Programme Area: Energy Storage and Distribution

Project: Consumers, Vehicles and Energy Integration (CVEI)

Title: Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Abstract:

This report represents Deliverable D5.1, Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials. The purpose of this report is to supplement, and where relevant, update the information in the Stage 1 deliverable D1.4, providing all necessary additional details of the design of the Consumer Trials, the printed / electronic materials to be used with Trial Participants, and the management arrangements and detailed plans.

Context:

The objective of the Consumers, Vehicles and Energy Integration project is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. Additionally, it aims to develop an integrated set of analytical tools that models future market scenarios in order to test the impact of future policy, industry and societal choices. The project is made up of two stages:

• Stage 1 aims to characterize market and policy frameworks, business propositions, and the integrated vehicle and energy infrastructure system and technologies best suited to enabling a cost-effective UK energy system for low-carbon vehicles, using the amalgamated analytical toolset.

• Stage 2 aims to fill knowledge gaps and validate assumptions from Stage 1 through scientifically robust research, including real world trials with private vehicle consumers and case studies with business fleets. A mainstream consumer uptake trial will be carried out to measure attitudes to PiVs after direct experience of them, and consumer charging trials will measure mainstream consumer PiV charging behaviours and responses to managed harging options.

PROJECT REPORT

CVEI Stage 2

D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Part 1 – Consumer Uptake Trial Study Plan

Consumer Uptake Trial

Background

The purpose of the Consumers, Vehicles and Energy Integration (CVEI) project is to investigate challenges and opportunities involved in transitioning to a secure and sustainable low carbon vehicle fleet. The project explores how integration of vehicles with the energy supply system can benefit vehicle users, vehicle manufacturers and those involved in the supply of energy. The project's objective is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. In addition to developing new knowledge and understanding, the project aims to develop an integrated set of analytical tools that can be used to model future market scenarios in order to test the impact of future policy, industry and societal choices.

Project scope

The project is made up of two stages: Stage 1 aims to characterise market and policy frameworks, business propositions, and the integrated vehicle and energy infrastructure system and technologies best suited to enabling a cost-effective UK energy system for low-carbon vehicles, using the amalgamated analytical toolset. Stage 2 aims to fill knowledge gaps and validate assumptions from Stage 1 through scientifically robust research, including real world trials with private vehicle consumers and case studies with business fleets.

Purpose and scope of this deliverable

The Consumer Uptake Trial will provide high validity measures of attitudes towards adoption of PiVs by Mainstream Consumers who have had real-world experience of using a BEV and a PHEV. This will provide robust inputs to the Analytical Framework to allow more accurate prediction of the likely future uptake of PiVs by the Mass-Market, and the resulting impact on UK aggregated EV charging demand. The data collected will advance understanding of Mainstream Consumers' willingness to adopt and will ensure that the outputs of modelling the uptake of PiVs are as valid as possible.

This report details the rationale, methodology, design and management arrangements that will be employed for the Consumer Uptake Trial.

The deliverable sets out the proposed method for the Uptake Trial, superseding the draft method set out in D1.4. The project team developed the trial's experimental design, recruitment strategy, piloting procedure, research instruments, trial management procedures, data collection and data analysis approach to set out a complete method for the Uptake Trial and subsequent output (Deliverable D5.2).

Trial Design and Method

The Consumer Uptake Trial will utilise a within-participants design. A within-participant design is most suitable for this study because it controls for individual differences. Each of the participants will experience both the BEV and the PHEV (and a control ICE vehicle).

The target sample for the Consumer Uptake Trial is 200 mainstream consumers. Mainstream consumers are defined as all those whose adoption of technology has been influenced by diffusion of awareness, knowledge, and positive attitudes from people who have already adopted the innovation (i.e. everyone except Innovators).

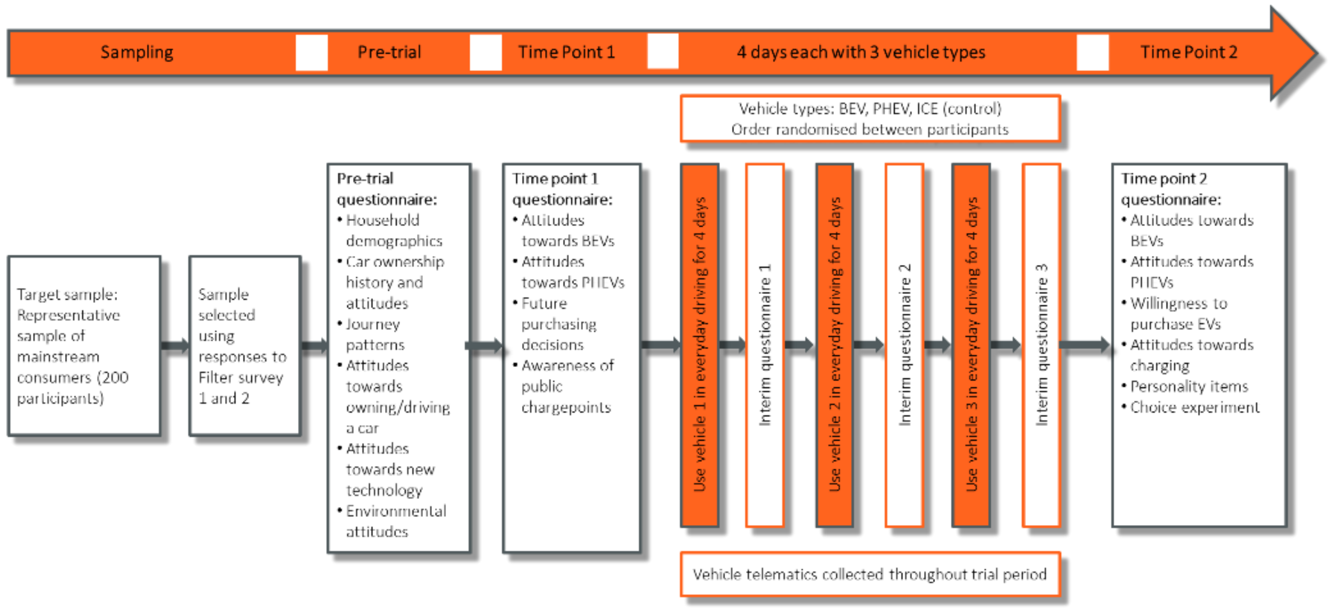

Figure 1 - Overview of procedure for Consumer Uptake Trial

Participants will be recruited from within a 50-mile radius of TRL and Cenex, with a 50/50 split between the two trial locations (i.e. 100 participants recruited from around TRL and 100 recruited from around Cenex). The recruitment strategy (including two filter surveys) is intended to eliminate participants not suitable for the trials (including innovators).

A Mode 2 charging socket on a dedicated circuit, with RCD protection, will be installed in participants' homes to enable them to safely charge the BEV and PHEV during the trial. Participants will be given free access to the 'POLAR plus' public charging network.

Data collected during the trials will include questionnaires, a choice experiment and telematics data. The trial vehicles will be equipped with a telematics device which will collect event-based data (e.g. at ignition on/off), and journey data every 10 seconds whilst the vehicle is in operation.

Data will be processed for use in analysis and anonymised so that the dataset may be used for potential future research. Core data analysis will address the research questions. Further supplementary analysis will be carried out to provide a further in-depth view of the reasons behind the answers to the key Research Questions.

Conclusions

The Consumer Uptake Trial is unique in its application of a controlled scientific experimental design to measure Mainstream Consumers' willingness to adopt PHEVs and BEVs following experience with a mid-sized family vehicle of both types, and an equivalent ICE car as control, reducing their psychological distance before measurement.

Within the wider CVEI project, outputs from the Consumer Uptake Trial and the Consumer Charging Trials) will be used as inputs to the Analytical Framework.

Insights

The CVEI project aims to model the potential integration of UK aggregated PiV charging demand into the wider UK energy system for the period to 2050. The validity of that analysis depends on having a clear picture of the prospective patterns of adoption of both BEVs and PHEVs by mainstream consumers over the coming decades.

Consumer Charging Trials

Background

The purpose of the Consumers, Vehicles and Energy Integration (CVEI) project is to investigate challenges and opportunities involved in transitioning to a secure and sustainable low carbon vehicle fleet. The project explores how integration of vehicles with the energy supply system can benefit vehicle users, vehicle manufacturers and those involved in the supply of energy. The project's objective is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. In addition to developing new knowledge and understanding, the project aims to develop an integrated set of analytical tools that can be used to model future market scenarios in order to test the impact of future policy, industry and societal choices.

Project scope

The project is made up of two stages: Stage 1 aims to characterise market and policy frameworks, business propositions, and the integrated vehicle and energy infrastructure system and technologies best suited to enabling a cost-effective UK energy system for low-carbon vehicles, using the amalgamated analytical toolset. Stage 2 aims to fill knowledge gaps and validate assumptions from Stage 1 through scientifically robust research, including real world trials with private vehicle consumers and case studies with business fleets.

Purpose and scope of this deliverable

The Consumer Charging Trials will investigate Mainstream Consumer charging behaviour with PHEVs and BEVs, and their responses and attitudes to alternative customer propositions which aim to manage energy demand associated with charging PHEVs and BEVs. This will provide robust inputs to the Analytical Framework to allow more accurate prediction of the likely charging behaviour and use of Demand Management schemes by the Mass-Market, and the resulting impact on UK aggregated EV charging demand.

This report details the rationale, methodology, design and management arrangements that will be employed for the Consumer Charging Trials.

The deliverable sets out the proposed method for the Charging Trials, superseding the draft method set out in D1.4. The project team developed the trial's experimental design, recruitment strategy, piloting procedure, research instruments, trial management procedures, data collection and data analysis approach to set out a complete method for the Uptake Trial and subsequent output (Deliverable D5.3 and D5.4).

Trial design and method

Two separate trials for PHEV and BEV drivers will be conducted to investigate the charging behaviours, attitudes and responses of mainstream consumers. Each trial will use a between-participants Randomised Controlled Trial (RCT) design, in which participants are randomly allocated to one of three groups:

1. a **Control Group**, in which participants are free to charge their vehicles as they wish, in the absence of a specific Managed Charging scheme.
2. a **User-Managed Charging** (UMC) group, in which participants are incentivised to actively shift their charging to periods of generally favourable supply-demand balance, through a banded tariff structure.
3. a **Supplier-Managed Charging** (SMC) group, in which participants are encouraged to relinquish control of their charging to a simulated energy supplier in exchange for consequent savings on overall charging cost.

A total of 240 participants will be recruited across the two trials (120 participants for the PHEV Consumer Charging Trial and 120 for the BEV Consumer Charging Trial). This allows for 40 participants per condition (control, SMC, UMC) in each trial.

Participants in the UMC and SMC group will be given a smartphone User App which they will use to engage with the Managed Charging scheme. Participants will be given a plug-in vehicle for a period of 8 weeks to use for their normal day-to-day journeys, and a Mode 3 chargepoint installed in their homes. Participants in all three experimental groups will receive incentives for taking part in the trial and engaging with vehicle charging.

Vehicle telematics and data from the chargepoint in participants' homes will be collected during the trial, along with questionnaire and choice experiment data. In addition, usage and preference data will be obtained from the smartphone app.

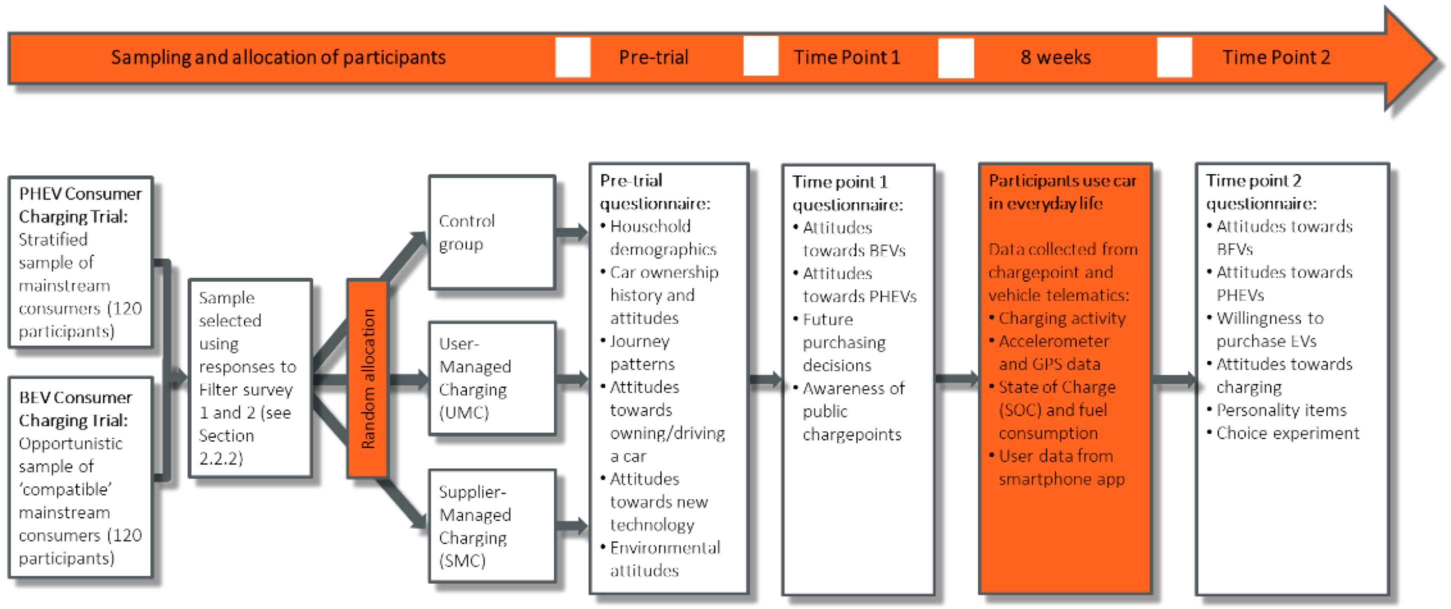

Figure 1 - Overview of procedure for Consumer Charging Trials

Data will be processed for use in analysis and anonymised so that the dataset may be used for potential future research. Core data analysis will address the research questions. Further supplementary analysis will be carried out to provide a further in-depth view of the reasons behind the answers to the key Research Questions.

Conclusions

The Consumer Charging Trials are unique in their application of a controlled scientific experimental design to measure Mainstream Consumers' charging behaviour and their acceptance of and behavioural response to propositions to control energy demand when charging a PiV. The data collected will advance understanding of Mainstream Consumers' charging behaviours and responses to Managed Charging schemes and ensure that representation of Mainstream Consumer behaviour in the Analytical Framework is as valid as possible.

Insights

The CVEI project aims to model the potential integration of UK aggregated charging demand into the wider UK energy system to 2050. The validity of that modelling depends on having a clear picture of the charging behaviours of mass market consumers who drive BEVs and PHEVs.

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Abbreviations

AC	Alternating Current
ACEA	European Automobile Manufacturers' Association
AER	All Electric Range
ALARP	As Low As Reasonably Practicable
ANOVA	Analysis Of Variance
API	Application Programming Interface
BEAMA	British Electrotechnical and Allied Manufacturers' Association
BEV	Battery Electric Vehicle
BIK	Benefit-in-Kind
BIT	Behavioural Insights Team
CAN	Controller Area Network
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CLASS	Customer Load Active System Services
CNG	Compressed Natural Gas
CPAT	Commercial Policy and Accounting Tool
CPMS	Chargepoint Management System
CSM	Charge Station Manager
CVEI	Consumers, Vehicles and Energy Integration project
DC	Direct Current
Defra	Department for Environment Food and Rural Affairs
DfT	Department for Transport
DM	Demand Management
DNO	Distribution Network Operator
DSR	Demand Side Response
DUoS	Distribution Use of System
DVLA	Driver and Vehicle Licensing Agency
ECCo	Electric Car Consumer
EE	Element Energy
EOBD	European On-Board Diagnostics
ESME	Energy System Modelling Environment

ESOS	Energy Savings Opportunity Scheme
EV	Electric Vehicle (including all plug-in vehicles)
EVSE	Electric Vehicle Supply Equipment
ETI	Energy Technologies Institute
FCV	Fuel Cell Vehicle
FIPS	Federal Information Processing Standard
FTP	File Transfer Protocol
GB	Great Britain
GEE	Generalised Estimating Equations
GPS	Global Positioning System
HAZID	Hazard Identification
HEV	Hybrid Electric Vehicle
IC-CPD	In-Cable Control and Protective Device
ICE	Internal Combustion Engine
ID	Identification
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers
IMS	Integrated Management System
IPIP	International Personality Item Pool
ISO	International Organization for Standardization
KPH	Kilometres per Hour
LD	Light Duty
LPG	Liquified Petroleum Gas
MC	Managed Charging
MCAR	Managed Charging Availability Ratio
MCB	Miniature Circuit Breaker
MDSI	Multi-Dimensional Driving Style Inventory
MCPT	Macro Charging Point Tool
MHDT	Macro Hydrogen Distribution Tool
NICEIC	National Inspection Council for Electrical Installation Contracting
NEDC	New European Driving Cycle
NTS	National Travel Survey
OBD	On-Board Diagnosis

OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
ONS	Office for National Statistics
OSGR	Ordnance Survey Grid Reference
PHEV	Plug-in Hybrid Electric Vehicle
PIA	Privacy Impact Assessment
PiV	Plug in Vehicle
PM	Project Manager
RCD	Residual Current Device
RCT	Randomised Controlled Trial
RFQ	Request for Quotation
RPM	Revolutions Per Minute
SMC	Supplier Managed Charging
SMMT	Society of Motor Manufacturers and Traders
SMS	Short Message Service
SOC	State of Charge
SOH	State of Health
SQL	Structured Query Language
SQS	Simple Queue Service
SToU	Static Time of Use
TCO	Total Cost of Ownership
TNUoS	Transmission Network Use of System
TOU	Time of Use
TRL	Transport Research Laboratory
UF	Utility Factors
UK	United Kingdom
ULEV	Ultra Low Emission Vehicle
UMC	User Managed Charging
VAT	Value Added Tax
VDC	Vehicle Data Collector
VGL	Volkswagen Group Leasing
VKT	Vehicle Kilometres Travelled
VW	Volkswagen

VWFS	Volkswagen Financial Services
WP	Work Package

Glossary

Item	Description
Affective attitudes	The emotions and feelings evoked by owning and using a vehicle.
Analytical tools	The quantitative part of the Analytical Framework, used to calculate values for the quantitative Success Metrics.
Analytical framework	Overarching Multi-Criteria Assessment (MCA) framework applied to each narrative to help understand what ‘good looks like’ for mass market deployment and use of ULEVs and the potential trade-offs, via the assessment of the Success Metrics. This framework comprises the analytical tools which are used to help inform the quantitative assessment as well as a set of supporting qualitative assessment metrics.
Battery Electric Vehicle	A vehicle powered solely by a battery, such battery being charged only by a source of electricity external to and not part of the vehicle itself.
Consumer	A private, domestic, individual driver who owns or leases his/her own vehicle.
Demand management	The modification of one or more energy consumers’ demand for energy through various methods including financial incentives, time of use tariffs and/or education.
Descriptive (or behavioural) norms	Perceptions of what other group members you associate with actually do.
Early adopter	Those who adopt after Innovators, and only after awareness, knowledge, and positive attitudes have diffused to them from Innovator. Times to adoption are between one and two standard deviations before the mean time to adopt.
Injunctive norms	Perceptions of what other group members (e.g. family group, friendship group) approve or disapprove of.
Innovators	People high in innovativeness who are first to adopt new technology. They are sources of awareness, knowledge, and positive attitudes towards the innovation whose times to adoption are greater than two standard deviations before the mean time to adopt
Instrumental attitudes	Attitudes towards factors relating to general practical or functional attributes of driving a vehicle.
Mainstream consumer/adopter	All those whose adoption of technology has been influenced by diffusion of awareness, knowledge, and positive attitudes from people who have already adopted the innovation (i.e. everyone except innovators)

Managed charging	Means the management of vehicle charging in such a way as to control the timing and/or extent of energy transfer to provide Demand Management benefits to the energy system and the vehicle user.
Personal norms	Perceived obligations to act in a way consistent with personal views.
Plug-in Hybrid Electric Vehicle	A vehicle that is equipped so that it may be powered both by an external electricity source and by liquid fuel.
Provincial norms	The same as injunctive norms but more specifically referring to other people who live under similar conditions such as in the same locality.
S Range-extended Electric Vehicle	A vehicle that is equipped so that it may be powered both by an external electricity source and by liquid fuel; similar to a PHEV, except that a RE-EV generally uses the engine solely to charge the battery whereas a PHEV generally uses the engine for direct propulsion).
Self-identity	The perception of oneself including how you see yourself and how one perceives others see them.
Social norms	Similar to injunctive norms but mores specifically referring to the approval or disapproval by close friends/family/colleagues. Informal understandings that influence the behaviour of members of a group, or wider society.
Symbolic meaning/ attitudes	What the vehicle says about its owner/driver in terms of social status, social conscience and personal values

Preface

The purpose of the Consumers, Vehicles and Energy Integration (CVEI) project is to investigate challenges and opportunities involved in transitioning to a secure and sustainable low carbon vehicle fleet. The project explores how the integration of vehicles with the energy supply system can benefit vehicle users, vehicle manufacturers and those involved in the supply of energy.

The objective of the project is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. In addition to developing new knowledge and understanding, the project aims to develop an integrated set of analytical tools that can be used to model future market scenarios in order to test the impact of future policy, industry and societal choices.

This report details the design, materials and management arrangements for the consumer uptake and charging trials for Stage 2 of the CVEI project.

Stage 2 of the project aims to test, and as far as possible validate, the solutions identified in Stage 1. This will address gaps in knowledge, by conducting scientifically robust research, including real-world trials with private vehicle consumers, and in-depth research with business fleets. The results of the research activities conducted in Stage 2 will be used to update and improve the analytical framework developed in Stage 1. The updated framework will be used to further develop the system analysis and develop prominent policy and industry strategies to enhance energy integration between consumers, vehicles and energy systems in the future.

Stage 2 will consist of four Work Packages (WPs):

- WP5: Consumer Trials
- WP6: Fleet Study
- WP7: Modelling and System Analysis
- WP8: Project Management and Dissemination

This document provides details relating to the WP5 Consumer trials and supersedes the details relating to the Consumer trials in Deliverable D1.4. Deliverable D1.4 provides details related to WP6 and WP7.

There are four parts to this report:

- Part 1: Consumer Uptake Trial Study Plan (this document)
- Part 2: Appendices to Consumer Uptake Trial Study Plan
- Part 3: Consumer Charging Trials Study Plan
- Part 4: Appendices to Consumer Charging Trials Study Plan

This document covers Part 1, the study plan for the Consumer Uptake Trial. The other parts of Deliverable 5.1 are provided in separate documents.

The contents of this document provide full details of the rationale, methodology, design and management arrangements that will be employed for the Consumer Uptake Trial. Example copies of the materials which will be used throughout the trial (such as recruitment adverts, questionnaires, and Participant Information Packs) are provided in Part 2 of Deliverable 5.1: Appendices to Consumer Uptake Trial Study Plan. For ease of cross-referencing, the appendices are also listed in Section 5 of this document.

1 Introduction

1.1 Summary of Task 5.1 – Consumer Uptake Trial

The Consumer Uptake Trial is Task 5.1 of the CVEI project. The aims, objectives and value of Task 5.1, along with the roles and responsibilities of the project team, is summarised in Table 1.

