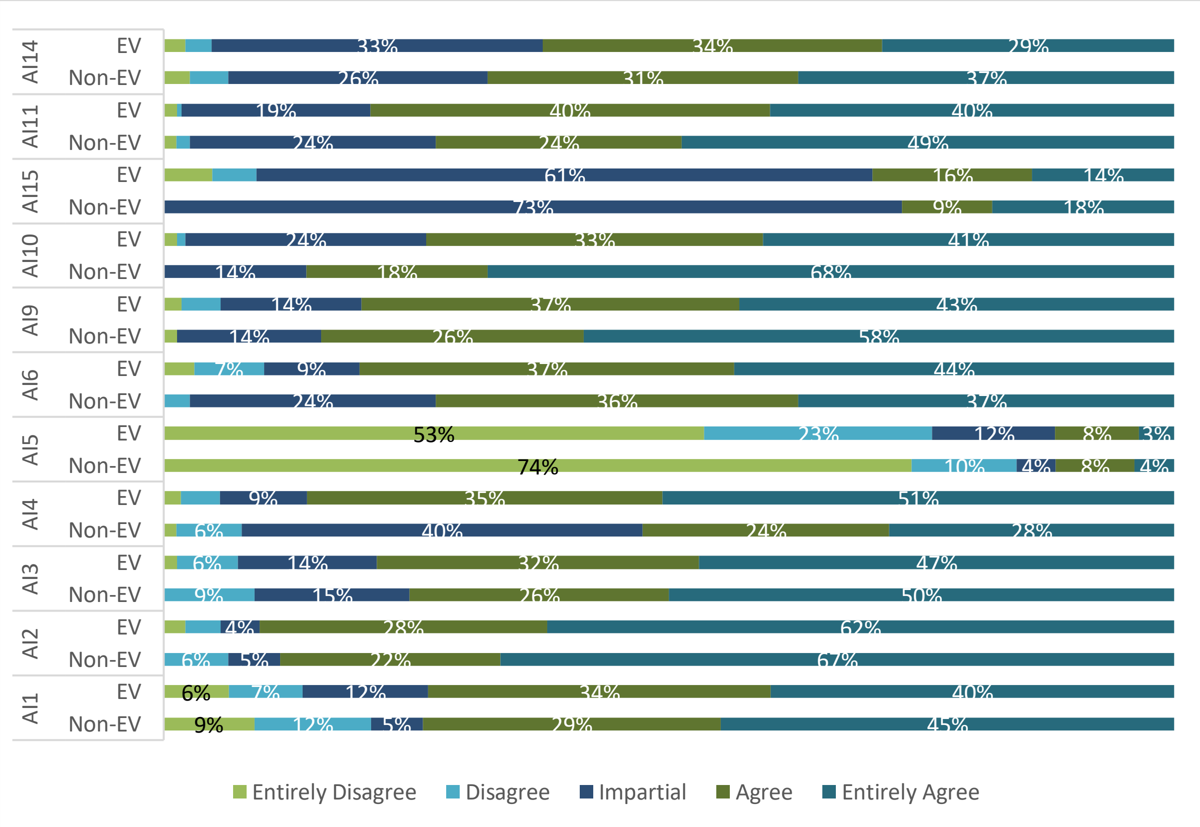
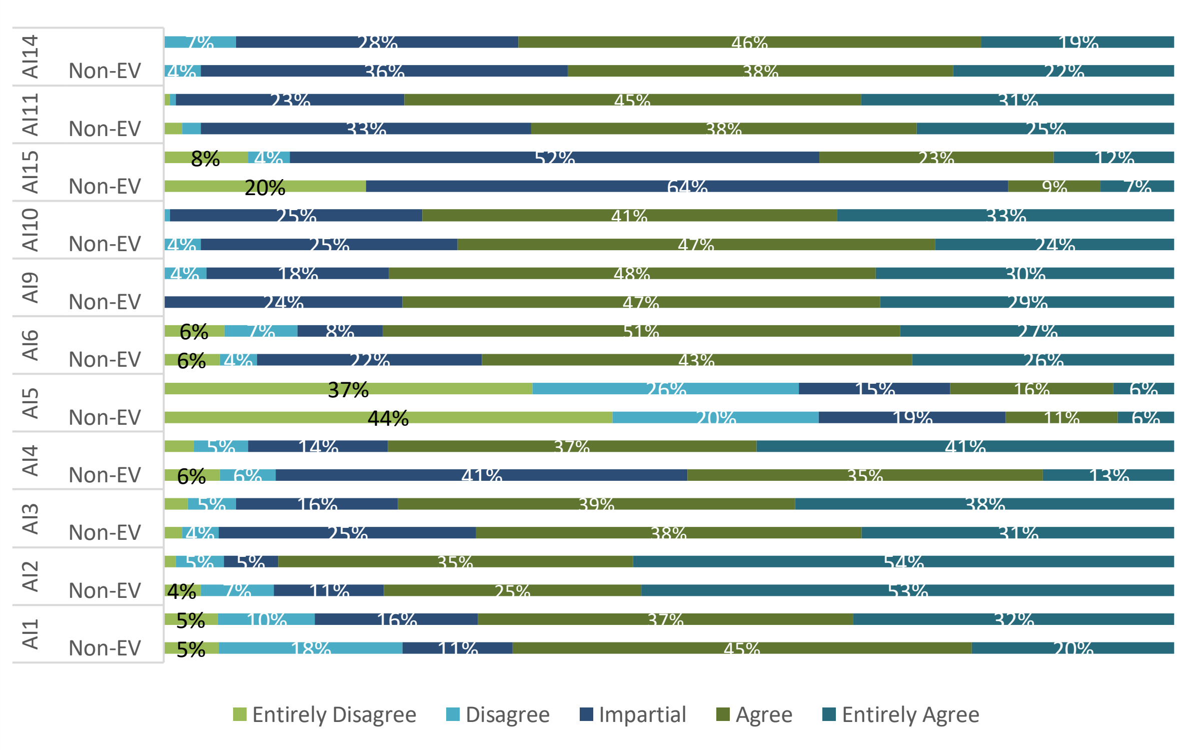


Figure 17 – Mean responses to Attitudes/Emotions & Social Influence questions – second iteration



3.1.2.5 *Summary of qualitative comments*

Figure 18 shows the frequency of keywords in the comments entered by the respondents in the first iteration. The lack of noise resulting in potential for collisions with pedestrians, as well as issues with charging/CPs were mentioned most frequently. Figure 71 shows that the most common keywords in the second iteration were charging and charging points, which reflects the increase in drivers who agreed that limited charging facilities impacted their daily tasks.

Figure 18 – Keyword Frequency, first iteration

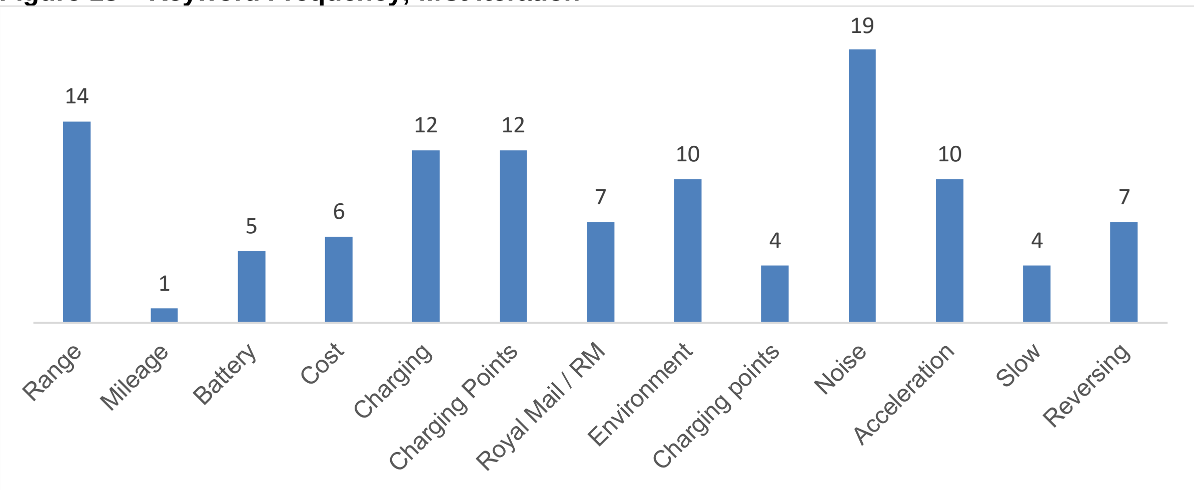
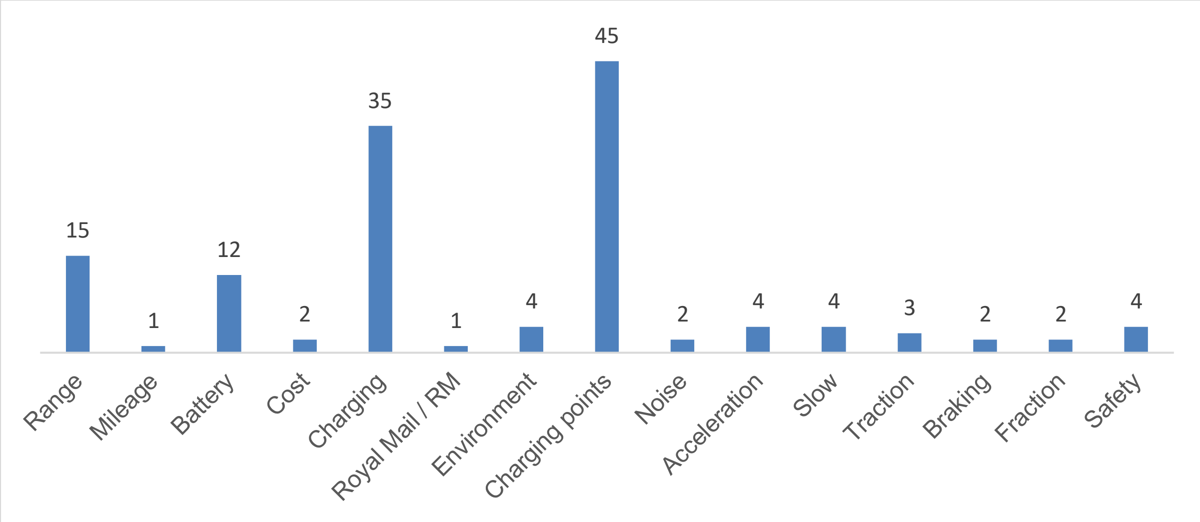


Figure 19 – Keyword frequency, second iteration



3.1.3 Depot Managers' questionnaire results

3.1.3.1 Overview

The Depot Manager's role is focused on operational responsibilities, such as scheduling, staff management, and coordination of vehicle availability. A depot may have several Depot Managers (specific job titles may differ). Depot Managers are not responsible for the success of the rollout of EVs or the charging infrastructure within their depots. They also do not have responsibility for the running costs, such as electricity and fuel. 15 Depot Managers responded to the first questionnaire.

Results from the first iteration show that only 37% of depot managers had driven the EVs (Figure 20). This number increased to 100% during the second iteration. However, the number of respondents during the second round of questionnaires decreased from 15 to five (80% of which had also responded to the first iteration). Regarding decision-making on vehicle technologies, fleet management, and energy management technologies, 50% of depot managers believed that decisions are highly centralised in the first iteration (Figure 21). This increased to 80% of the respondents during the second iteration, indicating Depot Managers' lack of influence.

Figure 20 – Frequency of depot managers driving EVs

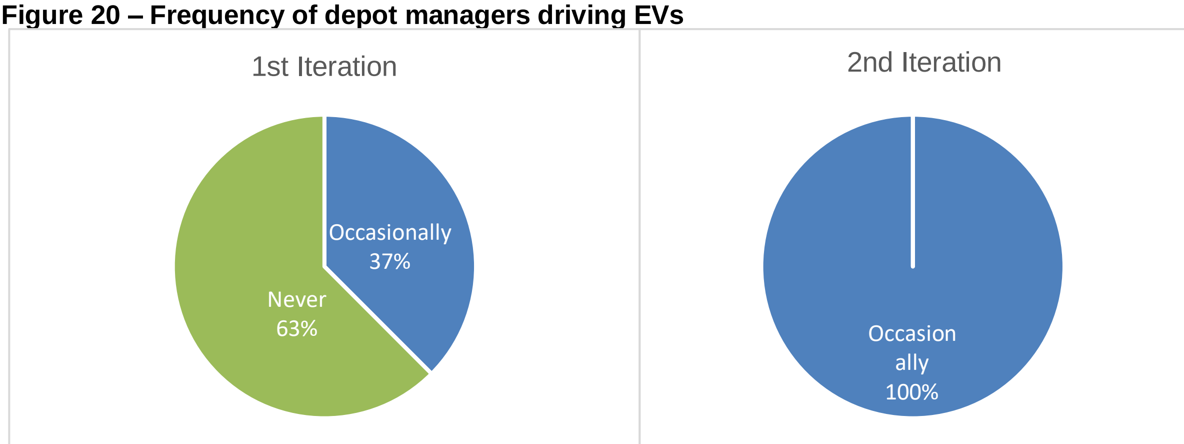
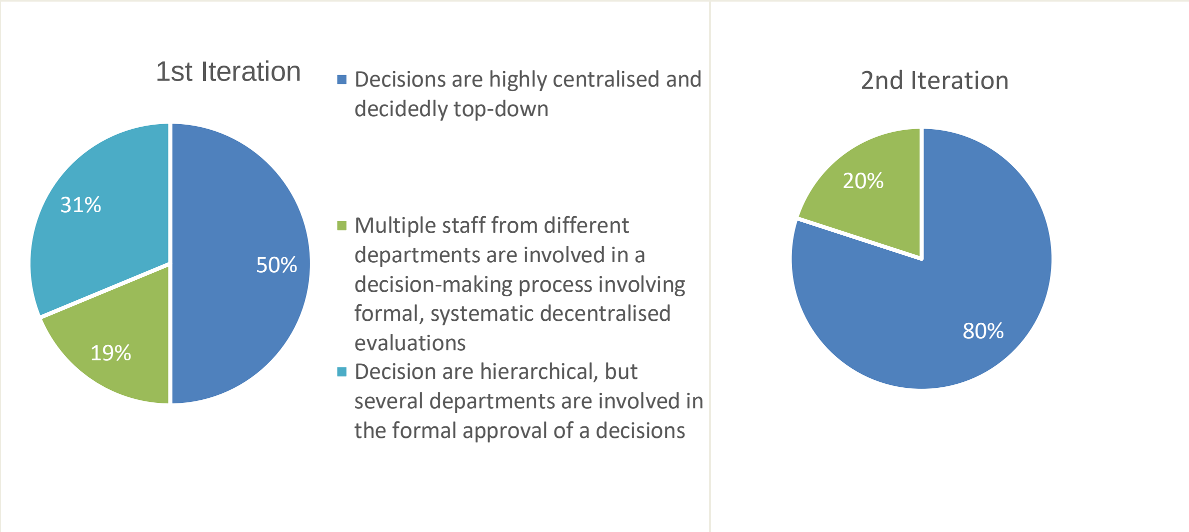


Figure 21 – EV decision drivers

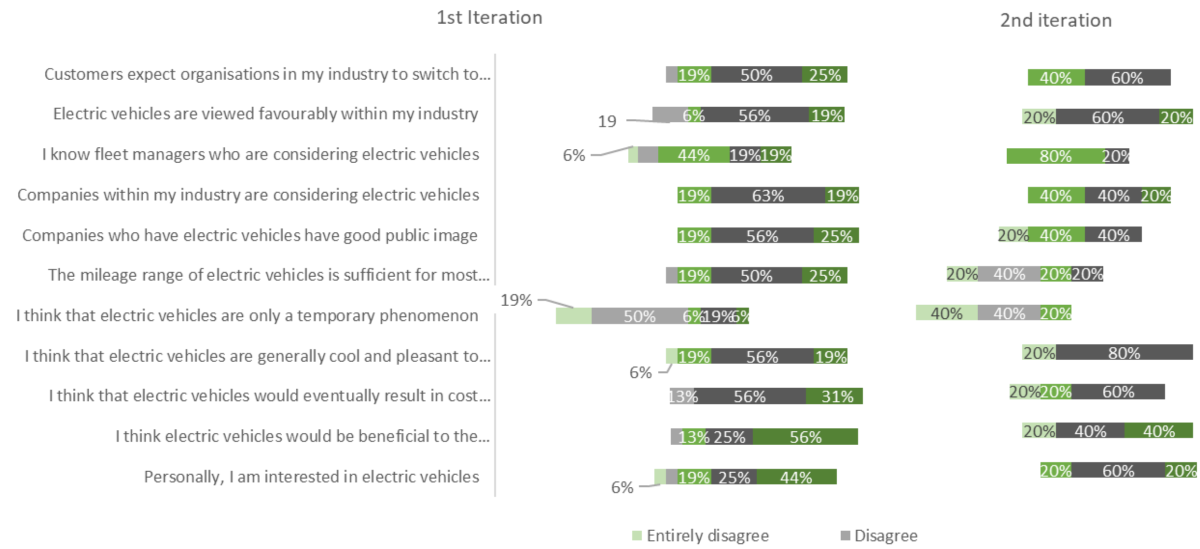


3.1.3.2 Attitudes, Emotions and Social Influence

During the first iteration of the questionnaire, 87% of depot management agree that EVs will result in cost savings in the industry, compared to 79% of EV drivers and 76% of non-EV drivers (Figure 22). During the second iteration, the number of Depot Managers who agree with that statement decreased to 60%, while the drivers remained at a higher level with 77% agreement from EV drivers and 69% from non-EV drivers. The disproportionate decrease in the confidence of management, compared to drivers, towards the ability of EVs to deliver cost savings may reflect the different priorities and experiences of management, although the low number of responses from management weakens the conviction of this finding.

A significant difference was found in the response to the statement that “mileage range of EVs is sufficient for most shifts” between survey iterations. While the percentage of drivers who agreed with this statement remained high for both iterations, Depot Managers that agreed fell from 75% in the first iteration to 20% by the second iteration. Whilst this could be linked to higher battery usage during the winter, no comments were received to substantiate this. Other factors are likely at play due to the magnitude of the shift.

Figure 22 – Mean manager responses to Attitudes/emotions and social influence questions



3.1.3.3 *Summary of qualitative comments*

One issue repeated in comments across both iterations was regarding breakdown recovery and servicing. In both instances, the problems identified were due to the length of time it takes to service EVs, slow recovery of a breakdown and limited support provided during a breakdown.

3.1.4 Corporate Management

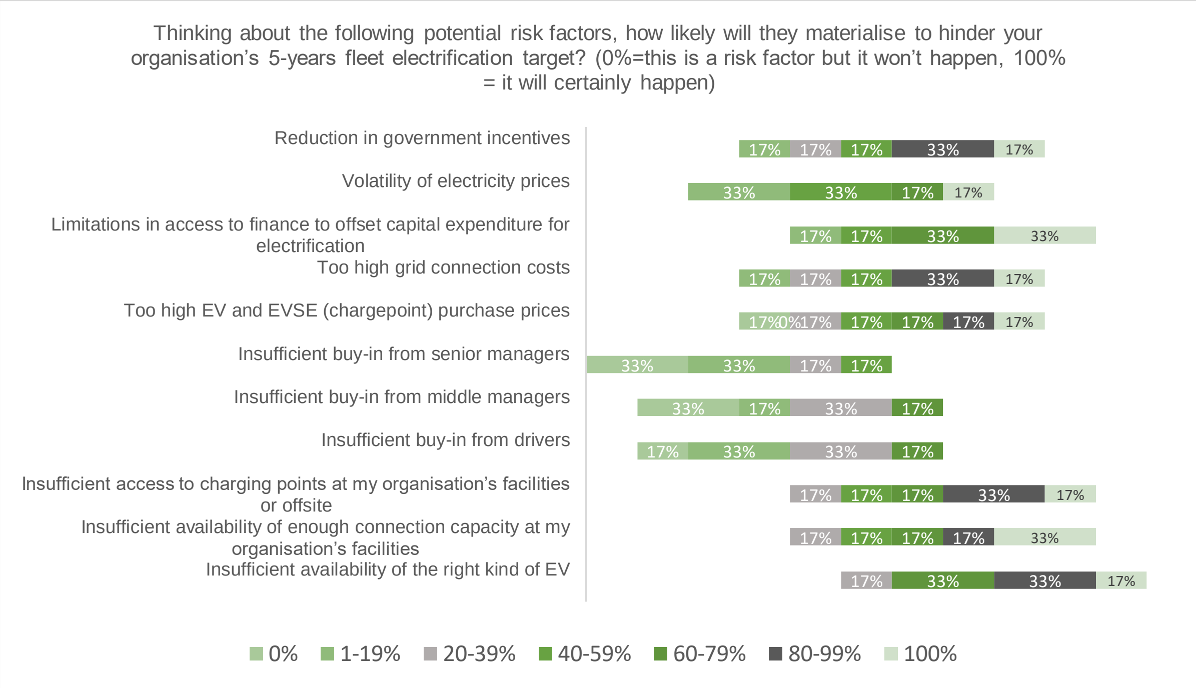
3.1.4.1 *Overview*

All survey participants were aware of EVs and smart charging either being used or planned to be used. Five out of six were aware that data monitoring and software technologies to optimise energy/fuel use were in use or planned to be used. However, only one member of management was aware of an organisation-wide target for EV penetration over the next five years, which they said to be 'Up to 30%'.

3.1.4.2 *Risk to EV adoption*

A lack of buy-in from staff at different organisational levels (senior management, middle management or drivers) is seen as least likely to hider the transition to EV, while insufficient availability of the right type of EVs and insufficient connection capacity are seen among the biggest risks (Figure 23).

Figure 23 – EV risk factors



3.1.4.3 *Barriers to EVs*

Participants were asked to list the most important external barriers to the full electrification of their fleet. Lack of availability or supply of the right type of vehicles is seen as the main barrier by all respondents. There is also awareness of the electricity network capacity issues, with five out of the six respondents referring to this.

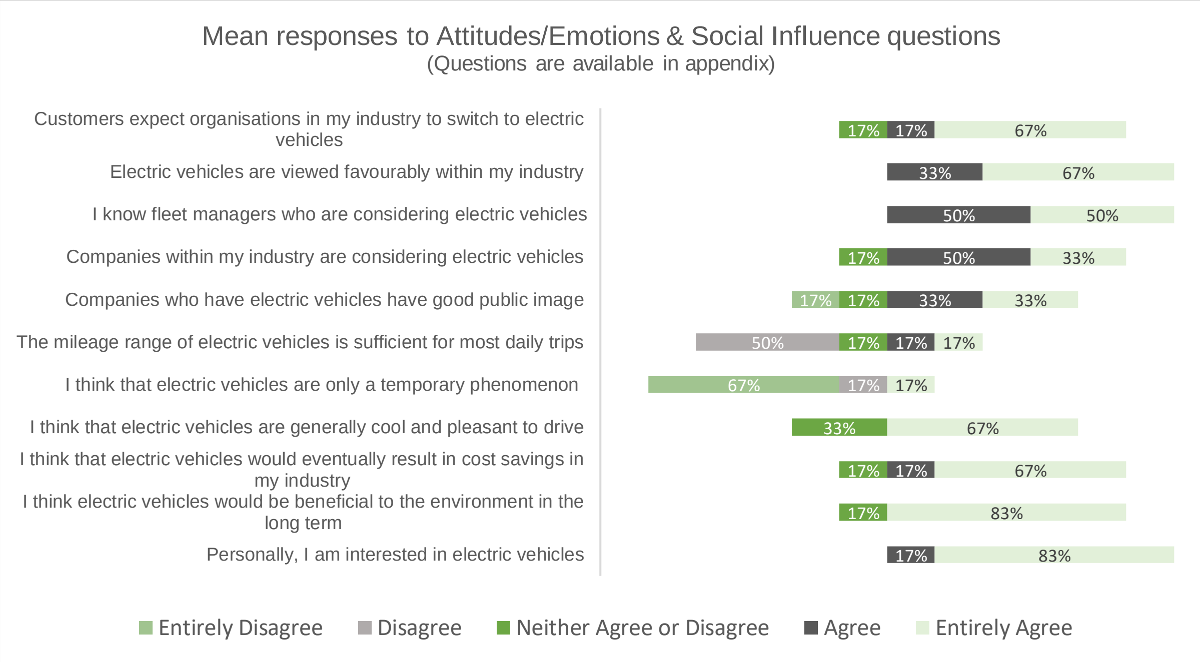
3.1.4.4 *Enablers to EVs*

Participants were also asked to list the three most important external enablers to the full electrification of their fleet. The responses were mostly around government action (legislation or incentives), cost effectiveness and ability to reduce the environmental impact of the company.

3.1.4.5 *Attitudes, Emotions and Social Influence*

Overall, Corporate Managers have a positive view of EVs and have all expressed personal interest in them. However, they hold concerns around the range of the EVs, highlighted by only 34% agreeing that it is sufficient for most daily trips (Figure 24). This question did not focus on the use of EV for Royal Mail purposes, so it is likely that this is a broad concern, rather than specific to the range requirements of Royal Mail's corporate fleet.

Figure 24 – Management Attitudes/Emotions and Social Influence responses



3.1.5 Summary of key learnings

Royal Mail drivers ultimately prefer EVs to ICEVs

Although the level of agreement varied from depot to depot, both iterations showed that overall, drivers prefer EVs to ICEVs. The number of drivers preferring EVs did drop slightly in the second iteration due to the uncovering of further issues and concerns amongst non-EV and EV drivers alike.