Table 1: Overview of Task 5.1

Task Lead: TRL	**Key Support: CENEX, EE, EV Connect, BIT**
Task Aims, Objectives and Value	
Aims	To provide high validity measures of attitudes towards adoption of PiVs by Mainstream Consumers who have had real-world experience of using a BEV and a PHEV. This will provide robust inputs to the Analytical Framework to allow more accurate prediction of the likely future uptake of PiVs by the Mass-Market, and the resulting impact on UK aggregated EV charging demand.
Objectives	• To give a sample of Mainstream Consumers sufficient experience of both BEV and PHEV vehicles to reduce their psychological distance to such vehicles; • To measure their attitudes towards adoption of such vehicles following this experience, in order to inform modelling of likely Mass-Market uptake; • To implement the Consumer Uptake Trial design while ensuring the health and safety and privacy of Trial Participants; and • To provide data in the required format for input into WP7.
Value	The Consumer Uptake Trial is unique in its application of a controlled scientific experimental design to measure Mainstream Consumers' willingness to adopt PHEVs and BEVs following experience with a mid-sized family vehicle of both types, and an equivalent ICE car as control, reducing their psychological distance before measurement. The data collected will advance understanding of Mainstream Consumers' willingness to adopt and will ensure that the outputs of modelling the uptake of PiVs are as valid as possible.
Deliverables, Dependencies, Constraints and Assumptions	
Deliverables	• **D5.1** – Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials; (This Deliverable covers both Task 5.1 and Task 5.2); and • **D5.2** – Consumer Uptake Trial Report: Mainstream Consumers' Attitudes and Willingness to Adopt BEVs and PHEVs.

Dependencies	• Recruitment of required sample of Trial Participants; and • Availability of suitable vehicles.
Constraints	• The design provides maximum robustness and validity within the project's budget; and • In the event that a requirement is identified for analysis beyond that set out in the research questions section below, this may be subject to a Variation Request.
Assumptions	• Direct experience of using a BEV or a PHEV will provide sufficient reduction in Trial Participants' psychological distance from these categories of vehicle.
Roles and Responsibilities	
TRL	• Manage and implement Trial design, leading engagement with Subcontractors and the ETI; • Design and pilot questionnaire materials (excluding Choice Experiment items by EE below); • Pilot Trial procedures and vehicle telematics systems; • Obtain ethics approval; • Recruit Trial Participants and obtain informed consent; • Run Trial from TRL headquarters, managing Trial Participants in line with ethical, health and safety and privacy protection protocols; • Ensure standardisation of Trial procedures run by CENEX; • Cross-reference data from EV Connect with questionnaire data and share with Baringa and Element Energy; and • Analyse and report on attitudinal responses to PiVs, including segmentation of Mainstream Consumers based on responses of Trial Participants.
CENEX	• Continual support and engagement with TRL trials team during Trial procedure development and preparation phase; • Follow standardised Trial procedure developed by TRL; • Pilot Trial procedures and vehicle telematics systems as required by TRL; and • Run Trial from CENEX headquarters, managing Trial Participants in line with ethical, health and safety and privacy protection protocols.
Element Energy	• Design and pilot Choice Experiment; and • Analyse and report the results of the Choice Experiment for input into Deliverable D5.2 and use in WP7.
EV Connect	• Set-up data management system to collect telematics data from Trial vehicles;

	• Input into and support of piloting; • Data collection, processing and cleaning during Trial; and • Provide cleaned data in agreed format to TRL.
BIT	• Review of results and deliverables to ensure input into policy analysis and WP7.

1.2 Background and rationale

1.2.1 Adoption of plug-in electric vehicles by mainstream consumers

Across a broad range of technological and other innovations, adoption behaviours differ widely. Times to adoption are typically normally distributed within a population, with a few adopting early, a majority adopting on similar timescales and a few only adopting much later.

The most widely accepted and used theory of adoption, "Diffusion Theory" (Rogers, 2003), proposes that these differences are driven by an individual characteristic termed "innovativeness". In Diffusion Theory, adopters are segmented operationally not by a direct measure of innovativeness (such as a psychological scale measure) but by a behavioural measure – their time to adoption. The theory defines a segment called "Innovators" as people who adopt innovations early, largely without direct social influence from others because they have particular personal goals (motives) that are supported by such behaviour. "Innovators" are statistically defined as people whose times to adoption lie earlier than two standard deviations before the population mean time to adoption; that is, they represent the first 2.5% (approximately) of the eventual adopter population, assuming a normal distribution.

In the UK there are approximately 30 million cars (DfT, 2016a). If all of these were eventually replaced by PiVs, "Innovators" would represent the first 750,000 to adopt. At present, there are around 310,000 "alternative fuel vehicles" [1] (DfT, 2016a), which includes PiVs, representing approximately 1% of the total car fleet. Therefore, according to Diffusion Theory, *all* present owners/users of PiVs are Innovators, and this will remain the case for some time.

Rogers (2003) showed that, across a wide range of categories of innovation, the attitudes of Innovators cannot be used to predict the adoption behaviour of the majority of the population. The literature review conducted during Stage 1 of this CVEI project (see Deliverable D2.1) confirmed that almost all present and previous trials measuring responses to PiVs, attitudes to PiVs, use of PiVs, or charging behaviour with participants' own PiVs, have been with Innovators rather than mainstream consumers (i.e. the non-Innovator majority). Previous trials in which PiVs were provided to participants have also used samples biased towards those with substantial pro-PiV motivations. It follows that none of these studies can be used to make valid predictions regarding mainstream consumers' responses to PiVs, attitudes towards adoption of PiVs, use of PiVs, or charging behaviour.

[1] "Alternative fuel vehicles are those able to use a range of alternatives to purely petrol or diesel fuel, including gas, electricity, or a combination such as gas bi-fuel and hybrid electric" (DfT, 2016a)

This Consumer Uptake Trial will provide valid measures of responses to PiVs, and attitudes towards adoption of PiVs and use of PiVs, by mainstream consumers. This will provide robust inputs to the analytical framework to allow more accurate prediction of the likely future uptake of PiVs by mainstream consumers, and the resulting impact on UK aggregated PiV charging demand and to enable the project to deliver appropriate recommendations concerning policies and market structures.

1.2.2 Alternative types of plug-in electric vehicle

A previous ETI PiV project (Anable, Kinnear, Hutchins, Delmonte, & Skippon, 2011) indicated that mainstream consumers are more likely to adopt PHEVs than BEVs over the period to 2050. PHEVs have substantially smaller batteries than BEVs: and thus smaller individual charging demands. However, a greater willingness of mainstream consumers to adopt PHEVs than BEVs (as suggested by Anable *et al.*, 2011) may imply that, collectively, PHEVs could make a much bigger contribution to overall PiV charging demand than BEVs.

Nevertheless, because of their relatively later introduction to the vehicle market, there has been very little empirical research with PHEVs, and none which has investigated the responses, attitudes, behaviour and likely adoption of PHEVs by mainstream consumers. This Consumer Uptake Trial will therefore measure mainstream consumer responses to PHEVs as well as BEVs.

1.2.3 Psychological distance

Research with mainstream consumers has so far been restricted almost exclusively to qualitative methods, survey methods, and choice experiments with people who have had no direct experience of PiVs (see Deliverable D2.1). Assessment of consumers' preferences for "really new" product categories can be methodologically challenging (Hoeffler, 2003). Construal Level Theory (Liberman, Trope & Stephan, 2007; Trope & Liberman, 2003) proposes that psychological distance affects the level of abstraction with which a product is construed. An object is psychologically distant when it is detached from a person's direct experience; the more psychologically distant an object, the more it is construed in high-level, abstract terms, rather than low-level, concrete terms that relate directly to lifestyle. This suggests that research in which participants have not directly experienced PiVs may be subject to large uncertainties and therefore have limited validity.

One previous study conducted by TRL on behalf of Shell (Lloyd, Kinnear, Stannard, Scoons, Delmonte & Hutchins, 2012; Skippon, Kinnear, Lloyd, & Stannard, 2016), has addressed this issue by measuring the responses and attitudes of mainstream consumers following direct experience of using a BEV. Results of this study challenged a common assumption that experience of a PiV would result in more positive attitudes towards PiVs, and therefore a greater likelihood of adoption. The trial found that while attitudes towards PiVs were more positive following experience of a BEV, willingness to adopt a BEV reduced. This shows the crucial importance of addressing psychological distance in research on the uptake of PiVs. Unfortunately at the time that this research was carried out (circa 2012), PHEVs were not yet widely available in the UK market, and so were not included. Thus, there remains no research into the uptake of PiVs with mainstream consumers whose psychological distance to both BEVs and PHEVs has been reduced following direct experience of using them.

Previous evidence from the TRL-Shell BEV trials suggests that 36 hours is sufficient to elicit a substantial (downward) shift in willingness to consider having a BEV and a substantial (upward) shift in evaluation of the driving experience and performance of a BEV (Lloyd *et al.*, 2012; Skippon *et al.*, 2016). For this Consumer Uptake Trial, a unique approach will be taken by reducing the psychological distance of a sample of mainstream consumers by providing them with direct experience of using both a BEV and a PHEV for a period of four days each. This will ensure the experience is sufficient to reduce psychological distance from both BEVs and PHEVs and yield valid responses in the questionnaires and choice experiment.

To reduce psychological distance from a category of products such as BEV or PHEV, it is not necessary that participants have a *comprehensive* experience of that category (i.e. of all its possible embodiments, or of all possible usage experiences). It is sufficient that participants experience those attributes or combinations of attributes that distinguish the category from other categories. Consider, as an analogy, what would be necessary in order to reduce the psychological distance of a person who was familiar with cows, but had no experience of rhinoceroses or elephants, from the latter two categories. A brief direct experience of a White Rhinoceros and an Indian Elephant would be sufficient. There would be no need to also experience Black, Sumatran, or Javan rhinoceroses, or African elephants, since the within-category distinctions are small compared to the between-category distinctions (e.g. the category “elephant” includes possession of a trunk and tusks). Nor would it be necessary to experience all possible behaviours of rhinoceroses or elephants; only those that are distinctive to the category (e.g. elephants picking up objects with their trunks).

1.2.4 Sample bias

Sample bias arises when an aspect of the research design or sampling strategy leads to the sample being, in some relevant sense, not fully representative of the population from which it is drawn. Most behavioural science research suffers from at least one source of sample bias; participants are necessarily drawn from those members of the population under study who are willing to engage in research.

Analysis of data from biased samples can in principle be corrected for sample bias, but only if the relationship between the bias and the dependent variable is known *a priori*, e.g. from previous studies. It is relatively unusual for this to be the case in behavioural science research, and it is particularly difficult to assess the potential impact, if any, of bias associated with using participants willing to engage in research.

Where there is a known, quantifiable relationship between an identified bias and any of the dependent variables measured in the trial (if, for instance, such a relationship has been identified in prior research) then it will be possible to apply a specific correcting factor; results will then be reported in both corrected and uncorrected form. For the majority of potential biases it is unlikely that such a relationship will be known. In those cases, the conventional approach in behavioural science research will be followed, which is to report the uncorrected results, whilst acknowledging the known biases and discussing their likely magnitude, direction and impacts on the validity and generalisability of the results; this is the approach that will be taken in the CVEI project.

Within the wider CVEI project, outputs from the Consumer Uptake Trial (outlined in this document) and the Consumer Charging Trials (outlined in Part 3 of Deliverable D5.1) will be used as inputs to the Analytical Framework. It will be possible to assess the impacts of any sample biases identified through sample characterisation of the outputs from the Analytical Framework; this will be achieved via sensitivity analyses. For example, this type of analysis will explore questions such as 'What if BEV uptake were higher or lower than predicted using the data from the Consumer Uptake Trial?' Sensitivity analyses will be used in this way to ensure that the Analytical Framework outputs and the resulting policy recommendations are robust; the results of these analyses will be reported in Deliverable D7.6.

1.2.4.1 Specific sources of bias

There are some known sample biases resulting from the design of the Consumer Uptake Trial. The trial has been explicitly designed to reduce participants' psychological distance from both BEVs and PHEVs through direct experience of using them (see section 1.2.3). An ability to charge the plug-in vehicles is integral to this experience, and since there is no extant network of public charging points at sufficient density to ensure convenient charging close to participants' homes, it is necessary to recruit participants whose homes are compatible for charging a PiV off-road (on a driveway or in a garage) using a dedicated Mode 2 charging point installed for the project (see section 2.7).

This introduces a sample bias since it excludes those Mainstream Consumers who are currently unable to have a chargepoint fitted at their home. Individuals who can charge a PiV at home will always have one more charging option available to them than those who cannot, irrespective of the distribution and density of public charging points. It may therefore be reasonable to assume that this bias may lead to the trial results potentially over-estimating willingness to consider having a PiV, and unlikely to lead to an under-estimate. The results from the Consumer Uptake Trial will be reported in Deliverable D5.2 without correction for this bias, because there is no a priori knowledge of the relationships between the bias and the dependent variables and so no basis on which to make a suitable statistical correction. However, in discussing the results, the existence of the bias shall be acknowledged along with the potential impacts on validity and generalisability.

Attrition of the sample through participants dropping out after recruitment may also lead to bias if the reason for some participants dropping out is systematically connected to the research topic – for instance, if participants who are predisposed against PiVs were to drop out more frequently than participants who are neutral or are predisposed towards PiV adoption. Since willingness to consider is first measured at Time Point 1, it will be possible to make an inter-group comparison of willingness to consider at this stage between those who withdraw vs. those who complete the study (note however that for ethical reasons, participants who withdraw have the right to withdraw ALL their data, including data collected before their withdrawal, without explanation). Participants who withdraw before Time Point 1 will be replaced.

Another potential source of bias arises if one or more of the recruitment channels by which potential participants are contacted preferentially accesses people who are more or less predisposed to consider a PiV than the population as a whole. For instance, followers of TRL's and Cenex's social media outputs may have more interest in transport (TRL) and specifically PiVs (Cenex) than the general driving population. In this case, since the recruitment channel for each participant is recorded, inter-group comparisons can be made between participants recruited via different channels, to identify any significant differences between them in willingness to consider.

1.2.4.2 Control of "Hawthorne" effects

All field research is vulnerable to "Hawthorne" effects which can bias findings due to participants changing their behaviours, attitudes or preferences because they are aware that they are being observed, rather than in response to the research stimuli. Research studies can be typically classed as 'controlled' or 'uncontrolled'. Uncontrolled studies are those which make no attempt to limit the impact of known biases, whereas controlled studies take a rigorous approach and include mitigation measures to ensure results are as valid and free from bias as possible. This difference can be illustrated by considering bias associated with order effects; that is, a bias which results from the order in which certain stimuli are presented to participants. If two stimuli were administered in the same order for all participants, this would represent an uncontrolled study. A controlled study on the other hand would randomise the order of presentation of the stimuli, in order to be able to measure the true effect of the stimuli themselves, rather than the order in which they were presented.

Observed effect sizes in uncontrolled studies are often substantially larger than those in studies using research designs that control for Hawthorne effects (Graham-Rowe, Skippon, Gardner & Abraham, 2012) because uncontrolled designs measure the sum of two effects (i.e. any effects due to the independent variable *plus* the Hawthorne effect). To yield valid results, research must be designed so as to control for Hawthorne effects. The literature review performed during Stage 1 of the CVEI project confirmed that most field trials measuring consumer responses and attitudes to PiVs have used uncontrolled designs, thus meaning their findings could contain an unsubstantiated level of bias (see Deliverable D2.1). Because of the potential for Hawthorne effects to bias the findings, this Consumer Uptake Trial will measure mainstream consumer responses using a controlled research study design.

1.2.5 Measuring attitudes, responses, and choice

Quantitative measurement of attitudes and responses is most commonly carried out using self-report methods in questionnaires (e.g. Ajzen, 2005; Oppenheim, 1992; Saris & Gallhofer, 2007). However when considering choice between alternatives that vary in respect of independent attributes, people may hold different and potentially conflicting attitudes towards those attributes, so must trade them off against each other. Desirable attributes may come at a cost: for instance, increased all electric range (AER) in a PiV may be associated with higher purchase price.

The most appropriate method to characterise choice between alternatives that differ in respect of multiple attributes is the choice experiment (e.g. Anderson, de Palma, & Thisse, 1992; Louviere, Henscher, & Swait, 2000). A choice experiment presents participants with discrete choices to be made between alternatives that vary in respect of the attributes under study. In making their choices, participants must mentally trade off some attributes against others. Although each participant is only asked to make a limited number of such choices, across the whole set of participants choices are presented in such a way that the independent effects of each attribute can be identified. The results of many choices made by many participants are used to build a choice model that reflects the relative influence of each attribute on the choices that would be made by the population represented by the experimental sample. A choice model constructed from a choice experiment is therefore the principal output of the Consumer Uptake Trial. The choice model will deliver the aim of the Trial: it will provide high validity measures of attitudes towards adoption of PiVs by

Mainstream Consumers who have had real-world experience of using a BEV and a PHEV. The new choice model will be used to update ECCo, the consumer choice model within the Analytical Framework, enabling the Analytical Framework to make more accurate predictions of the likely future uptake of PiVs by the Mass-Market, and the resulting impact on UK aggregated EV charging demand.

However there are practical constraints in choice experiments; it is difficult for participants to deliberate on choice options that differ in respect of more than six to eight attributes. This limits the range of research questions that can be addressed together in a single choice experiment. Specifically, where there are more than eight attributes that might potentially influence choices, some must be omitted from the choice experiment, which will focus only on those attributes which, for theoretical reasons or based on prior empirical findings, are considered most likely to be important influences on choice.

Accordingly in the Consumer Uptake Trial the choice experiment will be supplemented with self-report questionnaires, that will enable some assessment of the influence on willingness to consider a BEV or PHEV of factors not included in the choice experiment. The questionnaires will provide a richer dataset, enabling supplementary research questions (that cannot practically be accommodated within the choice experiment alone) to be addressed.

1.3 Research questions

Research design begins with the specification of research questions: "*Specifying the research question is the methodological point of departure of scholarly research in both the natural and social sciences*[2]". All research studies are designed to address questions defined in advance. In experimental studies, clear questions are needed in order to define what will be manipulated (independent variables), what will be controlled for, and what will be measured (dependent variables).

The CVEI project aims to model the potential integration of UK aggregated PiV charging demand into the wider UK energy system for the period to 2050. The validity of that analysis depends on having a clear picture of the prospective patterns of adoption of both BEVs and PHEVs by mainstream consumers over the coming decades.

Published research on the potential adoption of PiVs, carried out in the UK and elsewhere was reviewed in Stage 1 of this project (see Deliverable 2.1). The review identified substantial weaknesses in previous research that limit the value of the findings as inputs into the CVEI Analytical Framework. The ETI's previous PiV project developed a set of predictions of BEV and PHEV uptake, grounded in research with mainstream consumers. This remains one of very few studies that has researched the attitudes of mainstream consumers, rather than PiV Innovators, so its findings represent an important basis for modelling future adoption. It found that mainstream consumers were likely to adopt many more PHEVs than BEVs. However, at the time it was conducted, there were few PiVs available in the UK market and participants were not given direct experience of using either a BEV or a PHEV: thus, they were "psychologically distant" from PiVs. Skippon *et al.* (2016) subsequently measured mainstream consumers' responses and attitudes towards BEVs in a rigorous RCT that involved reduction

[2] from Wikipedia: https://en.m.wikipedia.org/wiki/Research_question , retrieved 10/7/19

of psychological distance through direct experience of using a BEV. However, their study did not address responses and attitudes towards PHEVs, which the PiV project has suggested are likely to be the most widely adopted category of PiV in the decades leading up to 2050.

There is thus a substantial gap in current knowledge, leading to the primary research question for this Consumer Uptake Trial:

> **What will be the rates of adoption of BEVs and PHEVs by mainstream consumers between 2016 and 2050?**

Clearly, it is not possible to answer this question *directly*, as it is not possible to conduct research with future consumers. However, research can be conducted into the responses and attitudes of today's mainstream consumers to a range of potential future PiV configurations, with a range of attributes. The literature review and PiV project have identified a range of PiV attributes such as AER, cost, and recharge time, plus external factors such as availability of public charging, as relevant to consumer uptake, and these considerations generate further, more specific research questions to be addressed. These Research Questions, and the primary Research Question posed above, will be addressed through a Choice Experiment administered to participants after their psychological distance from BEVs and PHEVs has been reduced.

Other Research Questions have also been identified in Stage 1 as a result of a stakeholder workshop to discuss the purpose of the trial and desirable outcomes, findings of qualitative interviews with PiV Innovators, and identification of other knowledge gaps and assumption limitations identified from the analytical tools. These questions will be addressed through analyses of responses to a questionnaire, also administered to participants after their psychological distance from BEVs and PHEVs has been reduced.

The Research Questions to be addressed by the Consumer Uptake Trial are shown in

Table 2 below, along with a summary of how each question will be addressed.

Table 2: Research questions

	Consumer Uptake Trial research questions	**How will the research questions be addressed?**	
		Questionnaires	**Choice Experiment**
1	How much does the potential All Electric Range (AER) of a BEV or PHEV influence willingness to consider adoption?		✓
2	How much does the potential purchase cost of a BEV or PHEV influence willingness to consider adoption?		✓
3	How much does the potential running cost saving associated with using a BEV or PHEV influence willingness to consider adoption?		✓
4	How much does the recharge time associated with a BEV or PHEV influence willingness to consider adoption?		✓

5	How much are personal characteristics (personality, innovativeness, liminality, self-congruity, driving style, demographic variables, etc.) predictive of willingness to consider adoption of a BEV or PHEV?	✓	
6	How much are personal-situational variables (e.g. income, annual mileage) predictive of willingness to consider adoption of a BEV or PHEV?	✓	
7	What effect does varying the perceived level of access to public charging stations (e.g. density, type of location, type of charger) have on willingness to adopt BEVs or PHEVs?		✓
8	What effect does convenient access to public transport options for longer journeys have on willingness to consider adoption of a BEV?	✓	
9	What effect does the rate of depreciation of residual value have on willingness to consider adoption of a BEV or PHEV?	✓	
10	What effect does access to additional ULEV benefits (e.g. access to bus lanes, free congestion charge, free parking) have on willingness to consider adoption of a BEV or PHEV?	✓	
11	What other factors might compensate users for lack of long-range mobility sufficiently for them to consider adoption of a BEV?	✓	
12	What effect does convenient access to a long-range vehicle (whether within the household or hired) for longer journeys have on willingness to consider adoption of a BEV?	✓	

In addition to the analyses that directly address the Research Questions, and link directly into the Analytical Framework, further data will be gathered in order to perform supplementary analyses that will provide a comprehensive, “holistic” exploration of factors that influence mainstream consumer willingness to consider having a BEV or PHEV. This will supplement the analyses conducted to address research questions 5 and 6, which explore the influences of personal variables (e.g. personality traits or self-reported usual driving style) or in personal-situational variables (e.g. income), by including other factors represented in the whole dataset. Further details are provide in section 3.3.2.

1.4 Comprehensive database for future research

ETI and the project team recognise the potential value of the data collected from the Stage 2 trials to address further research questions in the future, after completion of the CVEI project itself. Such questions might use the dataset to explore, for instance, differences in the ways BEVs and PHEVs are used in practice, given their different characteristics. The existence of this dataset could simplify some future research by removing the need to run time-consuming and costly further field trials. Accordingly, the project team will take the opportunity (within time and budget constraints) to record certain additional data (e.g. telematics data) that is not needed for the Consumer Charging Trials, but may add value to the dataset.

2 Method

2.1 Overview of experimental design

This trial will utilise a within-participants design. A within-participant design is most suitable for this study because it controls for individual differences – each of the participants will experience both the BEV and the PHEV (and a control ICE vehicle). Thus differences in Choice Experiment and Questionnaire responses to BEVs and PHEVs cannot be attributed to differences in the characteristics of the people experiencing them (which could be the case if the different vehicles were experienced by different groups of people). A within-participant design can, however, potentially be confounded by order effects - if all participants were to experience the vehicles in a fixed order, differences in responses could be attributed to the order in which they were experienced as well as to differences in the vehicles themselves. The experimental design therefore includes measures to control for order effects by presenting vehicles to different participants in different orders.

The purpose of the vehicle experience in this trial is to reduce participants' psychological distance from the unfamiliar categories BEV and PHEV; it is not to seek their evaluations of the specific models of ICE, BEV, and PHEV that they have experienced. Post-experience, participants will be asked to choose between members of the categories BEV, PHEV, and ICE having different levels of multiple attributes (see section 2.9). None of the choice options will represent the specific models experienced in the trial. Participants will draw on their understanding of the categories BEV and PHEV, rather than their responses to the specific trial vehicles.