EV effort appears to increase as drivers become slightly more experienced with EVs

By the second iteration, fewer drivers disagreed that "the limited range of EVs make it more difficult to fulfil daily work tasks", pointing to the growing prevalence of range anxiety. This aligns with depot managers' views – those who agreed that milage is sufficient for most shifts declined to just 20%. More drivers in the second iteration also agreed that long charging durations are very impractical. The growth in concerns with EV range and expected effort indicates the presence of a behavioural barrier to EVs, making it imperative to address through increasing the confidence and knowledge of non-EV drivers.

Limited charging facilities negatively impacts drivers' perception of their ability to fulfil daily work tasks

The number of EVs across depots cumulatively increased by 42% by the second iteration of drivers' questionnaires, yet the number of charging points remained the same. This appeared to have a large impact on responses in the second iteration of surveys. The number of drivers who agreed that limited availability of charge points made it more problematic to complete their daily work tasks increased from 31% to 73%. It is crucial to address this and ensure charge point accessibility to improve drivers' confidence towards electrification.

EVs are seen as beneficial to the environment in a long term

EV drivers, non-EV drivers and depot management all voiced agreement that EVs are beneficial environmentally in the long-term. The ability to reduce the environmental impact of the company was also mentioned as among the biggest enablers for EV adoption by corporate management.

EVs are seen to result in cost saving in the industry

This statement received a high percentage of agreement across both iterations both from drivers and depot management.

Risks, barriers, and enablers of EV adoption were identified by surveying corporate management

The insufficient availability of the right kind of EVs seen as the biggest risk and barrier to EV adoption, whilst government actions (legislations or incentives) were viewed as a leading enabler to EV adoption.

3.2 Centrica

3.2.1 Overview of the Surveys

The Centrica surveys were targeted at British Gas drivers and managers responsible for fleet operations. There were 108 responses to the first survey which remained open for 24 days having been distributed amongst Centrica's British Gas engineers internal Yammer message-board on the 23 February 2021. The second survey remained open for 25 days from the 1 October 2021, was distributed in the same way, and yielded 230 responses (Table 5).

Table 5 – Descriptive Statistics of the Centrica British Gas Behavioural Surveys.

	First Iteration	Second Iteration
Distribution Period:	23 February 2021 to 18 March 2021	1 October 2021 to 25 October 2021
Distribution Method:	Centrica via internal Yammer message-board	Centrica via internal Yammer message-board
Total Responses:	108	230
EV Responses:	19 (22% total EV fleet)	86 (12% total EV fleet)
ICEV Responses:	89 (82% of total responses)	144 (62% of total responses)
Demographic:	97% Male Median Age of 35-44	97% Male Median Age of 35-44
Returning Respondents:	Overall, 30 repeat responses were received in the second iteration from those that responded to the first iteration.	

Despite the count of EV respondents being far higher in the second iteration, this represented a relative decrease in the proportion of the EV fleet compared with the first iteration. The 19 drivers who responded to the first survey constituted 22% of Centrica's total EV fleet at that time, whereas the 89 who responded to the second survey represented 12%. Centrica's EV fleet roll-out had progressed significantly during the Optimise Prime project, resulting in a larger pool of engineers driving EVs by the time of the second iteration.

There were 30 repeat respondents who answered both the first and second iterations of the survey. 13 of these drivers responded to the first iteration as ICEV drivers but answered the second survey as EV drivers. This gave valuable insight into how opinions about EVs can shift once a driver has experienced driving one.

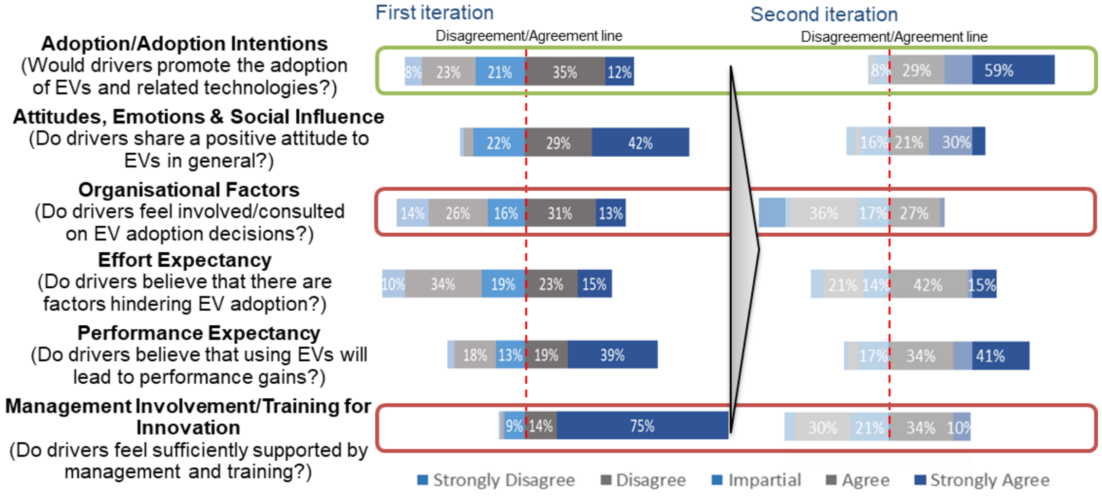
3.2.2 General Results

Following the FAST framework methodology, outlined in section 0, there were some immediately observable changes to the six fundamental variables measured across the first and second surveys:

- Adoption intentions
- Attitudes, emotions & social influence
- Organisational factors
- Effort expectancy
- Performance expectancy
- Management involvement/training for innovation.

There was a positive change in measurements of adoption intentions. However, there were noticeable negative shifts in perceptions of organisational factors and management involvement/training for innovation (see Figure 25). When examining these results, it is important to note the real-world context in which they were answered. The timing of distribution may have had implications on how positively or negatively the engineers would respond to matters concerning their beliefs about their organisation at that time. The statistical significance of these changes is discussed later in the report. Nevertheless, there is a clear improvement in the extent to which British Gas drivers would promote the adoption of EVs and related technologies in their organisation.

Figure 25 – Overview of the aggregated results according to the FAST framework for both the first and second iterations of Centrica's behavioural surveys



For presentation purposes, 7-point scale was aggregated to 5-point. Neutral responses showed on a disagreement side

There were further changes between the first and second iterations (see Figure 26). The results of the first survey showed EV drivers reporting lower mileages than ICEV drivers, estimating their typical distance at 50 miles per day and 90 per day respectively. It was perhaps unexpected that EV drivers would report driving further than ICEV drivers in the second survey for both the average typical distances they covered, as well as their maximum distances covered per day.

35 EV drivers (40%) reported driving further than the average typical daily mileage of their ICEV driving counterparts. 34 of these 35 reported that they plugged in their vehicle to charge at home, and only one disagreed that free parking would make it easier to use EVs. Although it is unreliable to make any absolute conclusions from this, these results do indicate a relationship between a driver's ability to charge their vehicle at home and their confidence or ability to drive long distances while fulfilling their daily tasks.

Figure 26 – Self-reported daily mileages driven by British Gas drivers for both the first and second iterations

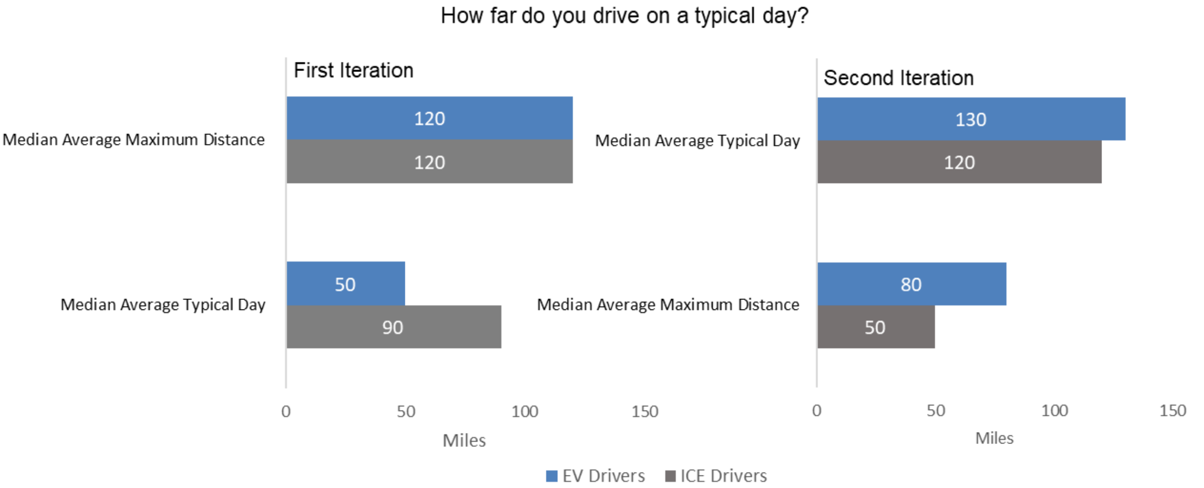
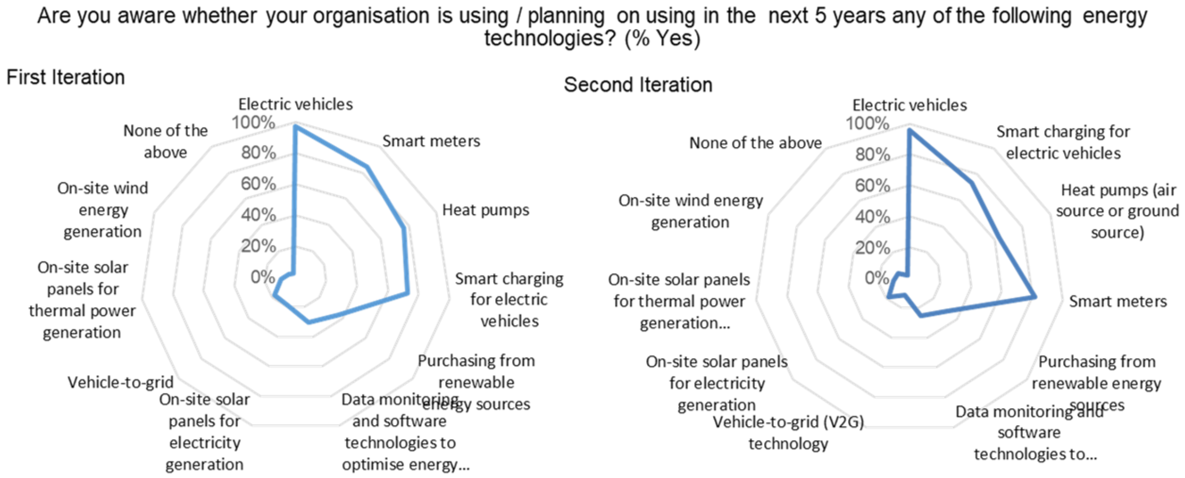


Figure 27 – Awareness of technologies amongst British Gas drivers, from both the first and second iteration



The reported awareness of well-known low-carbon technologies amongst the drivers remained relatively consistent across the two surveys, as illustrated by Figure 27. In both instances, reported awareness was high for EV roll-out in Centrica's fleet, as well as for smart meters and the implementation of smart charging.

Answers on typical charging behaviour cannot be tracked from the first to the second iteration since the wording of the question was changed. The results for both iterations are in Figure 28 and Figure 29.

Figure 28 – Responses on charging behaviour from the first iteration

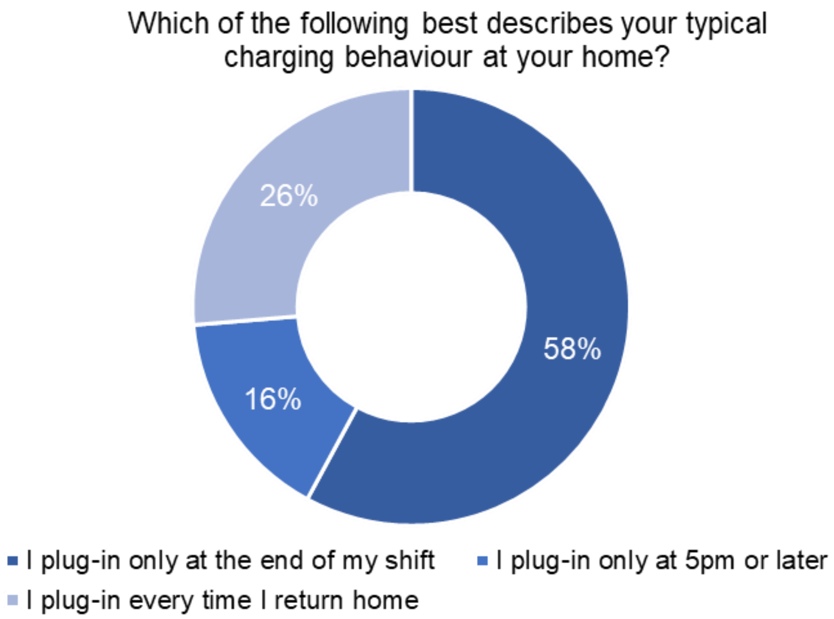
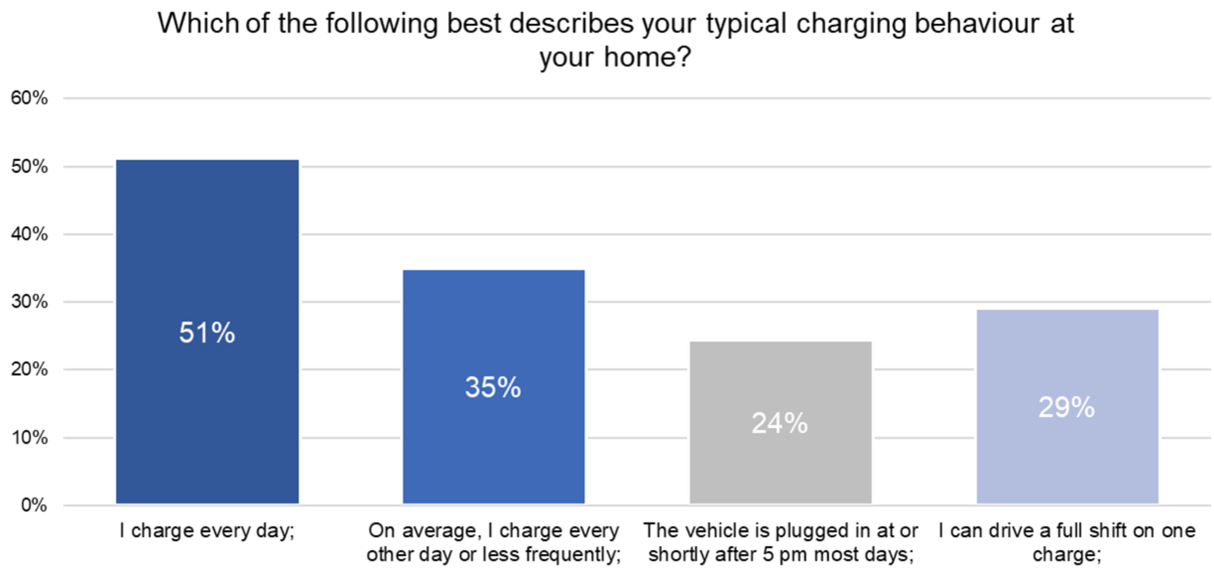


Figure 29 – Responses on charging behaviour from the second iteration

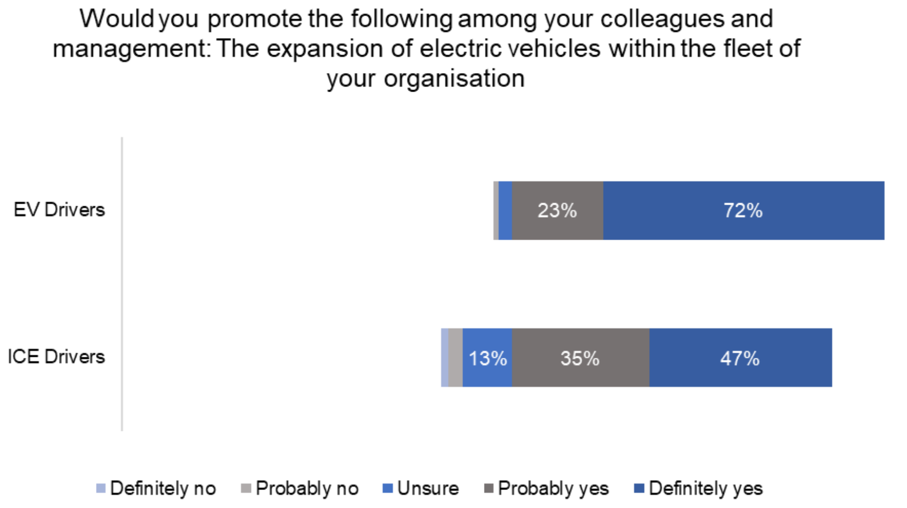


3.2.3 FAST Framework Analysis

3.2.3.1 *Adoption Intentions*

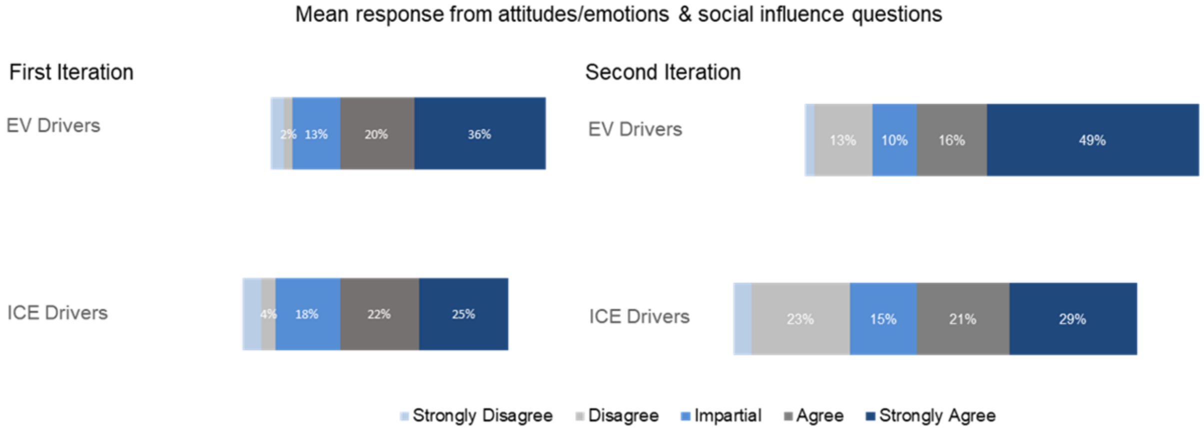
The levels of advocacy British Gas drivers had for adopting EVs remained steadily positive from the first to the second iteration. The results from both surveys showed that 82% of ICEV drivers would promote the transition to EVs. There was a 1% increase in the proportion of EV drivers who would do the same, with 95% in the second iteration compared with 94% in the first iteration (Figure 30). This suggests that there is significant and stable support within Centrica for introducing an electric fleet.

Figure 30 – Adoption Intentions results from the second iteration



3.2.3.2 *Attitudes, Emotions and Social Influence*

Figure 31 – Mean results for Attitudes, Emotions and Social Influence responses for both the first and second iterations

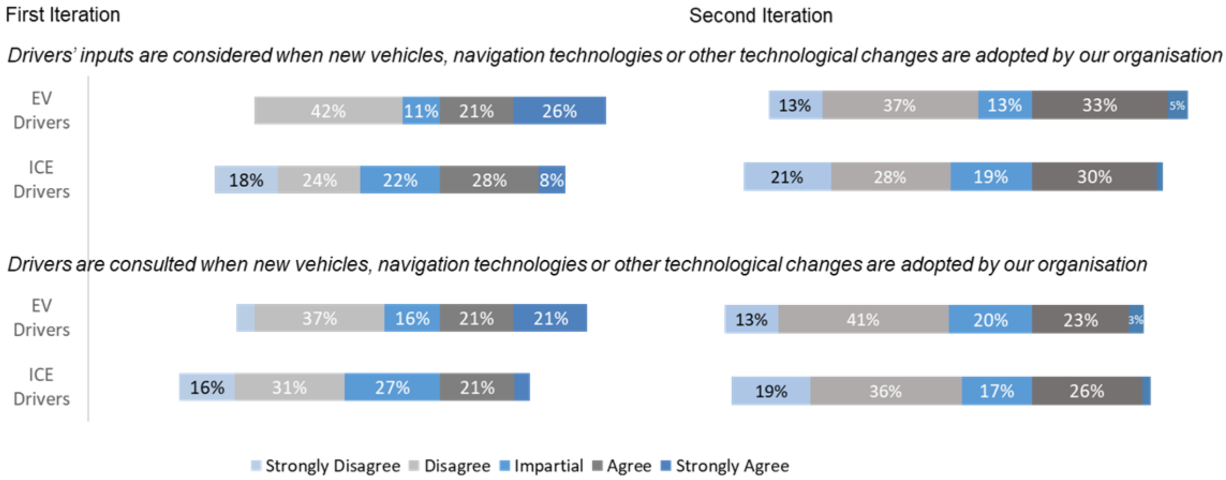


The surveys measured similar levels of attitudes, emotions, and degrees of social influence on EVs amongst the British Gas driver sample (Figure 31). In both iterations, over half of EV drivers exhibited positive attitudes towards EVs and EV adoption in the industry. Across both iterations again, there were higher rates of agreement among EV drivers compared to ICEV drivers.

3.2.3.3 *Organisational Factors*

EV drivers feel less connected to technology adoption decisions than they did in the previous survey. 38% (down from 47%) drivers said their inputs are considered, and 26% (down from 41%) feel consulted about the adoption of new technology (Figure 32).

Figure 32 – Responses on Organisational Factors from both the first and second iterations

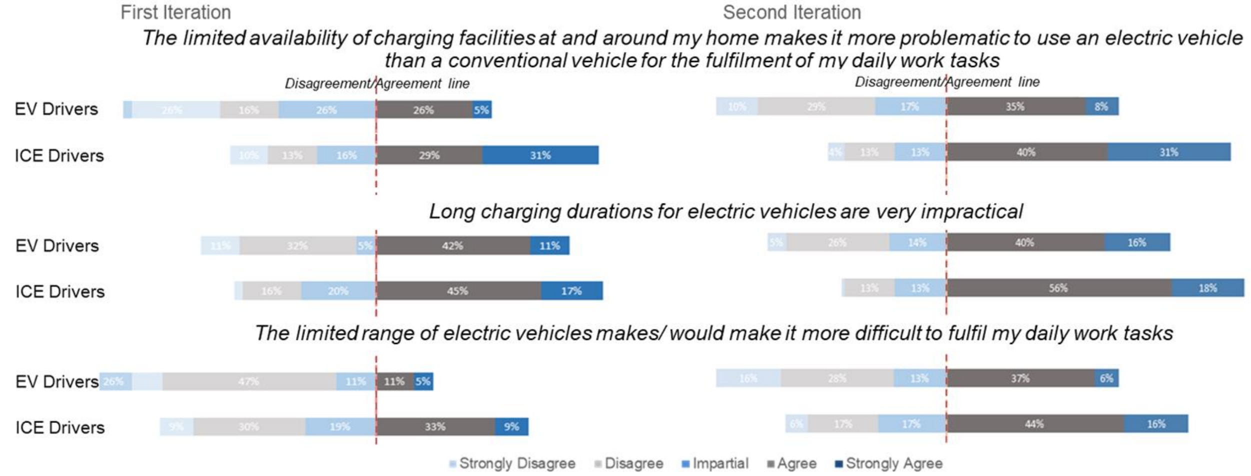


3.2.3.4 *Effort Expectancy*

The range of an EV became a common concern amongst EV drivers by the time of the second survey (Figure 33), with 43% agreeing that the limited range of EVs makes their work more difficult (up from 16%). This could be explained by the increase of the EV fleet roll-out since the first iteration. It is possible that the engineers who held more favourable attitudes towards EVs would be prioritised first in the roll-out and therefore perhaps had more positive perceptions on EV range. However, as more and more EVs are rolled-out, the dominance of this early-adopter group would reduce as more engineers (who perhaps hold less enthusiasm) start driving EVs.

Corroborating this, Figure 26, demonstrates that EV drivers were driving further in the second iteration. As a result, they would be draining more energy from their battery on-shift perhaps contributing to greater range anxiety. These drivers would also be more likely to be charging at public charging stations which, for new EV drivers, would be a new and potentially less desirable experience since it is more time-consuming than refuelling ICEVs.

Figure 33 – Results for Effort Expectancy for both the first and second iterations

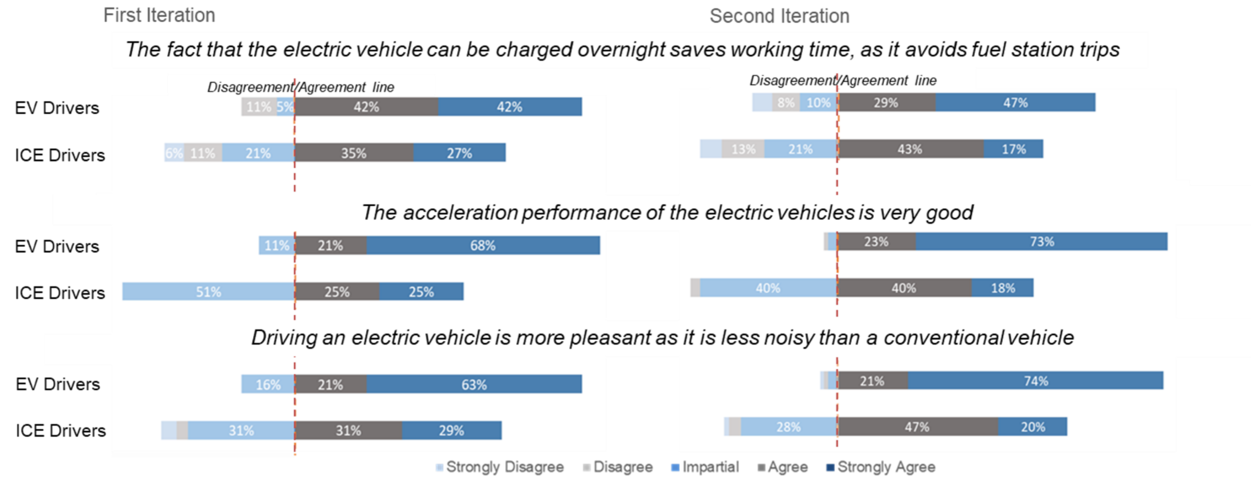


3.2.3.5 *Performance Expectancy*

Perceptions of EV performance – in terms of acceleration and more pleasant driving experience – have improved since the first survey amongst both EV and ICEV drivers (Figure 34). The second survey showed EV drivers to be overwhelmingly positive about the acceleration and the quietness of the vehicles with 95% having positive feelings for both points.

There was a slight decrease in positivity when the drivers were questioned on whether EVs could save working time by being charged overnight, from 84% showing positivity in the first to 76% in the second surveys. As described in Section 3.1.2.3, on effort expectancy, this may also indicate the slight dip in enthusiasm for EVs as the positive early adopters begin to constitute a smaller percentage of the overall fleet.

Figure 34 – Results for Performance Expectancy for both the first and second iterations



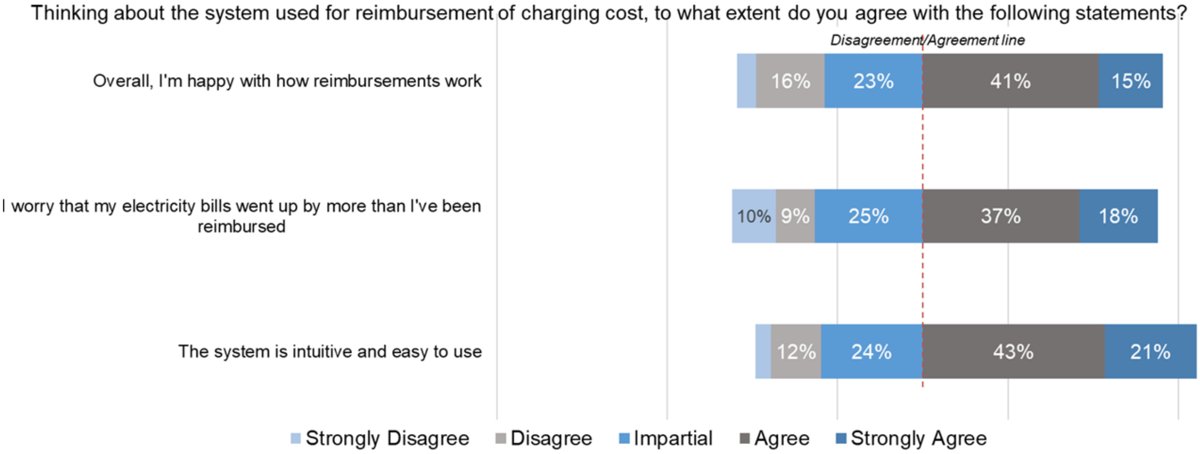
3.2.4 New Questions in the second iteration

3.2.4.1 *Reimbursements*

As is the case for diesel payments, Centrica's engineers get reimbursed for all the electricity they use for their vehicles, although the process is different. Since a large proportion of charging occurs at engineers' homes, Centrica has established a reimbursement system where a driver submits their bill and the energy drawn from the vehicle is automatically calculated. The associated cost is then reimbursed directly to the engineer at the end of each month.

Despite quite positive perceptions of this reimbursement system as illustrated by Figure 35, this topic overall received balanced views.

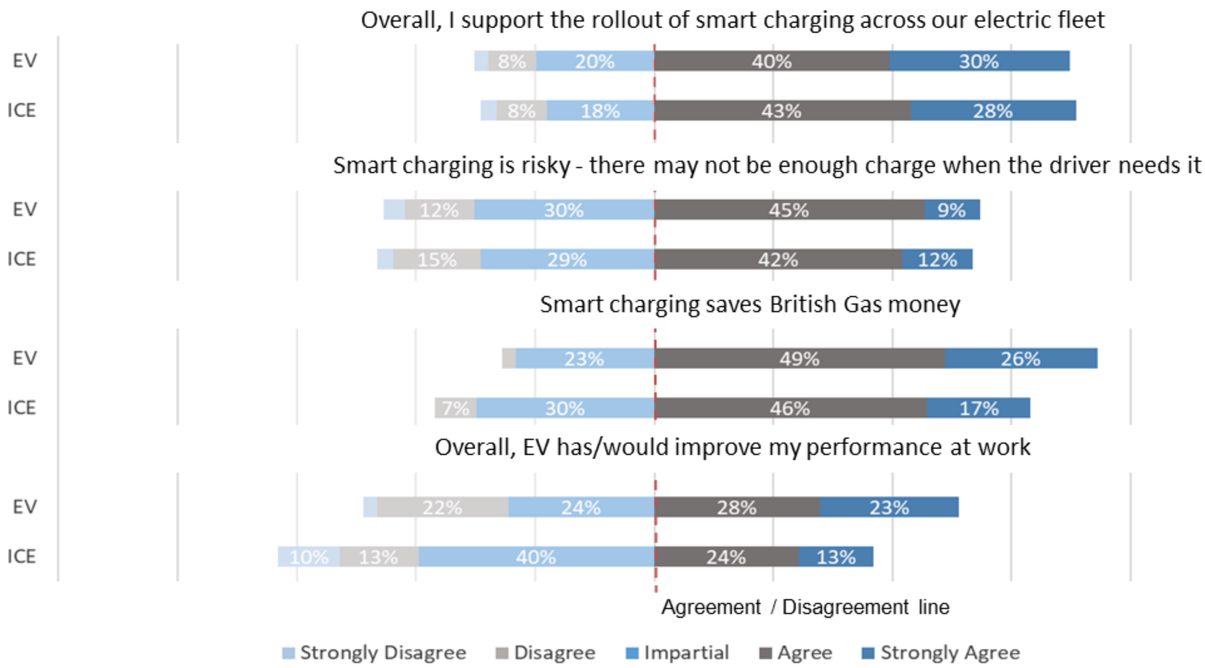
Figure 35 – Perceptions of Centrica's reimbursement system (second iteration)



3.2.4.2 *Smart Charging*

There is a mixed perception amongst British Gas drivers for smart charging (Figure 36). While there was overall support for smart charging, and a commonly held belief that it can save the business money, there was also a perceived risk that it might not guarantee enough charge. This suggests that confidence in smart charging is fragile and requires frequent communication to maintain drivers' confidence in it. This may be the case with all the technologies associated with EV adoption, and decarbonisation more widely.

Figure 36 – Perceptions of Smart Charging (second Iteration)



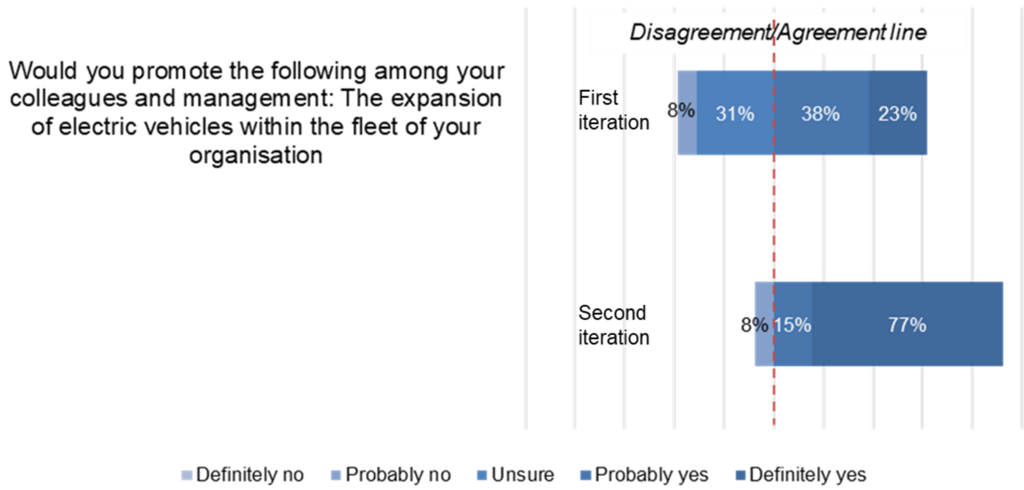
3.2.5 The 13 Repeat Respondents: 13 ICEV-EV Transitioned Drivers

There were 13 drivers who responded to the first survey as an ICEV driver and responded again to the second as an EV driver. This allowed us to assess these drivers' changes in perception of EVs, after having started to drive one.

3.2.5.1 *Adoption Intentions*

There was a major shift in the extent to which these drivers would advocate for expansion of EVs across the fleet. 92% of these 13 transitioned drivers said they would promote EVs in their organisation in the second survey, whereas only 61% would when they responded to the first survey as ICEV drivers (Figure 37).

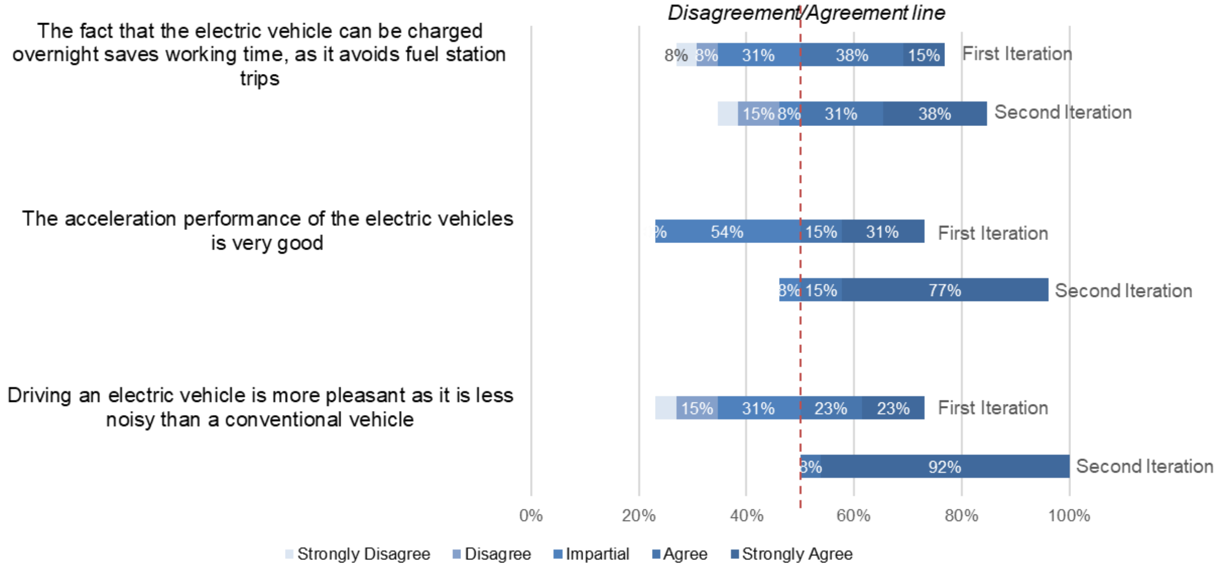
Figure 37 – Adoption intentions of the 13 transitioned drivers



3.2.5.2 Performance Expectancy

There were significant improvements in the perceived performance of EVs among this group. Every driver believed driving an EV to be more pleasant than an ICEV, when previously less than half of the drivers had this attitude (Figure 38), whilst 92% drivers believed the vehicle's performance to be very good – up from 46% in the first survey. There was also an improvement towards the perceived practicality of EVs, since they can save working time by charging at home while engineers are off shift. These results are positive in demonstrating the value of EVs, not only for the environment, but also for the drivers' experiences.

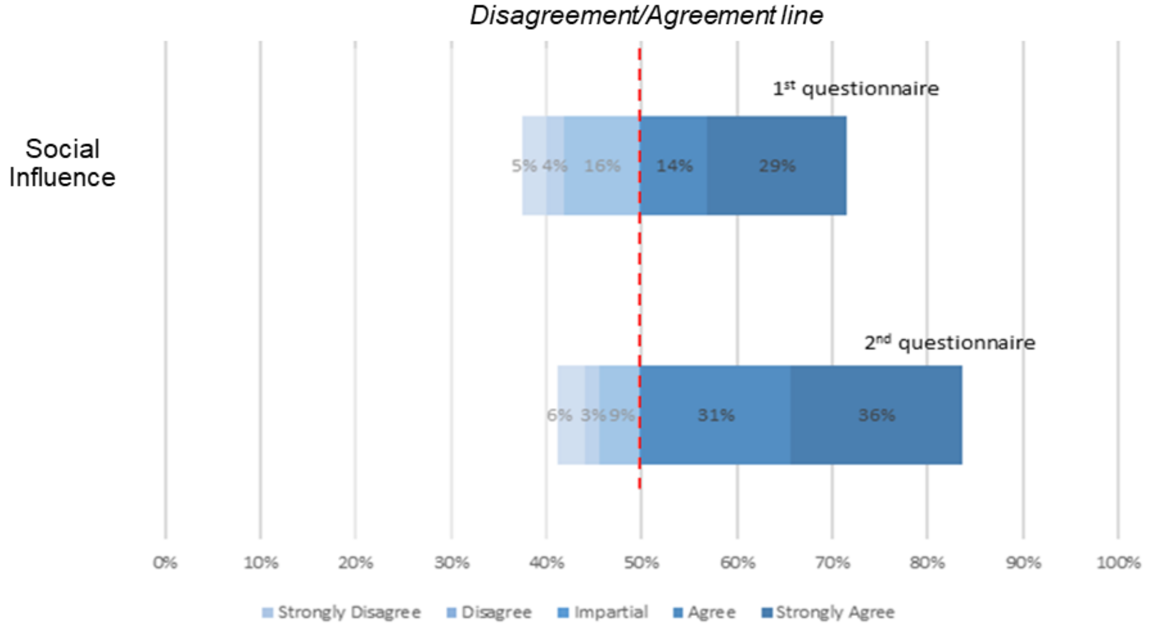
Figure 38 – Performance Expectancy of the 13 transitioned drivers



3.2.5.3 Social Influence

Having driven an EV, this sub-sample responded more favourably in the metrics measuring social influence around EVs than they did in the first survey (Figure 39). This was derived from increases in drivers mostly agreeing to certain social indicators, such as knowing fleet managers who are considering transitioning or business leaders talking about transitioning to EVs. Both questions saw mostly agree responses increase five-fold.

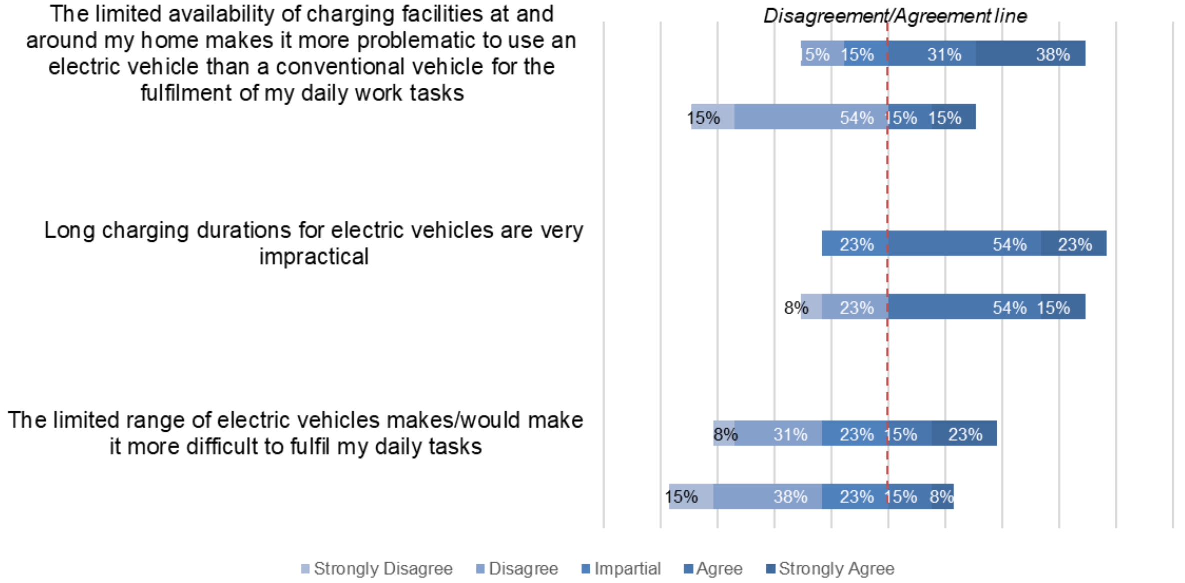
Figure 39 – Social Influence results of the 13 Transitioned Drivers



3.2.5.4 *Effort Expectancy*

There was also a decrease in the perceived amount of effort required for EVs (Figure 40). Out of the 13 respondents who transitioned to EV since the first survey, only 30% continued to see limited availability of charging as a problem, compared to 69% when driving an ICEVs. Perception of range has also improved: 23% seeing it as a limitation to their daily work compared to 38% when driving an ICEVs. Responses of mostly agree to the statement ‘that range was sufficient to complete most daily trips’ increased six-fold. Yet, this shift in opinion was less significant than seen in the areas of Adoption Intentions and Performance Expectancy.

Figure 40 – Effort expectancy of the 13 Transitioned Drivers



3.2.6 Key learnings

After drivers have tried EVs, they tend to feel more positively about the technology

The experience of driving an EV significantly improved drivers' perceptions of EVs, with the most notable shifts in opinion being seen for adoption intentions, performance expectancy and social influence. The positive shift in perception of EVs amongst the 13 new EV drivers was substantial, creating a positive outlook for EVs since drivers appear to prefer EVs once given an opportunity to try them.

There is some scepticism about the robustness of technologies associated with EVs, with negative feelings about range and smart charging being common

There was not universal confidence in EVs amongst the British Gas engineers. Reassurance and consistent communication about the potential and robustness of the technology may be needed in order to ensure that drivers are comfortable with adopting EVs and do not dismiss the technology before trying it.

EVs can offer significant value for drivers, as well as the environment, making the business case for transition even stronger

EVs can provide significant value to drivers and make their working lives easier. There were overwhelmingly positive beliefs about the performance of EVs when compared to ICEVs. Amongst the EV driver population in the second survey, 95% had positive attitudes towards the acceleration and quietness of the vehicles, and 76% said that EVs could save them time at work by allowing them to charge when they are not working.

3.3 Uber

3.3.1 Overview

The Uber behavioural research questionnaire was distributed to Uber drivers in London through a mailing list. The first iteration was distributed in May 2021, and the second in December 2021 (Table 6). An incentive was offered to encourage responses. In total, 1,750 responses were recorded and analysed, of which 169 responded to both the first and second iteration; 459 (26%) were EV drivers. The 10-minute survey analysed the attitudes of Uber drivers towards EVs, and their adoption intentions in the coming years.

3.3.2 Descriptive statistics

1,750 questionnaires were completed by Uber drivers over two iterations. 169 of these answered both the first and second survey. Of the 1,750, 459 were EV drivers, with the remaining being ICEV or hybrid drivers (Figure 41). Demographics were predominantly male (96%), of median age 35-44.

Of the Uber drivers surveyed, two thirds drive more than 90 miles per day, with 84% driving 67 miles or more. 62% of drivers said the maximum distance in a day would exceed 120 miles (Figure 42).

Table 6 – Details of Uber behavioural survey

	First iteration	Second iteration
Distribution Period:	19/05/2021 - 20/05/2021	01/12/2021 - 09/12/2021
Distribution Method:	Uber via newsletter	Uber via newsletter
Total Responses:	798	952 (66 duplicates excluded)

	First iteration	Second iteration
EV Responses:	**71** (3% total EV fleet)	**388** (~10% total EV fleet)
ICEV Responses:	**727** (91% of total responses)	**564** (58% of total responses)
Demographic:	**95%** Male Median Age of **35-44**	**97%** Male Median Age of **35-44**
Returning Respondents:	Overall, 169 drivers responded to both surveys. Further analysis will reveal changes in attitudes specifically for these responses.	

Figure 41 – Vehicle types driven by respondents

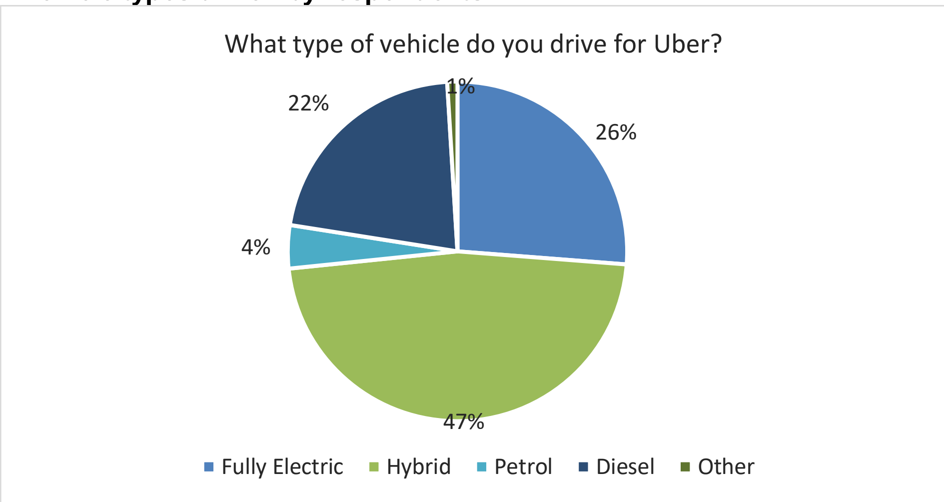
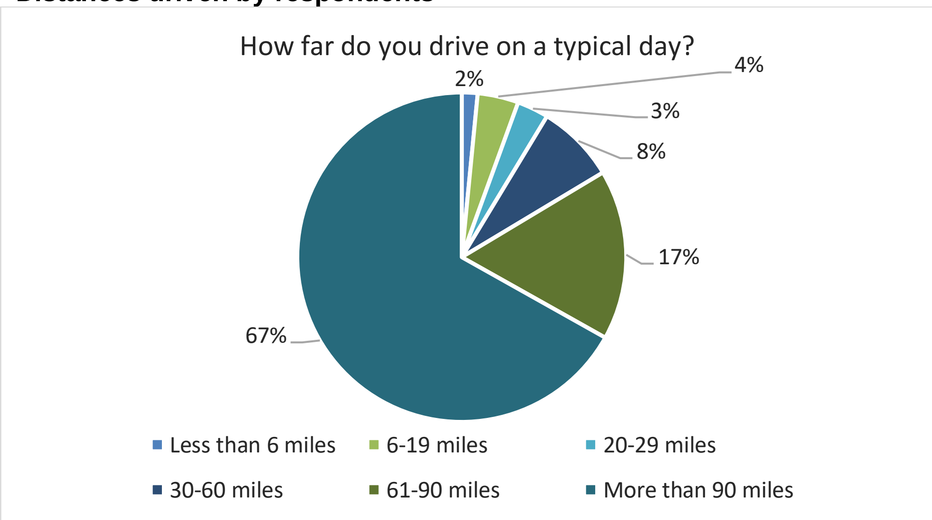


Figure 42 – Distances driven by respondents

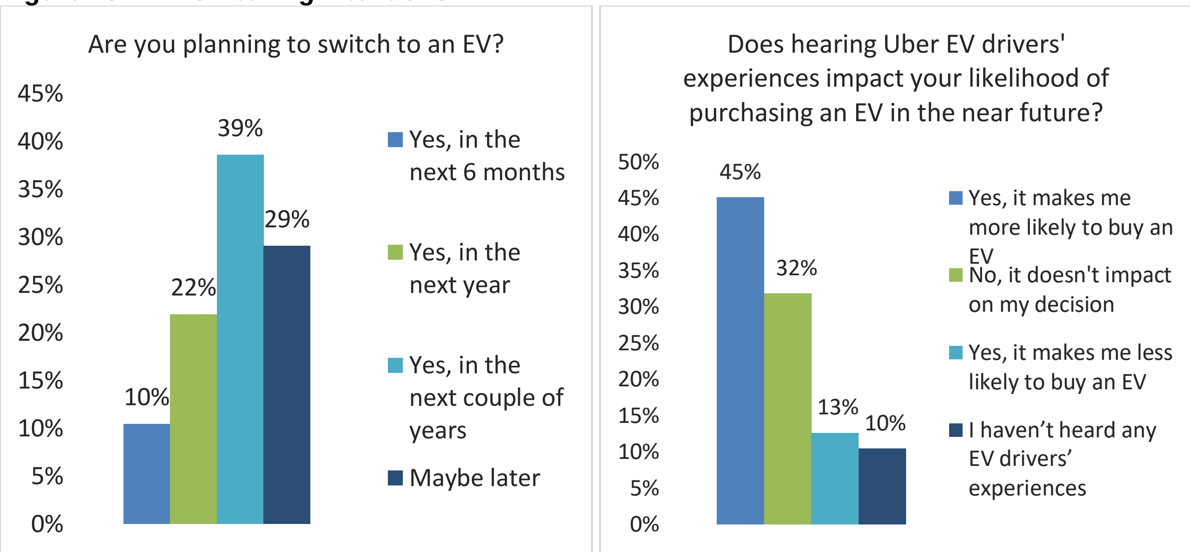


3.3.3 Results

3.3.3.1 Adoption intentions

Attitudes towards EVs and perceptions of their performance are largely positive (Figure 43). 71% of non-EV drivers state that they are planning to switch to an EV, with 10% planning to make the switch within the next six months. Sharing experiences between EV and non-EV drivers has a moderate impact on non-EV drivers' likelihood of switching to EV, with 45% of these saying it will make them more likely to do so. Only 13% state it would make them less likely to switch to an EV, suggesting some negative opinions. Furthermore, 10% of non-EV drivers stated they have not heard of any EV drivers' experiences, suggesting there is communication between Uber drivers which may impact the decision on electrification. Positive perceptions and experiences are therefore necessary to encourage EV adoption among the PHV fleet in London.