A sample of mainstream consumers will be given direct experience of using three types of vehicle for four days each:

- A **Battery Electric Vehicle (BEV)**: VW e-Golf hatchback (5dr, 2017 model)
- A **Plug-in Hybrid Electric Vehicle (PHEV)**: VW Golf GTE hatchback (1.4 TSI 5dr, 2017 model), and;
- An **Internal Combustion Engine (ICE) vehicle** for control purposes: VW Golf hatchback (1.4 TSI DSG GT Edition 5dr, 2016 model)

Three variants of the Volkswagen Golf were selected because the Golf is the only vehicle model that is currently commercially available with all three drivetrains (ICE, BEV and PHEV). The three models are similar in functional capability (other than the drivetrain differences) and are (as closely as possible) matched in trim (see section 2.6.1); this minimises the impact of any differences between vehicle types that are associated with vehicle characteristics other than the powertrain configuration.

Functional capability refers to the utility of the vehicle as a means of fulfilling a user's functional goals: the transporting of people or materials from one place to another. Functional capability includes range between refuelling, number of people that can be carried, legroom, volume and weight of luggage that can be carried, occupant safety, etc. Within a manufacturer's model range, models differ in functional capability (reflected in the SMMT segmentation – an A segment vehicle generally has less functionally useful space than, say, a C segment vehicle; and both have fewer seats than an MPV). Between manufacturers, models that have the same SMMT segment classification may nevertheless differ substantially in functional capability, particularly in terms of range (e.g. petrol vs. diesel engine; smaller models having smaller fuel tank capacity, internal passenger space, and luggage space). The functional capability of a vehicle is an objective characteristic; however the extent to which any given user evaluates that capability as enabling fulfilment of their functional goals varies between users, as they have different functional goals. Such between-participant differences are controlled for in this research by ensuring a sufficient sample size.

The matching of trim and accessory features is not exact, but is the closest that is possible between models in the Golf range. This is certainly the closest matching of ICE, PHEV, and BEV models available in the current UK market; no other model range yet includes suitable versions of all three powertrain types.

Differences between trim and accessory features in principle could affect participants' responses to the trial vehicles in the sense that participants with different affective or symbolic goals may evaluate them differently (whether explicitly or implicitly) because the vehicles have different utilities in respect of those goals. Such goals are related to personal identity, and so they vary among members of the UK driver population. Such differences are controlled for in this research by ensuring a sufficient sample size.

A key aim of this design is to reduce participants' psychological distance from BEVs and PHEVs, by giving them experience with using both of these types of vehicles (see section 1.2.3). Thus, a number of steps will be taken to ensure the experience of participants during the trial is sufficient for this purpose:

1. Prospective participants' typical vehicle usage will be assessed through Filter survey 1 to ensure that it is substantial enough for the trial: potential participants will be excluded if they report that they usually drive only once per week or less.
2. Participants will be requested to store their own vehicle with the research team for the duration of the trial. This will increase the likelihood that participants will use the trial vehicle for their regular day-to-day journeys, and will also ensure that participants with limited parking space at home will still be able to participate. Where the household has multiple vehicles, preference will be given to replace the participant's main vehicle (i.e. the vehicle they usually drive).
3. Participants will be requested to drive each vehicle at least once per day, and to recharge the BEV and PHEV at least twice during each of the four day trial periods.

Each participant will be provided with a Mode 2 charging socket installed on a separate circuit at their residence.

Participants will be asked to complete a series of questionnaires during the trial (see section 2.8):

- **Recruitment Filter Surveys**: screening questionnaires administered during the recruitment process (see section 2.2.1)
- **Pre-trial questionnaire:** administered following receipt of consent to participate
- **Time Point 1 questionnaire**: administered approximately 7-10 days before initial vehicle handover
- **Interim questionnaires**: administered during vehicle handovers directly after experience with each vehicle

- **Time Point 2 questionnaire**: administered approximately seven days after the return of the final vehicle. This will include the Choice Experiment.

The data used to address the Research Questions will be generated in the Time Point 2 questionnaire. Data to be used in the supplementary analyses will be generated in all of the questionnaires.

Data will also be collected from all vehicles via a telematics unit. This will be used in the supplementary analyses to (1) assess whether there were any systematic differences in the ways participants used each type of vehicle; (2) characterise participants' individual usage of each vehicle (to explore whether their willingness to consider a BEV or PHEV was systematically associated with the way they used the different vehicles).

Participants will receive £200 compensation for their participation in the trial, administered as follows:

- £20 Amazon voucher upon completion of the Pre-trial questionnaire
- £20 Amazon voucher upon completion of the Time Point 1 questionnaire
- £20 cash upon return of Vehicle 1
- £20 cash upon return of Vehicle 2
- £20 cash upon return of Vehicle 3
- £100 cash upon completion of the Time Point 2 questionnaire

In addition, participants will be entered into a prize draw for a chance to win £2,500.

An overview of the trial methodology is provided in Figure 1.

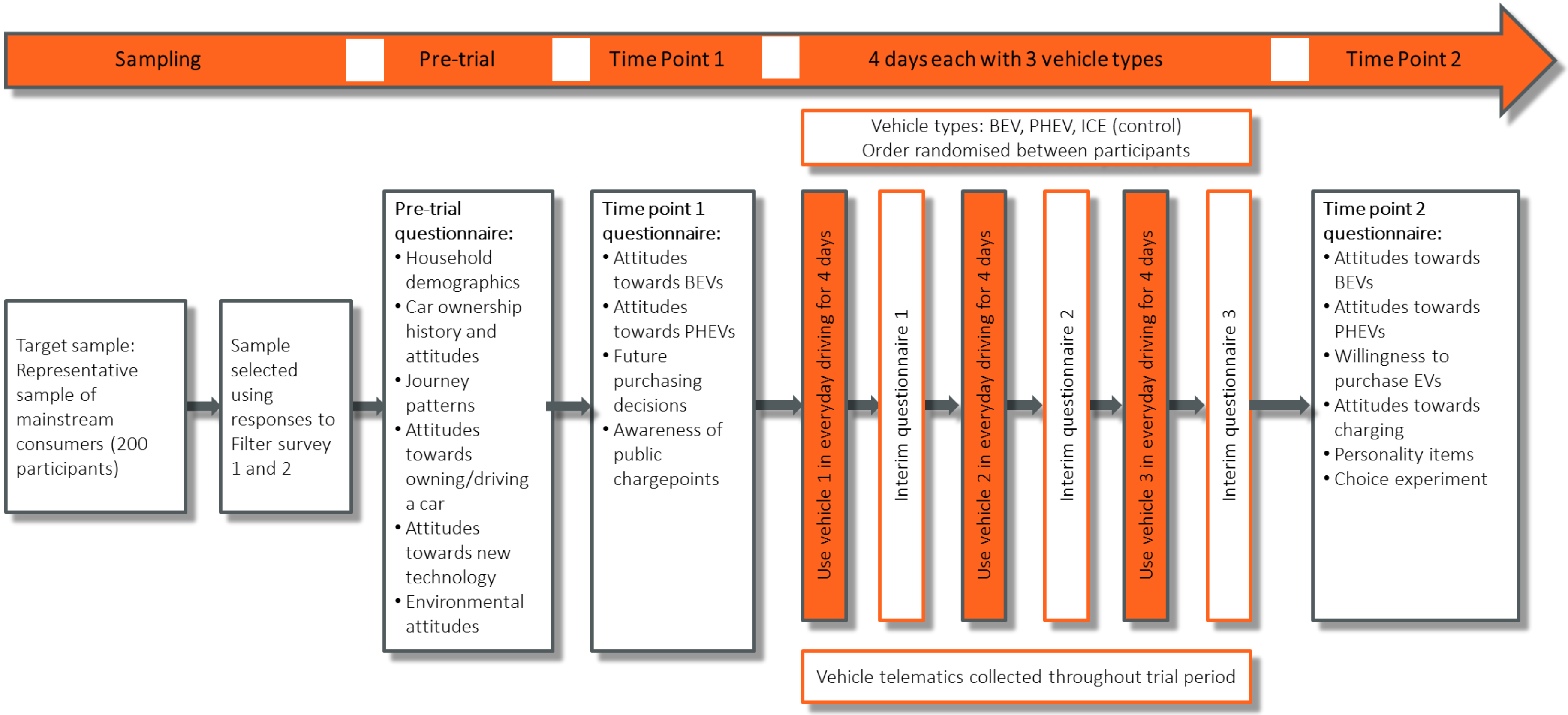

Figure 1: Overview of methodology for Consumer Uptake Trial

2.2 Participants

2.2.1 Sampling

2.2.1.1 Sample size

The statistical power of a research design reflects its capacity to avoid Type I and Type II errors. Statistical power depends on the sample size, anticipated effect size, and required criterion for statistical significance. The design of the Consumer Uptake Trial has been informed by power calculations based on effect sizes obtained in a previous BEV uptake trial performed by TRL for Shell (Lloyd *et al.*, 2012; Skippon *et al.*, 2016). In this previous trial, 200 experimental group participants experienced use of a Nissan Leaf BEV for 36 hours, while 200 control group participants experienced use of an equivalent unfamiliar ICE car (Ford Focus diesel) for 36 hours. The Consumer Uptake Trial for the CVEI project will adopt a different experimental design to the TRL-Shell BEV trial because participants must be given direct experience of both a BEV and a PHEV, and (to control for Hawthorne effects, see section 3.4) an equivalent ICE car. Accordingly a within-participants design will be used, rather than the between-participants design used previously (Lloyd *et al.*, 2012).

Based on the effect size and variability observed in this previous study it is estimated that a sample size of 200 is appropriate for this trial. It should enable, for example, a 3km difference in average journey distance between ICEs, BEVs and PHEVs to be detected as statistically significant.

2.2.1.2 Target sample

The target sample for the Consumer Uptake Trial is 200 mainstream vehicle consumers. Mainstream consumers are defined as all those whose adoption of technology has been influenced by diffusion of awareness, knowledge, and positive attitudes from people who have already adopted the innovation (i.e. everyone except Innovators). This includes all consumers in Rogers' (2003) Diffusion Model segments except for Innovators; that is the Early Adopter, Early Majority, Late Majority, and Laggard segments (see Figure 2).

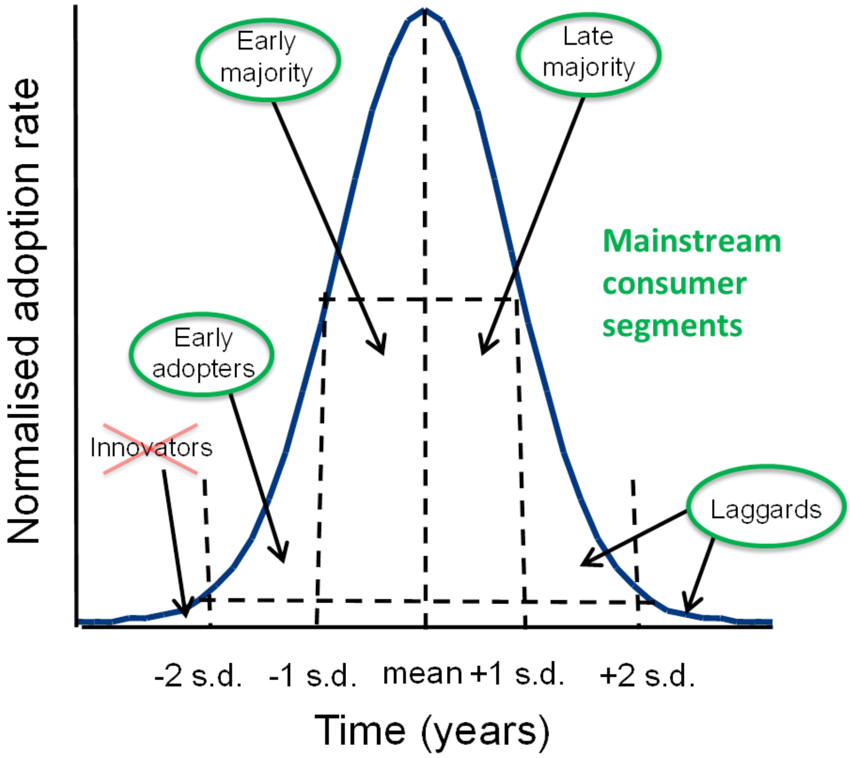

Figure 2: Segments from Rogers' (2003) Diffusion Model which are included in the 'mainstream consumer' population

As described in section 1.2.1, Innovators represent the first 2.5% (approximately) of the eventual adopter population, assuming a normal distribution. "Alternative fuel vehicles" currently represent around 1% of the total car fleet in the UK (DfT, 2016a), and so according to Diffusion Theory, assuming an eventual full uptake, all present owners/users of PiVs are Innovators, as will be those who adopt the next 1.5% of the fleet. In order to ensure the sample is representative of mainstream consumers, it is necessary to exclude Innovators. Individuals who currently have, have had, or have had regular driving experience with a plug-in vehicle in the last 5 years, and those who are currently considering acquiring a plug-in vehicle in the next six months will therefore be excluded from the study. In addition, employees of TRL, Cenex, and ETI will be excluded because of the possibility that they might have a particular interest in PiVs by virtue of their employment.

It is also important to ensure that the sample is representative of the driving population in Great Britain. As a minimum, a sample that is intended to be representative should have the same male/female ratio and the same age distribution as the parent population. In transport research, ensuring a representative distribution between urban and extra-urban residency is also important, as this impacts on vehicle usage. A stratified sampling approach based on driving licence data from the Driver and Vehicle Standards Agency (DVSA), and population and travel data from the National Travel Survey (NTS) and the Office of National Statistics (ONS) will be applied for this purpose (see Table 3).

Stratified sampling reduces the risk of sample bias. It has been used previously in PiV uptake research by Skippon, et al (2016), but to date has been rare in PiV research in general.

Table 3: Target sample matrix stratified using DVSA, NTS and ONS data

Resident area[3]	Age group[4]	Gender		Total
		Male	Female	
Rural	19-29	2	2	**4**
	30-49	6	6	**12**
	50+	12	11	**23**
Urban	19-29	14	12	**26**
	30-49	34	30	**64**
	50+	39	32	**71**
Total		**107**	**93**	**200**

Participants will be recruited from within a 50-mile radius of TRL (RG40 3GA) and Cenex (LE11 3QF), with a 50/50 split between the two trial locations (i.e. 100 participants recruited from around TRL and 100 recruited from around Cenex).

To control for order effects, participants will be randomly allocated to one of six orders to determine when they experience each vehicle type (see Table 4). The trial will also be scheduled so as to balance the experiences of each of the vehicle types across weekdays and weekend days (see section 2.5.1.2).

Table 4: Counterbalancing for vehicle order effects

Order	Vehicle 1	Vehicle 2	Vehicle 3	Number of participants
1	ICE	BEV	PHEV	34
2	PHEV	ICE	BEV	33
3	BEV	PHEV	ICE	33
4	ICE	PHEV	BEV	33
5	BEV	ICE	PHEV	33
6	PHEV	BEV	ICE	34
			Total	**200**

2.2.2 Recruitment

In order to recruit participants who are suitable for the project it is necessary to employ a filtering process to select eligible participants and exclude ineligible participants. This process is described below, and illustrated in Figure 3:

[3] The 2011 rural-urban classification (RUC2011) from the Office for National Statistics (ONS) will be used to define the rural/urban classification.

https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications/2011ruralurbanclassification

[4] 17-18 year olds will be excluded to mitigate increased crash risk associated with young and novice drivers.

- **Advertise**: A variety of advertisements will be published via different channels to reach a wide variety of prospective participants as required to achieve the stratified sample.
- **Step 1**: Interested prospective participants will complete Filter Survey 1 to register their interest, using the URL provided in the advertisements.
- **Step 2**: Prospective participants who are eligible (based on responses to Filter Survey 1) will be invited to complete Filter Survey 2. This is a short but more detailed questionnaire in order to further filter prospective participants and assess suitability specifically for each trial.
- **Step 3**: Prospective participants who are eligible (based on responses to Filter Survey 2) will be invited to participate in the Consumer Uptake Trial, the BEV Consumer Charging Trial or the PHEV Consumer Trial. In some cases an eligible prospective participant may fit a stratified category that is already full. Where this is the case the prospective participants will be sent an email thanking them for their time and asking them if they would be happy to be kept on a reserve list. Those who agree will be kept on the participant management database and will either be invited to participate later, where another participant drops out, or be informed that the trial is full once all data have been collected for that group.

The above steps represent a standardised recruitment process which will be used for both the Consumer Uptake Trial and the Consumer Charging Trials (see Parts 3 and 4). The responses to Filter Survey 1 and Filter Survey 2 will be used to determine which trial prospective participants are eligible for. Where prospective participants are eligible for more than one trial, their assignment to a particular trial will be based on the current sampling requirements.

The recruitment process is described in more detail in this section, and is repeated for convenience and consistency in Part 3, which contains the study plan for the Consumer Charging Trials.

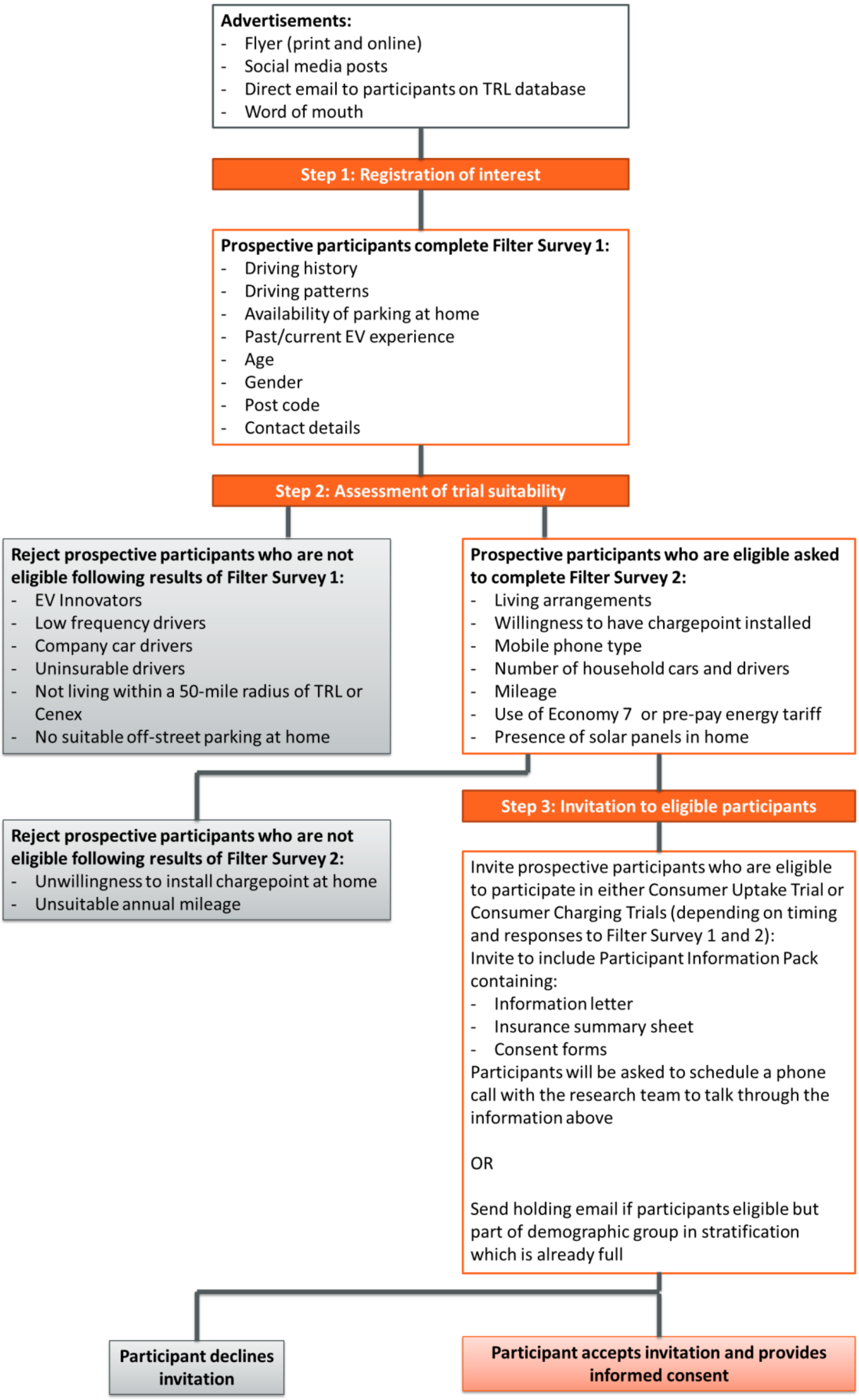

Figure 3: Overview of recruitment strategy up to the point of trial invitation

2.2.2.1 Advertisements

In previous experience recruiting for research trials, using a variety of advertising methods has proven effective for recruiting participants from a wide range of demographic backgrounds and social groups.

For example, use of social media (especially Twitter) has worked well for recruiting younger participants. The vast majority of TRL's Twitter followers are between the ages of 25 and 44 years with a 70:30 male to female ratio. LinkedIn has also been used for recruitment and tends to draw a more professional audience. TRL's LinkedIn followers are from a range of backgrounds and interests, but most relate to engineering and transport research.

Recruitment via social media carries the potential risk of bias towards PiV Innovators. While it is possible that TRL and Cenex may attract a larger-than-normal proportion through social media compared with other organisations, not all social media followers of these companies will be PiV Innovators. TRL conducts research in a broad range of topics and has followers interested in wider and unrelated domains. Nevertheless, it would clearly be undesirable to recruit solely from TRL social media followers; hence diversity is necessary through the use of other approaches to engage the wider public. In any case, Innovators who express interest in participation will be excluded from the sample by identifying individuals who currently have or have had regular experience of a plug-in vehicle, or who are considering adopting a plug-in vehicle in the next six months; these questions are contained in Filter survey 1. In addition, diversity is supported through the process of stratifying the sample (see section 2.2.1.2).

Word of mouth is also an extremely valuable resource. Interested prospective participants can be invited to share information about the trial and the registration links to others[5], thus providing a 'snowball' effect. This will also occur naturally via social media which allows users to share. In addition to snowballing via interested prospective participants, members of the project team (and members of staff in the wider TRL Group in which the project is managed), can also share adverts on their own social media accounts (e.g. Facebook, Twitter, Instagram, Linkedin) and in doing so, request that their followers also repost the adverts. This enables adverts to rapidly reach a large number of individuals from a broad range of backgrounds. From previous trials, such word of mouth recruitment has proven to be a very powerful recruitment tool.

The use of flyers and newspaper/magazine adverts can help to avoid biasing the sample towards people who use social media, in particular only those who follow certain accounts on social media (such as TRL or Cenex). Flyers can be used to target a range of different socio-economic backgrounds by being circulated through businesses to employees and around local educational and medical facilities. This will attract people from professional and non-professional environments and a wide range of ages. Newspaper and magazine adverts will also reach audiences from different socio-economic backgrounds and are expected to attract an older audience. They will also cover broader geographical areas and may reassure people of the credibility of the advert compared to paper flyers.

[5] Due to the limited amount of information that will be provided on the adverts and recruitment surveys, the information available to be shared via word of mouth will be consistent with the research needs.

For the reasons discussed above, a variety of advertising methods will be used to attract prospective participants from the varied demographics needed for the sample. An overview of the types of advertising methods that will be used, and the expected level of effectiveness for reaching each target age group is summarised in Table 5.

Table 5: Advertisement methods and expected level of effectiveness by age group (darker shading represents greater anticipated effectiveness)

Age group	Existing TRL database	Newspaper/ magazine adverts	Local employers	Public places	Twitter	LinkedIn	Facebook	Word of mouth	Local forums (e.g. Gumtree)
19 - 29									
30 - 49									
50+									

Adverts will be used to promote the study within the targeted geographical locations (i.e. within a 50-mile radius of the TRL and Cenex headquarters in Crowthorne and Loughborough, respectively). An advertising database has been produced which includes a list of organisations and places within the target areas that will be used to advertise through. The advertising database currently contains contact details from various members of relevant local authorities, universities, hospitals/health centres, newspapers, and private-sector businesses (see Table 6).