Figure 43 – EV switching intentions



3.3.3.2 Charging behaviours

3.3.3.2.1 Home charging and public charging

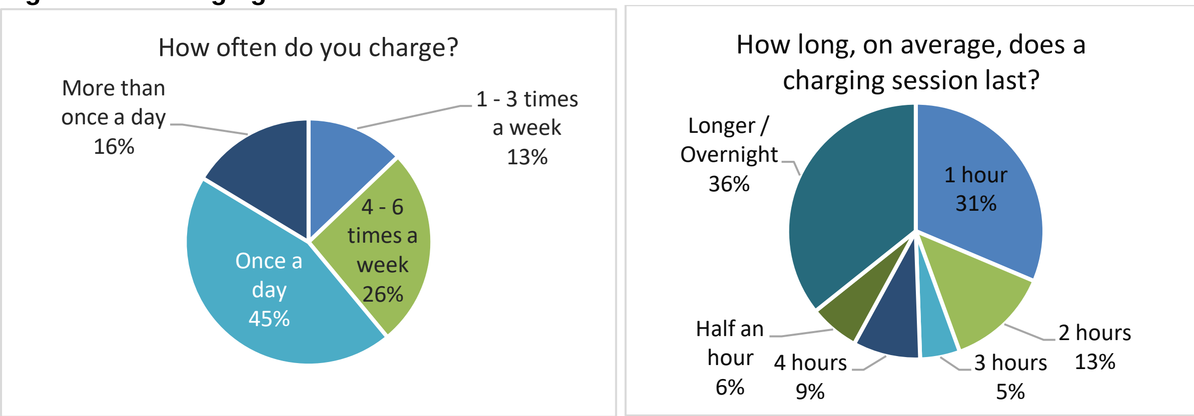
The majority of Uber EV charging occurs at public CPs. As the demographic of PHV EV drivers changes from early adopters to the majority, following Rogers' diffusion of innovation model[2], the percentage of drivers with off-street parking and home CPs installed will decrease. Currently:

- 11% of EV drivers who have a home CP exclusively charge at home, meaning a large majority charge in a public location – accounting for 80% of total energy used.
- 37% of the EV drivers who charge with a home CP have changed their electricity tariff, suggesting that most EV drivers may not be receiving the best value of EV charging and do not engage in smart charging.

Figure 44 shows that most drivers (61% over both surveys) charge once a day or more. Charging sessions are mostly one hour or longer/overnight, suggesting that the shorter sessions are on-shift top-ups on rapid CPs while longer sessions are on-street CPs at night, off-shift. Preferred charging speed was predominantly rapid and ultra-rapid, with the latter becoming more popular in the second survey based on the roll-out of new CPs in London and driven presumably by the desire to reduce the opportunity cost of charging over driving.

2 Rogers, E.M. (1962) *Diffusion of Innovations*. Free Press of Glencoe.

Figure 44 – Charging behaviour



Around a fifth of EV drivers are developing experience and familiarity in finding CPs. However, the majority use software to decide which charging station to utilise. Charging network loyalty is low, with around 30% of EV drivers sticking to a specific network when charging in public during shifts. On-shift charging seems to be opportunistic rather than pre-planned or driven by low state of charge, suggesting that range anxiety is not a significant issue. Only ~15% of EV drivers plan their charging into pre-planned stops such as lunch. This has implications on the predictability of PHV charging behaviours in London, and other cities across the UK, as charging locations and timings are not based on habit.

3.3.3.2.2 Charging cost, availability, and reliability

Just over half of EV drivers agree that the cost of using public CPs is reasonable. However, reliability remains an issue, with 31% of EV drivers stating that charging stations are unreliable. Given the high utilisation of public CPs and the opportunity cost for drivers, this is an important aspect to correct in order to maintain positive opinions among PHV drivers.

3.3.3.3 Barriers to EV adoption and Effort expectancy

The purchase price of EVs is seen as the main barrier to EV adoption for Uber drivers: 73% of respondents, who do not yet own an EV, state that too high a purchase price has a high or very high effect on their choice of vehicle. This is followed by:

- Insufficient access to charging, both at home and in public: half of non-EV drivers rated these as a significant barrier respectively
- Lack of availability of second-hand EVs. Uber drivers often purchase second-hand vehicles to lower the initial CAPEX
- Access to vehicle financing options was cited as an issue for just under half of drivers.

The awareness of TCO calculations and incentives may be a good solution for transitioning cost-conscious PHV drivers to EVs.

Effort: range anxiety remains an issue for most drivers: 64% agreed that it would make it more difficult to fulfil their daily tasks, while 75% stated that long charging durations would be an issue. More than three quarters of drivers agreed that limited availability of EV charging infrastructure makes it problematic to use an EV for their role. This is consistent with the TCO findings on the opportunity cost of charging and the importance of the availability of functioning rapid and ultra-rapid CPs within the city.

3.3.3.4 Organisational factors

Opinion on support from Uber is largely positive and split evenly amongst EV and non-EV drivers. A high level of impartial responses suggests some drivers are not aware of the organisational efforts towards EVs or have no opinion on the way this is managed.

3.3.3.5 Performance Expectancy

75% of non-EV drivers agree that driving EVs will improve air quality and be beneficial to the environment, compared to 87% of EV drivers. Despite the difference between the two groups, it is clear that Uber drivers recognise the environmental benefit of switching to EVs and it is likely there will be further support from this group.

EV drivers are very positive about their driving experience and acceleration: 90% approve of the acceleration performance and enjoy the lack of engine noise. While more than half of non-EV drivers shared this opinion, the average was closer to 60% compared to 90%. As EVs become more widespread and OEMs focus production on new EV models, it is likely that opinions of non-EV drivers will start to converge with their EV colleagues regarding vehicle performance.

3.3.3.6 Qualitative comments

An open-text section allowed survey respondents to leave their opinions on EVs in general. Keyword frequency was used to identify key trends in the comments, while maintaining the anonymity of respondents. Charging, range, and cost were main themes, with comments clarifying the barriers to adoption: lower purchase price, easier and quicker charging, and higher range; all were repeatedly requested by Uber drivers.

3.3.4 Key learnings from the results

Reliable public charging infrastructure is critical for the adoption of EVs among PHV drivers

There is a strong reliance on the public charging network: only 28% of early adopters use a home CP, and often top-up with public CPs. Range anxiety remains a predominant barrier in EV adoption, with a significant amount of both EV and non-EV drivers citing CP availability and reliability as an issue. Rapid and ultra-rapid CPs are strongly preferred, presumably due to the lower opportunity cost (see Uber TCO section).

PHV charging behaviour in London remains difficult to predict as EV charging locations and timings are not based on habit

Early EV adopters tend to charge as and when needed, rather than in pre-planned breaks. Little consideration is given to charging network and location.

Main barriers to EV adoption for non-EV drivers are both financial and operational

High purchase price was the greatest barrier to EV adoption, with references to difficulties in accessing finance. Operationally, access to home and public CPs was a main concern.

Positive attitudes suggest a willingness to change once concerns are addressed

Respondents showed a strong interest in EVs, with non-EV drivers recognising the performance of EVs in acceleration and pleasantness to drive.

4 Further analysis of the results of the behavioural surveys

This section summarises the additional analysis of the survey data carried out by Imperial College Consultants to complement the descriptive analysis of the statistics in the previous pages. The questionnaires were designed using the FAST (Firm Adoption of Sustainable Technologies) framework (introduced in Section 0) and this is utilised here in exploratory factor analysis (EFA). This analysis was performed to understand the level of correlation among the attitudinal statements contained in the survey and to identify the underlying latent factors (or variables) characterising the respondents.

The following sections describe this methodology and present additional analysis using the factor analytical approach to combine the responses to a wide range of Likert-scale type attitudinal questions. Insights and implications of this analysis for EV transition for Centrica, Uber and Royal Mail are presented, followed by an analysis of cross-fleet similarities and differences.

4.1 Factor Analysis of Likert-scale type questions

4.1.1 Background

Since ordinal data from discrete items were investigated, EFA was performed to understand the level of correlation among the attitudinal statements contained in the survey and to identify the underlined latent factors (or variables) characterising the respondents. The latent factors are not directly measurable by the analyst. Therefore, EFA helps understand by which statements they are manifested and to what extent (and in which direction) they influence the factor. Insights generated from this analysis can confirm whether the framework was appropriate and a good fit for the application domain, and extract which underlying aspects that influence the respondent's perspective are particularly critical. This can then be used to design interventions by deciding where to focus on, and which aspects are less relevant in shaping the overall views. It should be stressed that the EFA is complementary to the descriptive statistics that are based on the same data sets. Where the descriptive statistics cover the responses to individual questions and variation amongst the responses, the factor analysis looks at the relationships and how various questions can be combined to study correlated variability and to determine to what extent they can be associated with a common factor (or theme).

4.1.2 Factor Analysis methodology

EFA was undertaken with the entire set of attitudinal questions for each of the three fleets: Centrica, Uber, and Royal Mail. When performing the analysis, it was first decided to perform the EFA separately per fleet and for each iteration separately. This was done for two reasons:

- Some information is lost as the iterations have, in certain cases, different statements and different missing values, which need to be excluded to run the EFA
- Combining the two iterations will not help find the correlation between the two iterations. When combined, EFA would treat the iterations as a single block of responses, so changes in attitude between these iterations would not be found.

The survey contained questions designed to explore the FAST framework. Rather than undertaking a factor analysis within each block of questions characterising each FAST construct, it was decided to undertake a factor analysis with the entire set of questions (for each fleet) and let the data and analysis lead to the identification of the factors.

This multiple-item investigation, through different constructs, was carried out in order to identify the latent variables that are only observable with the help of the factor analysis[3]. This analysis, undertaken on the whole set of attitudinal items, has two benefits that help define a more precise latent variable. First, it confirms the correlation inside the constructs as in the previous literature[4] and to obtain a more concise number of items defining the latent construct. Second, it enables investigation of the possible correlation among the constructs.

A rigorous statistical procedure was undertaken in order to evaluate the reliability of the survey dataset by applying the factor analysis correctly and to determine suitability of the method. This analysis found a high sampling adequacy across the surveys – further details can be found in Annex 6.1.

4.1.3 Interpreting the EFA results

Factor loadings show the variance explained by the statement on that particular factor and can be seen as the correlation coefficients between statements and factors. When comparing different cases to decide the best number of explained factors, it is important to find a balance between the variance explained by each solution (the more factors extracted the higher degree of variance explained) and the parsimony of the solution (i.e. avoiding solutions with an excessive number of factors that are not highly loaded or only highly loaded by one variable)[5]. Considering this trade-off, the best factor solutions were identified considering factor loadings equal to or higher than 0.4. Note that semantically positive and negative statements have a different direction and, therefore, opposite loading signs.

After the factor analysis of the fleets individually, a cross-fleet analysis is performed considering two types of clustering:

- Those with first-hand experience driving an EV and those without, combining statements that are consistent throughout the three fleets
- Those who would recommend EVs to colleagues or others, and those who would not recommend them. This analysis only considers those statements that all questionnaires have in common.

The radar/spider web charts display the factor loadings graphically for each of the identified factors. On the outside of the circle, the identifiers of the statements are shown (two letters corresponding to the FAST constructs followed by a number) which refer to the statements in Table 1. Each of these variables get its own axis running as a spoke from the centre to the outside of the chart. The spokes on the chart display the relevant value range (between -1 and +1 with a solid circle indicating the 0, 0 and +1, or -1 to 0, or using smaller highs and lows where applicable given the spread of the data). The range is shown at the vertical axis from the centre of the circle to 12 o'clock. The numbers visualised are taken directly from the relevant table with factor loadings and highlight a single column from those tables. These figures show which of the statements load for the factor listed in the caption, what the values are, how these compare to other relevant statements, and how they changed between

[3] Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, *4*(3), 272–299. and Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3rd ed.). McGraw-Hill.
[4] Mohammed, L., Niesten, E., & Gagliardi, D. (2020). Adoption of alternative fuel vehicle fleets–a theoretical framework of barriers and enablers. *Transportation Research Part D: Transport and Environment*, *88*, 102558.
[5] Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). *Using multivariate statistics* (Vol. 5). Pearson Boston, MA.

iterations. Points on adjacent spokes are connected with a line to aid in the relative comparison of the variables, as differences are made apparent by the shape and size of the polygons.

4.1.4 High-level Factor Analysis results by fleet

By looking at the statements with similar factor loadings and exploring their semantics, it can be seen that five common factors explain the different main tendencies in the different fleets and iterations while one more factor is identified for Centrica, iteration two, given some extra statements presented to the respondents.

Table 14, Table 15 and Table 16 in Annex 6.2 show the EFA results for Centrica, Uber and Royal Mail respectively. In general, across the fleets and iterations, the following six latent factors are characterised by some common statements which can also be recognised from the FAST framework (in brackets):

- **Benefits of EV to the organisation:**
  - Thinking that EVs would be beneficial to the environment in the long term (*FAST: Attitudes/emotions & social influence*)
  - Thinking that EVs would eventually result in cost savings in respondent's industry (*FAST: Attitudes/emotions & social influence*)
- **Compliance to external expectations:**
  - Companies within the respondent's industry are considering EVs (*FAST: Attitudes/emotions & social influence*)
  - Business leaders in respondent's industry are talking about switching to EVs (*FAST: Attitudes/emotions & social influence*)
  - Policy makers expect companies in respondent's industry to switch to EVs (*FAST: Attitudes/emotions & social influence*)
  - Customers expect organisations in respondent's industry to switch to EVs (*FAST: Attitudes/emotions & social influence*)
- **Impact of transport electrification on work tasks:**
  - The limited range of EVs makes/would make it more difficult to fulfil my daily work tasks (*FAST: Effort related to EV adoption*)
  - Long charging durations for EVs are very impractical (*FAST: Effort related to EV adoption*)
- **Considerations of the drivers' perspective from decision-makers in the organisation:**
  - Shift to EVs is supported by sufficient information and training provided by our organisation (*FAST: Management involvement and training*)
  - Managers implementing strategies and technologies to ensure that the switch to EVs has minimal impact on our tasks (*FAST: Management involvement and training*)
- **Opinion of EV drivers on the driving experience with their vehicle:**
  - Driving an EV is more pleasant as it is less noisy than a conventional vehicle (*FAST: EV performance*)
  - The acceleration performance of the EV is very good (*FAST: EV performance*)
- **Pro-smart charging, supportive views on smart charging (only Centrica, iteration 2):**
  - Smart charging is risky – there may not be enough charge when the driver needs it (*FAST: Effort related to EV adoption*)
  - Smart charging saves British Gas money (*FAST: Attitudes/emotions & social influence*)
  - Overall support to the rollout of smart charging across our electric fleet (*FAST: Attitudes/emotions & social influence*)

Table 9, Table 10 and Table 11 also show that the identified latent factors mainly correspond to the FAST constructs, confirming the framework was suitable for the study. Apart from the common statements across fleets and iterations, some of these factors are also characterised by other statements, that are different depending on each case, and come from different FAST constructs.

4.2 Results and discussion of Factor Analyses for each fleet

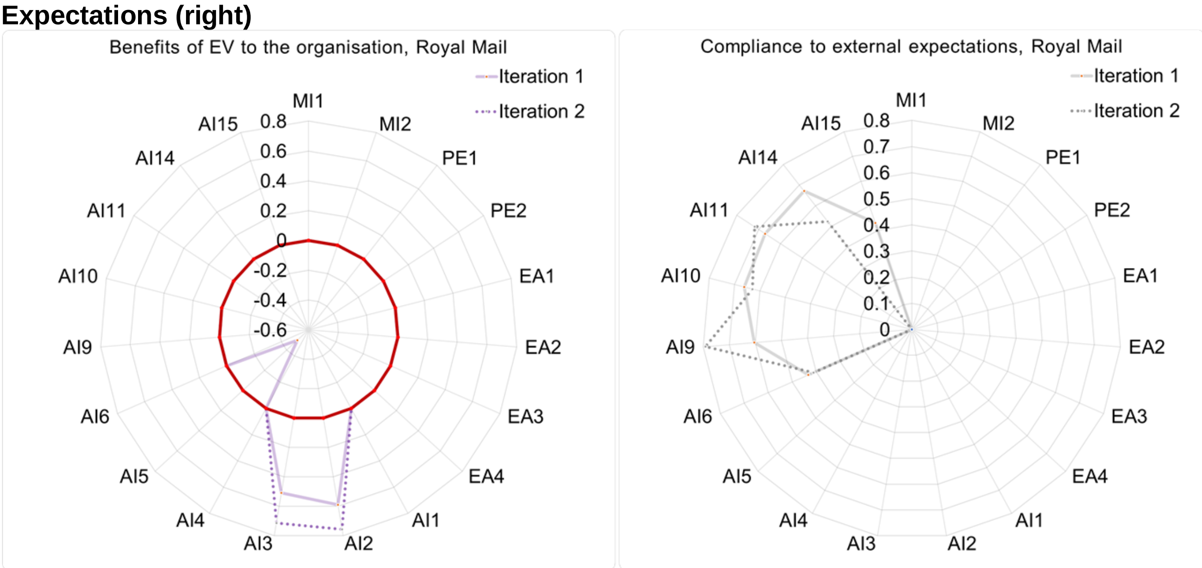
Building on the factor analysis performed and the data in Annex 6.2 for the individual fleets, the following sections discuss the implications of the findings. For each fleet, there is a discussion based on the overall analysis of the table, for that fleet, as well as the changes between the iterations per factor, as displayed in the radar/spider web charts. After a discussion of the three fleets individually, results of a cross-fleet analysis are shown.

4.2.1 Discussion of the Royal Mail results

The EFA on the statements regarding Royal Mail drivers also identified the same five factors for both iterations namely: benefits of EV to the organisation, compliance to external expectations, impact of electrification on work tasks, considerations of drivers' perspective, and opinion on driving experience. The factors characterising iteration one and iteration two are also consistent. No significant changes can be observed in the statements associated with the latent factors, but the loading of some individual statements can change as discussed below.

The radar chart below (Figure 45, left) shows the factor loadings characterising the factor benefits of EV to the organisation. This is mainly explained by the statements AI2 and AI3. All the benefits related to both cost and environment appear to be clear since the beginning of the study. In iteration two, the opinion on EVs being a temporary phenomenon (AI5), which was negatively correlated in iteration 1, is not significant anymore (as in the Uber case).

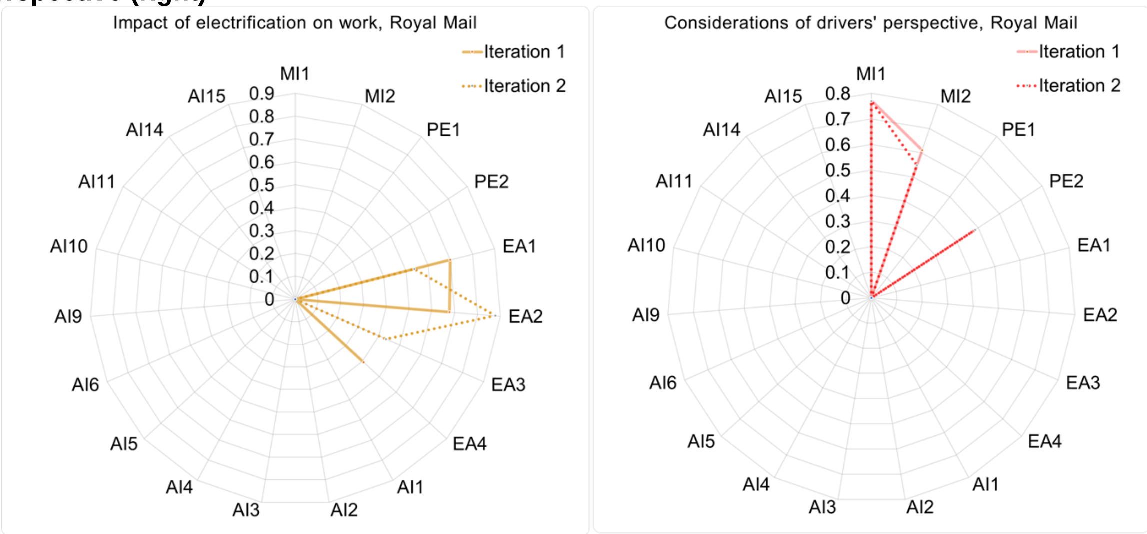
Figure 45 – Royal Mail – Benefits of EV to the Organisation (left) Compliance to External Expectations (right)



The second factor, compliance to external expectations, shown in Figure 45 (right), has similar loading for all the statements concerning the drivers' understanding regarding the consideration that EVs have in both private and public domains (AI14, AI11 and AI10). Opinion on the positive impact on public image of the companies with EVs (AI9) becomes the statement with a greater explanation of variance in iteration two, that is the most important explaining the factor even though it already played a key role in iteration one already.

The third factor, impact of electrification on work tasks, (Figure 46, left) is strongly related to three statements EA1, EA2, EA4 in iteration one while, in iteration two, EA4 is replaced by EA3. This is consistent with the analysis of the other fleets, suggesting availability of charge points is the key factor now rather than remembering to plug in as drivers got more familiar with the process. Challenges with the availability of charging points could be related to an increase in the number of EVs without sufficient additional charging capacity provided.

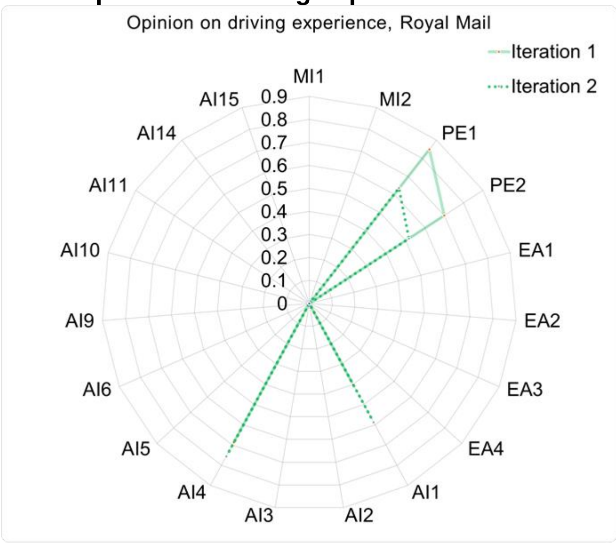
Figure 46 – Royal Mail – Impact of electrification on work (left) consideration of drivers' perspective (right)



The fourth factor, considerations of drivers' perspective, shown above in Figure 46 (right) is exactly characterised by the two statements MI1 and MI2. The loading with greater magnitude is of the statement MI1 which suggest that in the drivers' perception, the company provides sufficient information and training to allow a smooth transition to EVs. No changes in the loading can be observed between iterations. In iteration two the statement PE2, regarding acceleration of EVs, explains some of the variance related to the latent factor on drivers' perspectives. This could perhaps be interpreted as drivers recognising that the type of vehicle used in the fleet, as chosen by management, responds well to their interest and needs for the job. The acceleration could also be particularly relevant as Royal Mail drivers need to stop and start frequently, rather than drive longer distances at a constant speed, and possibly was used as one of the main benefits in communication from management.

The fifth factor, opinion on driving experience, shown in Figure 47, is manifested specifically by two statements with greater impact: PE1 and PE2. This suggests a positive perception on the EV characteristics, specifically about noise and acceleration. Furthermore, the driver's opinion is also influenced by the interest in EV in general (AI1) and the perception that EVs are cool and pleasant to drive (AI4), AI1 to a lesser extent.

Figure 47 – Royal Mail – Opinion on driving experience



Key insights:

- The benefits related to both cost and environment seem to be clear since the beginning of the study, and the consideration that EVs are only temporary is not significant anymore for the impact on Royal Mail.
- There are only minor variations on compliance to external expectations, with the statement "companies who have electric vehicles have good public image" becoming the one with a greater explanation of variance in iteration two.
- Access to charging points has become a key area of concern in iteration two, where it was not the case for the first iteration. For the first iteration, the impact on work tasks was linked to range and remembering to plug in at the end of a shift. After becoming more familiar this concern disappears. Charging time remains the topic which most explains impact of EVs on the job.
- Little changes between iterations related to the consideration of the driver's perspective in decision making, though vehicle performance plays a small role in iteration two suggesting that the vehicle is a good fit for the needs of the drivers.
- Driving experience is manifested by statements on vehicle performance as well as attitudes/emotions, with positive perception on the EV characteristics. Vehicle noise and acceleration become slightly less important, relatively to the other statements, in the second iteration.