Table 6: Breakdown of organisations contained within the advertising database

	TRL	CENEX
Local authorities[6]	203 contacts	222 contacts
Hospitals	44 hospitals	28 hospitals
Private sector industries[7]	568 contacts	161 contacts
Universities[8]	65 contacts	84 contacts
Local newspapers	22 newspapers	24 newspapers

The primary aim of the adverts will be to direct prospective participants to the first step of the recruitment process so that they can register their interest in taking part. Each method of

[6] Local authorities are broken down into seven different levels; County, Borough, District, Unitary, City, Town and Parish.

[7] Private sector industries include organisations from automotive, aviation, consultancy, engineering, legal, insurance, media, rail, electronics and retail.

[8] Universities include, where possible, contacts within internal communication teams and student unions.

advertising will have its own unique web address / QR[9] code which will link interested prospective participants to Filter Survey 1; this will enable identification of where the prospective participant saw the trial advertised. If it is determined that particular methods of advertising are not effective for recruiting the desired sample then alternative approaches will be considered. For example, in the case of social media adverts, it may be deemed appropriate to consider a targeted Facebook advert if generic adverts prove to be ineffective. Additional escalation options, such as local radio advertisement, will also be considered where the pace of recruitment does not match the requirements of the trial.

Post-hoc supplementary analyses will be carried out to identify whether there were any systematic differences in willingness to consider a BEV or a PHEV between participants recruited via the different channels.

Adverts will not mention “electric” or “low emission” vehicles specifically; this will avoid undesirable interest from PiV enthusiasts (who are unlikely to represent mainstream consumers) and instead simply advertises the opportunity to participate in ‘vehicle trials research’. Further details about the trials will be provided to the prospective participant in Steps 2 and 3.

Four advertisements have been produced in collaboration with TRL’s marketing department. These are shown in Appendix A in Part 2 of Deliverable 5.1 and described in more detail below:

[9] A Quick Response (QR) code is a type of matrix barcode (or two-dimensional barcode) that can be linked to online material, such as a survey, via readable devices such as smartphones.

Flyer (see Appendix A)

The flyer is a highly visual A5 document which can either be posted online (e.g. on a business's intranet) or printed and displayed on a notice board. Very high level information about the trial is included on the flyer, along with a hyperlink and QR code for Filter Survey 1. A pdf version of the flyer will be emailed to local councils, large businesses, supermarkets, hospitals, health centres, large educational facilities etc. requesting them to circulate the flyer as well as print and display it on their notice boards. This method relies on external companies posting or circulating the advert within the business. Typically, organisations will post the advert on their internal intranet or circulate it via email; however TRL will also offer printed copies if they would prefer. Previous experience working with many of the contacts in the database has shown a good level of cooperation.

In the Loughborough area, Cenex will support TRL in identifying further contacts to add to the advertising database. A member of the TRL recruitment team, who is based in TRL's Nottingham office, will lead recruitment for the Cenex area and will be responsible for engaging with local businesses to ensure responsiveness to these requests.

In addition, TRL will print 1,000 flyers (500 for the TRL area and 500 Cenex area) to pass onto organisations who agree to help with advertising. These flyers will also be distributed by members of the Cenex and TRL teams (who live within 50-miles of Cenex or TRL, respectively) in their local areas in order to supplement the advertising database (e.g. cafés, shops and other community locations). Each member of the team will be asked to obtain consent before distributing any flyers and to record the date and location they have been distributed.

In order to maximise reach, the research team will also be tasked with distributing paper copies of the flyer to businesses and noticeboards within the local area. Previous experience has shown that a good response level can be achieved through this approach.

Social media advert (see Appendix A)

TRL has around 8,000 social media followers on Twitter, LinkedIn, and Facebook combined. A social media advert that consists of a project strapline (an eye catching sentence that describes the trial at a high level) and a link to the Step 1 registration of interest survey will be posted by TRL's Twitter and LinkedIn accounts and Cenex's Facebook, Twitter, and LinkedIn in accounts.

This advert will also be shared on active local forums and groups (with the aim of attracting a more diverse and non-professional demographic as well as samples unlikely to include PiV Innovators). The adverts will also be reposted by the research team via personal social media accounts.

Newspaper/magazine/online advert (see Appendix A)

The advert will contain the same level of information as the social media post but it will have a more structured graphical design in order to be newspaper- and magazine- friendly. The research team will contact local newspapers and magazines (such as local Round and About magazines) to organise having an advert posted (newspapers and magazines are also included in the advertising database). The advert will also be posted on online local forums, such as Gumtree.

Email invitation (see Appendix A)

TRL has a participant database of over 2,000 volunteers who have agreed to be contacted about participating in future research projects. An email containing a copy of the flyer and a link to the Filter Survey 1 registration of interest questionnaire will be emailed to all prospective participants on the database.

2.2.2.2 Step 1: Registration of interest

Step 1 is for prospective participants to register their interest for the trials; this will be achieved by asking prospective participants to complete Filter Survey 1 (see section 2.8 and Appendix B). This provides a way for the research team to determine the suitability of individuals for each of the trials.

At this step of the process the survey contains minimal information about the design and aims of the research to avoid attracting interest from PiV enthusiasts, in particular Innovators. The survey will provide information about the incentives and the trials' contact email address; an email address dedicated to the trials which will be monitored daily.

The questionnaire covers essential information only and the questions only require quick response yes/no or short multiple choice answers.

The choice of questions is designed to filter out unsuitable prospective participants who can be rejected outright, including: Innovators, low frequency drivers, company car drivers and uninsurable drivers. Eligible prospective participants will be contacted by email informing them that they may be suitable and inviting them to progress to Step 2; this is described in the section 2.2.2.3. Two reminder emails will be sent to prospective participants who have not completed Step 2 in the two weeks after the initial invite email.

2.2.2.3 Step 2: Assessment of trial suitability

Step 2 of the process is to further assess trial suitability using Filter Survey 2 (see section 2.8 and Appendix B), which contains a more detailed questionnaire to obtain data on living arrangements, chargepoint installation, smartphone type, the number of cars and drivers within the household, annual mileage, and household energy use information. The questions require quick response yes/no or short multiple-choice answers only.

The Filter Survey 2 questionnaire includes an outline of both trials on the cover page. This is to provide prospective participants with additional information so that they can provide informed interest at this stage in the process. The survey will allow prospective participants to indicate if they have a preference for participating in either trial. Matching prospective participants to the trial they have a preference for is desirable for increasing the participant retention rate, although not essential. If a respondent is not suitable for the trial they expressed a preference for, the research team may still contact them (by email or telephone) regarding participating in the other trial. This will be done on an individual basis and will be determined by the success of recruiting in line with the stratified target sample.

Completion of the Filter Survey 2 questionnaire will provide the research team with sufficient information for assessing prospective participants' suitability for the Consumer Uptake Trial:

- **General suitability criteria:**
    - Must live within 50 miles of the TRL or Cenex headquarters
    - Must not currently own, have previously owned or had previous regular experience driving a PiV in the last five years
    - Must not be considering acquiring a PiV in the next six months
    - Must have held a valid UK driving licence for a minimum of two years
    - Must have received no penalty points if under 25 OR no more than 3 penalty points if aged 25 and over[10]
    - Must have not had an 'at fault' insurance claim in the last three years
    - Must be a current car owner
    - Must drive regularly (at least once every two or three days)
    - Must not have a company car as their main vehicle
    - Must not require Class 2 or 3 business insurance for their vehicle (i.e. does not require business travel beyond regular commute to work and occasional trips to external locations, such as for meetings)
    - Must have access to off-street parking at a location where a chargepoint could be installed safely
    - Must be willing to have a chargepoint installed in a suitable location
- **Other information required:**
    - Age group
    - Gender
    - Urban/rural classification

[10] According to data from the DVLA, the proportion of drivers with more than 3 points on their licence is 1.7%. New drivers (of whom 70% are aged 17-25 years) are impacted by the New Drivers Act which restricts them to a maximum of 6 points within the first two years of gaining a full driving licence. Introduction of the Act has been associated with a reduction in the proportion of young drivers with penalty points. Approximately 10% of new drivers commit a violation within the first two years of licenced driving; implying that around 90% of drivers under 25 will have no points on their licence. As such, the effect of these insurance conditions on the representativeness of the sample is minimal.

- Living arrangements (home owner[11], living with parents etc.)
- Number of drivers in the household
- Number of cars registered at the household address
- Contact details (name, email address, and contact number)

The Filter Survey 1 and Filter Survey 2 questionnaires will be hosted online using 'SmartSurvey'[12]. TRL has a corporate SmartSurvey account. Data can be downloaded at any point whilst the survey is live. The URL is fully customisable, and it is possible to set-up access to the survey via a Quick Response (QR) code. As described above, SmartSurvey also provides the ability to monitor which advertising methods are most effective; unique QR codes and URLs will be provided on the various forms of adverts in order to link survey responses to the location at which prospective participants learned about the trial. This will provide information to the research team about which recruitment methods are most successful and which may need additional consideration. SmartSurvey is an effective research tool which has been successfully utilised on numerous previous projects run by TRL.

2.2.2.4 Step 3: Invitation to participate

Step 3 in the recruitment process is to invite eligible prospective participants to participate in the Consumer Uptake Trial, BEV Consumer Charging Trial or PHEV Consumer Charging trial, depending on their responses to Filter Survey 1 and 2 and the spaces within the target samples for each trial.

Once a prospective participant has been allocated to the Consumer Uptake Trial, they will be sent an invitation to participate by email. As part of this email, prospective participants will be sent the Participant Information Pack (see Appendix C). This pack will contain:

- An information letter
- A description of the key terms and conditions of the vehicle insurance policy
- The consent form and a link to a webpage where the consent form can be completed online

The information letter will include a description of the trial, information about what participation in the trial will involve and how the trial will run. It will also include information on health and safety and contact details for the research team should the prospective participant have additional questions.

In the invitation email, prospective participants will be asked to schedule a phone call with a member of the research team to talk through all the information in the Participant Information Pack, should the participants have any questions on any aspects of participating in the trial. Possible start dates for the prospective participant will also be discussed in the phone call (e.g. noting planned holidays or business trips).

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[11] Home owners will be preferred over tenants where multiple potential participants are available within sampling categories as this will ensure they are able to consent to chargepoint installation.

[12] https://www.smartsurvey.co.uk/

Reminder emails will be sent out a week after the initial invitation if there has been no reply.

2.2.2.5 Exclusion points

In line with ethical practice, participants will be free to withdraw from the trial at any time without giving a reason. This will be made clear to prospective participants in the information sheet and consent form. There are also circumstances where TRL or Cenex may deem a participant unsuitable. These include:

- **Uninsurable drivers**
    - All drivers will be requested to provide permission for TRL to electronically access their DVLA records to ensure that their licence is valid and meets trial insurance requirements in terms of penalty points, violations and time held. Participants who do not meet the insurance criteria will be unable to continue in the trial.
- **Household unsuitable for installation of chargepoint**
    - Prior to installation of the chargepoint by Rolec (or Rolec's partner ChargedEV), they will check the property is suitable for safe installation of the chargepoint. Where no safe or suitable installation is possible the participant will be unable to continue in the trial. Further detail of where an installation may be deemed unsuitable is provided in the Health and Safety Plan.
- **Unsafe or illegal driving**
    - Vehicle familiarisation drives with a TRL or Cenex staff member will be completed at vehicle handover. The purpose of these drives is to allow the participant to become familiar with the vehicle. If the participant exhibits behaviours which are unsafe or illegal then this will result in the researcher terminating the trial for that participant.

All of these interactions and the outcomes will be logged in the participant management database.

2.2.3 Participant management

Participant recruitment will be managed through a secure participant management database[13]. The database will contain data from the Filter Surveys as well as a log to track participants' progress through the trial and details of any communication between the research team and the participant. The database will be in Microsoft Access and will have associated forms for any tables that require input from the recruitment team.

The recruitment process will be managed on a rolling basis; as responses to Filter Survey 1 are received, data will be transferred into the participant management database. A member of the recruitment team will then assess the responses and categorise them as either 'reject' or 'progress'. This will involve, for example, checking the prospective participant's post code

[13] Data privacy and protection is discussed in section 4.5 and in the CVEI 'Managing Data Protection' document.

is within the recruitment region assigning them to either TRL, Cenex or 'out of area'. The allocation will be stored in the database along with any notes.

A unique participant identification number will be generated and stored in the database for all prospective participants who progress to Step 2. An email will be sent to all those who progress to Step 2 asking them to complete the Filter Survey 2 questionnaire and providing them with their participant ID. Recruitment correspondence will be completed by TRL using mail merge to ensure the contact details and unique reference number is included in each email.

Responses to Filter Survey 2 will also be transferred into the participant management database. A member of the recruitment team will then assess the responses and indicate which trials the prospective participant is suitable for:

- Consumer Uptake Trial
- BEV Consumer Charging Trial
- PHEV Consumer Charging Trial
- Not suitable

In the case that a participant is not suitable for any of the trials they will be sent an email to thank them for their interest and inform them that they are not suitable.

Following this, the current sampling requirements will be assessed on the basis of the stratified sampling matrix (see Table 3 on page 25). Where the stratification requirements have not yet been met, a researcher will filter the newly added responses by those who are suitable for the trial and have the required characteristics (e.g. aged 19-29, male, rural location). The researcher will then add the prospective participant to the invite list.

If the number of eligible prospective participants within a given cell in the matrix is bigger than the target size of that cell, participants will be selected using a random number generator[14] until the specific target cell size has been reached. Prospective participants who are eligible but not required (i.e. because their cell is full) will be sent an email thanking them for their time and asking them if they would be happy to be kept on a reserve list. Those who agree will be kept on the participant management database and will either be invited to participate later, where another participant drops out, or be informed that the trial is full once all data have been collected for that group.

Assessment of the recruited sample against the target stratified sample will be monitored throughout the trials. Where there is a discrepancy or difficult to reach group, this will be specifically targeted within the boundaries of the project timeline. If it is unlikely that a target sample group, in line with the stratified sampling, can be obtained, a pragmatic approach will be taken in order to achieve the total sample and the sampling criteria may be relaxed. In the event that this approach is required, it will be discussed and agreed with the ETI before proceeding[15].

[14] This will be subject to certain preferences, for example, home owners will be preferable to tenants.

[15] Relaxations to the sampling criteria will only be permitted with the express prior written consent of the ETI.

2.3 Participant compensation

Participants in the Consumer Uptake Trial will receive £200 compensation for their participation in the trial. This will be administered at different points during the trial so as to ensure participants feel compensated for their time and stay engaged with the trial. The breakdown will be as follows:

- £20 Amazon voucher given upon completion of the Pre-trial questionnaire
- £20 Amazon voucher given upon completion of the Time Point 1 questionnaire
- £20 cash given upon return of Vehicle 1
- £20 cash given upon return of Vehicle 2
- £20 cash given upon return of Vehicle 3
- £100 cash upon completion of the Time Point 2 questionnaire

In addition to these fixed rewards, participants will be entered into a prize draw for a chance to win £2,500. The winning name will be drawn at random once all participants have completed the trial.

For participants who choose to withdraw from the study (or who are excluded from the study by the research team), the level of compensation they receive will depend on the stage in the trial they get to. For example, if a participant is excluded from the trial at the Vehicle 1 handover due to an invalid driving licence then they will have received 2 x £20 Amazon vouchers for their participation to date. The participant would also be given a £10 cash payment to compensate for travel expenses incurred.

2.4 Piloting

Piloting will take place before commencing with the trial following approval of the trial method and materials by the ETI. This will ensure that the method and materials can be fully tested prior to going 'live' with real participants. There will be four distinct phases to piloting:

- **Pilot phase 1: Cognitive testing**
  - All questionnaires and the choice experiment will undergo cognitive testing to ensure that the wording of questions is understandable for participants, that the questions can be answered in a reasonable timeframe, and that the delivery methods are suitable. The principle aim of cognitive testing is to sense check the questions to ensure that wording is clear and free from errors, that comprehension of questions is correct, and that scale and multiple-choice items are logical and appropriate.
  - All questionnaires (Filter Survey 1, Filter Survey 2, Pre-trial, Time Point 1, Interim 1, Interim 2, Interim 3 and Time Point 2, including the choice experiment) will be tested as hosted online to ensure evaluation of the online functionality of the questionnaires.
  - Cognitive testing will be undertaken with five TRL staff who are not involved with the CVEI project. Pilot respondents will be asked to time how long it takes for them to complete each questionnaire, and make a note of any

typographical or formatting errors, and any functionality issues with the online portal.

- Pilot respondents will be interviewed upon completion of the survey to gauge their general response (e.g. how long it felt to complete, appropriateness, etc.) and discuss any specific questions that stood out (e.g. that may have caused some confusion or didn't represent their answer). Feedback from the cognitive interviews will be used to refine and update the questionnaires as necessary.
- This will enable any issues with questionnaire wording and functionality to be identified prior to commencing the trial.

- **Pilot phase 2: Equipment testing**
  - This phase of piloting will involve doing a full test of the vehicles and the OBD-II telematics dongle.
  - TRL staff will do up to three practice drives with each vehicle type (BEV, PHEV and ICE) once the telematics dongle is installed. Each drive will be a minimum of 30 minutes. At the end of the drive with the BEV and PHEV, the vehicles will be plugged into a chargepoint at TRL's Crowthorne House site.
  - Following each drive, TRL will work with EV Connect and FleetCarma to check that the telematics data are being recorded, are sensible and appropriately labelled, and that they can be extracted. This will include checking that charge event data are captured in the case of the BEV and PHEV.
- **Pilot phase 3: Incident rehearsals**
  - Health and safety is critical to the success of the project. TRL has developed an Incident Reporting Escalation Procedure which conforms with the ETI's Project Incident Protocol.
  - In order to ensure that this procedure is robust and fully understood by the research team, up to four 'Incident rehearsals' will be conducted during phase 3 of the piloting process.
  - Up to two rehearsals will be conducted where the mock incident originates at TRL, and up to two will be conducted where it originates at Cenex.
  - Key staff within TRL, Cenex and the ETI will be made aware that the rehearsal is taking place in order to avoid unnecessary escalation beyond that required for the purposes of testing procedural robustness.
  - Following piloting, the protocol and/or staff training will be updated, as required, if any issues with the reporting process are identified.
- **Pilot phase 4: Practice trials**
  - The final phase of piloting will involve completing a full practice run of the trial with up to four participants; two from the area surrounding TRL and two from the area surrounding Cenex.
  - 'Mock' pilot participants will be recruited (from responses to the adverts) for the purpose of the pilots, and will undergo exactly the same procedure as 'real' participants (see section 2.5). This is important because it will ensure that all

aspects of the trial procedure are fully tested before commencing with the trials for real.

- If the practice trials are completed without any technical issues or other problems, then the 'mock' status of participants will be removed and the data collected during the pilots will be treated as real trial data.

2.5 Trial procedure

Following the delivery of the Participant Information Pack, receipt of returned and completed consent forms will signal that the participant is fully signed up for the trial. Completed consent forms will be stored in the participant management database. The next stages of the trial procedure will then commence; these are illustrated in Figure 4.

The trial procedure will be standardised to minimise any potential bias resulting from the use of two locations (TRL and Cenex). TRL will run a training workshop with all vehicle handover staff (including those from TRL and Cenex) prior to commencing the pilot (and again following the pilot if necessary), which will include specific training on the vehicles from VW representatives, a full safety briefing, and training on how to brief participants and manage vehicle handovers (see Appendix E for a copy of the researcher protocol). This will ensure that all staff involved in the trial procedure are fully briefed and informed. As a further check, a TRL researcher will attend the first few trial days at Cenex to ensure consistency across the two trial locations.

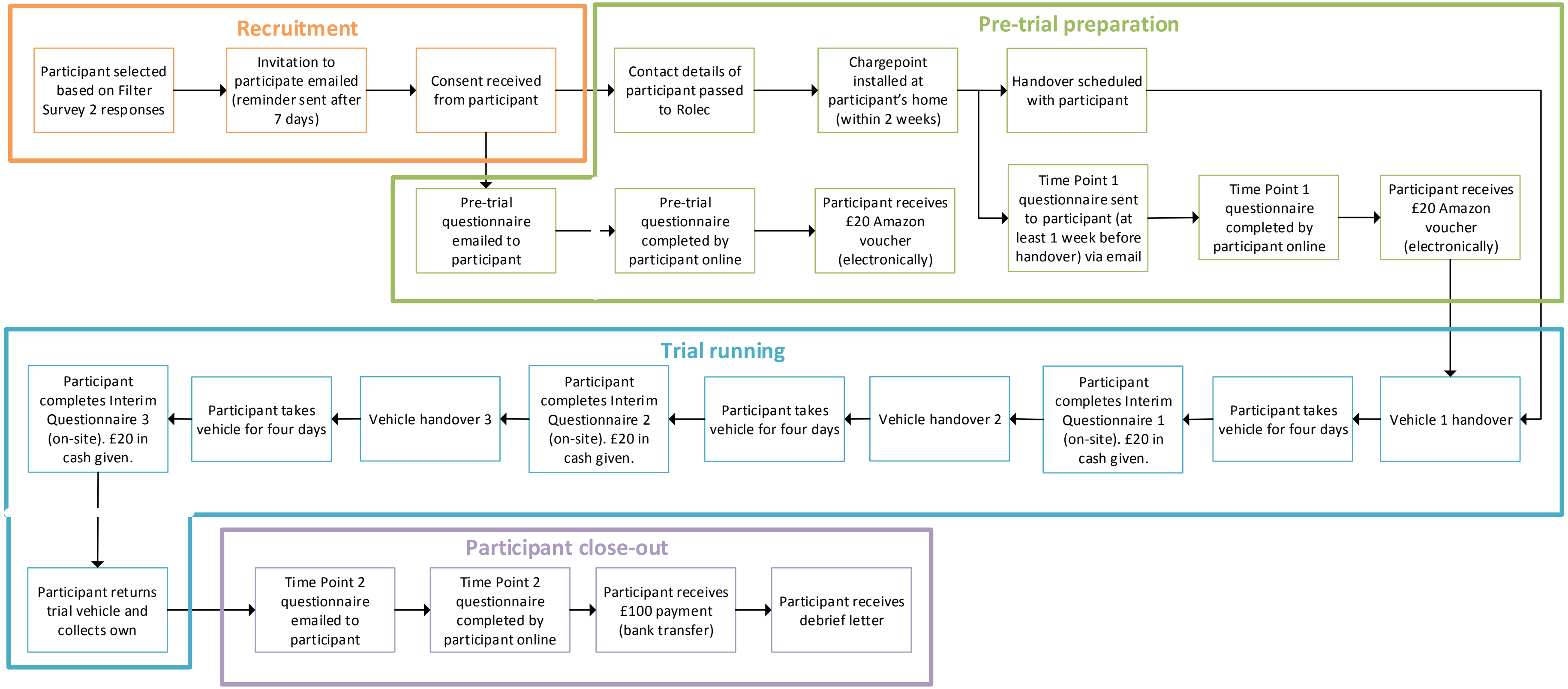

Figure 4: Trial procedure flow diagram

The following sections provide a more detailed description of each stage of the trial procedure.

2.5.1 *Pre-trial preparation phase*

2.5.1.1 Installation of charging sockets

Mode 2 charging sockets will be supplied and installed by Rolec Ltd and their installation partner ChargedEV (a trading name of Hybrid Energy Solutions Ltd, company registration no. 09666725).

Installation work will be undertaken by professional experienced contractors, trained by and working on behalf of the manufacturer of the socket, and only after a participant survey and/or site inspection has taken place with the participant to make sure their property is suitable. All installations will be preceded by a dynamic risk assessment to document anything on site which might result in hazards which are not within, or different from that within, the standard Risk Assessment. An "abort" arrangement will be setup with criteria to determine when it is not safe to undertake installation. A flow diagram outlining the installation process can be found in Appendix G .

At the end of the trial, participants will be given the option of keeping the socket, or having it removed, and any rectification work required undertaken, at no cost to them.

2.5.1.2 Scheduling vehicle handovers

Once confirmation has been received from Rolec that the Mode 2 charging socket has been safely installed at a participant's home, the participant will be contacted by the research team in order to schedule vehicle handovers.