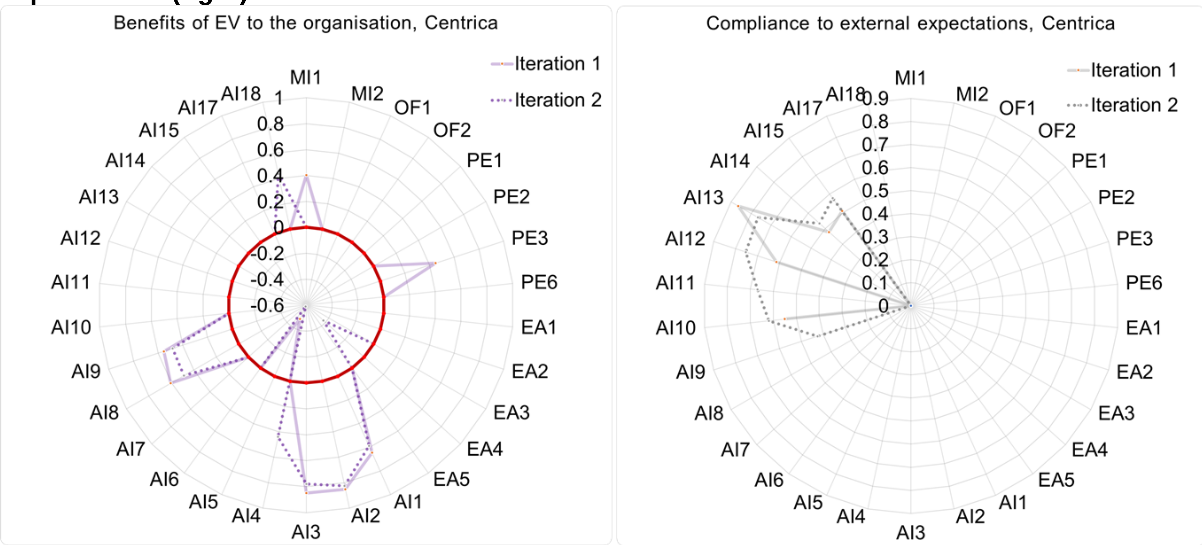
4.2.2 Discussion of the Centrica results

The EFA on the statements that were presented to Centrica employees identified five factors for iteration one namely: benefits of EV to the organisation, compliance to external expectations, impact of electrification on work tasks, considerations of drivers' perspective, and opinion on driving experience, with six factors for iteration two (with the addition of pro-smart charging) given the addition of four statements in the second iteration of the questionnaire. No significant changes can be observed in the statements associated with the latent factors; however, some statements can be different.

The variance of the factor, benefits of EV to the organisation, (Figure 48, left) is mostly explained by statements AI1, AI2, AI3 and AI8. This shows a good understanding of benefits for the organisation across drivers. The factor, benefits of EV to the organisation, is also influenced, but to a lesser extent, by variables related to the FAST constructs *Management and Training* as well as *Electric Vehicle Performance* for iteration one.

Having to remember to plug in might reduce the EV benefit for drivers who are concerned about this – observed by the negative value on statement EA4, consistent throughout the two iterations. Statement PE3 instead shows a change in belief regarding charging habits: in the second iteration, the statement, the fact that electric vehicles can be charged overnight saves working time as it avoids fuel station trips, is no longer significant. This could be linked to some EV drivers being unable to charge at home and thus using the public charging network.

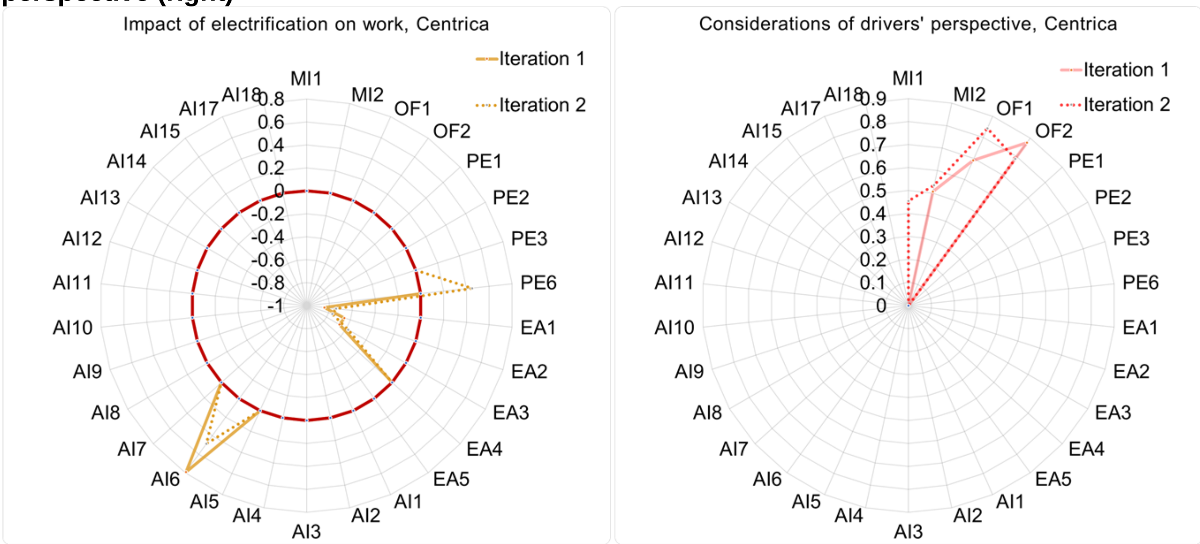
Figure 48 – Centrica – Benefits of EV to the organisation (left) compliance to external expectations (right)



In the second factor, compliance to internal expectations (Figure 48, right), drivers are aware of the move to transition to EVs by government (AI13) and other businesses (AI12), and that EV adoption impacts the reputation of their business. Between the two iterations this view of the positive reputational impact of EVs has increased, with more drivers believing that EVs are viewed favourably (AI11) and give companies a good public image (AI9).

The third factor, impact of electrification on work tasks, (Figure 49, left), demonstrates that across both iterations there are a variety of views amongst drivers. While many drivers find EV range sufficient (AI6), some drivers do have concerns over the practical difficulties resulting from vehicle range (EA1) and CP availability (EA2).

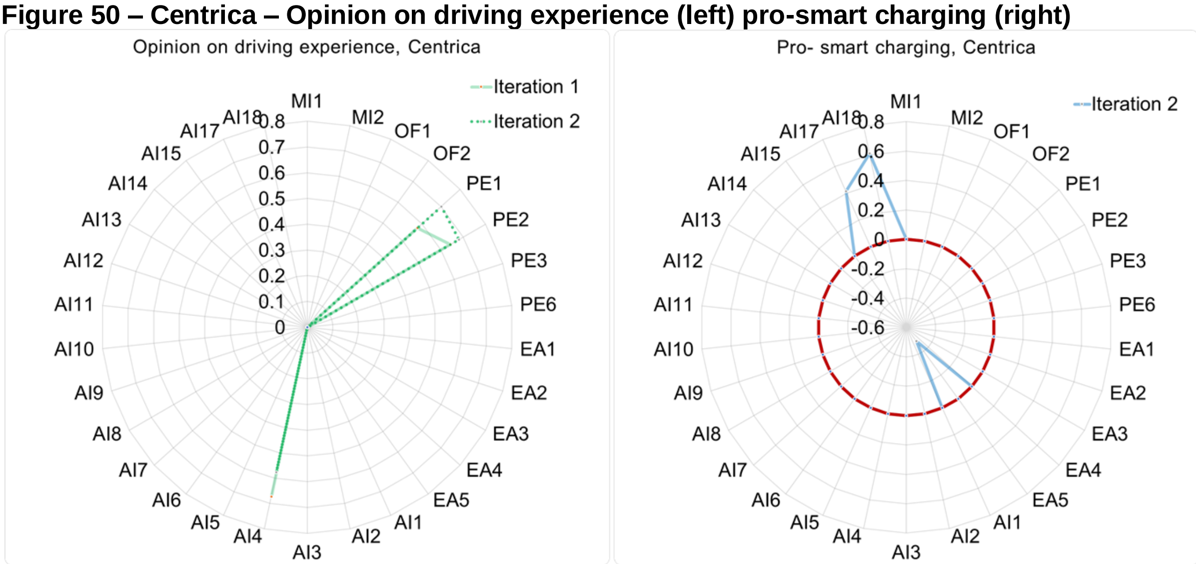
Figure 49 – Centrica – Impact of electrification on work (left), considerations of drivers' perspective (right)



The fourth factor, consideration of drivers' perspectives, (Figure 49, right) shows that information seems to be communicated effectively to the drivers and that they feel they are properly consulted by the company.

The fifth factor, opinion on driving experience, (Figure 50, left), shows positive perceptions relating to EV characteristics, specifically about noise (PE1), acceleration (PE2) and driving experience (AI4) which are based directly on the driver's experience. While these views might be subjective, they show that the right choice of vehicle is an important part of getting the drivers on board with the transition to EVs, and that driver experience should be considered alongside cost and operational factors when choosing vehicles.

Figure 50 – Centrica – Opinion on driving experience (left) pro-smart charging (right)



The pro-smart charging factor (Figure 50, right), which only applies to Centrica's second survey iteration, demonstrates an overall positive view of smart charging (AI18) and the potential financial savings (AI17), although some drivers expressed concern over the risks that it may impact their ability to drive when needed (EA5). Good communications about smart charging strategies and any safeguards in place might be useful to reduce those concerns.

Key Insights:

- The factors characterising both iterations are consistent for Centrica, with only minor variations.
- There is a good understanding of the benefit of EVs for the organisation across drivers
- Some small changes can be observed on the influence of charging, possibly linked to new habits or better understanding
- Drivers perceive the interests of both private and public stakeholders on the EV transition and recognise the impact of these views on the expectations for the organisation, and this seems to be improving
- In both iterations, the drivers have concerns on charging range and CP availability and recognise that practical difficulties could influence their ability to do the job with an EV. Views related to effort of using an EV, attitudes/emotions to sustainability, and vehicle performance all influence the impact on work to some extent.
- The driving experience is shaped mostly by noise, acceleration, and how ‘cool’ the EV is perceived. Little changes in between iterations.
- Drivers think that smart charging can lead to monetary savings but have concerns about having sufficient charge left. Good communications about smart charging and constraints set for a minimum state-of-charge at the start of a shift are key.

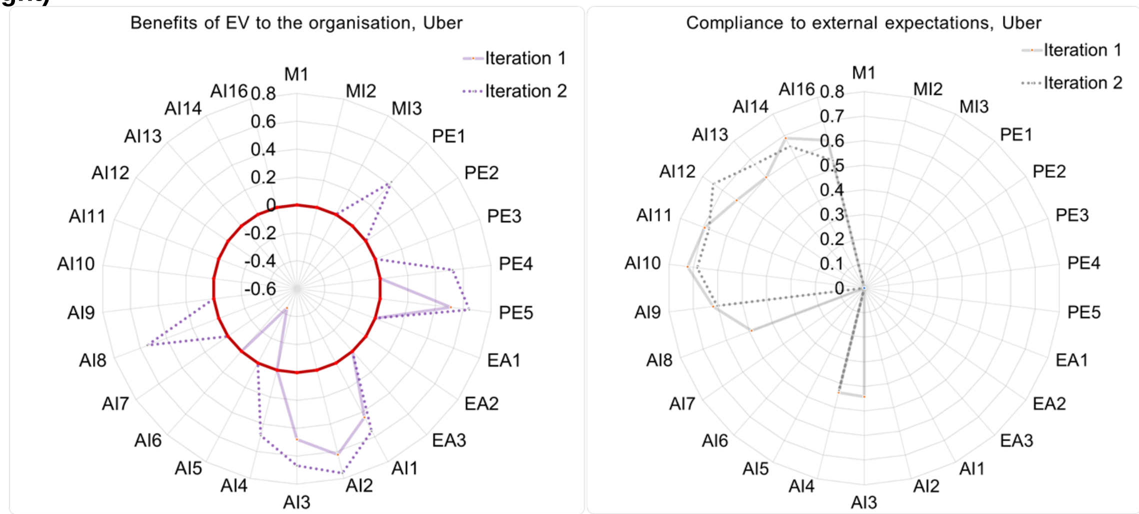
4.2.3 Discussion of the Uber Results

The EFA on the statements that were presented to Uber drivers identified five factors for both iterations, namely: benefits of EV to the organisation, compliance to external expectations, impact of electrification on work tasks, considerations of drivers' perspective, and opinion on driving experience. The factors characterising both iterations are consistent, and no significant changes can be observed in the statements associated with the latent factors, but some statements can change. This is most notable for opinion of driving experience, and benefits to the organisation.

Figure 51 (left) suggests the drivers have a positive view on the environmental impact and a pro-environmental attitude among the other benefits for the organisation. It also shows that the benefits to the organisation are not linked to just one aspect of the FAST framework (AI2, AI3, PE5).

All the benefits related to cost and environment appear to become clearer over time between the iterations. Because Uber drivers own their own vehicle, which they use to provide transport service on behalf of the organisation, the benefits to the organisation factor can also be interpreted as directly being advantageous to the driver and their ability to earn a living with their car. This factor could therefore also be considered as benefits of EV to the Uber driver.

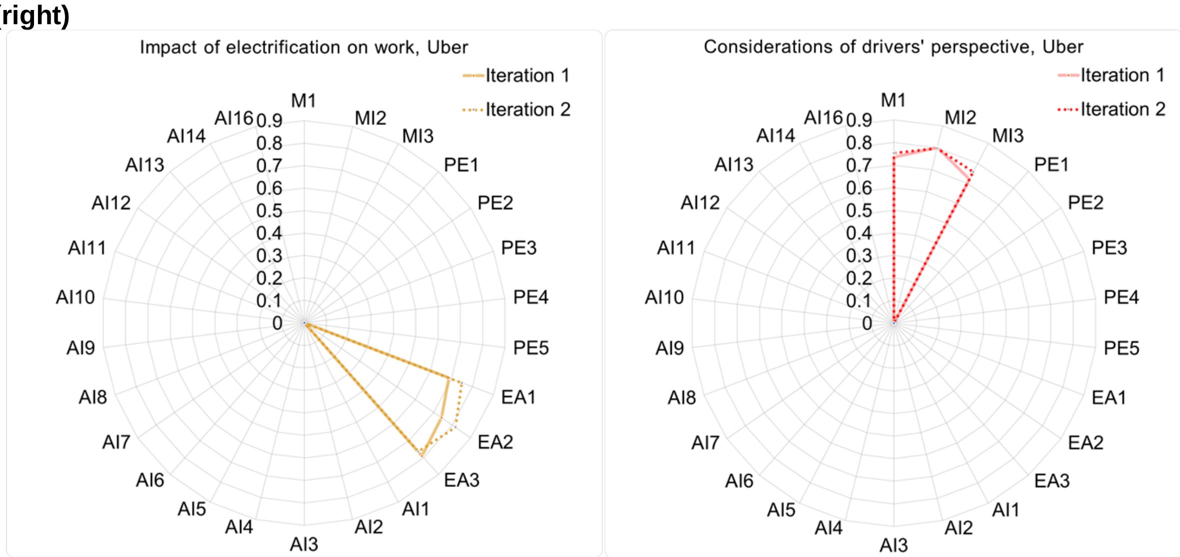
Figure 51 – Uber – Benefits of EV to the Organisation (left) compliance to external expectations (right)



The second factor, compliance to external expectations, shown in Figure 51 (right), is only associated to the *FAST construct "Attitudes/emotions & social influence*" with very similar loading for all the statements concerning the drivers' understanding regarding the consideration that EVs have in both private and public domains such as AI10, AI13, AI11, and AI12. This shows that drivers have a good awareness of the overall direction the industry and policy makers are taking, and how this will shape their own transition.

The third factor, impact of electrification on work tasks (Figure 52, left), exactly corresponds with the three statements characterising the effort related to EV adoption of the FAST framework in both iterations, namely through EA1, EA2, and EA3 regarding range, charging duration and charging facilities respectively. This confirms that these issues are of particular concern for the Uber drivers, and they recognise that difficulties with charging will influence their work directly and show a good fit of the FAST framework in understanding these attitudes. Although these statements are semantically negative, their loading factors are all positive as they are all contributing to the factor in the same direction. There are no clear differences between the first and second iteration, indicating this is an ongoing concern for Uber drivers despite increases in available public CPs throughout 2021 (ZapMap, 2022).

Figure 52 – Uber – Impact of electrification on work (left) consideration of drivers' perspective (right)

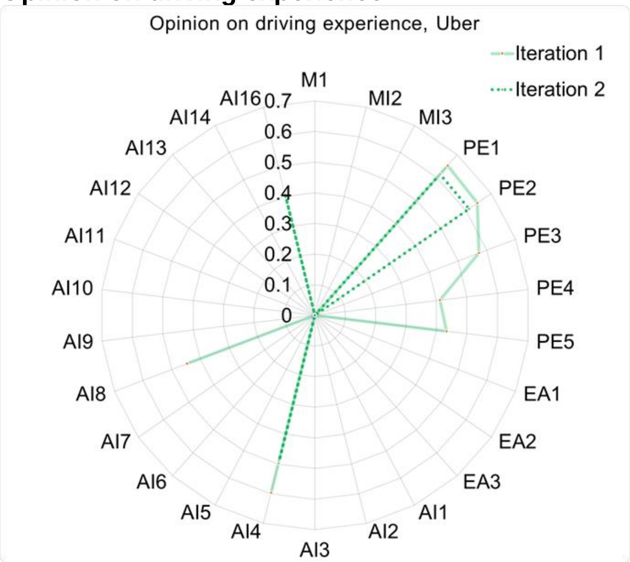


The fourth factor, considerations of drivers' perspective, shown in Figure 52 (right), is exactly characterised by the statements of the FAST construct: *Management involvement and training*. The loading with greater magnitude is of the statement Uber are implementing strategies and technologies to ensure that the switch to EVs has minimal impact on our tasks (MI2) showing that in the drivers' perception the company is working on a smooth transition to EVs, and that these decisions are linked to the experience of the driver themselves. However, there are no noticeable differences between both iterations in the loading of statements on this topic.

The fifth factor, opinion on driving experience, (Figure 53), the two statements with greater impact are about the pleasantness of driving an EV due to lack of noise (PE1), and the acceleration performance of EVs (PE2). This suggests positive perception on the EV characteristics regarding noise and acceleration. The driver's opinion is also influenced by the perception that EVs are cool and pleasant to drive (AI4 -*FAST: "Attitudes/emotions & social influence*"). This is presumably not only linked to the driver themselves, but also to the comfort of their passengers. This can be part of a positive experience and might differentiate drivers with an EV from their colleagues.

The statement, the fact that the electric vehicle can be charged overnight saves working time, as it avoids fuel station trips, (PE3) no longer loads any factor in iteration two. This might be related to a better understanding of the charging events and charging availability, or an adjustment of expectations related to availability of home overnight charging compared to on-shift public charging, which is seen as an opportunity cost.

Figure 53 – Uber – Opinion on driving experience



Key insights:

- The changes in the factor analysis between iterations are most prominent for opinion of driving experience, and benefits to the organisation
- EV benefits related to cost and environment appear to become clearer over time between iterations, which are more aligned to benefits to the organisation. Benefits to the organisation is a more difficult construct for Uber, given the role of the driver. Relevant statements include those on EV performance as well as attitudes/emotions. Drivers have positive views on sustainability.
- Drivers have a good awareness of the overall direction the industry and policy makers are taking, and how this will shape their own transition.

- Charging is an ongoing concern and drivers recognise that difficulties with charging will influence their work directly, with no clear differences between the first and second iteration.
- The company is working on a smooth transition to EVs in the drivers' perception
- EV drivers positively rate their vehicle and driving experience (also for their passengers) which is shaped by acceleration, noise, and social influence. The statement, the fact that the electric vehicle can be charged overnight saves working time, as it avoids fuel station trips, no longer has a correlation with the driving experience. This might be related to changes in the charging experience, or an adjustment of expectations.

4.3 Cross-fleet analysis of factor analysis results

The cross-fleet analysis firstly compares the factors from the individual fleet analysis, and then combines the data of all three fleets and analyses that new data set as a whole.

Overall, the factors are similar across the three fleets, and a good fit to the FAST framework with the latent factors observed from the factor analysis closely linked to the statements in relevant categories from FAST. This confirms the hypothesis that the FAST framework was suitable for the application to the fleets considered in this study, and that the responses from the drivers are mostly in line with the correlation between statements, based on the literature to influence the factors identified, and which are consistent across the fleets.

The main difference for the factor, impact of electrification on work tasks, was that Royal Mail drivers initially did not observe difficulties with EV charging in respect to their ability to fulfil their tasks. By iteration two, this has become an issue for all vehicle fleets as EV numbers increased while home, public, and depot-based CPs did not keep up.

Similarly, for iteration one, the statement, the fact that the electric vehicle can be charged overnight saves working time, as it avoids fuel station trips, (PE3) is correlated to the factor benefits to the organisation (Centrica) and driving experience (Uber). In the second iteration, the statement no longer relates to drivers' opinion on benefits or driving experience, meaning this is no longer seen as a major benefit by drivers.

Having considered the fleets individually, next the fleets have been combined for analysis. For this purpose, the data from drivers of the three fleets have been merged utilising the statements that were common across the three fleets. These statements are shown in Table 7. The corresponding total number of observations is 2,572. Respondents are split in two different ways: EV driver vs non-EV driver, and those who recommend EVs vs those who do not recommend them to colleagues, with the analysis presented below.

Table 7 – Common or equivalent statements across all three fleets (Centrica, Uber and Royal Mail)

FAST Framework	Item	Statement
Management involvement and training	MI1	Our shift to electric vehicles is supported by sufficient information and training provided by our organisation
	MI2	Our managers are implementing strategies and technologies to ensure that the switch to electric vehicles has minimal impact on our tasks
Electric vehicle performance	PE1	Driving an electric vehicle is more pleasant as it is less noisy than a conventional vehicle
	PE2	The acceleration performance of the electric vehicles is very good
Effort related to EV adoption	EA1	The limited range of electric vehicles makes/ would make it more difficult to fulfil my daily work tasks

FAST Framework	Item	Statement
	EA2	Long charging durations for electric vehicles are very impractical
	EA3	The limited availability of charging facilities at and around my home makes it more problematic to use an electric vehicle than a conventional vehicle for the fulfilment of my daily work tasks
Attitudes/emotions & social influence	AI1	I am interested in electric vehicles
	AI2	I think electric vehicles would be beneficial to the environment in the long term
	AI3	I think that electric vehicles would eventually result in cost savings in my industry
	AI4	I think that electric vehicles are generally cool and pleasant to drive
	AI5	I think that electric vehicles are only a temporary phenomenon
	AI6	The range of electric vehicles is sufficient for most daily trips
	AI9	Companies who have electric vehicles have good public image
	AI10	Companies within my industry are considering electric vehicles
	AI11	Electric vehicles are viewed favourably within my industry

The generated factor loadings are illustrated in Table 17 (EV drivers) and Table 18 (non-EV drivers) of Annex 6.2. The same five factors analysed for each fleet above are identified, benefits of EV to the organisation, compliance to external expectations, impact of electrification on work tasks, considerations of drivers' perspective, and opinion on driving experience.

The most important finding from this analysis is that, for both EV and non-EV drivers, the factors of iteration one and iteration two contain almost the same statements with very similar factor loadings. This indicates that for both EV drivers and non-EV drivers the same set of statements are relevant, and that these have remained mostly unchanged between the first and second iterations of the questionnaire. They therefore indicate clear relationships between statements and variables which can be used when designing further interventions and monitoring impact.

Related to this, the only change in the number of statements manifesting the latent factors can be noticed from the EV drivers in iteration two where the statement, the range of electric vehicles is sufficient for most daily trips, (AI6) loads on the factor, impact of electrification on work tasks, as has been observed in the factor analysis results of Centrica. The semantically positive statement AI6 and the negative statements EA1, EA2 and EA3 have a different direction and, therefore, opposite loading signs. One interesting difference is for statements related to availability of charging infrastructure (EA3). For EV drivers, the loading increases between iteration one and iteration two indicating growing concern with access to charging, but for non-EV drivers over the same time interval this is decreasing – suggesting that those who do not have to charge a vehicle themselves have the impression that this is getting easier. In both cases it continues to be the third ranked statement related to the impact on work tasks, with range and charging time having a higher loading than availability of charge points. This could indicate a gap between expectations and reality.

Key insights:

- Availability of charging points was loading for the factor, impact of electrification on work tasks, for Centrica and Uber already in the first iteration, but for all three fleets after the second iteration.
- The statement, the fact that the electric vehicle can be charged overnight saves working time, is no longer an area of concern in the second iteration, where this was present to explain the variance of benefits to the organisation (Centrica) and driving experience (Uber) in iteration 1.
- When combining the data for all fleets and separating them into EV drivers and non-EV drivers, the same five factors analysed for each fleet above are identified, benefits

of EV to the organisation, compliance to external expectations, impact of electrification on work tasks, considerations of drivers' perspective, and opinion on driving experience. No significant changes can be observed from the data for each fleet individually.

- EV drivers are increasingly concerned with charging access, while non-EV drivers have the perception that access is becoming easier.

4.4 Effect of influence from colleagues

Following the analysis of the combined fleet for EV drivers and non-EV drivers, the population is split in two depending on their overall recommendation to others. The project considered similar statements on whether they would recommend EVs to other drivers (for Centrica and Uber) or their stated preference driving an EV versus a conventional vehicle (in the case of Royal Mail). While these are not fully equivalent statements, they are considered as representing an overall attitude towards EVs based on experience of both EVs and previously ICEVs. Figure 54, Figure 55 and Figure 56 on the following pages show the responses to the equivalent statements (as listed in Table 7).

The figures show a marked difference responding to the factor, impact of electrification on work tasks, in which drivers who themselves do not recommend an EV to others mostly or entirely agree with the statements pointing out the (experienced) drawbacks of driving an EV: limited availability of charging facilities (60% mostly or entirely agree – EA3), long charging duration (~50% mostly or entirely agree – EA2) and limited battery range (40% mostly or entirely agree – EA1). Those who do recommend EVs to others have far more positive views/experiences on these themes, though a significant number still agree that these are obstacles, particularly EA3 with 40% of EV drivers who mostly or entirely agree, while for EA1 and EA2, these numbers decrease respectively to 20% and 30%.

Individuals who do not recommend EVs also show some doubts on the EV performance: a large percentage disagree with the fact that the EV is more pleasant because they are less noisy (PE1), have a good acceleration (PE2) or are cool (AI4) (~25% somewhat to entirely disagree), which is significantly different from drivers recommending the EV, for which the level of agreement is nearly 100%. This may be related to different preferences, perhaps related to the specifics of the job. Different types of vehicles could be considered as part of the fleet if alternative models would be better received by those not keen on the current model.