The vehicle fleet will consist of 33 vehicles with a total of 15 vehicles at TRL (5 x ICE, 5 x PHEV, 5 x BEV) and 18 at Cenex (6 x ICE, 6 x PHEV, 6 x BEV) (see section 2.6.1). At TRL, the trial will be run in four 'blocks', with space for 30 participants to take part in each block. At Cenex, only 3 blocks will be required because the greater number of vehicles available will provide opportunity for 36 participants to take part in each block. The block structure has been designed to facilitate the sequencing of cycling vehicles to participants within each block, and to ensure there is sufficient contingency (2 days) between when a vehicle is returned by one participant and when it has to go out to the next participant.

Each block will run over a period of 38 days, and there will be a minimum of four days in between successive blocks. An illustration of the structure of Cenex's 'Block 1' is shown in Figure 5; this shows the schedule for running the first 36 participants from Cenex using six BEVs, six PHEVs, and six ICEs from the start of May 2017 to early June 2017[16] (the equivalent schedule with five BEVs, five PHEVs, and five ICEs will be run simultaneously at TRL).

Across the whole trial, participants will be split into 18 groups. The groups will contain up to 5 participants at TRL and up to 6 participants at Cenex (see Table 7). The groups represent sets of participants who will take part in vehicle handovers on the same day; the grouping of participants in this way facilitates the scheduling of vehicle handovers during each block.

[16] Precise dates shown in the table may be subject to change.

Table 7: Participant grouping structure; each group contains 6 participants

TRL Block 1	TRL Block 2	TRL Block 3	TRL Block 4
Group 1	Group 7	Group 13	Group 19
Group 2	Group 8	Group 14	Group 20
Group 3	Group 9	Group 15	Group 21
Group 4	Group 10	Group 16	Group 22
Group 5	Group 11	Group 17	Group 23
Group 6	Group 12	Group 18	Group 24

Group size: 5 participants
Vehicles: 15
Capacity: 120 participants
Duration: 5.5 months

Cenex Block 1	Cenex Block 2	Cenex Block 3
Group 1	Group 7	Group 13
Group 2	Group 8	Group 14
Group 3	Group 9	Group 15
Group 4	Group 10	Group 16
Group 5	Group 11	Group 17
Group 6	Group 12	Group 18

Group size: 6 participants
Vehicles: 18
Capacity: 108 participants
Duration: 4 months

The scheduling process which will be used at Cenex is as follows (equivalent process will be used at TRL but with 15 vehicles instead of 18, and five participants per group instead of six):

- The first six participants (in Group 1) receive a car on Day 1 of the trial, at the start of the block. This batch of vehicles consists of two BEVs (B1 and B2), two PHEVs (P1 and P2) and two ICEs (I1 and I2).
- Group 2 (participants 7-12) receive a car on Day 3 of the trial; again this batch of vehicles consists of two BEVs (B3 and B4), two PHEVs (P3 and P4) and two ICEs (I3 and I4).
- On Day 4, upon completion of their first four day experience, Group 1 returns their first set of vehicles, and each participant is given Vehicle 2 immediately; this batch of vehicles also consists of two BEVs (B5 and B6), two PHEVs (P5 and P6) and two ICEs (I5 and I6).
- The process repeats with Groups 3, 4, 5, and 6 until all 36 participants in the block have experienced all three types of vehicle, in the correct counterbalanced order.

All blocks will be identical in structure and will be run consecutively after each other. This process will allow up to 66 participants in each of Block 1, 2 and 3 to be completed using the full fleet of trial vehicles across the two trial locations (36 at Cenex and 30 at TRL). Block 4 (TRL only) will enable a further 30 participants to be completed. The total capacity across all blocks will therefore be 228 participants, providing 14% contingency above the required 200 participants. This contingency will be used to reduce risk from drop-outs, technical issues and a lower than expected response rate during recruitment.

In summary, the scheduling process ensures that:

- the order in which participants experience the three types of vehicle is fully counterbalanced;
- there are two days of contingency between when one participant returns a vehicle and when the next participant has to collect it; this provides sufficient time to ensure

that the vehicles are safety checked, cleaned and refuelled/recharged and also allows for some flexibility in case a participant returns a vehicle late, and;

- there is sufficient contingency to cater for drop-outs, technical issues, low recruitment response.

<table>
<tr><td></td><td></td><td colspan="38">BLOCK 1 - 38 DAYS</td></tr>
<tr><td rowspan="2">Vehicle ID</td><td>Trial day</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td><td>37</td><td>38</td></tr>
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Figure 5: Illustration of Block 1 structure for running Consumer Uptake Trial at Cenex (comparative block with 15 vehicles and 30 participants per block will also simultaneously take place at TRL)

2.5.2 Trial running phase

2.5.2.1 Vehicle handovers

This section describes the standardised vehicle handover process which will be used for the Consumer Uptake Trial.

An Admin Portal (Appendix N) will be used to record the assignment of participants to either the Consumer Uptake Trial or the Consumer Charging Trial as appropriate, and to record the assignment of vehicles to/from participants at handovers.

Vehicle 1 handover

1. Participants will arrive at trial headquarters (TRL or Cenex) at the date and time specified. On arrival participants will be met by the researcher.
2. Participants will be directed to the secure parking area where their personal vehicles will be stored for the duration of the trial. A researcher will accompany the participant on a walk-around of their personal vehicle to ensure that the existing condition of the vehicle, including any damage, is noted. If necessary, photos of the vehicle will be taken and saved in the secure project area. The mileage of the vehicle will also be recorded. The participant will be asked to sign a form confirming the current condition of their vehicle. One copy of this form will stay with TRL and one copy of this form will be given to the participant. The researcher will take the keys to the participant's vehicle and add a key tag with the vehicle details. The keys will then be stored in a secure location.
3. Participants will be met by a member of the research team. As requested in the letter in the Participant Information Pack (see Appendix C), participants will be asked to provide their driving licence and DVLA authorisation check code. A member of the research team will then verify the licence details online[17]. To do this they will need the last eight characters from the driving licence and the check code. This will confirm the vehicles that the participant can drive, and any penalty points or disqualifications. Participants will also be asked to provide another form of ID to confirm their identity and address (e.g. utility bill or bank statement). If the participant wishes to add an additional driver in the household to the insurance they will be asked to provide the additional driver's licence and DVLA authorisation check code also.
4. Participants will be asked to undertake an eyesight test, to the standard required in the current driving test. If they are unable to successfully pass this test they will not be allowed to drive the vehicle. They will be given the option of either not participating in the trial or returning at a later time and trying again with their corrective eyewear.
5. Assuming the licence and eyesight checks are passed, participants will then be given a PowerPoint presentation by the researcher (Appendix I). The presentation will cover background information about the trial, what is expected of the participant and a comprehensive health and safety briefing. On completion of the presentation,

[17] https://www.gov.uk/check-driving-information

participants will be assigned to a researcher. The researcher will be responsible for providing the participant with further information about the vehicle they will take away.

6. Participants will complete a walk-around inspection of the trial vehicle condition, including an interior inspection, with the researcher. The condition of the vehicle and any existing damage will be noted on the vehicle condition form. In addition, the vehicle mileage, fuel level (if applicable), and battery charge level will be noted, and the presence of key equipment will be checked. The participant will be asked to sign that they agree with the description of the vehicle condition and will be given a duplicate copy of the vehicle condition form.
7. Researchers will then provide participants with an explanation of the vehicle controls and key features. Researchers will follow a set protocol in order to ensure that information given to participants is standardised and accurate (Appendix E).
8. Participants receiving a BEV or PHEV will be familiarised with the features and controls unique to these vehicles. They will also be given a demonstration of how to access the charging port on the vehicle, locate the charging cable, how to safely plug in the charging cable at both the vehicle and chargepoint ends, and how to remove the charging cable on completion of charging. Researchers will make sure that BEV and PHEV participants are familiar with the in-vehicle displays of battery SOC and range. This will also include providing them with information on the AER of the vehicle and the likely impact when operating it under various driving conditions (e.g. urban driving vs. motorway driving).
9. On completion of the vehicle briefing, participants will be asked to take the vehicle for a short familiarisation drive, accompanied by a researcher, to ensure that they have understood how the vehicle operates and are comfortable with driving the vehicle. The familiarisation drive will also give the researcher the opportunity to appraise the driving of the participant and assess whether it could be considered unsafe, or if any illegal manoeuvres are performed. If the participant's driving is unsafe or illegal, on return to the trial headquarters, the participant will be notified that they will not be able to take part in the trial.
10. On completion of a successful familiarisation drive the participant will be issued with the In-vehicle Information Pack (see Appendix J). The pack will include key information about how the vehicle operates, how to charge it (if applicable), health and safety information, and a list of key contacts, including what to do in the event of a breakdown or incident.
11. The ICE and PHEV trial vehicles will be given to participants with a full tank of fuel. The BEV and PHEV vehicles will have a SOC of at least 80%. Participants will be asked to return the vehicles with the same amount of fuel, and where relevant, as much charge as possible.
12. On completion of all briefing and handover activities, the participant will be given the opportunity to ask any questions and will then sign a consent form (see Appendix J). The researcher will check-out the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix N).

13. Participants will take Vehicle 1 away for use during their normal day-to-day activities for a period of four days.

Return of Vehicle 1

1. Participants will return Vehicle 1 to TRL/Cenex at a pre-arranged time at the end of the four-day period. Participants will be met by a researcher who will accompany them on a walk-around of the vehicle, and interior inspection, to check the returned condition against the condition of the vehicle when it was taken away. If there is any new damage to the vehicle this will be recorded and the participant will be encouraged to provide an explanation. If the damage requires repair, the participant will be notified that they may be liable for any costs up to the agreed maximum excess.
2. Researchers will record the mileage, fuel level and charge level of the vehicle (as applicable), and will check that all original equipment (owner's manual, first aid kit, locking wheel nut, and charge cable where applicable) is still with the vehicle.
3. The researcher will check-in the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix N).
4. Participants will complete Interim 1 questionnaire on a computer or tablet located in TRL/Cenex offices. Upon completion of the questionnaire they will be given a cash payment of £20. The handover process for Vehicle 2 will then commence.

Vehicle 2 handover

1. The process for the handover of Vehicle 2 will follow the same structure as for Vehicle 1, including a familiarisation drive, although it will not require the driving licence and other ID checks, the eyesight checks, or the trial briefing using the PowerPoint presentation.
2. On completion of all briefing and handover activities, the participant will be given the opportunity to ask any questions and will then sign a consent form (see Appendix J). The researcher will check-out the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix N).
3. Participants will take Vehicle 2 away for use during their normal day-to-day activities for a period of four days.

Vehicle 2 return

1. The process for the return of Vehicle 2 will follow the same structure as for Vehicle 1.
2. Participants will complete Interim 2 questionnaire on a computer or tablet located in TRL/Cenex offices. Upon completion of the questionnaire they will be given a cash payment of £20. The handover process for Vehicle 3 will then commence.

Vehicle 3 handover

3. The process for the handover of Vehicle 3 will follow the same structure as for Vehicle 2.
4. On completion of all briefing and handover activities, including a familiarisation drive, the participant will be given the opportunity to ask any questions and will then sign a final consent form (see Appendix J). The researcher will check-out the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix N).

5. Participants will take Vehicle 3 away for use during their normal day-to-day activities for a period of four days.

Vehicle 3 return

1. The process for the return of Vehicle 3 will follow the same structure as above.
2. Participants will complete Interim 3 questionnaire on a computer or tablet located in TRL/Cenex offices. Upon completion of the questionnaire they will be given a cash payment of £20.
3. Participants will be shown to their personal vehicle by a researcher who will accompany them on a walk-around of the vehicle, and interior inspection, to check the current condition against the condition of the vehicle when it was first brought in by the participant. If there is any new damage to the vehicle this will be recorded and the participant will be notified that an investigation will be undertaken. The participant will be notified that TRL will organise and cover the costs of repairing any damage.
4. The researcher will check-in the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix N).
5. Participants will be notified that the final questionnaire (Time point 2) will be sent to them by email within one week and that upon completion they will receive £100.

2.5.2.2 Vehicle safety checks and cleaning

Within each block of participants, there will be approximately 48 hours between the time when a vehicle is returned by one participant and the time when it is required by another participant. There will be a minimum of four days between each block (see section 2.5.1.2).

During these periods, safety checks will be performed on the vehicles. This will cover items such as tyre wear and condition, seatbelt functioning, lights, and oil, coolant and washer fluid level, as well as valeting. A copy of the vehicle checklist can be found in Appendix M. Where necessary, more extensive maintenance and servicing will also be arranged.

All vehicles will be given an interior and exterior valet by a third-party valet company in-between participant sessions.

2.5.3 Participant close-out phase

2.5.3.1 Participant debrief

Upon receipt of the completed Time point 2 questionnaires, participants will be given £100 cash as compensation for their time. Participants will be sent a debrief letter to thank them for their time and confirm what will happen to their data and when the findings of the research will be published. A copy of this letter is provided in Appendix Q.

2.6 Vehicle management

2.6.1 Trial vehicle fleet

The Consumer Uptake Trial will use three variants of the Volkswagen Golf. This model has been selected because this is the only vehicle model that is currently commercially available with all three drivetrains (ICE, BEV and PHEV). The three models are similar in functional capability[18] (other than the drivetrain differences) and are (as closely as possible) matched in trim and accessories; a detailed comparison of trim-related features and accessories in the Uptake Trial vehicle fleet can be found in Appendix C. The battery specifications of the PHEV and BEV models are shown in the table below.

Table 8: Vehicle manufacturer reported battery specifications for PHEV and BEV

Manufacturer reported specification	VW Golf GTE (PHEV)	VW e-Golf (BEV)
Nominal Capacity, i.e. units to full charge (kWh)	8.7	35.8
Maximum AER (miles)	31	186
Expected AER (miles)	25	175
Time to full charge (AC - 2.3kW) (hours)	3.75	17
Time to full charge (AC - 3.6kW) (hours)	2.25	10.5
Time to 80% charge (DC) (hours)	n/a	0.75

The three models are similar in functional capability (other than the drivetrain differences) and are (as closely as possible) matched in trim and accessories. As explained in section 2.1 this minimises the impact of any differences between vehicle types that are associated with vehicle characteristics other than the powertrain configuration. Functional capability refers to the utility of the vehicle as a means of fulfilling a user's functional goals: the transporting of people or materials from one place to another. Functional capability includes range between refuelling, number of people that can be carried, legroom, volume and weight of luggage that can be carried, occupant safety, etc. The vehicles do differ in respect of trim and accessories in ways that might impact on how far they are subjectively evaluated by participants as able to fulfil their affective or symbolic goals. Such subjective differences are addressed by having a sample of sufficient size.

There is, however, one difference in accessory level between the BEV and PHEV models that might be considered a difference in functional capability, rather than a difference in relation to participants' affective or symbolic goals: the e-Golf (BEV) is equipped with a built-in Satellite Navigation (SatNav) system, while the Golf GTE (PHEV) is not. It is understood that the manufacturer's perspective is that SatNav is a standard feature on the e-Golf because, given the relatively short AER of these BEVs, users may need the facility to locate and navigate to public chargepoints when their SOC is too low to complete their journey needs. However

[18] See section 2.1

the same need is absent for PHEVs, including the Golf GTE, as these vehicles are designed to switch to ICE mode when SOC is low, have much longer total range, and can be refuelled at conventional fuels retail sites when needed: thus SatNav is not fitted as standard (though it is available as an optional extra). The Golf GTE is an early entrant into the C-segment (medium family hatchback) market, and it may be the case that other vehicle manufacturers follow VW's lead in making SatNav standard on BEVs but not PHEVs, for the same reason.

SatNavs are a familiar technology, available in cars either as built-in dashboard equipment, independent dashboard-mounted accessories, or as smartphone Apps (with the smartphone mounted in a holder). Among drivers who use a SatNav, preferences for these types differ. Participants will be aware that SatNavs can be fitted to, or omitted from, any car, irrespective of its powertrain, via one or other of these routes; so this difference between the trial vehicles is unlikely to be salient in relation to reduction of psychological difference (see section 1.2.3). This is reinforced by evidence on factors that are relevant to consumer choices between vehicles, reviewed in the Stage 1 literature review: SatNavs do not feature as a salient choice feature in any of the studies reviewed.

To test the possibility that participants might, nevertheless, subconsciously but *systematically* respond more negatively to the Golf GTE relative to the e-Golf because of the absence of a SatNav in the former, the TP1 and TP2 questionnaires will include some specific items. In the question "How important or unimportant would the following factors be if you were considering a Battery Electric Vehicle (BEV) / Plug-in Hybrid Electric Vehicle (PHEV) for your household?", the following factors will be included: Built-in Satellite Navigation System; Hands-free Bluetooth Connectivity; Cruise Control; and Automatic Rain-Sensing Windscreen Wipers.

In the Supplementary Analyses, the mean willingness to consider having a PHEV for those who answer "very important" or "extremely important" will be compared to that of those who answer "not at all important" or "slightly important". Similar comparisons will be made for those who consider Bluetooth connectivity, cruise control, and rain-sensing wipers to be important/unimportant.

The inclusion of Bluetooth, cruise control, and rain-sensing wipers in addition to SatNav will control for response bias. Response bias can occur in questionnaires if participants become aware (or perceive that they are aware) of the objectives of the research – adding items which relate to optional equipment other than SatNav (Bluetooth, cruise control, and rain-sensing wipers) helps to mask the underlying aim of the question. If response bias is present, then it is likely to manifest in the other items and not only the SatNav item..These features are present in all three trial vehicles and so their inclusion provides a control for any response biases that are unconnected to having not experienced the feature in the PHEV.

The vehicle fleet will therefore consist of 33 new Volkswagen Golf vehicles; 11 petrol (or Internal Combustion Engine – ICE) GT Edition models, 11 PHEV GTE models, and 11 BEV e-Golf models. The vehicle fleet will be split between TRL and Cenex with a total of 15 vehicles at TRL (5 x ICE, 5 x PHEV, 5 x BEV) and 18 at Cenex (6 x ICE, 6 x PHEV, 6 x BEV) - see

Table 9.

Table 9: Consumer Uptake Trial vehicle fleet

Model		Total number	Number at TRL	Number at Cenex
VW Golf 1.4 TSI	ICE	11	5	6
VW e-Golf	BEV	11	5	6
VW Golf GTE	PHEV	11	5	6

The vehicles will be leased directly from Volkswagen Group Financial Services (VGFS) for a period of 12 months commencing March/April 2017. The manufacturer's warranty will cover all vehicles for the duration of the trial. Vehicle maintenance and servicing will be covered under the terms of the lease agreement; Volkswagen dealerships local to TRL and Cenex will be used for this purpose. Servicing or maintenance will, wherever possible, be scheduled in-between participant experiences or blocks so as to minimise disruption to the trial. The lease agreement will also provide comprehensive breakdown cover and tyre replacement; participants will be provided with full details of this cover (and what to do in the event of an incident) as part of the In-vehicle Information Pack (see Appendix J).

2.6.2 Vehicle storage

Trial vehicles will be stored at TRL's head office in Crowthorne, Berkshire and at Cenex's offices on the campus of the University of Loughborough in Leicestershire. Participants will be asked to leave their personal vehicles at either the Crowthorne House site or the University of Loughborough campus for the duration of the trial, or at a secure location in close proximity. As part of the vehicle handover process, participants' vehicles will be inspected on arrival to record any damage and log the mileage. Keys will be tagged with participant and vehicle details and locked in secure storage.

2.6.2.1 TRL

At TRL, both trial vehicles and participants' vehicles will be kept in allocated spaces in the main Crowthorne House car park and a secure storage yard in close proximity to TRL. Crowthorne House is a secure site; the reception is manned 24 hours a day by security personnel, there is full CCTV coverage across the site, including the car park, and there are regular foot patrols undertaken by the security team. The site also has access control outside of working hours. Trial vehicles will be given priority access to four Mode 3 chargepoints located in the Crowthorne House car park to ensure they can be fully charged before handing over to participants. There are a further four chargepoints at TRL's premises which can be used if required. At the off-site secure storage location, high security fencing and CCTV will be provided at all times and the site manned during working hours. Chargepoints will also be installed for trial purposes.

2.6.2.2 Cenex

At Cenex, trial vehicles and participants' vehicles will be kept on the second floor of Car Park One at the west end of Loughborough University campus. Loughborough University is a secure site with a strict traffic enforcement policy that includes gated access for vehicles and a dedicated automatic number plate recognition (ANPR) security and parking permit system. Loughborough campus is manned and patrolled 24 hours a day by security personnel, there is full CCTV coverage across the site, including Car Park One, and there are regular drive-by patrols of the multi-storey car park undertaken by the security team. The site also has access control outside of working hours. Trial vehicles will be given priority access to two Mode 3 chargepoints located on the second floor of Car Park One to ensure they can be fully charged before handing over to participants. There are a further 17 chargepoints on university campus property that can be accessed if required.

2.7 Vehicle charging

Both the e-Golf (BEV) and the Golf GTE (PHEV) will be supplied with both Mode 2 and Mode 3 charging cables. Participants will be asked to charge the BEV and PHEV at least twice each during the four-day period; this could take place at home or at public chargepoints. At the vehicle handover sessions, the research team will provide participants with a demonstration of how to charge the vehicles; hard-copy instructions will also be provided to participants as part of the In-vehicle Information Pack.

2.7.1 Charging at home

For long-term use of plug-in vehicles, Mode 3 charging (involving the use of a dedicated PiV charging station with its own circuit) is ordinarily the recommended method for domestic charging. However, given the time, cost and practical constraints of this short-term trial, an assessment was made that use of Mode 2 charging would be a suitable alternative charging solution for use in this trial. Mode 2 charging involves the use of a dedicated charging cable equipped with a residual current device (RCD) that can be connected to a domestic 3-pin socket, and which is suitable for occasional use.

Therefore, for the purposes of the Consumer Uptake Trial, a Mode 2 charging socket on a dedicated circuit, with RCD protection, will be installed in participants' homes to enable them to safely charge the BEV and PHEV during the trial. Mode 2 charging sockets will be supplied and installed by Rolec Ltd and their installation partner ChargedEV (a trading name of Hybrid Energy Solutions Ltd, company registration no. 09666725). Further information about the installation process is provided in section 2.5.1.

2.7.2 Public charging

Participants will be given free access to the 'POLAR plus' public charging network via a membership card or key fob which will be provided with each vehicle. POLAR is the UK's largest public charging network and contains thousands of charge points across the UK, ranging from 3-pin and Type 2 sockets, to their rapid charger, The Ultracharger. POLAR plus customers can also access the Charge Your Car (CYC) network of charge points.

The POLAR network gives access to over 5,000 chargepoints across the country. Maps showing the location of POLAR network chargepoints in the areas surrounding TRL and Cenex are shown in Figure 6 and Figure 7, respectively.

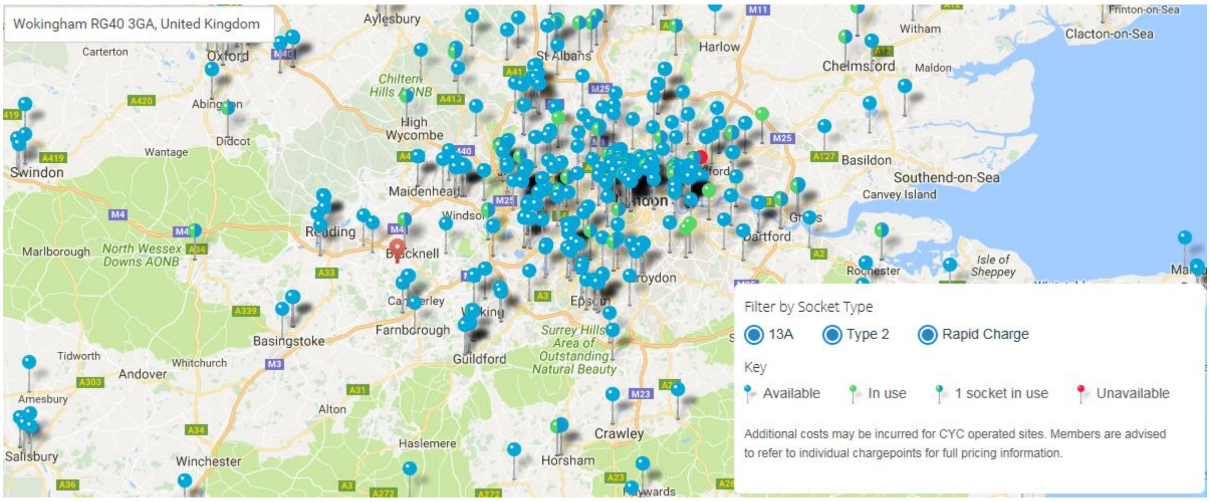

Figure 6: Location of public chargepoints on the Polar network in the area surrounding TRL

Figure 7: Location of public chargepoints on the Polar network in the area surrounding Cenex

TRL will register an account for each vehicle on a monthly subscription, which is free for the first six months. Around 80% of the network's charge points are free to use. Charge points requiring payment cost 9p per kWh and will be charged directly to the TRL account; participants will not be directly charged for the use of public charge points in this trial. Participants will be directed to the POLAR plus map web page (https://polar-network.com/map) during vehicle handover so that they are aware of how to find a local public charge point.