A large percentage of EV drivers who do not recommend an EV perceive that the shift to EVs is not supported by sufficient information and training provided by their organisation (~30% mostly or entirely disagree – MI1) and by adequate strategy and technologies to minimise the impact (~25% mostly or entirely disagree – MI2). Additionally, drivers not recommending EVs are sceptical about the benefits on the environment (~30% somewhat to entirely disagree – AI2) and the potential cost-saving for the industry (~25% somewhat to entirely disagree – AI3).

This difference in responses to these key factors suggests broad obstacles for those who are currently not recommending EVs to others based on their current experience. Early positive experiences and training for transition therefore remains a key aspect of fleet electrification for employees.

Figure 54 – EV drivers not recommending EVs

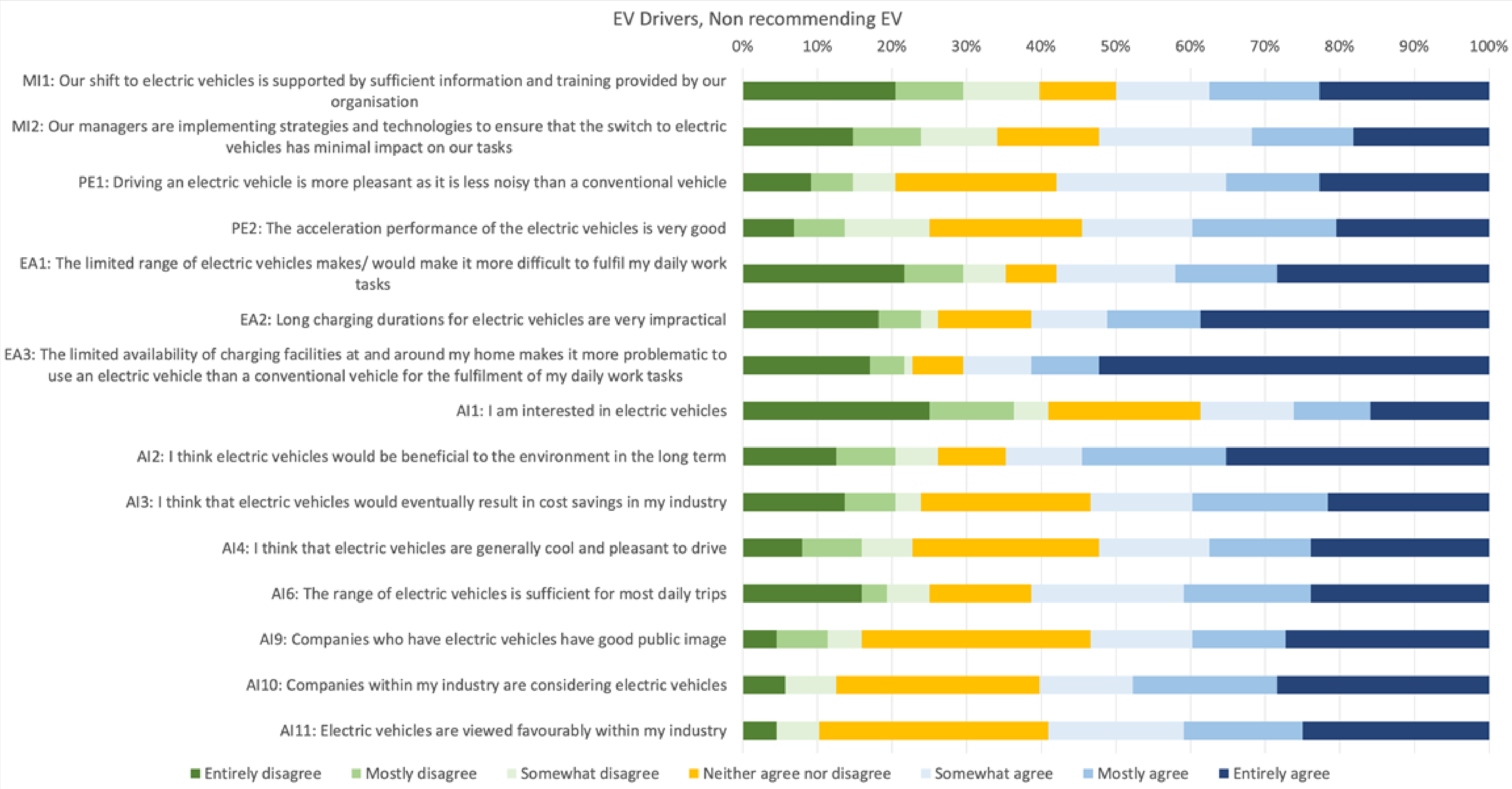


Figure 55 – EV Drivers unsure about recommending EVs

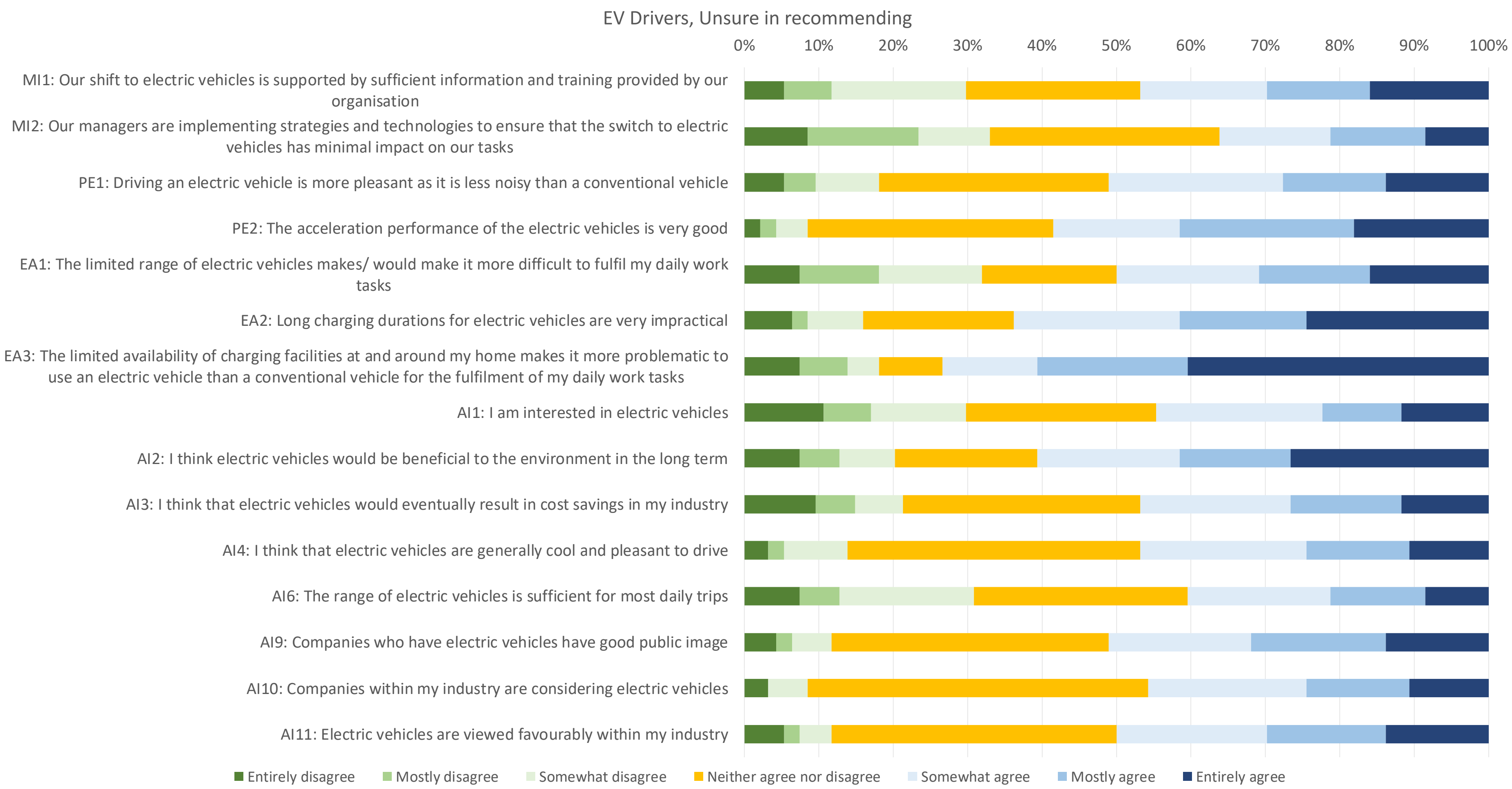
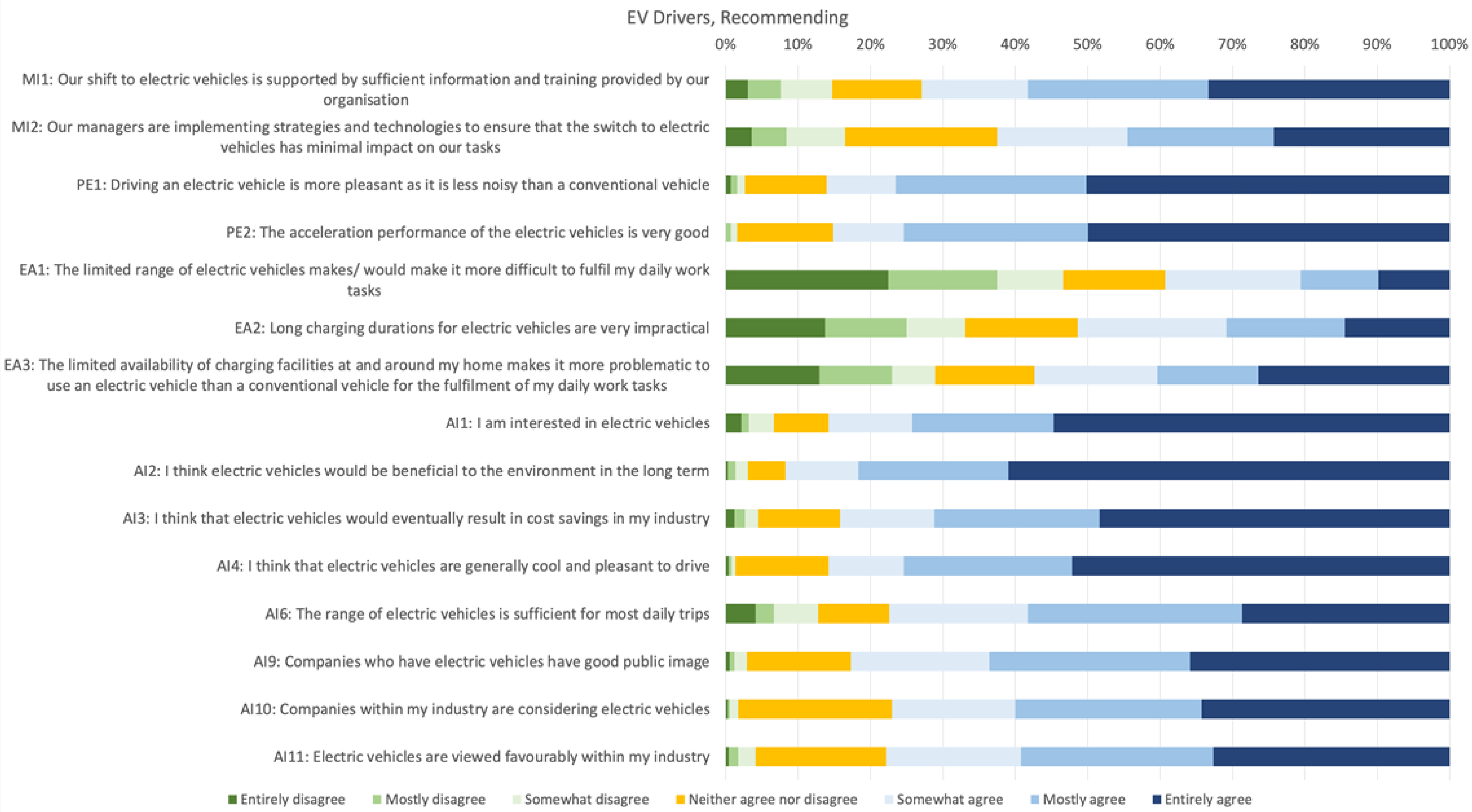


Figure 56 – EV drivers recommending EVs



It is also important to note that across the statements of the EV drivers who are unsure about recommending an EV, the percentage of people responding, neither agree nor disagree is very high for the statements related to the latent factor, compliance to external expectations, which show that these drivers do not have a clear idea, or they are neutral about strategies of other companies within their industry.

Key insights:

- Those EV drivers who said they did not recommend EVs have a markedly different response to statements relating to the factor, impact of electrification on work tasks, highlighting their obstacles related to access to charging, charging duration, and range. Those who would recommend EVs to others feel much more positively about these areas and are less concerned about the impact on their tasks.
- Respondents who do not recommend EVs also show doubts on EV performance, while there is a greater than 95% satisfaction among those who would recommend them. This means individual preferences can diverge even when informed by experience from the same vehicles and should be considered when selecting a vehicle or providing options for different models.
- Those not recommending EVs often do not feel that the transition is supported by management, and do not recognise environmental and cost-saving benefits to the organisation as much.
- The fact that those who are not happy with their EV have broad concerns over a range of technical, organisational, economic, and environmental aspects means there is not a single area that needs to be improved to get them on board. The particular concerns of those drivers could be explored further to identify how they could be addressed.

4.5 Conclusions and Further Analysis

The results for the three fleets demonstrate how the factor loadings compare between iteration one and iteration two, and between the various types of fleets, as well as for the combined data between EV drivers and non-EV drivers. The following key insights have been extracted from the study and the completed factor analysis:

- The three fleets, Centrica, Uber and Royal Mail, have similar factor loadings, though with some notable differences. Overall, this suggests lessons learned can be translated between fleets, given that the variation in responses for the examined statements can be linked to the same factors.
- Some small changes can be observed on the influence of charging, possibly linked to new habits or better understanding. For Royal Mail there is a clear increase in difficulty with access to charging points which has become a key area of concern by iteration two.
- The benefits related to both cost and environment seem to be clear to the survey respondents.
- Drivers are aware of the interests of both private and public stakeholders on the EV transition and recognise the impact of these views on the expectations for their organisations, and this appears to be improving (notably for Centrica)
- EV drivers positively rate their vehicle and driving experience. The driving experience is shaped mostly by noise, acceleration, and how ‘cool’ the EV is perceived. There are few changes in between iterations, so opinions on these topics do not significantly shift over time.
- The main difference between EV and non-EV drivers between the two iterations is that for EV drivers there is a growing concern with access to charging. For non-EV drivers over the same time interval this concern is decreasing.

- Those EV drivers who said they do not recommend an EV have a clearly different response to barriers, advantages and management support compared to those who would recommend EVs to colleagues. Those who are not happy with their EV have broad concerns over a range of technical, organisational, economic, and environmental aspects which means there is not a single area to improve to change their views.

Based on the results of the factor analysis the following opportunities for further analysis have been identified:

- The two iterations of the questionnaire were conducted to explore how views have changed over time. D7 will further explore how interventions from the companies, Optimise Prime team, or external factors have impacted driver experiences.
- Specific interventions could be designed to test their effectiveness in subsequent iterations of the model, based on the factors in this study. It should be stressed that the study itself can be seen as an intervention too, as the questionnaires and interviews could have been a trigger for staff to discuss the topic of EVs (and other topics related to sustainability) and share experiences, leading to information sharing and helping to resolve common misconceptions.
- Discussions could be facilitated between EV advocates and those who are not happy with their EV to extract insights in how individual circumstances and preferences shape their views, especially since these are markedly different across a wide range of themes. It is also possible be that differences are linked to a specific local context, and therefore that other external factors influence these views which have not been captured by the study.

5 Complementary behavioural analysis – Novuna Customers

5.1 Context and results

To assess whether the results from Royal Mail, Centrica and Uber are applicable to other fleets, the Optimise Prime behavioural studies were extended to drivers of a range of Novuna Vehicle Solutions' customers. Novuna is a commercial vehicle leasing provider. The companies surveyed included a freight company, a logistics and delivery company, veterinary care group, a convenience store company, a house building company and other Novuna customers. These companies are at a relatively early stage of electrification as part of Novuna's objective to operate a fully decarbonised fleet by 2030. The questionnaires took a similar form to those of other partners and the number of responses is shown in table 40.

Table 8 – Novuna questionnaire responses received

Organisation	Responses	Percentage EV drivers in responses
Freight company	26	23.08%
Logistics / delivery	50	40.00%
Veterinary group	28	17.86%
Convenience Store company	53	9.43%
Veterinary group	9	88.89%
Building company	246	46.34%
Novuna (other)	222	63.51%
Combined fleet	**634**	**47.16%**

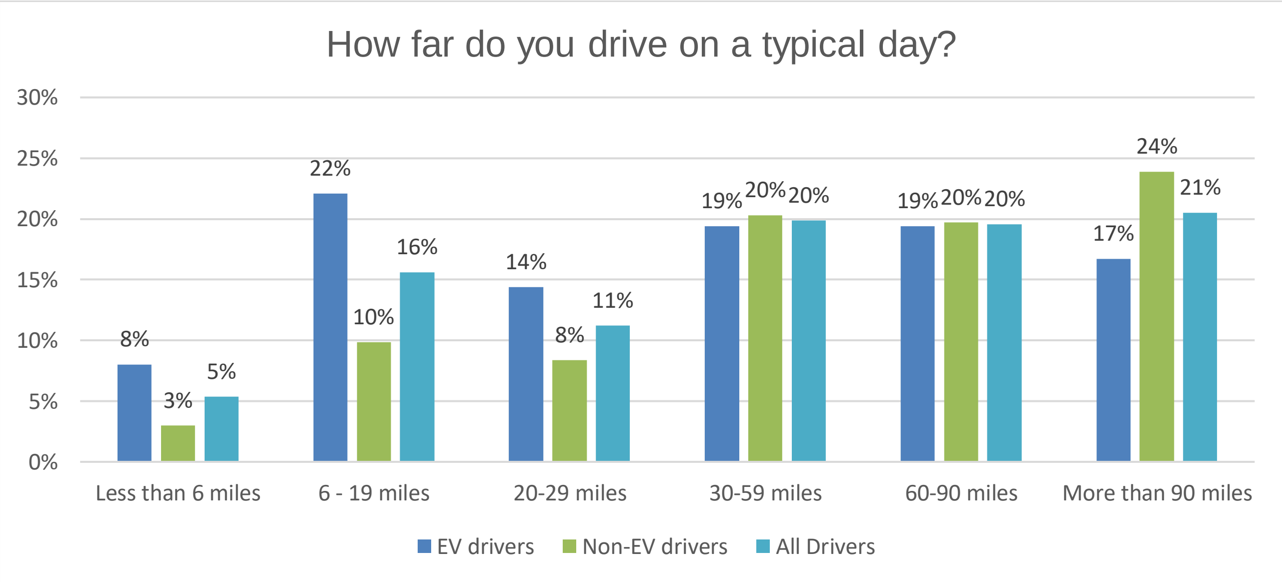
Due to the relatively small samples provided by some companies in this survey, the results of the Novuna customers are grouped together in the analysis. 66% of all drivers surveyed drive cars – this increased to 69% for those who drive EVs. 31% of respondents did not answer the vehicle type question.

5.1.1.1 EV use behaviour

When assessing distances travelled across all drivers, 61% travel more than 30 miles a day, 21% of which includes those travelling over 90 miles a day. However, EV drivers appear to drive slightly fewer miles on average, with more shorter trips, as shown in Figure 109. When comparing EV drivers to non-EV drivers this difference becomes expectedly greater. EV and non-EV drivers report similar behaviour on travelling between 30 and 90 miles a day, but the proportion of EV drivers typically travelling less than 19 miles is 17% higher than non-EV drivers. This shows the preference of shorter distances among EV drivers, which is reinforced by 7% fewer EV drivers travelling over 90 miles compared to non-EV drivers.

Novuna customers typically drive longer distances than Royal Mail's drivers, and slightly shorter distances than Centrica's drivers. The proportion of EV drivers that travel above 90 miles is 4% higher in Centrica's fleet, whilst the proportion of EV drivers travelling 60 to 90 miles is 17% higher. Overall, the use of vehicles included in this study is similar to Centrica but with a different distribution of journey lengths and the use of cars rather than vans.

Figure 57 – Typical daily driving distance – EV vs whole fleet



5.1.1.2 Charging behaviour

88% of drivers report that their organisation is not prescriptive of where nor when to charge, which might owe to a lack or unsuitability of on-site or depot charging for most of the organisations. The greater freedom provided to these drivers resulted in 85% of all EV drivers reporting that they plug in their vehicles at home. Most EV drivers (87%) can or have already installed a charging unit at home, showing the high ability and willingness of drivers to charge at home. Those who do not charge at home report doing so because of a lack of a driveway or ability to install an EV charger.

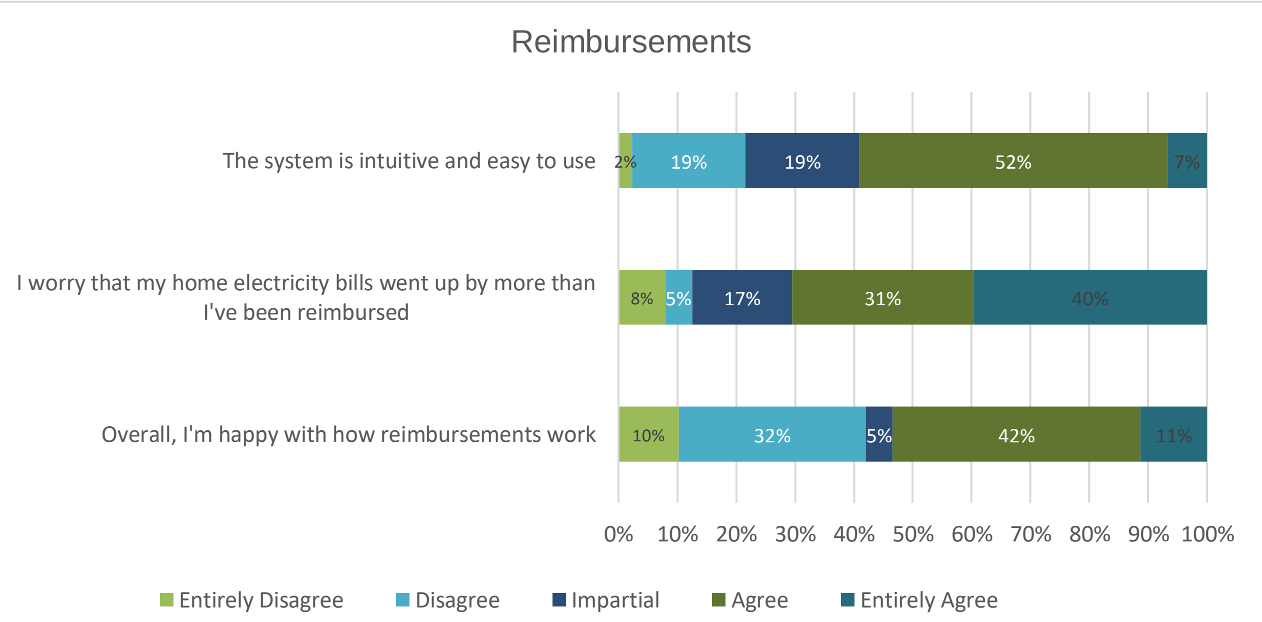
Yet only 37% of those drivers who already have a CP installed exclusively charge at home. Over half of Novuna customer drivers charge at destinations that they drive to for work (excluding their organisations facilities) despite having a CP at home. This indicates a high reliance on public charging among Novuna customer drivers. So, whilst the ability to charge at home is likely to be a key enabler in the transition to electric fleets, supported by results from Centrica's fleet analysis, public charging infrastructure remains crucial. This is particularly noteworthy since several drivers who could not charge at home expressed complaints about the price of public charging and the need to ensure charging accessibility before mass roll out of EVs.

The majority (79%) of Novuna customer drivers surveyed charge their EV every other day or less on average, leaving only 21% that charge every day. Novuna drivers charge their cars less frequently than Centrica drivers, 69% of which typically charge every day. This can be attributed to the shorter distances typically travelled among Novuna customer drivers.

5.1.1.3 Reimbursements

Drivers which are offered reimbursements, 29% of all Novuna EV drivers surveyed, have a balanced perception of their organisations' reimbursement system. As demonstrated in Figure 58, whilst 59% agree that the system is intuitive and easy to use, 71% are worried that their home electricity bills increased by more than what they were reimbursed. This reveals an important issue, particularly in the current climate of volatile energy costs, which may increase resistance to the transition to electric fleets and dissatisfaction among current EV drivers if mishandled.

Figure 58 – Perception of Novuna drivers' reimbursement system

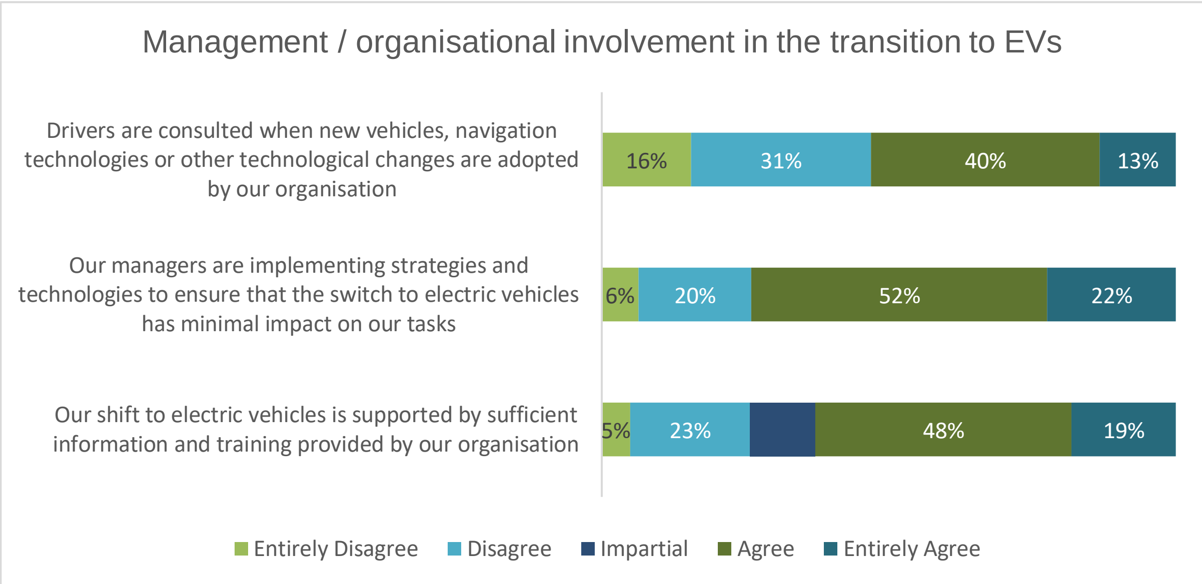


5.1.1.4 Opinions on Management Involvement

Since this analysis involves a range of companies, management have varying responsibilities. It was reported that most decisions around technology and fleet management are largely top down and centralised, although many staff from various departments are also often involved in the decision making and approval process.

Generally, management is perceived positively by drivers, highlighted by 74% of drivers reporting that they are implementing strategies and technologies to ensure the switch to EVs has minimal impact on drivers' tasks (Figure 59). Just 36% of drivers mostly or entirely agreed that they were consulted when new vehicles, navigation technologies or other changes are adopted by their organisation, which is similar to results from Centrica. Yet, 67% of drivers maintain that management provide sufficient information and training. These results align to those found for Centrica and Royal Mail, further supporting that fleet drivers generally view managers as providing adequate support, although it appears that there is substantial scope for improvement.

Figure 59 – Novuna drivers' perception of management support



5.1.1.5 Effort Expectancy

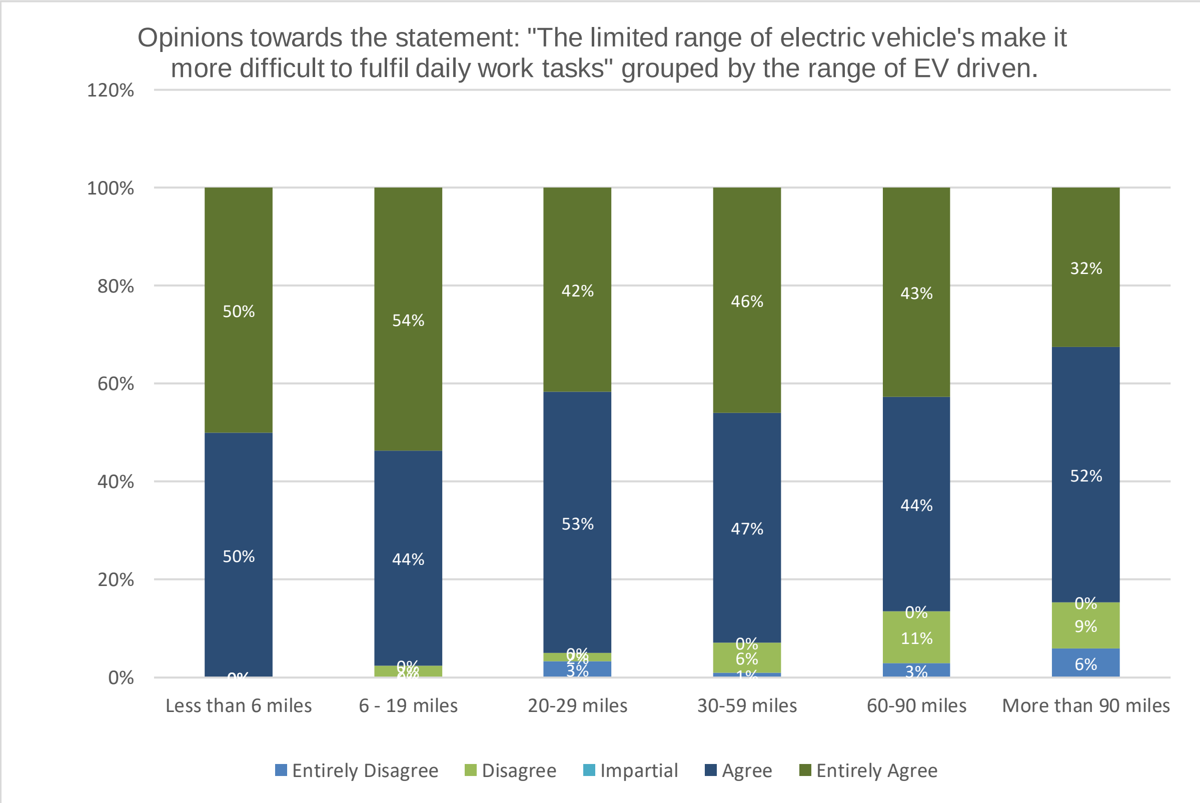
Range: Results from Novuna customer drivers support that the perceived limited range of EVs is a barrier to adoption. 48% of all EV drivers entirely agree that the limited range makes it more difficult to fulfil daily work, whilst 94% of drivers in total at least somewhere agree with this.

However, for EV drivers which travel the largest distances, more than 90 miles, the proportion which entirely agree with the statement drops to 32%, as shown by Figure 60. In other words, whilst range is clearly perceived to be a large issue among all drivers, those which travel the furthest distance, who are assumed to be both more experienced in driving EVs and drain more energy from their battery each day, are less concerned. This indicates that drivers travelling within smaller ranges are unreasonably worried about their EV's range capability to fulfil their tasks, perhaps driven by a lack of confidence or experience.

Ultimately, these results build upon the findings presented for Centrica and Royal Mail, which both found an increase in the number of EV drivers that agreed that completing daily work tasks was more difficult because of EV range limitations. The severity of this issue is heightened when it is considered that only 50% of non-EV drivers agree that range is an issue

– 44% less than EV drivers themselves. This demonstrates that negative perceptions on range is a strong barrier to widespread fleet electrification, since EV drivers attribute limited range to being less easily able to fulfil daily work tasks. However, since the findings also show that EV drivers travelling longer distances view this as less of a concern, this obstacle may diminish as drivers become more confident with greater experience.

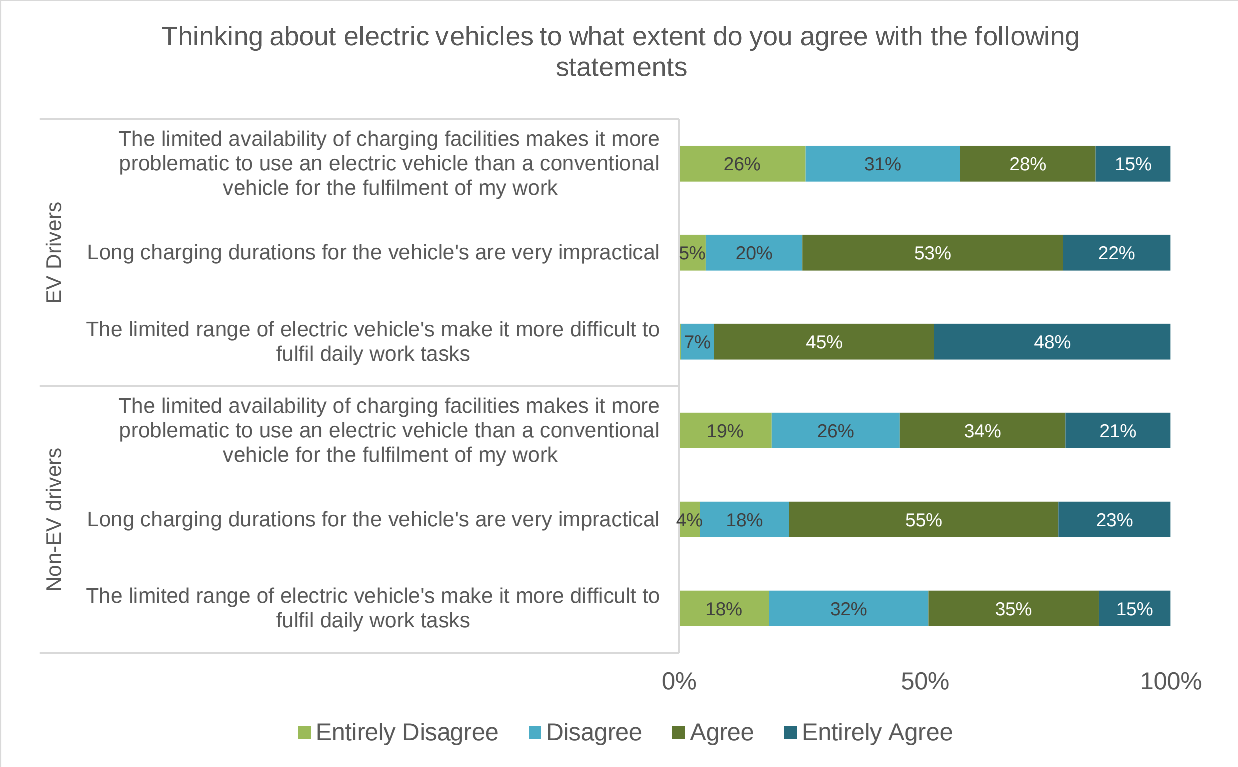
Figure 60 – Novuna drivers' opinions on the impact of limited ranges of EVs on their daily work



Charing durations: For EV drivers and non-EV drivers alike, the impracticability of long charging durations is a leading concern – over 75% of all drivers agreeing or entirely agreeing that this is an issue. Although those who disagree with this is slightly higher among EV drivers, indicating that this is not as large of an issue as perceived by non-EV drivers, the similarity in results (Figure 61) show the persistence of this as a behavioural barrier to the EV transition.

Charging accessibility: When assessing whether limited charging makes it more problematic to use an EV compared to a conventional vehicle for work, the difference between EV and non-EV drivers was larger. 12% fewer EV drivers compared to non-EV drivers disagreed that limited charging made completing their work more problematic. Accordingly, non-EV drivers are more concerned about charging capacity. This is reflective of findings from the other analyses, including Royal Mail's fleet, where 73% of drivers agreed that limited availability of charging points presented an issue for completing their tasks. The most likely explanation for this is that the roll out of EVs has not been matched by an increase in charging facilities available. This explanation aligns with many comments received from drivers and the other fleet analyses, further validating this explanation.

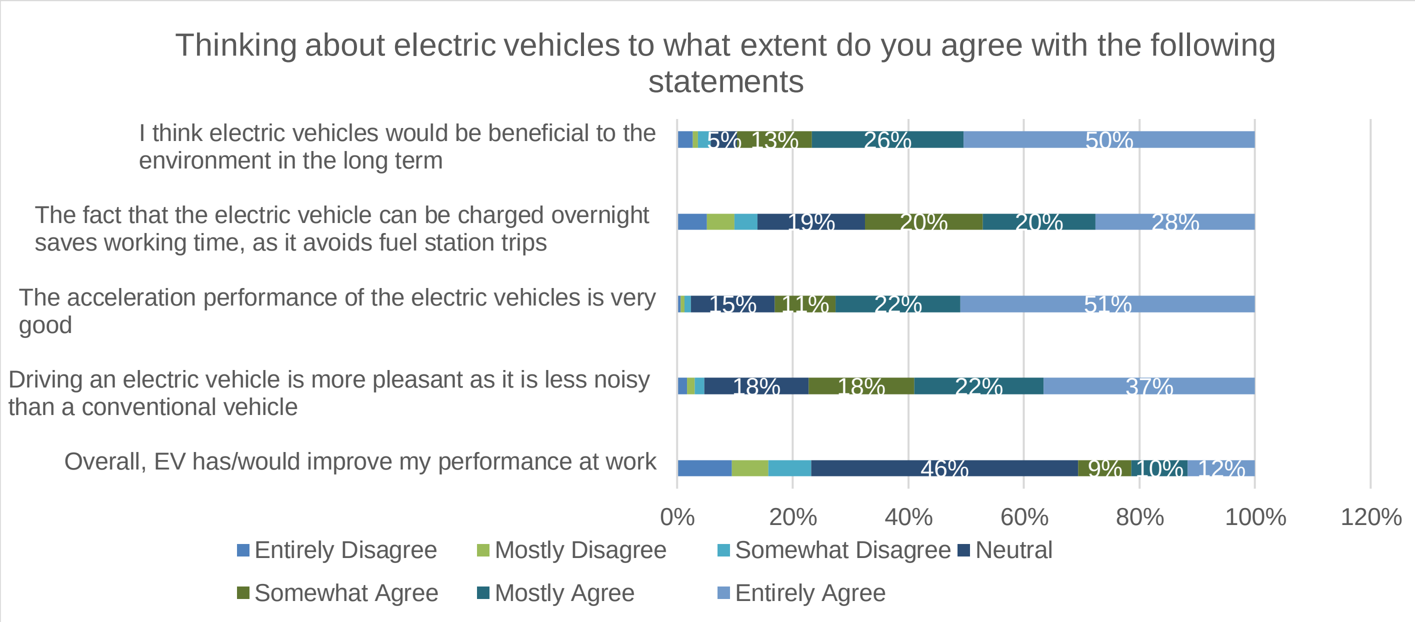
Figure 61 – Novuna drivers' opinions on EV effort and expectancy



5.1.1.6 Performance Expectancy

Overall, the performance and performance expectation of EVs is perceived to be positive among both EV and non-EV drivers (Figure 62). Results were most positive regarding the long-term environmental benefits of EVs, of which 89% drivers at least somewhat agreed with, and the acceleration performance of EVs, of which 83% at least somewhat agreed with. One area which drivers found EVs did not perform well was their ability to improve performance at work – only 31% agreed that it could at least somewhat deliver on this, while 46% were neutral on the matter.

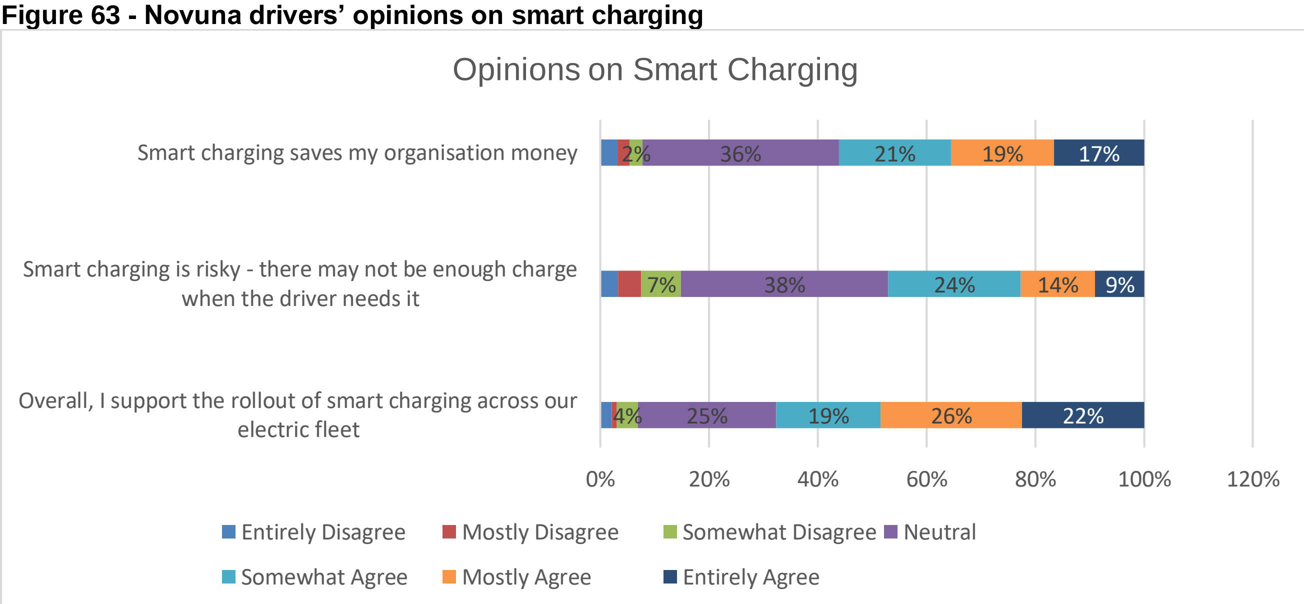
Figure 62 – Novuna drivers' opinions on the performance of EVs



5.1.1.7 *Smart Charging*

The drivers surveyed are generally very positive on smart charging, as shown by 48% mostly or entirely agreeing with the roll-out of charging across their respective organisations' electric fleet (Figure 63). Whilst 13% agree or mostly agree that smart charging is risky, this figure rises to 26% for those which believe that smart charging saves their organisation money. This supports that smart charging requires high communication to boost confidence among drivers, who otherwise support the technology.

Figure 63 - Novuna drivers' opinions on smart charging



5.1.1.8 Attitudes, Emotions and Social Influence

The attitude of Novuna customers' fleet drivers towards the shift to EVs is largely positive. Few (9%) view EVs as a temporary phenomenon, whilst 37% believe in the ability of EVs to deliver cost savings in their industry and that they are pleasant and cool to drive. Therefore, whilst the results show that drivers are less convinced that EVs will help them to better complete their daily tasks (Figure 115), they are supportive of them more generally, evidenced by widespread acknowledgment of benefits regarding the environmental, social, and public perception, and industry expectations.

5.1.1.9 Adoption Intentions

There is a high level of adoption advocacy among non-EV drivers surveyed. When asked, 88% responded that they either definitely (59%) or probably (29%) support the expansion of EVs with their organisation's fleet. This figure increases to 92% for existing EV drivers. This indicates that existing EV drivers have had a successful and positive experience with their EVs to the extent that they would advocate for their colleagues to also transition.

5.2 Factor analysis of the Novuna fleets

The investigation of the FAST construct for Novuna fleets was performed using EFA on 30 statements, which are the same as those presented to Centrica's drivers in the second iteration questionnaire.

The full results of the factor analysis can be found in Annex 6.3. Key insights from the factor analysis of the Novuna customer responses include:

- Novuna customer drivers believe that they are consulted regarding the switch to EVs and that managers try to minimise the impact that the switch to EVs have on their tasks
- Drivers are conscious that the transition to EVs is targeted by government and other businesses, and that customers might also expect their business to switch to EVs
- EV acceleration and lack of noise lead to positive perception of EVs
- Amongst the population of mostly non-EV drivers, there is particular concern about limited availability of charging facilities, limited range, and long charging durations
- The company's good public image, the advantage given by the low energy cost, the benefit to the environment in the long term are perceived as the most important benefits of EVs to the organisation

The small sample did not allow the project to conduct a reliable EFA separately for the EV drivers. Therefore, a frequency analysis was performed to understand if there are potentially interesting differences in response between the two groups. The main findings, based on a small sample, were:

- A higher percentage of EV drivers believe that the performance of EVs are better than conventional vehicles, especially with regards to noise (more than 50% of EV drivers mostly or entirely agree) and acceleration (more than 70% of EV drivers mostly or entirely agree).
- 37% of EV drivers entirely disagree with the question about forgetting to plug-in and 23% mostly or entirely agree that smart charging is risky.

5.3 Insights

Based on the analysis of the initial Novuna survey results the project concludes:

The results of the factor analysis are similar to those obtained for Centrica, Uber, and Royal Mail fleets

This confirms that the results and recommendations can be generalised.

Availability of charging points is a strong barrier to adoption for non-EV drivers

Non-EV drivers are highly concerned that the lack of charge points may present an issue for their daily work. Over 50% of EV drivers with home chargers still rely upon public charging, whilst several are unable to have a CP installed at home at all. Therefore, improving the availability of charging facilities, including public charging, is crucial. Failing to address this, risks a growing resistance to the electrification of fleets as charging becomes increasingly burdensome.

EV drivers who travel greater distances are less concerned about EV range as a barrier to completing their daily work tasks

The results show that drivers which travel the greatest distances of all Novuna customer drivers are less worried about the impact that limited EV range will have on the completion of their daily tasks, compared to those which travel shorter distances. Therefore, most drivers are inexplicably anxious about limited EV range, as it does not appear to present a serious risk for them. Increased confidence, perhaps through greater education and increased experience, is required among drivers to reduce this as a barrier to EV adoption.

Drivers' attitudes are generally positive towards EVs and smart charging

These findings build upon results from other fleet analysis, proving that drivers are largely positive and optimistic towards EVs, regardless of whether they view them as benefitting them in their work capacity. Smart charging is welcomed among almost all drivers.

6 Annexes

6.1 Reliability tests on behavioural survey responses

Since ordinal data from Likert-scale items are explored, a rigorous statistical procedure was undertaken in order to evaluate the reliability of the dataset by applying the factor analysis correctly and to determine the suitability beforehand. This includes initial tests of sampling adequacy using the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. The Kaiser-Meier-Olkin measure (KMO) indicates the level of sampling adequacy. High KMO values correspond to a greater correlation among variables and a smaller partial correlation among them[6]. KMO varies from zero to one, 0.5 being the acceptance threshold, 0.7 a good level and 0.9 an excellent level of adequacy. Bartlett's test of sphericity is performed to check the null hypothesis that the original correlation matrix was an identity matrix[7].

Looking at Table 9, Table 10 and Table 11, the KMOs for each fleet and each iteration are all very close to or greater than 0.9, showing an excellent level of adequacy. The very small p-values (threshold $p < 0.001$) obtained for Bartlett's test of sphericity mean that the null hypothesis of the identity matrix can always be rejected.

[6] Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31–36.
[7] Bartlett, M. S. (1951). The effect of standardization on a χ^2 approximation in factor analysis. *Biometrika*, *38*(3/4), 337–344.

Table 9 – Reliability tests, Centrica

KMO and Bartlett's Test			
		Iteration 1	Iteration 2
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.839	0.914
Bartlett's Test of Sphericity		1398.481	3683.976
	df	325	435
	Sig.	<0.000001	<0.000001
Number of Observations:		97	230

Table 10 – Reliability tests, Uber

KMO and Bartlett's Test			
		Iteration 1	Iteration 2
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.93	0.93
Bartlett's Test of Sphericity		10389.976	13212.396
	df	325	325
	Sig.	<0.000001	<0.000001
Number of Observations:		798	952

Table 11 – Reliability tests, Royal Mail

KMO and Bartlett's Test			
		Iteration 1	Iteration 2
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.848	0.835
Bartlett's Test of Sphericity		1882.374	1388.288
	df	171	171
	Sig.	<<0.000001	<<0.000001
Number of Observations:		312	209

EFA was conducted by extracting the factors with Principal Axis Factoring and rotating them with varimax orthogonal rotation in order to simplify the correlation among the items of each factor. Extraction and rotation produced the factor loading matrix and the factors were identified based on the similarity of the factor loading values.

For the cross-fleet analysis, shown in Table 12 and Table 13, the KMOs for each iteration are all very close to 0.9, showing a very good level of adequacy. The very small p-values (threshold p <0.001) obtained for Bartlett's test of sphericity mean that the null hypothesis of the identity matrix can always be rejected.