2.8 Questionnaires

Throughout the duration of the trial, participants will complete a number of questionnaires including a two-stage filter survey process to inform recruitment, a pre-trial questionnaire, an attitudinal questionnaire which is repeated before and after the trial and interim questionnaires for completion after each vehicle is returned.

The questionnaires are based on those developed for previous ETI PiV research (Anable, *et al.*, 2011). These were further developed for a Shell-TRL PiV trial (Skippon *et al.*, 2016) and variants were used in a segmentation survey study by Element Energy (DfT, 2016b).

The **filter survey questionnaires (Filter Survey 1 and Filter Survey 2)** will be used to determine the eligibility of participants to take part in the trial.

The **Pre-trial questionnaire** will collect data to be used for the segmentation and descriptive analysis to understand how participants fit into the different consumer segments based on their willingness to adopt. It contains questions relating to the participant's household, vehicle ownership history, travel patterns, attitudes about owning and driving a car, driving style, mobility-as-a-service, attitudes about new technology, personal travel and the environment.

The **Time Point 1 questionnaire** will be used to record participants' attitudes towards BEVs and PHEVs before experience of the vehicles. The questionnaire contains BEV and PHEV specific questions comparing them with conventional cars, affective, symbolic and instrumental attitudes towards BEVs and PHEVs, and willingness to consider a BEV or PHEV as a main or second car.

Interim questionnaire 1 contains the core willingness to consider questions from the Time Point 1 questionnaire. These are included at this point to test there is a Hawthorne Effect (see section 3.3) in which participants' attitudes are changed merely by participation (in which case, attitudes towards BEVs and PHEVs will change among participants who so far have only experienced the control ICE car). The questionnaire also contains questions on the evaluation of the vehicle performance (vehicle acceleration, responsiveness, comfort, noise etc.) of the first vehicle the participant has experienced.

Interim questionnaires 2 and 3 repeat only the vehicle performance questions for the second and third vehicles respectively.

Finally, the **Time Point 2 questionnaire** is an extended version of the Time Point 1 questionnaire. It includes the Choice Experiment and so provides the key data that inform the WP7 update to the Analytical Framework. It also repeats all the questions in the Time Point 1 questionnaire, enabling Supplementary Analyses that explore how far attitudes change with experience of the vehicles. In addition it contains questions on preferred charging locations, and a personality inventory, again for use in Supplementary Analyses.

A summary of the content and data collected by the questionnaires can be seen in

Table 10. The recruitment screening questionnaires (Filter Survey 1 and 2) can be seen in Appendix B and the Pre-trial, Time Point 1, Interim and Time Point 2 questionnaires can be seen in Appendix K.

Table 10: Breakdown of data being collected by each questionnaire

Questionnaire	Data being collected
Filter survey 1	**Section 1: Driving history** • Time holding a UK driving licence • Penalty points on driving licence • At fault insurance claims **Section 2: Vehicles and driving information** • Driving regularity • Car owner • Company car driver • Off-street parking • PiV ownership • Intention to adopt a PiV **Section 3: Information about you** • Age group • Gender • Contact details
Filter survey 2	**Section 1: Trial interest** • Trial interest • Living arrangement • Willingness to install a chargepoint **Section 2: Your car(s)** • Number of cars in the household • Number of licensed driver in the household • Car type • Number of car drivers • Annual mileage • Long journey (i.e. >typical BEV range) regularity • BEV acceptability **Section 3: Domestic energy information** • Smartphone suitability • Economy 7 and pre-pay tariffs

	• Solar panels
Pre-trial	**Section 1: General background** • Educational attainment • Employment status • Household income • Relationship status • Living status **Section 2: Your household and cars** • Household membership • Cars in the household • Car types • Car purchase method • Car mileage • Main car year of purchase • Main car purchase type (e.g. new or old) • Main car purchase price • Main car purchase choice factors • Main car fuel economy • Main car purchase decision influence **Section 3: Your journeys** • Commuting • Weekday and weekend typical mileage • Journey distance • Urban/rural driving • Mode use and regularity • Current car club membership • Current mobility services user • Journey app planning user **Section 4: Owning and driving a car** • Attitudes to car ownership (car-authority identity) • Driving style (Multidimensional Driving Style Inventory) **Section 5: New technology**

	• Attitudes to new technology **Section 6: The environment** • Attitudes to Driving and the Environment Inventory
Interim 1	**Section 1: Battery Electric Vehicles** • Willingness to adopt a BEV • Willingness to adopt a BEV by range • Willingness to adopt a BEV by time to charge • Current level of knowledge **Section 2: Plug-in Hybrid Vehicles** • [Repeat Section 1 for PHEVs] **Section 3: Next vehicle purchase** • Future car purchase intentions **Section 4: Experience with the vehicle** • Evaluation of vehicle performance • Household driver use
Interim 2 & 3	**Section 1: Experience with the vehicle** • Evaluation of vehicle performance • Household driver use
Time Point 1	**Section 1: Battery Electric Vehicles** • Instrumental, Symbolic and Affective attitudes towards BEVs • Self-congruity to BEVs • Willingness to adopt a BEV • Willingness to adopt a BEV by range • Willingness to adopt a BEV by time to charge • Important factors in decision to adopt a BEV • Influence of access to long-range vehicle options on willingness to adopt • Influence of depreciation on willingness to adopt **Section 2: Plug-in Hybrid Vehicles** • [Repeat Section 1 for PHEVs] **Section 3: Next vehicle purchase**

	• Future car purchase intentions **Section 4: Plug-in Vehicle charging** • Awareness of PiV public charging points
Time Point 2	**Section 1: Battery Electric Vehicles** • Instrumental, Symbolic and Affective attitudes towards BEVs • Self-congruity to BEVs • Willingness to adopt a BEV • Willingness to adopt a BEV by range • Willingness to adopt a BEV by time to charge • Important factors in decision to adopt a BEV • Influence of access to long-range vehicle options on willingness to adopt • Influence of depreciation on willingness to adopt **Section2: Plug-in Hybrid Vehicles** • [Repeat Section 1 for PHEVs] **Section 3: Next vehicle purchase** • Future car purchase intentions • Information on PHEVs or BEVs sourced **Section 4: Plug-in Vehicle charging** • Future charge location predictions • Awareness of PiV public charging points **Section 5: About you** • Self-identity to PiVs • Newcastle Personality Assessor **Section 6: Choice experiment**

2.8.1.1 Filter Survey questionnaires

The primary purpose of the Filter Survey questionnaires is to establish potential participants who are suitable for taking part in the trial. The questionnaires are designed to obtain information relating to factors that would rule prospective participants out of taking part (e.g. they currently have a PiV in their household); the remaining prospective participants can then be entered into the trial recruitment process (see section 2.2). Where a prospective participant is taken forward into the trial and becomes a participant, the demographic information recorded will be utilised in subsequent analyses.

2.8.1.2 Pre-trial questionnaire

The questions in the Pre-Trial Questionnaire do not need to be repeated before and after participants have completed their trial experience with the vehicles. They are, therefore, distinct from the items in the Time point 1, Interim and Time point 2 questionnaires.

The purpose of the Pre-trial questionnaire is to capture further details about participant demographics which were not obtained via the Filter Surveys. In addition, the questionnaire is designed to collect data regarding a participant's household (including members and cars within the household) and regular travel behaviour. The questionnaire also contains standardised scale-items to capture information on driving style, and attitudes towards the environment, technology, personal travel and journey purpose, and owning and driving a car. Further detail regarding data captured within this questionnaire is described below.

This questionnaire will be administered after participants have provided consent to take part in the trial.

The questionnaire also contains items relating to engagement with mobility-as-a-service exploring whether participants are current members of a car club such as City Car or Zipcar, currently use mobility services such as Uber, or regularly use apps to plan their travel (a proxy measure for future use of mobility-as-a service alternatives).

Car ownership

Car-authority identity will be measured with statements from measures of consumer novelty seeking (Manning, Bearden & Madden, 1995) and opinion leadership (Flynn, Goldsmith & Eastman, 1996). Statements, such as "My car says something about who I am" will be answered on a five-point Likert-type scale ranging from "strongly disagree" to "strongly agree". This can be seen in Section 4 of the questionnaire.

Multidimensional Driving Inventory (MDSI)

The MDSI (Taubman-Ben-Ari, Mikulincer & Gillath, 2004; see Section 4 of the questionnaire) was constructed to provide a broader conceptualisation of an individual's habitual driving style than other questionnaire measures that are focussed on crash risk. It was developed from a previous differentiation between driving skill and driving style (Elander, West & French, 1993). "Skill" refers to a driver's performance, that is their ability to maintain control of the vehicle and respond adaptively to complex traffic situations. "Style" is defined as the way the driver chooses to drive, or habitually drives. Driving style is thought to be influenced by attitudes and beliefs regarding driving, as well as by more general goals, including symbolic goals to signal aspects of identity. The MDSI was designed to assess driving style, rather than driving skill. The MDSI characterises driving style using eight scales: Angry, Anxious, Cautious, Dissociative, Distress Reduction, High Velocity, Patient, and Risky. Statements, such as "I like to take risks while driving", will be answered on a six-point scale ranging from "not at all" to "very much".

The MDSI data will be used to segment participants by self-reported driving styles, and participants' scores on the eight scales may be included as factors in regression models in the Supplementary Analyses.

Attitudes to new technology

Attitudes to new technology (see Section 5 of the questionnaire) are measured via a 16-item scale that was developed for the previous ETI PiV project. The statements were developed on the basis of a literature review conducted at the time and qualitative data from interviews with mainstream consumers who had experienced a PiV (Graham-Rowe *et al.*, 2012).

Statements, such as "I generally know more than other people about new technology", will be answered on a five-point Likert-type scale ranging from "strongly disagree" to "strongly agree".

Attitudes to Driving and the Environment Inventory

Section 6 in the questionnaire contains the Attitudes to Driving and the Environment Inventory. It is designed to measure attitudes to driving, travel and the environment by exploring the dynamic between car use, perceptions of travel choices and environmental impact.

Attitudes are measured by participants responding to multiple statements to indicate their degree of agreement. Participants will be asked to rate items (e.g. "I am actively trying to use my car less") on five-point Likert-type scale ranging from "strongly disagree" to "strongly agree". It is based on items used by Anable (2005) in segmentation studies of UK adults' travel choices and statements to measure pro-environmental identity, which are an expansion of those used by Whitmarsh and O'Neill (2010).

2.8.1.3 Time Point 1 questionnaire

The purpose of the Time Point 1 questionnaire is to capture data on attitudes towards, and willingness to purchase BEVs and PHEVs. These items are repeated in the Time Point 2 questionnaire to allow comparison of how attitudes and willingness to purchase are impacted by direct experience with BEVs and PHEVs. Willingness to purchase items will also be repeated in the Interim 1 questionnaire to establish whether or not there is an impact on these measures of simply participating in the trial (i.e. to identify the presence of Hawthorne effects).

This questionnaire will be administered approximately one week before participants attend the first vehicle handover session to collect Vehicle 1.

The Time Point 1 questionnaire begins by providing participants with an information sheet of a basic comparison of the vehicle types of interest (i.e. conventional vehicles and plug-in vehicles). This information has been developed from that used previously in the ETI PiV study (Anable *et al.*, 2011). The purpose is to ensure that participants are aware of the key differences between the vehicle types and therefore have a clear understanding in principle of the vehicle types being asked about in the questions (though not, at this stage, direct experience of using them).

Section 1 of the questionnaire asks questions relating to BEVs only and Section 2 repeats these questions for PHEVs only. The content of these sections is described in more detail below. Section 3 of the questionnaire asks basic questions relating to participants' next vehicle purchase intentions. Section 4 asks about awareness of PiV charging facilities in participants' local area.

Perceived instrumental, affective, and symbolic attitudes to PiVs

Three main motivational dimensions of consumer attitudes towards products have been distinguished: instrumental, affective (or hedonic), and symbolic (Vandecasteele & Geuens, 2010). Consumers are thought to focus most strongly on instrumental, affective, or symbolic attributes to the extent that they have instrumental, affective, or symbolic motives to adopt a product. Instrumental attributes refer to the functionality or utility that can be derived from functions performed by a product or new technology (Dittmar, 1992; Voss, Spangenberg & Grohmann, 2003). Affective attitudes refer to the emotional experience derived from using (i.e. driving) a new technology, such as joy or pleasure (Dittmar, 1992; Roehrich, 2004; Voss, *et al.*, 2003). Symbolic attitudes meanwhile refer to a sense of self or social identity that is afforded by being seen in, or associated with, a vehicle type and new technology (Dittmar, 1992; Roehrich, 2004).

In particular, car use and car ownership have been associated with instrumental, affective, and symbolic attributes (e.g. Anable & Gatersleben, 2005; Bergstad *et al.*, 2011; Steg, Vlek & Slotegraaf, 2001; Steg, 2005; Turrentine & Kurani, 2007). The adoption and use of PiVs is also likely to involve instrumental, affective, and symbolic motivations, although the dynamic is likely to be different since PiVs have different instrumental, affective, and symbolic attributes to ICE vehicles (Heffner, Turrentine & Kurani, 2006; Kurani, Turrentine & Heffner, 2007; Skippon & Garwood, 2011; Skippon *et al.*, 2016).

Schuitema, Anable, Skippon and Kinnear’s (2013) study of mainstream consumers’ intention to adopt PiVs noted that affective and symbolic attributes mediate the effect of instrumental attributes on PiV adoption. Further, people with a pro-environmental identity have more positive perceptions of PiV attributes. The results, utilising data collected for the earlier ETI PiV study, also found that PHEVs were perceived more positively than BEVs and there was a greater intention to adopt PHEVs than BEVs.

Sections 1 and 2 of the questionnaire therefore contain questions to measure instrumental, affective, and symbolic attributes to PiVs based on items previously developed and tested. The sections are repeated for BEVs (Section 1) and PHEVs (Section 2) separately noting the importance of the distinction between the vehicle types found previously. The statements were developed, and based on input, from a qualitative PiV interview study for the ETI (Graham-Rowe *et al.*, 2012) and a literature review completed for that project (Anable *et al.*, 2011).

Symbolic meaning

Sections 1 and 2 of the questionnaire also measure participants’ attributions of symbolic meaning to BEVs and PHEVs respectively. Symbolic meaning will be measured using the attribution-vignette method (Skippon, 2014; Skippon & Garwood, 2011). This is based on Miller’s (2009) reproductive fitness indicator theory of product symbolism. For example, participants are asked to indicate on a five-point scale ranging from “doesn’t fit the driver” to “fits the driver very well” how well a description (e.g. “Has a lot of fun”) can be attributed to the driver of a BEV (Section 1) or a PHEV (Section 2). Eighteen items like this measure participants’ attributions of personal characteristics to an imagined typical user of a BEV or PHEV. Responses can be compared to norms recorded in Skippon’s (2014) study of the symbolic meanings of the major types of European light duty cars.

Ten of the items are used to measure participants' attributions of the five-factor personality traits openness, conscientiousness, extraversion, agreeableness and neuroticism to an imagined typical user of a BEV or a PHEV. The remaining eight items measure participants' attributions of other mating-salient characteristics of an imagined typical user: status, gender, age, relationship investment (focus on long-term vs. casual relationships), and physical attractiveness.

Relative attractiveness of PiVs

Sections 1 and 2 also include a question set to measure the relative attractiveness of a BEV (Section 1) or PHEV (Section 2) in comparison to a conventional vehicle. The importance of asking about relative attractiveness outside of the choice experiment is that it provides a direct measure for each participant that can be used in regression analyses with driving style, personality traits (see Time Point 2 questionnaire), demographic and attitudinal variables to address Research Questions 5 and 6, and in the Supplementary Analyses. Responses to these questions will also be used in the segmentation analysis.

Intention to adopt

Intention to adopt PHEVs and BEVs as main and second car will be measured on a five-point scale ranging from "very unlikely" to "very likely" with the single statement: "In the next 5 years, I would choose to have a BEV (Section 1) or a PHEV (Section 2) as a main car; repeated for a second car.

Participants are also asked to indicate (by selecting 'yes' or 'no') whether they would consider owning a BEV (Section 1) as a main car in their household, if it had a range when fully charged of 50, 100, 150, 200 or 250 miles. These questions are repeated for ownership of a second car in the household. The same questions are repeated in Section 2 for PHEVs but with appropriate ranges for the vehicle type: 10, 25, 50, 75, 100 miles.

In the same way, participants are asked to indicate if they would consider owning a BEV (Section 1) or PHEV (Section 2) if the charge time to provide 100 miles of range was 1, 2, 4, 6, 8 hours. In both sections this question is repeated for the main and second car in the household.

These items will also be used in regression analyses to address Research Questions 5 and 6, and in the Supplementary Analyses.

Adoption influences and depreciation

Sections 1 and 2 also explore the importance of potential influences on the decision to choose a BEV or PHEV respectively. Participants are asked to highlight the importance of a series of factors known from the existing literature to be associated with adoption. In addition to some traditional factors (e.g. purchase price, brand) items have been added to explore and compare the relative importance of factors specifically related to the research questions: depreciation, access to public transport and access to another vehicle.

Policy incentives related to the research questions and aims of the study are also asked in a question developed for this study. These items ask participants to rate a series of benefits that might come with choosing a BEV (Section 1) or a PHEV (Section 2) on a five-point scale from "very unlikely" to "very likely". These include items such as "discounted access to hire cars (e.g. for longer journeys)" and "discounted access to public transport".

A question regarding attitudes towards depreciation is specifically designed for this study to address a research question directly. It is designed to collected data on the impact on willingness to consider a PiV of depreciation of a BEV (Section 1) or PHEV (Section 2) relative to a conventional car, where the PiV lost more or less value than a conventional car. Participants are asked to rate their response on a five-point scale from "very unlikely" to "very likely". To support this, new items on depreciation have also been added to the question set measuring the relative attractiveness of PiVs (e.g. rating agreement to statements such as "BEVs will lose value more quickly than a conventional car").

2.8.1.4 Interim questionnaires

The Interim questionnaires will be administered at TRL or Cenex during the vehicle handover sessions after participants return Vehicle 1, 2 and 3. The purpose of Interim questionnaires is to capture participants' evaluation of the performance of the vehicle they have just experienced. This is described in more detail below.

The Interim 1 questionnaire also includes questions to capture data on willingness to purchase BEVs and PHEVs, using items repeated from Time point 1, so as to establish whether or not there is an impact of participation in the trial on these measures (i.e. to identify the presence of Hawthorne effects).

Evaluation of vehicle performance

The evaluation of vehicle performance contains eleven items measuring participant ratings of performance of the vehicle experienced, plus other aspects of the driving experience. The items cover those aspects of performance identified by Skippon (2014) as the ways in which drivers construe vehicle performance: acceleration from 0-20mph, acceleration from 30-50mph, responsiveness, power, smoothness and noise when cruising. Top speed is not included because the top speed of all vehicles in the trial substantially exceeds the UK national speed limit, so asking drivers to evaluate it would not be ethical. Smoothness of gear changes is not included as it is not relevant for the trial PiVs. In addition, participants will be asked to rate overall performance, and three other aspects of the driving experience: comfort, safety and enjoyment.

The questionnaire uses the Borg CR-10 Category-Ratio scale. This scale is claimed (Borg, 1998, p39) "to be able to describe a psychophysical stimulus-response function over a wide range of stimulus intensities with a mathematical function that as accurately as possible reflects the genuine growth of the sensory perception", i.e. it is intended to reflect the form of mental "scales" of perceived stimulus intensity better than, say, Likert-type ordinal scales. The scale has a non-linear, positively accelerating growth function for perceived intensity, with verbal anchors ranging from "no (stimulus) at all" up to "extremely high" (the maximum the participant has ever experienced). The CR-10 scale also includes a final category, "maximal (stimulus)", defined as the highest value of the stimulus that the participant could imagine experiencing, but this will be omitted following feedback from the cognitive testing that this category was confusing. The scale was developed to measure perceived exertion and perceived pain, but has also been used previously for perception of vehicle performance attributes (perceived loudness of engine idle noise and perceived intensity of steering wheel vibration; Ajovalasit & Giacomin, 2007) and in the BEV study of Skippon, et al. (2016).

2.8.1.5 Time Point 2 questionnaire

The purpose of the Time Point 2 Questionnaire is to capture data on attitudes towards and willingness to purchase BEVs and PHEVs using items repeated from the Time point 1 questionnaire, to allow comparison of how attitudes and willingness to purchase are impacted by direct experience with BEVs and PHEVs. Sections 1 and 2 of this questionnaire are therefore identical to those in the Time Point 1 questionnaire.

This questionnaire also contains additional items to obtain information on personality characteristics (described in more detail below), self-congruity with PiV owners (based on the symbolic meaning questions in Sections 1 and 2) and bespoke questions to collect data on perceptions of preferred PiV charging locations.

This questionnaire will be administered approximately one week after participants have returned Vehicle 3.

The Time Point 2 questionnaire begins by providing participants with a reminder of the information sheet showing a basic comparison of the vehicle types of interest (i.e. conventional vehicles and plug-in vehicles). Although participants will have had real-world experience with these vehicles at this stage, the purpose is to ensure that participants are aware of the key differences between the vehicle types and therefore have a clear understanding of the vehicle types being asked about in the questions.

Section 1 of the questionnaire asks questions relating to BEVs only and Section 2 repeats these questions for PHEVs only.

Newcastle Personality Assessor (NPA)

The NPA is a brief measure of personality. Five dimensions of personality (extraversion, neuroticism, conscientiousness, agreeableness and openness) are assessed by a total of 12 items rated on five-point scales, with 1 being “very uncharacteristic”, 3 being “moderately characteristic” and 5 being “very characteristic”. Example items include: “planning parties and social events” (extraversion), “feeling stressed or worried” (neuroticism), “preparing for things well in advance” (conscientiousness), “making sure others are comfortable and happy” (agreeableness), and “thinking about philosophical or spiritual questions” (openness). Scores for each personality dimension are formed by summing the scores from the relevant two or three items.

Higher scores indicate a higher level of the personality trait. The NPA dimension scores correlate with coefficients of .7 or higher with those from the more extensive the International Personality Item Pool inventory (Goldberg *et al.*, 2006); the NPA has the advantage of being much shorter.

By measuring participants’ own personality profiles it is possible to calculate a measure of self-congruity, the extent to which the symbolic meaning of a product (in this case, a BEV or PHEV) is congruent with personal identity. Skippon *et al.* (2016) found evidence that self-congruity was a factor in willingness to consider having a BEV, particularly one with a shorter AER.

2.9 Choice experiment

2.9.1 Introduction to Discrete Choice Analysis

The purpose of Discrete Choice Analysis is to simulate as far as possible the decision-making process followed by consumers in the real world. When choosing between various alternatives, consumers are assumed to trade-off between the attributes of each in order to come to a decision. For a car, these attributes could include purchase price, fuel consumption and range etc. Discrete Choice Analysis is used to quantify the different weighting consumers apply to each attribute, and thus the overall 'utility' that each alternative would provide. A consumer will choose the alternative that offers the greatest 'utility', and so the results can be used to predict the likely uptake of each member of a choice set. This can be used to estimate how the market shares of vehicles will evolve over time as their attributes change. Critically, the technique simulates a choice between discrete alternatives which correctly represents the real-world process car-buyers go through when choosing between several distinct vehicles and choose only one (and cannot mix and match the attributes of each).

2.9.2 Choice experiment design for this trial

Discrete Choice Analysis requires a large dataset containing the results of consumer choices made between alternative products with known attribute values. For products which are already available on the market, this data can be gathered simply from historic market shares or so-called 'revealed preference' data. This has the advantage of being based on actual real-world decisions. However, for novel products, such as plug-in vehicles, where the models currently available are not representative of future models, revealed preference data either does not exist or is of limited range of variation (i.e. restricted to attribute combinations that currently exist in the market). Instead, a 'stated preference' choice experiment can be employed in which consumers in a survey are presented with a set of hypothetical product alternatives and asked to choose to purchase one of them. By varying the values of the product attributes between choice sets, a large dataset of consumer choice behaviour can be generated. From this, the 'Willingness to Pay' (WTP) for each product attribute can be derived independently, which enables the consumer preference for future products that do not currently exist to be modelled. This technique will be employed in this study.

The coefficients that underpin the Electric Car Consumer (ECCo) model's representation of vehicle purchase decision making were first derived from a choice experiment carried out by Element Energy during the ETI PiV study in 2010-2011. This study was tasked with identifying the factors considered by consumers when purchasing a new vehicle and quantifying the relative priority between them. The choice experiment was carried out with 2,700 buyers of new and nearly new cars, and included the following vehicle attributes:

- Upfront vehicle cost (£)
- Running cost (£/year)
- Performance (0-60 mph)
- Electric range (miles)
- Recharging/refuelling time

- Access to home/workplace charging
- Availability of public charging (% of parking spaces)
- CO_2 emissions (% relative to typical ICE car)

The large size of the survey enabled participants to be grouped into consumer segments representative of the total new car buying population. Members of each segment, such as 'Pioneers' and 'Rejecters', shared certain demographic and attitudinal characteristics and were found to weight the attributes of a car differently compared with the other segments when deciding on which powertrain to purchase.

The upfront vehicle and running costs were found to be key factors in a purchase decision. Participants' attitudes towards several non-financial attributes, such as electric range of PHEVs/BEVs and access to home charging, played a significant role. Willingness to pay for the latter was so high that it was made a pre-requisite in ECCo to even consider purchasing a plug-in vehicle. However, participants were seen to care very little about CO_2 emissions, demonstrating a low willingness to pay for lower emission vehicles. In reality, consumers might be willing to pay more for a low emission vehicle if CO_2 emissions determine certain ongoing costs for motorists, such as congestion charges, vehicle excise duty (VED) or resident parking permits[19]. Uptake models based solely on the economic "offer" of plug-in vehicles predicted considerably higher sales than have been observed since 2010, consistent with the findings of this choice experiment. For example, Berger (2009) forecasted the 2015 share of plug-in vehicles in the EU would be between 1.6% - 3.1%, which is more than the 1.1% observed. Likewise, IEA predicted a 2015 sales volume of 310,000 plug-in vehicles in (OECD) Europe (IEA, 2010), compared with 188,000 actual [20]. Other global forecasts estimated >1,000,000 plug-in vehicle sales in 2015 (Pike Research, 2011; Singh, 2010), which was approximately double the actual sales volume of 540,000[21].

However, it was noted in the report summarising the survey's findings that this choice experiment took place just before the launch of several 'new generation' plug-in vehicles (DfT, 2016b). The main survey was carried out in November 2010, at which time only 91 plug-in cars had been sold in the UK (year to date)[22], most being the Mitsubishi i-Miev city car with an official AER range of 150 km, and the REVA G-Wiz quadricycle with an AER range of only 80 km. Psychological distance from the plug-in cars featured in the choice experiment was therefore large, and potentially contributed to a strong bias against them. By 2015, however, both the 24 kWh and 30 kWh versions of the Nissan Leaf had been released, as well as the BMW i3, Renault Zoe, and Tesla Model S. PHEVs had also entered the market, including the highly popular Mitsubishi Outlander PHEV introduced in 2014. Given these developments, in

[19] In the ETI PiV choice experiment, respondents were asked explicitly to assume equal tax levels and other running costs, in order to determine whether they were willing to pay a premium for low CO_2 vehicles purely for their environmental benefits. Note that while the close linkage of UK VED with CO_2 emissions will be ended from 2017, zero-emission vehicles will remain exempt.

[20] European PiV sales figures sourced from the European Alternative Fuel Agency www.eafo.com

[21] Global PiV sales sourced from EV-Volumes.com

[22] SMMT EV and AFV Registrations October 2011: https://www.smmt.co.uk/2011/11/october-2011-ev-and-afv-registrations/

2015 Element Energy was commissioned by the DfT to carry out a further choice experiment (n=2,020) to update the purchase behaviour and consumer segmentation represented within ECCo (DfT, 2016b).

Since 2011, policy had shifted focus towards the provision of rapid charging and so DfT was particularly interested in understanding how a rapid charge network would alter the perceived value and convenience of PiVs. It was also suspected that a lack of available plug-in models from major OEMs was contributing to the low market share. Based on these areas of interest, and the findings of the original choice experiment, an amended list of attributes was explored:

- Purchase price (£)
- Annual running cost (£, presented as annual fuel cost in the choice experiment)
- Electric range (miles)
- Access to charging for local journeys
- Access to rapid charging for long distance journeys (intervals between charge points on motorways and A-roads)
- Rapid charging performance (additional range obtained from 20-minute charge)
- Brand supply (number of brands selling similar vehicle)

These are the attributes that currently constitute the representation of the purchase decision in ECCo. Since the choice experiment in this trial is intended to update the ETI CVEI analytical framework designed in Stage 1 of the project, the choice of attributes should be influenced by its compatibility with ECCo. The DfT (2016b) choice experiment provided a comprehensive view of all new car buyers and successfully recreated observed market shares in ECCo. The consumer survey and choice experiment in this work aim to specifically reflect attitudes of mainstream consumers once they have experience of PiV powertrains, and thus more closely represent the purchase behaviour of these consumers in the future.

Since this trial focuses on mainstream attitudes, early adopters of PiVs are explicitly excluded from the trial. A complete re-segmentation of car buyers is therefore not in scope and the trial size (n=200) prohibits a statistically robust partial segmentation of mainstream consumers. Instead, the intention is to map participants to the existing consumer segments derived in DfT (2016b), in order to test the extent to which attitudes may have changed after psychological distance towards PiVs is reduced. Should each consumer segment be sufficiently populated with trial participants, the resulting choice coefficients can be used in ECCo to explore how increased experience of PiVs may impact uptake.

The primary aim of the choice experiment is to answer several of the Research Questions (see Table 11). The full set of Research Questions require investigation of the effects on uptake of several attributes that have not yet been explored through a choice experiment nor incorporated into ECCo:

- Depreciation
- Local policy incentives (e.g. free parking and bus lane usage)
- Access to public transport

- Access to another long-range car

To aid the assessment of whether to incorporate each attribute in this choice experiment and how they should be represented, a literature review of similar recent studies was carried out. Details of this literature review are provided in Appendix L.

Table 11: The Consumer Uptake Trial research questions which highlight possible choice attributes for the choice experiment

	Research Question	Relevant choice attribute	Currently included in ECCo?
1	How much does the potential AER of a BEV or PHEV influence willingness to consider adoption?	Electric range	Yes
2	How much does the potential purchase cost of a BEV or PHEV influence willingness to consider adoption?	Purchase price	Yes
3	How much does the potential running cost saving associated with using a BEV or PHEV influence willingness to consider adoption?	Running cost	Yes
4	How much does the recharge time associated with a BEV or PHEV influence willingness to consider adoption?	Charging time	Rapid charging only
7	What effect does varying the perceived level of access to public charging stations (e.g. density, type of location, type of charger) have on willingness to adopt BEVs or PHEVs?	Access to charging	Yes
8	What effect does convenient access to public transport options for longer journeys have on willingness to consider adoption of a BEV?	Access to public transport	No
9	What effect does the rate of depreciation of residual value have on willingness to consider adoption of a BEV or PHEV?	Depreciation	Only fleet buyers (incl. user choosers)
10	What effect does access to additional ULEV benefits (e.g. access to bus lanes, free congestion charge, free parking) have on willingness to consider adoption of a BEV or PHEV?	Perks e.g. access to bus lanes, free congestion charge, free parking	Congestion charge considered in running cost
12	What effect does convenient access to an alternative long-range vehicle for longer journeys have on willingness to consider adoption of a BEV?	Access to another long-range car	No

2.9.2.1 Discussion of attributes

There is a limit to the number of attributes that can be explored in a given choice experiment, since having participants trade-off a large number leads to excessive cognitive burden. Too many makes choice sets too difficult to choose from and results in participants simply choosing randomly (or failing to complete the questions entirely). In Element Energy's previous choice experiment for the ETI (2011), advice from Professor Kenneth Train (a leading expert on Discrete Choice methods) suggested that no more than ten attributes should feature in the choice set. It should be noted that there is no single 'best practice' value for the number of attributes included, since cognitive burden varies with the complexity of the attributes as well as their number. Due to the numerical nature of much of the final attribute list in the PIV project's choice experiment (e.g. purchase price, running cost, range) the number of attributes was reduced to eight. Since the present project involves a much smaller sample it is prudent to reduce the number of attributes further, to six. These will be prioritised as follows: (1) must be relevant to the key Research Questions, and consistent with ECCo; (2) must be easily quantifiable and understood by participants; (3) it must be possible to estimate how the attribute will differ between conventional ICE and plug-in cars, both today and in the future. In the following sections each potential attributes is considered in turn.

Purchase Price: This is a critical attribute, and is the largest contributory factor to consumer purchase behaviour. In addition, a purchase price attribute is normally used as the reference point against which the 'willingness to pay' values for all other attributes are calculated. In this case, the willingness to pay of each attribute represents the additional purchase price a consumer is willing to accept to receive the value of that attribute. The importance of the purchase price is indicated by its prevalence in the previous choice experiments (see literature review in Appendix L). Only one choice experiment reviewed did not feature a purchase price (Lieven, 2015). However, this study looked specifically at the relative value that consumers placed in various incentive packages when purchasing an EV, rather than the car itself. Consequently, it was implicit that all cars offered in the choice set were identical (including their purchase price). Of the other studies identified in the literature review, seventeen of them presented the purchase price as an absolute monetary value. The remaining four studies presented the purchase price relative to a standard ICE either as a percentage (Kim *et al*., 2014; Element Energy for H2 Mobility, 2012) or absolute value (Ida *et al*., 2014; Tanaka *et al*., 2014). All choice experiments reviewed therefore allow participants to calculate an absolute purchase price for the vehicles they must choose from. To reduce the cognitive burden and ensure that participants correctly value the capital cost premium of a plug-in car, against which all other attributes are compared, the absolute purchase price will be used in this choice experiment. In similar fashion to Element Energy for DfT (2015), the purchase prices presented in the choice sets will be pivoted with the participant's previous car purchase price (see Table 14 for example) to make the choice more realistic for that specific participant.

Although purchase price must be shown in order to calculate the most widely used definition of willingness to pay, a considerable share of car purchases are in fact made through a lease contract. However, only one previous choice experiment was identified in the literature that explored lease prices (Glerum, Stakovikj, Thémans, & Bierlaire, 2014). Here an illustrative monthly lease fee was shown alongside the purchase price, though it is not stated how this fee is calculated. The difficulty with showing a lease price is that it is dependent on several other factors, not just purchase price, and it is critical that the representation accurately reflects the lease price that participant would be offered, to avoid unfairly biasing them either for or against a particular vehicle. Factors such as lease length, deposit contribution and contract type are all dependent on the personal preferences of the participant and could in theory be pivoted on answers from the questionnaire. However, the depreciation rate applied by the leasing company is a major contributory factor to the lease fee and this is independent of the participant. Since it would be unknown whether the participant considered the purchase price or lease fee, the resulting willingness to pay values would only be valid if the depreciation rate was kept fixed, and this restricts their use in ECCo. An additional depreciation rate attribute would therefore have to be introduced (this is discussed in more detail later in this Section).

Alternatively, either a purchase price or lease price could be shown to each participant depending on their preferred purchasing method and willingness to pay calculated relative to the metric selected. However, this would require the results of each purchasing method group to be analysed separately, and due to the already small sample size makes failure to find a set of statistically robust solutions more likely. Furthermore, this would restrict the ability to compare results to ECCo's previous choice parameters. Purchase price alone is, therefore, the preferred metric, since this is something that all consumers are presented with in the dealership showroom before going on to select their preferred method of purchase.

Annual Running Cost: The cost components considered in annual running cost include fuel and electricity cost, maintenance, insurance, and ongoing ownership taxes (e.g. vehicle excise duty and company car tax). The original choice experiment for ECCo (Element Energy for ETI, 2011) presented participants with a total annual running cost attribute, and found over the whole sample that consumers were willing to pay £5 upfront per £1 of annual cost saving. Element Energy for DfT (2015), however, provided participants with just an annual fuelling cost, as previous Element Energy focus groups had highlighted difficulty with maintenance costs and conflated them with reliability. It was assumed that because fuelling costs constitute the dominant component of ongoing costs, the willingness to pay for the former could be applied to the latter. Analysis of results for the whole sample yielded an estimated willingness to pay of £7 per £1 saving in annual fuel costs. Some discrepancy with the previous choice experiment (Element Energy for ETI, 2011) will be due to the different compositions of the two samples; however, it is possible that participants were factoring in the unstated costs, such as maintenance and vehicle tax, when making their choices.

There is no consensus on how to present ongoing costs in the choice experiments featured in the literature. Some choose to show fuel/electricity spend and other ownership costs separately, while others include only fuel/electricity spend or total ongoing costs. In addition, this can be on both a per km and per year basis. Bahamonde-Birke and Hanappi (2016) presented both fuel and maintenance costs in €/100 km and found consumer's willingness to pay was identical for both, suggesting they do correctly evaluate the different ongoing cost components of the total running cost.

For this study, a total running cost attribute will be used and its component parts will be explained beforehand to participants. Since participants will have had experience of electric cars, they may be more knowledgeable about the large maintenance and tax savings that can be made through owning one, and thus the risk of these costs being factored into the choice if just a fuel cost is shown is greater. This could have a significant effect on the perceived running cost. For example, during the market research carried out as part of Element Energy's work for DfT (2015), it was found that maintenance savings for ULEVs are of the order of £100 - £250 per year depending on powertrain and segment. From 2017, UK vehicle excise duty will involve a flat rate of £140/year for conventional petrol and diesel ICE cars, £130/year for hybrids and alternatively fuelled vehicles and zero for zero-emission vehicles (cars with a list price of >£40,000 will also pay a supplement of £310/year for five years). Thus BEV users will be able save £140 per year in ongoing costs compared to ICE users. It is therefore not necessarily valid to say that fuel costs are the dominant component of running costs when comparing conventional and ULEV powertrains. Indeed, Figure 8 reveals that maintenance costs, which are known to be lower for electric powertrains, in particular play a significant role in a car buyer's decision (raw data stratified to ensure results are representative of the UK population at large).

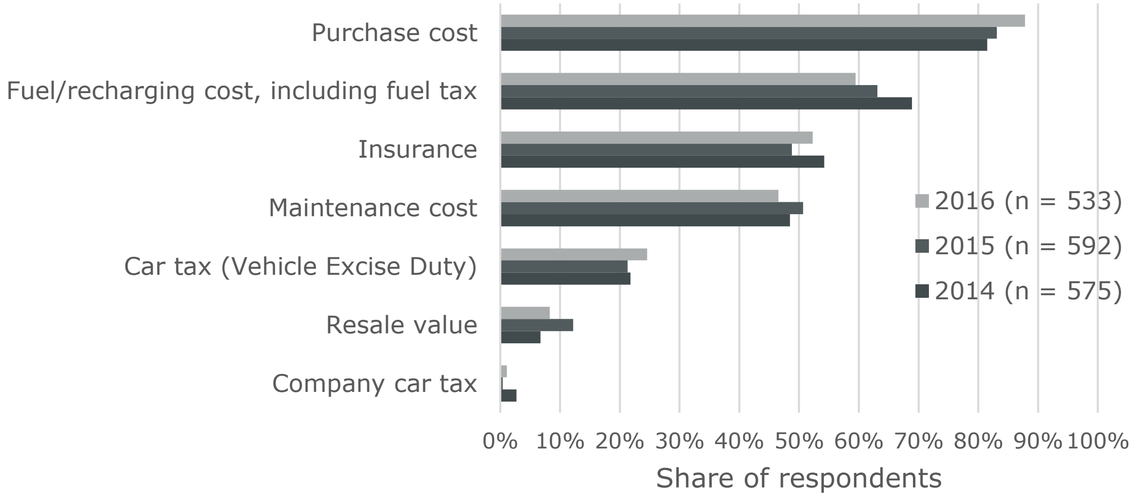

Figure 8: Cost factors when buying a car or van, from DfT's Public Attitudes towards Electric Vehicles survey (UK Department for Transport, 2016). Participants asked to select up to three cost factors they think about when purchasing a car.

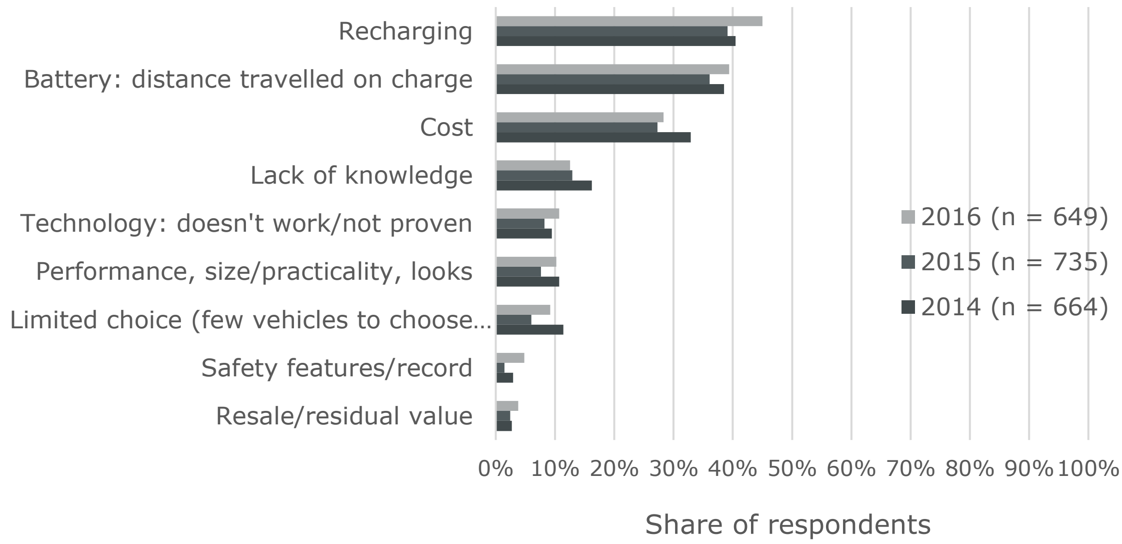

Figure 9: Factors deterring people from buying an electric car or van, from DfT's Public Attitudes towards Electric Vehicles survey (UK Department for Transport, 2016). Participants asked to select which factors would put them off buying an electric vehicle in the next 12 months.

Electric Range: Figure 9 reveals that electric range is a significant factor in people's decision not to buy a plug-in car, and as a result features in nearly all of the choice experiments found in the literature. Element Energy for ETI (2011) found that the willingness to pay for additional electric range is non-linear and falls significantly beyond 240 km (150 miles) as drivers correctly recognise their driving patterns place a limit on their requirements. For example, on average participants were willing to pay £2,300 to increase BEV range from 160 km to 240 km (£29/km), but only a further £300 to increase from 240 km to 320 km (£4/km). Element Energy for DfT (2015) identified a similar willingness to pay for additional range, with an average value of £13/km when measured between ranges of 160km and 640km. For PHEVs, where range is less of a constraint, the average willingness to pay was less at £9/km when measured between 16km and 96km.

The ranges of conventional ICEs are usually more than 500km and refuelling takes less than five minutes, thus range under liquid fuel power is much less of a concern. Jensen et al. (2013) presented participants with both fuel and electric range and found that willingness to pay for an additional kilometre of range in a petrol ICE car was €3.0 (£2.2), compared with €65 (£47) for a BEV measured at 100km. Although not directly comparable, these values are in a similar range to those derived for BEVs during Element Energy for ETI (2011), and also suggest a strong non-linear relationship.

Jensen et al. (2013) repeated the choice experiment after participants took part in a vehicle trial, where they were provided with a Mitsubishi i-Miev (or other similar BEV) for 3 months. After this period, it was found the willingness to pay for additional electric range rose to €134 (£90) per km, with the experience clearly reinforcing fears surrounding restricted range. A similar effect may be observed in this study, when the choice experiment results are compared with Element Energy for ETI (2011) and for DfT (2015). However, the vehicles used by Jensen et al. (2013) had a real-world range of only 100km which may have exaggerated the additional range requirements perceived by the participants. The real world range of the VW eGolf used in the Consumer Uptake Trial is considerably higher at closer to 200km.

The influence of all electric range on willingness to consider a plug-in car is a key research question and clearly must be included in this choice experiment. In the other choice experiments reviewed, range is either presented as total, electric only, or distinguished by fuel and electric range, but the willingness to pay for range under liquid fuel power is often ignored. However, it should still be shown to remove the ambiguity of not showing a total range for ICEs and PHEVs.

To simulate an actual car purchase, the choice experiment will present electric range in a similar manner to that used by vehicle manufacturers in their marketing documents. This normally features an 'official' type approval range, as measured under laboratory conditions, and a suggested range that owners should expect under real world driving. For electric range this will be set at 66% of the NEDC range in line with what is currently published by vehicle manufacturers. This ratio will not be varied between choice sets, and so this remains a single range attribute. For range under liquid fuel, a value of 75% of the NEDC range will also be shown, to reflect the current real world emissions gap (Element Energy for the CCC, 2015), although the expectation is that this figure will have little bearing on the participants' choices. In addition, in the description of attributes that participants will see before the choice questions, information will be provided on how range under highway and urban driving conditions compares with the official type-approval range.

Charging time: Figure 9 shows that recharging is the biggest barrier to EV adoption in the UK. Recharging time is currently represented in ECCo only for rapid charging, since it is assumed that the large windows available for home and work charging makes them time unconstrained i.e. if the vehicle is parked overnight for 9 hours then owners should show little concern for the total charge time as long as it is less than 9 hours. Element Energy for ETI (2011) did include a charging time attribute; however, at the time EV ranges were considerably lower and there was no rapid charge network available. Consequently, in-journey charging time at 3-7 kW was a major consideration for car buyers.

Other studies have also featured a generic recharging time which can range from minutes to hours and have a significant impact on vehicle utility:

- Hackbarth & Madlener (2013): €17/minute (£12/minute)
- Hoen & Koetse (2014): €24/minute (£19/minute)
- Jacobs *et al*. (2016): €1,088 (£790) to reduce BEV charge time from 8 hrs to 20 minutes (€2.4/minute; £1.7/minute), and €1,924 (£1,396) to reduce PHEV charge time from 2 hours to 20 minutes (€19/minute; £14/minute)

However, with the advent of >50 kW charging rates and a rapid charging network with near national coverage, providing a single charge time value is an ambiguous representation of EV charging, since the requirements for destination and in-journey charging are so different. The average daily mileage for cars in the UK is ~40 km, and so daily electricity usage for a BEV is only 5-10 kWh. Even at a minimum of 3 kW charging power, the time available for overnight charging is therefore more than enough for daily energy needs. Once drivers become accustomed to charging overnight, rather than periodically at filling stations as with conventional cars, they are unlikely to perceive home and work charging time as a major barrier to adoption. Evidence from the My Electric Avenue EV trial (Quirós-Tortós, Ochoa, & My Electric Avenue, 2015), where participants established a regular charging routine in less than one week, suggests that this aspect of EV ownership is easily understood by consumers. Regardless, in most homes the electricity supply limits charging rate to only 3-7 kW, and so charging time at home is not something that will change in future. The inconvenience, if any, associated with home charging time is therefore captured in the alternative specific constant, and does not need to be explicitly investigated as a variable attribute in the choice experiment.