Table 12 – Reliability tests, EV Drivers

EV driver			
		Iteration 1	Iteration 2
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.854	0.870
Bartlett's Test of Sphericity		1964.172	4170.207
	df	120	120
	Sig.	<<0.00001	<<0.00001
	Number of observations	302	634

Table 13 – Reliability tests, Non-EV Drivers

Non-EV driver			
		Iteration 1	Iteration 2
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.868	0.87
Bartlett's Test of Sphericity		5441.244	4788.798
	df	120	120
	Sig.	<<0.00001	<<0.00001
Number of observations		879	757

6.2 EFA Results

Table 14 – EFA, Centrica

		Centrica											
		Iteration 1						**Iteration 2**					
		Factor loadings						Factor loadings					
FAST	ITEM	Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience		Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience	Pro-smart charging
Management involvement and training	MI1	0.404					MI1				0.455		
	MI2				0.506						0.535		
Organisational structure	OF1				0.691						0.843		
	OF2				0.875						0.789		
Electric vehicle performance	PE1					0.576						0.701	
	PE2			0.459		0.643						0.682	
	PE3	0.449											
	PE6						PE6			0.45			
Effort related to EV adoption	EA1			-0.845						-0.741			
	EA2			-0.654						-0.766			
	EA3			-0.669						-0.581			
	EA4							-0.423					
	EA5						EA5						-0.485
Attitudes/emotions & social influence	AI1	0.645						0.589					
	AI2	0.852						0.826					
	AI3	0.848						0.78					
	AI4	0.47				0.672		0.439				0.576	
	AI5	-0.484						-0.588					
	AI6			0.79						0.486			
	AI7												
	AI8	0.605						0.487					
	AI9	0.553						0.483	0.426				
	AI10		0.551						0.619				
	AI11						AI11		0.669				
	AI12		0.614						0.753				
	AI13		0.864						0.766				
	AI14		0.478						0.534				
	AI15		0.509						0.577				
	AI17						AI17						0.414
	AI18						AI18	0.434					0.611

Table 15 – EFA, Uber

		Uber										
		Iteration 1						Iteration 2				
		Factor loadings						Factor loadings				
FAST	ITEM	Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience		Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience
Management involvement and training	M1				0.736						0.753	
	MI2				0.801						0.798	
	MI3				0.719						0.756	
Electric vehicle performance	PE1					0.653		0.423				0.616
	PE2					0.644						0.611
	PE3					0.573						
	PE4					0.411	PE4	0.524				
	PE5	0.511				0.433		0.644				
Effort related to EV adoption	EA1			0.688						0.75		
	EA2			0.741						0.817		
	EA3			0.79						0.764		
Attitudes/emotions & social influence	AI1	0.442						0.552				
	AI2	0.624						0.762				
	AI3	0.479	0.442					0.668				
	AI4		0.437			0.596		0.484	0.429			0.497
	AI5	-0.445										
	AI6											
	AI7											
	AI8		0.49			0.446	AI8	0.546				
	AI9		0.619						0.603			
	AI10		0.723						0.685			
	AI11		0.694						0.675			
	AI12		0.63						0.746			
	AI13		0.602						0.672			
	AI14		0.689						0.651			
	AI16		0.619						0.534			0.406

Table 16 – EFA, Royal Mail

		Royal Mail										
		Iteration 1						**Iteration 2**				
		Factor loadings						Factor loadings				
FAST	ITEM	Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience		Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience
Management involvement and training	MI1				0.772						0.77	
	MI2				0.611						0.549	
Electric vehicle performance	PE1					0.849						0.635
	PE2					0.7					0.486	0.516
Effort related to EV adoption	EA1			0.699						0.537		
	EA2			0.677						0.879		
	EA3						EA3			0.434		
	EA4			0.407								
Attitudes/emotions & social influence	AI1					0.402						0.588
	AI2	0.589						0.757				
	AI3	0.508						0.714				
	AI4					0.687						0.757
	AI5	-0.498										
	AI6		0.433						0.41			
	AI9		0.604						0.792			
	AI10		0.661						0.629			
	AI11		0.67						0.718			
	AI14		0.671						0.524			
	AI15		0.431									

Table 17 – Factor Loadings, EV Drivers (cross-fleet analysis)

		EV drivers										
		Iteration 1						**Iteration 2**				
		Factor loadings						Factor loadings				
FAST Framework	ITEM	Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience		Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience
Management involvement and training	MI1				0.834						0.79	
	MI2				0.592						0.717	
Electric vehicle performance	PE1					0.816						0.772
	PE2					0.612						0.742
Effort related to EV adoption	EA1			0.832						0.751		
	EA2			0.723						0.807		
	EA3			0.456						0.637		
Attitudes/emotions & social influence	AI1	0.464						0.468				
	AI2	0.653						0.73				
	AI3	0.544						0.684				
	AI4					0.701						0.636
	AI5											
	AI6						A16			-0.401		
	AI9		0.536						0.608			
	AI10		0.727						0.727			
	AI11		0.776						0.647			

Table 18 – Factor Loadings, Non-EV Drivers (cross-fleet analysis)

		non-EV drivers										
		Iteration 1						**Iteration 2**				
		Factor loadings						Factor loadings				
FAST Framework	ITEM	Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience		Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience
Management involvement and training	MI1				0.698						0.642	
	MI2				0.824						0.802	
Electric vehicle performance	PE1					0.702						0.739
	PE2					0.738						0.645
Effort related to EV adoption	EA1			0.696						0.551		
	EA2			0.765						0.744		
	EA3			0.792						0.637		
Attitudes/emotions & social influence	AI1	0.483										
	AI2	0.713										
	AI3	0.61										
	AI4					0.555						0.58
	AI5											
	AI6											
	AI9		0.607						0.614			
	AI10		0.729						0.754			
	AI11		0.654						0.669			

6.3 Details of Novuna customer behavioural analysis

This annex provides the detailed analysis of behavioural surveys of Novuna Vehicle Solutions customer fleets, summarised in Section 5.

6.3.1 Factor analysis of the Novuna fleets

The investigation of the FAST construct for Novuna fleets is performed with EFA on 30 statements, which are the same as those presented to Centrica's drivers (iteration two) and shown in Table 1, from a total of 105 (out of 107) drivers with complete responses. Unlike what has been done for the project's partner fleets, in this case the limited number of responses for each fleet (51, 28 and 26) does not allow a separate EFA to be performed for each of them. Therefore, the Novuna fleet is considered for the factor analysis as a single group.

It should also be stressed that, considering that only 16 out of 105 responses come from EV drivers, the following results refer to a population of predominantly non-EV drivers. EV and non-EV drivers have been combined for the analysis presented here. To verify the outcomes, a separate factor analysis was also completed for the set of 89 non-EV drivers. The results of this analysis are not presented here as they were almost identical, and the number of EV drivers is too small to determine statistically significant differences.

Table 19 indicates that there is high reliability in the sample including all three fleets. The KMO measures for each iteration are all close to 0.9, showing a good level of adequacy. The small p-values (threshold $p < 0.001$) obtained for Bartlett's test of sphericity mean that the null hypothesis of the identity matrix can always be rejected.

Table 19 – Reliability tests, Novuna

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.873
Bartlett's Test of Sphericity		2160.678
	df	435
	Sig.	0

The results of the EFA are shown in Table 20, detailing the factor loadings for all relevant statements, with a threshold of 0.4. The outcome is similar to the previous three fleets for Uber, Centrica, and Royal Mail. It is possible to identify five factors that are in line with the discussions presented for those fleets, namely: benefits of EV to the organisation, compliance to external expectations, impact of electrification on work tasks, consideration of drivers' perspective and opinion on driving experience.

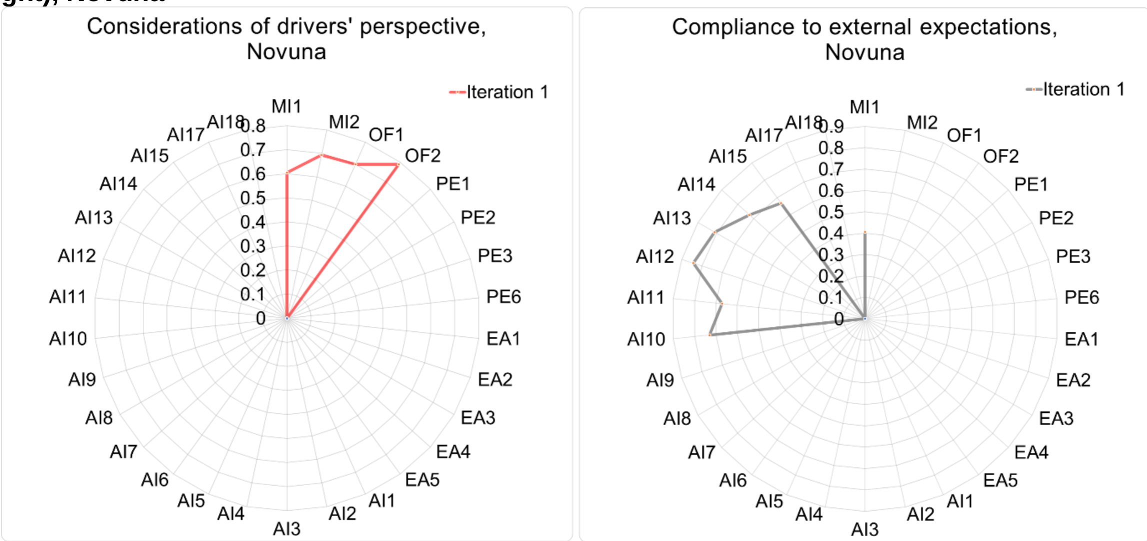
Table 20 – Factor Loadings of the Novuna vehicle fleets

		Factor loadings				
FAST	Item	Benefits of EV to the organisation	Compliance to external expectations	Impact of electrification on work tasks	Considerations of drivers' perspective	Opinion on driving experience
Management involvement and training	MI1		0.406		0.604	
	MI2				0.692	
Organisational structure	OF1				0.7	
	OF2				0.79	
Electric vehicle performance	PE1					0.62
	PE2					0.861
	PE3	0.458				
	PE6	0.565				
Effort related to EV adoption	EA1			0.709		
	EA2			0.698		
	EA3			0.814		
	EA4			0.463		
	EA5			0.423		
Attitudes/emotions & social influence	AI1	0.713				
	AI2	0.729				
	AI3	0.73				
	AI4	0.647				
	AI5					
	AI6	0.478				
	AI7	0.661				
	AI8	0.763				
	AI9	0.784				
	AI10		0.73			
	AI11		0.672			
	AI12		0.843			
	AI13		0.811			
	AI14		0.726			
	AI15		0.668			
	AI17	0.491				
	AI18	0.624				

Similar to the Centrica results, in the second iteration, the factor, considerations of drivers' perspective, (shown in Figure 64, left) explains the variance of the statements included in the two FAST framework constructs, management involvement and training (MI), and organisational structure (OF). This indicates that the drivers appear to be involved at different levels to understand the changes in the organisation required when transitioning to EVs. They believe that information is communicated efficiently by the organisation and managers (MI1 – our shift to electric vehicles is supported by sufficient information and training provided by our organisation and MI2 – our managers are implementing strategies and technologies to ensure that the switch to electric vehicles has minimal impact on our tasks); they are consulted (OF1

– drivers’ inputs are considered when new vehicles, navigation technologies or other technological changes to are adopted by our organisation and OF2 – drivers are consulted when new vehicles, navigation technologies or other technological changes are adopted by our organisation). Therefore, their perspectives can influence the companies’ decisions. The loadings for MI1 and MI2 are slightly higher than for Centrica, and all four statements here have a more similar weighting to each other.

Figure 64 – Consideration of drivers' perspective (left) compliance to external expectations (right), Novuna

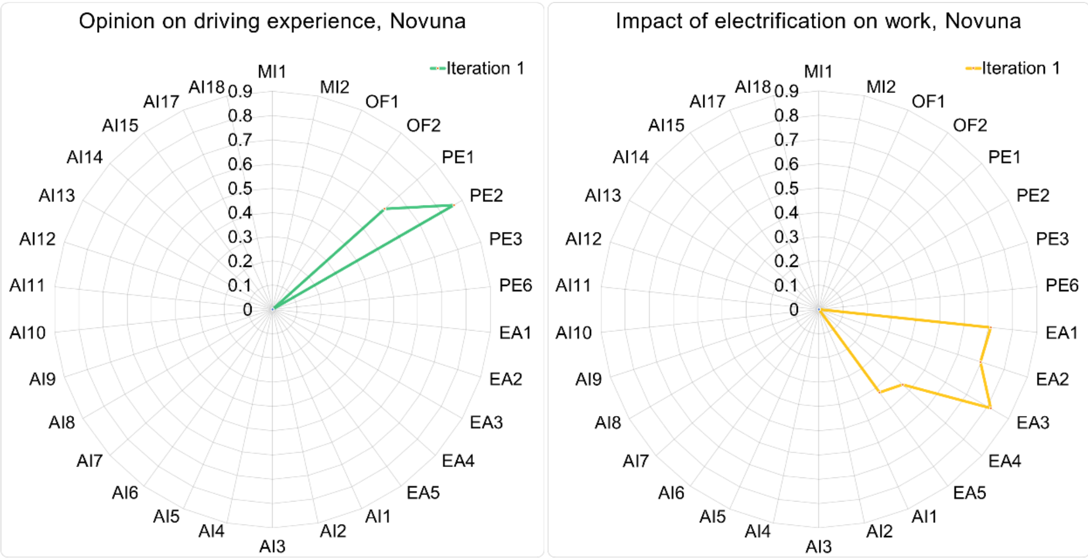


The two factors, compliance to external expectations, (Figure 64, right) and opinion on driving experience, (Figure 65, left) also agree with the conclusions of the other fleets. The first factor demonstrates that drivers are conscious of the transition to EVs that is targeted by government (AI13) and other businesses (AI10, AI12 and AI15), and that customers expect a switch to EVs (AI14). The statement on information and training provided (MI1) is above the threshold, which was not the case for the other fleets, which suggests that external expectations are communicated well from within the organisation. However, it is important to note that the MI1 statement is mostly involved in the explanation of the factor, considerations of drivers' perspective, for which its factor loading is much higher (i.e. 0.604).

For the factor, opinion on driving experience, (Figure 65, left), the two key statements, driving an electric vehicle is more pleasant as it is less noisy than a conventional vehicle, (PE1) and the acceleration performance of the electric vehicles is very good, (PE2). In this case, importance is particularly given to acceleration. Views of the drivers on whether EVs are cool and pleasant to drive (AI4) do not appear to play as much as a role for Novuna customers, as Centrica. In this analysis, the factor on benefits to the organisation, instead of for the driver, reflects the image of the company rather than the driver’s experience. It should be noted that this is based on all responses where the overall majority does not currently drive an electric vehicle and so answers are based on expectations or influenced by experiences of others.

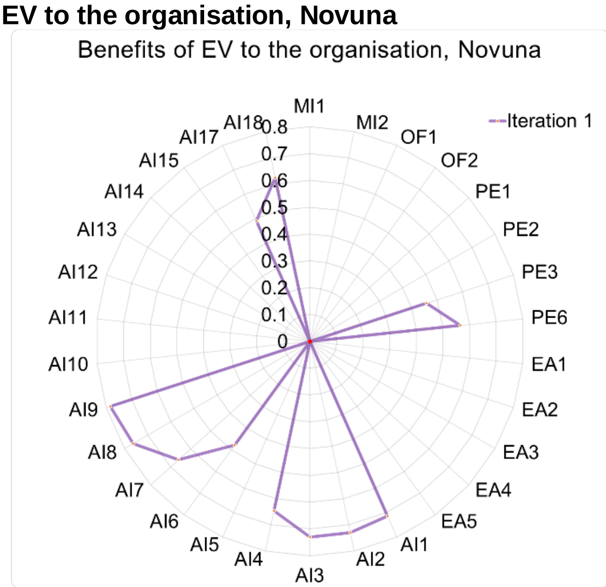
Contrasting to Centrica’s results, the three statements on smart charging (EA5, AI17 and AI18) do not group together in a single factor. An EFA solution with six factors (rather than five) was tested to see if smart charging statements could be grouped. This was not possible, and it did not show a new, stand-alone factor on pro smart charging attitudes (as in the case of Centrica’s iteration two). This difference might be because these three statements (EA5, AI17, AI18) were presented during the second Centrica survey when drivers could have been more exposed to EV technology and had a better understanding of the smart charging and its specific benefits. This cannot be observed in Novuna's results given the small number of EV drivers.

Figure 65 – Opinion on driving experience (left) and impact of electrification on work (right), Novuna



The two statements, it is difficult to remember to plug-in the electric vehicle at the end of the day/shift, (EA4) and smart charging is risky – there may not be enough charge when the driver needs it, (EA5) load onto the factor, impact of electrification on work tasks, which now corresponds to the group of statements, effort related to EV adoption. This indicates that, during this iteration across Novuna fleets, drivers are concerned about all the different issues related to EVs that can affect the work tasks, which are in order of importance based on factor loading magnitude (as seen in Figure 65, right): limited availability of charging facilities (EA3), limited range (EA1), long charging (EA2), difficulty remembering to plug-in (EA4) and risks of smart charging (EA5). The free-text comments also confirm that drivers are concerned about range and access to charging points (both at home, and while away on the job) and that these might be obstacles even though the driver would otherwise be keen on an EV.

Figure 66 – Benefits of EV to the organisation, Novuna



The other two statements related to smart charging (AI17 and AI18) relate to the factor, benefits of EV to the organisation (Figure 66). This is the factor characterised by the greatest number of statements (12) from the FAST framework constructs, EV performance, (PE) and attitudes/emotions & social influence (AI). Based on the magnitude of the factor loadings, it is of particular importance the attitudes about the company's good public image given by EVs (AI9), the advantage given by the low energy cost (AI8), the benefit to the environment in the long term (AI2) and their propensity to be interested in EV (AI1).

Key insights from the factor analysis of the Novuna customers:

- Novuna drivers are involved at different levels to understand the changes in the organisation that are part of the switch to EVs. They believe that information is communicated efficiently by the organisation and managers and are consulted.
- Drivers are conscious of the transition to EVs that is targeted by government and other businesses, and that customers might also expect a switch to EVs.
- Driver's opinion on EV driving experience is clearly affected by EV acceleration and noise.
- Given the population of mostly non-EV drivers, there is particular concern about limited availability of charging facilities, limited range, long charging.
- The company's improved public image from the switch, the advantage of lower energy costs, the benefit to the environment in the long term are perceived as the most important benefits of EVs to the organisation.

6.3.2 Novuna EV vs non-EV drivers

The small sample does not allow a reliable EFA to be performed separately for the EV drivers, as only 16 drivers in this data set are EV users. Therefore, a frequency analysis has been performed to understand if there are potentially interesting differences in response between the two. A factor analysis has been performed on the non-EV drivers, which gave similar factor loadings as shown in Table 20 for the entire dataset.

Comparing the percentages from the chart below (Figure 67 for non-EV drivers, and Figure 68 for EV-drivers), a higher percentage of EV drivers believes that the performance of EVs are better than conventional vehicles, especially regarding noise (PE1, more than 40% of EV drivers mostly or entirely agree) and acceleration (PE2, more than 80% of EV drivers mostly or entirely agree).

Additionally, 40% of EV drivers entirely disagree with the possibility to forget to plug-in (EA4); almost 30% entirely disagree with the fact that the limited range might affect the daily work task (EA1), and only 15% mostly or entirely agree that smart charging is risky (EA5).

Figure 67 – Frequency analysis - non-EV drivers

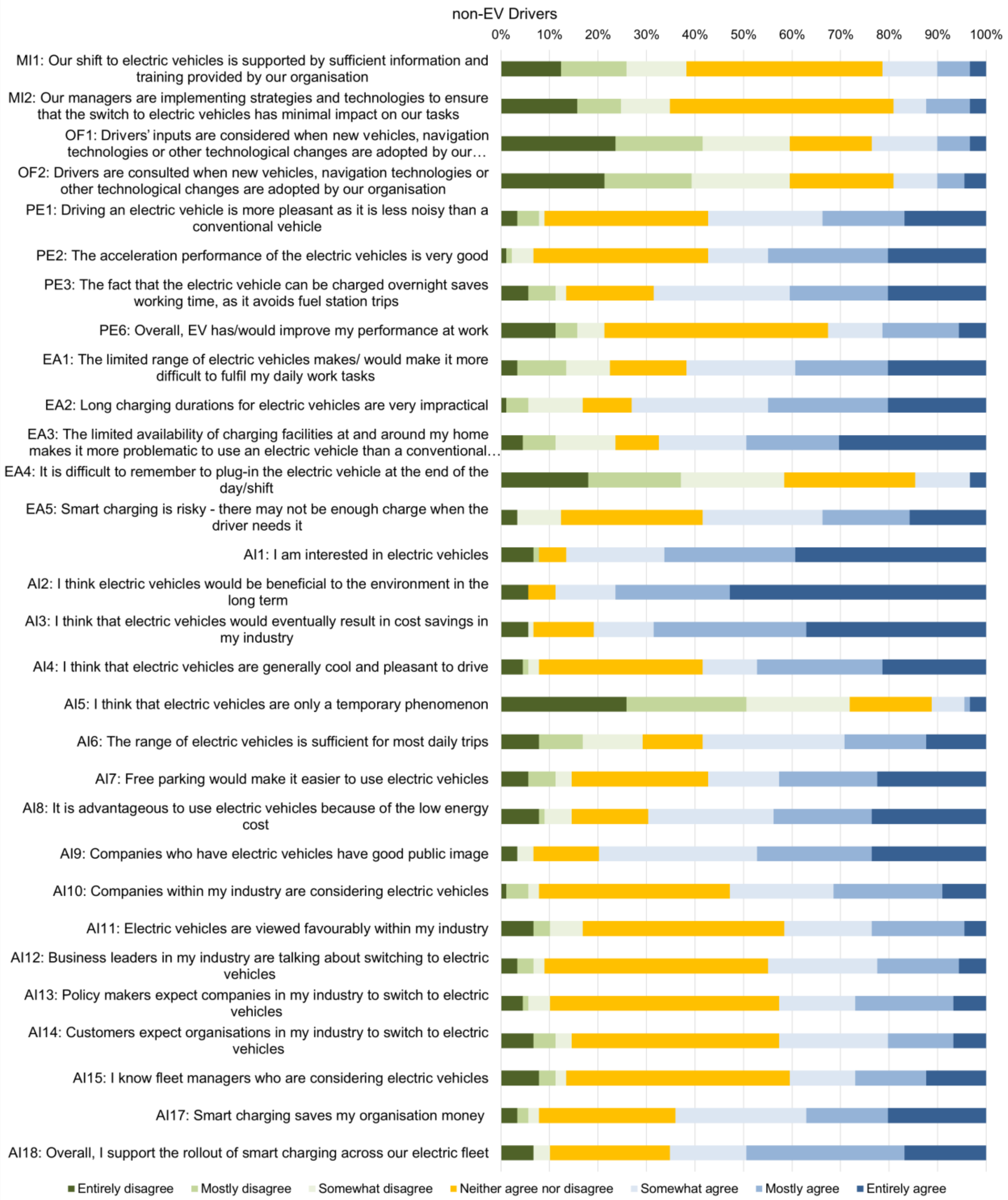
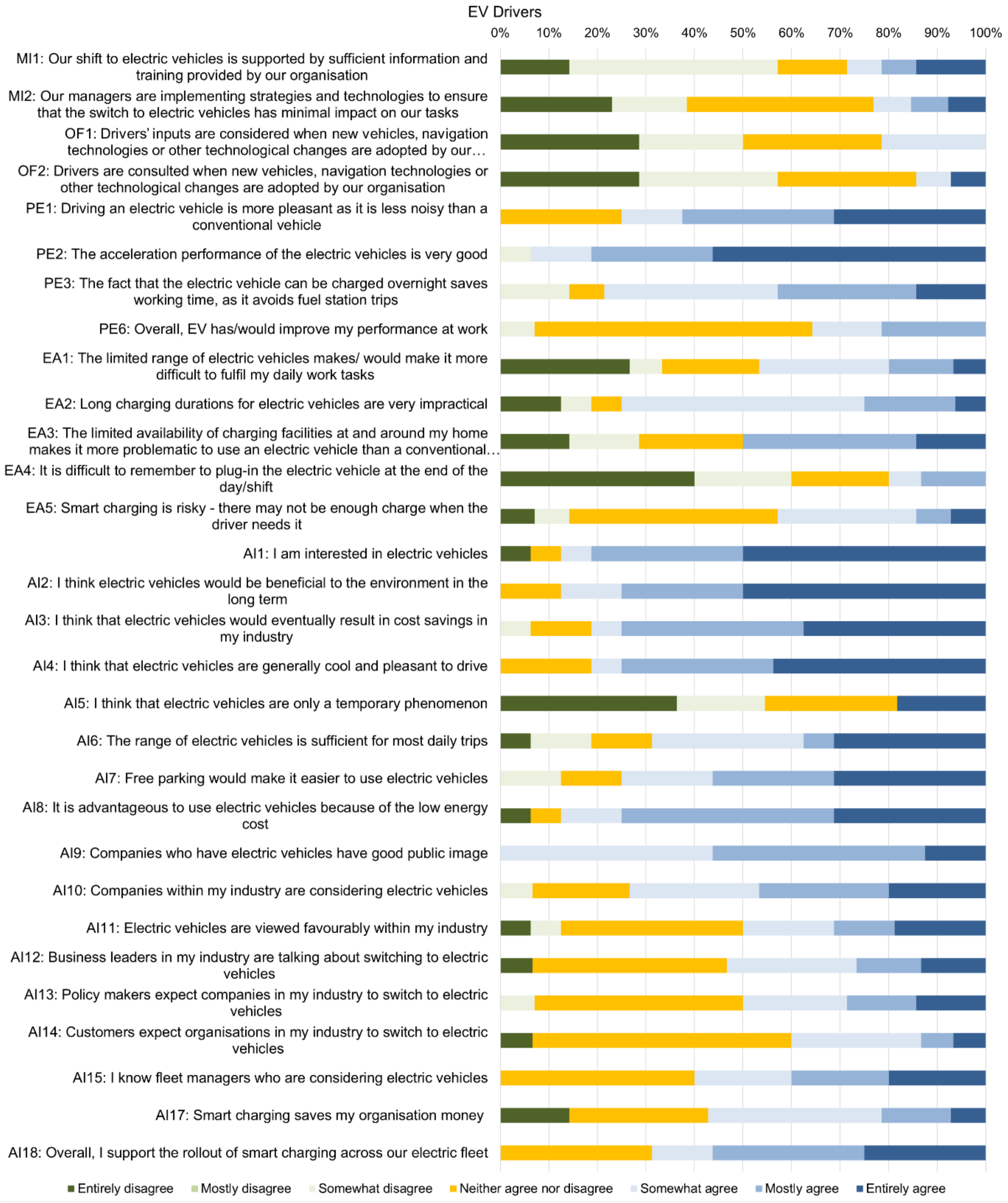


Figure 68 – Frequency analysis - EV drivers



6.3.3 Final comments on the analysis of the Novuna fleet data

The results of the factor analysis are similar to those obtained for Centrica's second survey, and the overall results of the Uber and Royal Mail fleets. This confirms that the results and recommendations can be generalised, given these fleets are similar to Centrica's predominantly home-based fleet. The outcomes also present the view of the whole population of drivers; the results of the factor analysis for the non-EV drivers were almost identical to the results of the whole dataset.

To better understand the differences between those with experience driving EVs and those who do not use an EV (at least for work) more responses are required. It is also key to clarify how EVs were distributed within the organisation, because drivers may be biased (e.g. if they were already feeling positive towards electric mobility and therefore asked to be first to try a new EV, while colleagues who were not as interested in the topic opted to keep their ICEV). However, the preliminary insights suggest that more exposure and experience of using an EV leads to higher, positive, rating of EVs.

There appears to be clear differences in typical driving ranges between the constituent fleets, as well as within each fleet, although the small data set makes it difficult to confirm if this would hold for a wider population. Still, it is relevant given the range of the EV used and the allocation process of these vehicles as they are being introduced. Current EV drivers seem to drive less than average, but it is not clear if this is because of their EV or if they have an EV because of the distances they need to travel. By selecting drivers whose driving distance works well with the EV battery size as well as the charging availability, a good match can be found to ensure positive response to the introduction of EVs that does not negatively impact the employees' tasks and provides them a comfortable and zero-carbon vehicle which they are happy to drive. Further analysis is required to better understand the relationship between attitudes towards EVs and the driving distance of the respondents.