However, the occasional requirement to rapid charge during a journey is likely to influence the decision to purchase a vehicle, since it adds journey time. Both charge rate and density of the rapid charge network are set to increase significantly in future. For example, OLEV has a budget of £190m allocated to charging infrastructure, much of which to support rapid charging infrastructure in London and through the Go Ultra Low Cities Scheme, while investment from the private sector is growing. Major automotive OEMs, such as BMW, Volkswagen, Mercedes and Ford, have also signed a memorandum of understanding to deliver 350 kW highway charging at 400 sites across Europe from 2017[23] (compared with the current 50 kW standard). It is therefore important to explicitly capture how these developments will affect plug-in car uptake in the future.

Since the intention of in-journey rapid charging is to provide enough electricity to get the car to its destination, and the charge rate slows considerably as the state of charge approaches full capacity, the time spent to fully charge a battery is a less important characteristic of charging time. For Element Energy's choice experiment for DfT (2015) rapid charge time was therefore represented as driving range added per 20 minute charge. A similar metric will be repeated for this study to aid compatibility with the current structure of ECCo, and also to provide a means of direct comparison with participants in 2015 who had not necessarily experienced an EV. The charging time of 20 minutes was originally chosen as this matched

[23] Announced 29th November 2016: http://media.daimler.com/marsMediaSite/en/instance/ko/BMW-Group-Daimler-AG-Ford-Motor-Company-and-Volkswagen-Group.xhtml?oid=14866747

the average length of stay by all drivers at motorway service stations[24]. It was therefore easily relatable for participants. However, this duration makes testing faster rapid charging rate challenging, since additional mileage becomes limited by battery capacity as well as charging duration. For example, a charge point rated at 350 kW could supply ~120 kWh in 20 minutes which is considerably more than the usable battery capacity of a typical BEV now (~30 kWh) and in the future (40-60 kWh). Therefore, the choice sets will present the miles added per 10 minutes of charging as this allows higher charging rates to be considered and is easily multipliable should participants want to quickly calculate miles delivered for longer charges. However, a constraint must be put in place to avoid choice sets that include an electric range lower than the distance that can be added per 10-minute charge.

<u>Access to charging/refuelling infrastructure:</u> Along with charging time, the other aspect of recharging that heavily influences consideration of an EV is access to charge points. A key assumption in ECCo is that buyers that do not have the potential for guaranteed access to an overnight charge point (i.e. off-street parking or bookable residential charging) will not consider an EV. Since all participants in this choice experiment must have access to off-street parking to be eligible for the trial, investigating access to home charging will not be necessary. Access to workplace, slow public and rapid charging are also binary attributes that represent whether a user perceives access to these locations. Unlike home charging, these do not influence the choice set, only the utility of plug-in vehicles. In Element Energy for DfT (2015) access to home, work and slow public charging were combined into a single attribute, charge point availability for local journeys, for which participants were presented with one of four levels: home access; home & work access; home & slow public access; and home, work & slow public access. Attitude towards rapid charging was one of the focus points of the study and so was treated as an entirely separate attribute: charge point availability for long distance journeys. A continuous variable was used to characterise the density of rapid charge point coverage, employing the metric of miles between charge points and their location (motorways and/or A-roads). During the cognitive testing stage this proved easier to understand than total number of rapid charging sites on the road network. The results of the choice experiment showed that the additional willingness to pay for an EV when there is a rapid charge point network with charge points on average 40 miles apart on motorways was around £1,000 (compared with no network). However, willingness to pay was not found to increase for higher coverage, such as rapid charging every 20 miles on motorways and A-roads. This was a novel finding since no other choice experiments identified in the literature distinguished between slow/fast alongside destination/in-journey charging in the same way.

The base level in this latest choice experiment describes the current state of the rapid charging network in the UK. In February 2016, charge points had been installed at only 70 service stations but this still meant that 98% of (GB) motorway traffic was within 20 miles of a service station charge point.[25] More recent data from the National Charge Point Registry (January 2017), reveals that rapid charge points have been installed at all major UK service

[24] According to Ecotricity (the UK's largest rapid charging network operator by number of charge points): Ecotricity FAQs, available at https://www.ecotricity.co.uk/for-the-road/faqs/general-faqs [accessed 03/01/2017]

[25] Charge points at two thirds of motorway service stations, RAC Foundation, 12th February 2016 [online], available at http://www.racfoundation.org/media-centre/electric-charge-points-at-two-thirds-of-motorway-service-stations [accessed 11/01/2017]

stations (Moto, Welcome Break, RoadChef and Extra), and 88 of the 97 service stations nationwide (all but one are operated by Ecotricity). The base level will therefore be set at rapid charge points installed every 20 miles on all major motorways and A roads and stated to be equivalent to installing at all UK service stations. A medium level will show rapid charge points installed in 20 mile intervals on all motorways and A-roads. This is in line with the Department for Transport's aim to have charge points every 20 miles along 95% of the strategic road network by 2020, and make them rapid where possible (UK Department for Transport, 2015). Based on Element Energy's previous choice experiment for DfT (2015), the expectation is that willingness-to-pay will be broadly similar for these two levels.

Recently, attention and funding has shifted to also providing rapid charging in locations other than on highways, such as in cities to support battery electric commercial vehicles. The UK Government-funded Go Ultra Low Cities Scheme will see rapid charging infrastructure installed in London, Bristol, Nottingham, Derby as well as Dundee, York and the North East. Shell has also discussed the possibility of installing charge points at their 1,000 petrol stations. It is therefore of interest to explore whether an additional willingness to pay is observed if widespread coverage is extended to other road type (i.e. B, C and unclassified roads). A third level will also be included that provides rapid charging every 20 miles on motorway and A-roads, as well as at the same frequency as petrol stations on other road types. Petrol stations are deemed a suitable reference point as all participants should have a clear view of what this level of coverage entails. Although in future rapid charge points will not necessarily be co-located at petrol stations, this is less ambiguous than stating, for example, they are located at all major car parks or shopping areas. This is also clearer than extending the format of the attribute by stating charge points at fixed intervals on other road types, since many of these roads, particularly in cities, are considerably shorter than the fixed interval used.

Finally, a 'no network at all' level should also be included to calculate the willingness to pay for rapid charging in general. This allows the utility of BEVs that are not capable of rapid charging to be evaluated.

Information prior to the choice experiment will indicate that at each level of rapid charge point coverage there will be sufficient rapid chargers at each location to ensure that queuing is unlikely. This ensures that the choice experiment tests willingness-to-pay for perceived coverage; since consumers will likely discount occupied rapid charge points as they fail to meet the fast charge requirement for in-journey charging.

However, in reality the risk of having to queue for available rapid charge points is considered to be small. Charge point operators interviewed by Element Energy as part of recent studies into rapid charging best practices intended to avoid queuing by increasing charge point supply rather than implementing alternatives, such as booking systems, which they deemed unfeasible. Since charge times are at present considerably longer than liquid refuelling stops, certainty of access is critical to encouraging PiV uptake and therefore the operators' business models. The risk of queuing will be mitigated further by the existence of live charge point availability mapping, which was recently mandated in the Government's Vehicle Technology and Aviation Bill 2017, and is already available for the POLAR charging network. This underscores the assumption in the analytical framework that the rate of charge point build out always matches demand. However, if the risk of queuing is to be explored, since this is a measure of perceived access, it is also possible in ECCo to simulate insufficient build-out by scaling down the access to rapid charging values.

Availability of plug-in vehicle models: The DfT's 2016 survey of public attitudes towards electric vehicles (see Figure 9) revealed that 11% of car buyers are deterred from purchasing an electric vehicle due to limited choice. This is currently represented in ECCo through a brand supply coefficient, which values the utility of the number of major manufacturers that a buyer can choose between when considering a plug-in vehicle. This was measured as part of the choice experiment in Element Energy for DfT (2015) to test whether the lack of ULEVs across a wide range of manufacturers is a barrier to purchase. For each ULEV choice, participants were told whether the vehicle was available from three brands (either their preferred or other manufacturers), the majority of brands or all brands. The choice experiment showed that the average willingness to pay for availability in three preferred brands over non-preferred brands was £1,285. However, there was no statistically significant additional willingness to pay for more availability. Hoen & Koetse (2014) also included the number of models available for each vehicle choice, but found that willingness to pay was on average only €5 (£3.6) per additional model. However, their definition of model includes both the number of brands offering the vehicle and the number of variants available such as different engine size, acceleration and car size.

The number of models presented in the choice set is also anywhere between 1 and 100, and as Element Energy for DfT (2015) shows, car buyers care very little once they have a small number of models to choose from. A review of the market reveals that there are currently 35 plug-in cars available for sale in the UK. The numbers of plug-in cars for sale in the UK in each year from 2010 are shown in Figure 10.

The number of plug-in cars available in the future is shown in Figure 10 include only actual models announced by OEMs: at least 8 scheduled for release by end of 2018, and a further 15 beyond that. However, electrification strategies published by major OEMs (see

Table 12) suggest that the true number of available models will be considerably higher.

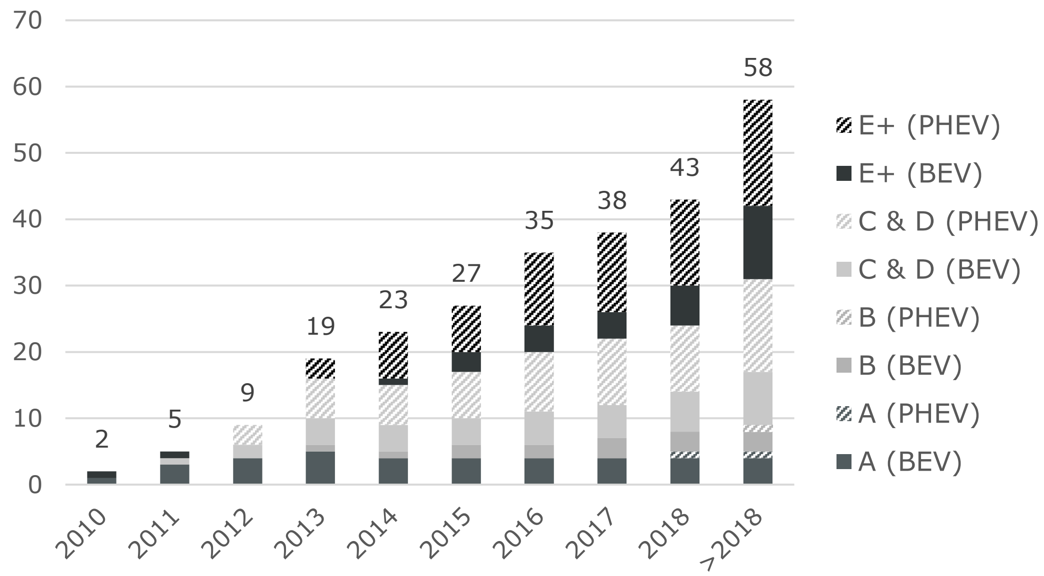

Figure 10: Change in the number of BEVs and PHEVs available in the UK over time, including future vehicles announced by OEMs

As a consequence of these future releases, the suppression of plug-in car sales due to brand supply is a short-term phenomenon which is unlikely to continue into the 2020s. Since this study is focussed on decision making of mass market consumers in the future, it is proposed that brand supply should not be explored again in the choice experiment.

The research questions for this study provide additional attributes that could be considered for investigation in the choice experiment:

<u>Depreciation:</u> Research Question 9 relates to the importance of depreciation rate and residual value in the purchase of a car. Figure 8 shows the most important cost factors that people consider when buying a car, and that resale value has consistently ranked as one of the lowest priorities, despite often being the largest component of total cost of ownership. However, the Research Question specifically asks what effect residual value has on willingness-to-pay for a plug-in car. Early EVs have been found to suffer from high depreciation rates, although recent evidence suggests that these are now converging with those of conventional ICEs Go Ultra Low, 2016). From Figure 9, which shows the factors considered specifically when buying a plug-in vehicle, it can be seen that residual value still does not feature highly in a buyer's purchase decision. Furthermore, depreciation does not appear in any of the choice experiments identified during the literature review.

Depreciation could be included in this choice experiment as an additional attribute, but this would increase the cognitive burden on participants. This could be reduced by providing participants with a net cost (purchase price minus residual value) instead of a purchase price, but this would not reflect the advertised price that consumers see at car dealers and on price comparison websites. It would also depend on how long the participant was anticipating owning the car for. Since the evidence suggests that depreciation bears little consideration during car purchase, this appears an unnecessary complication and so it was decided that depreciation should not be investigated in this choice experiment. Research Question 9 will instead be addressed using Time Point 2 questionnaire items.

Table 12: Recent announcements from OEMs regarding targets for new EV models

OEM	Plan	Source
Ford	Aiming to have thirteen nameplates in its range by 2020, including a BEV with >200 miles of real world range by 2019.	https://media.ford.com/content/fordmedia/fna/us/en/news/2015/12/10/ford-investing-4-5-billion-in-electrified-vehicle-solutions.html
Peugeot-Citroen	Will release four new BEVs and seven new PHEVs between 2019 and 2021	http://media.groupe-psa.com/sites/default/files/attached_files/7/DP%20innoday2016_FR.pdf
Mercedes	Has launched "Project EQ" to develop plug-in models, and intends to have ten PHEVs in its range by the end of 2017 (currently they have four)	https://www.mercedes-benz.com/en/mercedes-benz/next/e-mobility/concept-eq-mobility-revisited
Hyundai	Targeting four BEVs and four PHEVs in their range by 2020	https://electrek.co/2016/11/16/hyundai-new-all-electric-cars-2020/
Volvo	Has a goal of at least two plug-in variants per car model.	Volvo Sustainability Report 2015 (p.37) available at: http://www.volvocars.com/intl/about/our-company/sustainability

Policy incentives: Research Question 10 relates to the potential effects of various policy incentives on PiV uptake. Financial policy incentives such as grants and tax exemptions are considered within ECCo through the purchase price and running cost attributes. It is assumed that drivers value a purchase price or a running cost saving the same regardless of its component parts. In other words, £1/year of VED reduction is equal to £1/year saving in fuel costs. At present, ECCo includes the plug-in car grant, vehicle excise duty, company car tax and the London Congestion Charge. The inclusion of the latter requires that, when calculating uptake, those who are affected by the Congestion Charge must be treated entirely separately from those who do not. Further policy incentives that have featured in other choice experiments include discounted parking in cities, access to bus lanes and free public transport. The challenge in including these in a choice experiment, and then subsequently ECCo, is that their utility value is highly dependent on the personal circumstances of the participant, most notably where they live. To be eligible for the trial, participants must live within 50 miles of TRL and Cenex and so can include people from both highly rural and urban locations. The value of each of these incentives is therefore likely to differ greatly between participants and the current segmentation structure from Element Energy for DfT (2015) will not capture these differences. For example, the value of bus lane access will be far more dependent on whether a driver lives in an area, or routinely drives on roads with bus lanes, rather than the demographic characteristics or general attitudes towards car purchasing of the consumer segment to which they belong. The value of free parking does not necessarily need to be included in the choice experiment as it could be incorporated into the running cost attribute. However, the cost saving will depend on the extent to which each driver uses public parking and the price that they would normally pay.

Hackbarth & Madlener (2013) did successfully derive a willingness to pay for free parking and bus lane usage of €1,622 - €3,279 (£1,175 - £2376) in their choice experiment with 711 German drivers. However, it is noted that the sample was overly-representative of drivers living in urban areas. Likewise, Langbroek *et al*. (2016) found the willingness to pay for free parking was €5,665 (£4,111), and bus lane usage was €3,200 (£2,322) for drivers in Stockholm (N = 269). Given this strong urban focus, it could be argued that the samples did not contain the level of geographic variation one might expect in a survey of mass market consumers. Hoen & Koetse (2014), on the other hand, surveyed 1903 Dutch drivers that were representative of the general population and were unable to find statistically significant choice coefficients for free parking and access to bus and taxi lanes.

Since the highly-localized factors that impact the value of these incentives are not captured in ECCo's current segmentation, a re-segmentation would be required to derive statistically valid choice coefficients. However, a segmentation to the level of detail required is not possible with the sample size available in this trial, if at all. There is a danger that inclusion of these policy incentives in the choice experiment could pollute the results for the other attributes without offering any usable value in themselves, and so it is recommended that these should not be included. Research Question 10 will instead be addressed using Time Point 2 questionnaire items.

<u>Access to public transport:</u> Research Question 8 relates to the potential effect of convenient access to public transport on uptake of PiVs. The challenges that face the evaluation of the willingness to pay for free public transport are similar to investigating how public transport access influences willingness to purchase an ULEV. As discussed for the local policy incentives above, the value of public transport depends on how close each participant lives to a bus or train station and the quality of service on offer. Again, segmentation to the level required will not be possible. The value of this incentive was previously investigated by Bahamonde-Birke & Hanappi (2016) who concluded that an annual Park and Ride or a one-year ticket for public transportation would not increase willingness-to-pay for electromobility. As such, evaluating this incentive should not be prioritised in the choice experiment. Research Question 10 will instead be addressed using Time Point 2 questionnaire items.

<u>Access to another long-range car:</u> Research Question 12 relates to the potential effect of access to another, long-range car within the household on uptake of PiVs. This is not directly considered in ECCo at present and features in only one of the choice experiments reviewed in the literature. Jensen *et al*. (2013) compared the willingness to purchase an EV amongst both single and multiple car households, but only differentiated the outputs for electric range and availability of battery swap stations. As expected, willingness-to-pay for both is higher amongst single car households: since they do not have the option of using their ICE car if they need to make long trips. For example, before experiencing an EV, participants from single car households were willing to pay on average €65 (£47) per additional kilometre of range, compared with €46 (£33) in multiple car households. After EV experience, this grew to €134 (£97) and €84 (£61), respectively.

However, a similar approach was in fact taken in Element Energy for DfT (2015) as multiple car ownership was used as one of the characteristics to segment car buyers. Its effect on purchase decision is therefore implicitly included in the resultant choice parameters of each segment. Research Question 12 will instead be addressed using Time Point 2 questionnaire items.

2.9.2.2 Final list of attributes

This discussion of attributes thus yields six that will be used in the choice experiment. This is one fewer than what was featured in DfT (2016b) but, given that the sample size of this latest choice experiment is an order of magnitude smaller (n=200 vs n=2,020), this is appropriate to ensure statistical robustness.

Comparison with the studies identified in the literature review show seven of the nineteen featured investigated more than six attributes, however, all of these had larger sample sizes than is available here. Despite this, many of these failed to identify statistically significant relationships between the consumer choices and some of the attributes presented (see Table 13).

The number of attributes is not purely limited by sample size, since greater statistical robustness can be achieved by asking more choice questions to participants. The inclusion of a seventh attribute, such as further policy incentives, might therefore be possible in principle. However this approach has practical limits: completing too many choice items leads to participant fatigue and boredom, and hence inaccurate choice expression.

Table 13: Previous choice experiments that have explored more than six attributes

Reference	Sample size, *n*	No. of attributes	Comments
Hackbarth & Madlener (2013)	711	7	Larger sample size
Jensen *et al.* (2013)	369	8	Failed to identify statistically significant choice coefficients for two attributes (top speed, battery life)
Hoen & Koetse (2014)	1903	7	Larger sample size, but failed to identify statistically significant coefficients for additional policy incentives (free parking and access to bus lanes)
Kim *et al.* (2014)	726	11	Very low significance found for the four "social influence" attributes: share of PiVs amongst friends, family, colleagues, social peers
Bahamonde-Birke & Hanappi (2016)	787	9	Could not identify significant choice parameters for two attributes (free Park and Ride subscription, and free public transport)
Dumortier *et al.* (2015)	2759	9	Not a conventional stated preference choice experiment as the values of attributes were not varied. Instead investigated how inclusion of an illustrative total cost of ownership or 5-year fuel cost saving affects the purchase decision
Lieven (2015)	8147	8	Considerably larger sample size

However, addition of a seventh attribute, that could not be reflected in ECCo, would also pose an analytic risk since choices affected by this attribute would contaminate the choice parameters of the other attributes. For these reasons, only six attributes be explored in this choice experiment. The final attribute list, and the levels that will be presented in the choice experiment, are presented in Table 14.

Table 14: Description of each attribute to be explored in the Consumer Uptake Choice Experiment and how it will be represented

Attribute	Description	Levels
Purchase price	Upfront cost of purchasing the car, including VAT and grants (£)	*5 levels*, pivoted on price of last main car purchase • £10k / £11k / £12k / £13k / £14k if last car purchase <£15k • £16k / £18k / £20k / £22k / £24k if last car purchase between £15k and £25k or participant does not know • £24k / £27k / £30k / £33k / £36k if last car purchase >£25k
Running cost	Ongoing costs of running car, such as fuel/charging, maintenance, insurance and road tax (£/year)	*4 levels*, pivoted on annual mileage • £500 / £1000 / £1500 / £2,000 for mileage <15k miles • £1,000 / £2,000 / £3,000 / £4,000 for mileage >15k miles
Driving range	Official (type-approval) distance car can travel on either a full battery or tank of fuel (miles)	*4 levels* • For PHEVs: 10 / 20 / 40 / 60 electric miles, 400 fuel miles • For BEVs: 100 / 200 / 300 / 400 miles *Participants will also be shown an average real world range (66% of official for electric, 75% for fuel)* *Participants will be advised prior to the choice experiment of how the "real world" range varies between urban and extra-urban highway driving*
Destination charge point availability	Charge point availability at work and public spaces	*4 levels* • home only / home & work / home & public / home, work & public
Rapid charge point coverage	Density of rapid charge points on motorways and A-roads, expressed as availability every "x" miles on "y" roads	*4 levels (for BEVs only)* 1. No rapid network available 2. Rapid charging sites every 20 miles on motorways and major A roads (equivalent to charging at all motorway services) 3. Rapid charging sites every 20 miles on all motorways and A roads 4. Rapid charging sites every 20 miles on all motorways and A roads, and at a similar frequency as petrol stations on all other road types)

		Participants will be advised prior to the choice experiment that charge points will be present at all locations in sufficient numbers that queuing to access one is unlikely
Rapid charging rate	Average charge rate of rapid charging points, expressed as range (miles) added per 10-minute charge	*3 levels* • Additional 25/75/150 miles per 10-minute charge

2.9.2.3 Choice experiment sets

The choice sets have been generated with the software Ngene by ChoiceMetrics using so-called D-efficient design. Efficient designs aim to avoid unbalanced choice sets, which occur when the utility of one choice is considerably higher than the others and the choice is obvious for the vast majority of participants (for example, a case where a conventional car has a lower purchase price and running costs than PiVs and no charging infrastructure is available). Instead, efficient design creates only choices where participants must carefully consider the full range of attributes, thereby optimizing the amount of useful information that can be drawn from the limited number of choice questions.

Mathematically, efficient design is the same as minimizing the standard errors on the choice coefficients for a given number of choice sets. This requires the Ngene software to be provided with 'priors', estimates of the choice coefficients for each attribute. These were based on the choice parameters derived during DfT (2016b).

Each choice set includes three alternatives: a conventional petrol/diesel, a PHEV, and a BEV. The relevant attributes for these vehicles are then varied between choice sets. One-hundred choice sets have been created and allocated to ten blocks. Participants will be randomly allocated to one block so that each participant will answer ten questions each. An example choice set as well as the information and instructions that will be provided beforehand to each participant is shown in Appendix L. Participants will initially be free to choose between all three alternatives. However, if they choose the conventional petrol/diesel car, they will then be asked to choose between the two PiVs. This will ensure that data is still collected on differences in consumer attitudes towards PiVs.

2.10 Telematics

The trial vehicles will be equipped with a telematics device in the form of a lightweight cellular data logger fitted to the OBD-II port. The dongles will be supplied and maintained by FleetCarma; a Cleantech Information and Communications Technology company based in Ontario, Canada with experience working with more than 150 clients across 23 countries[26].

[26] https://www.fleetcarma.com/about/

The hardware consists of a self-contained unit which clips simply into a vehicle's OBD-II port (see Figure 11).

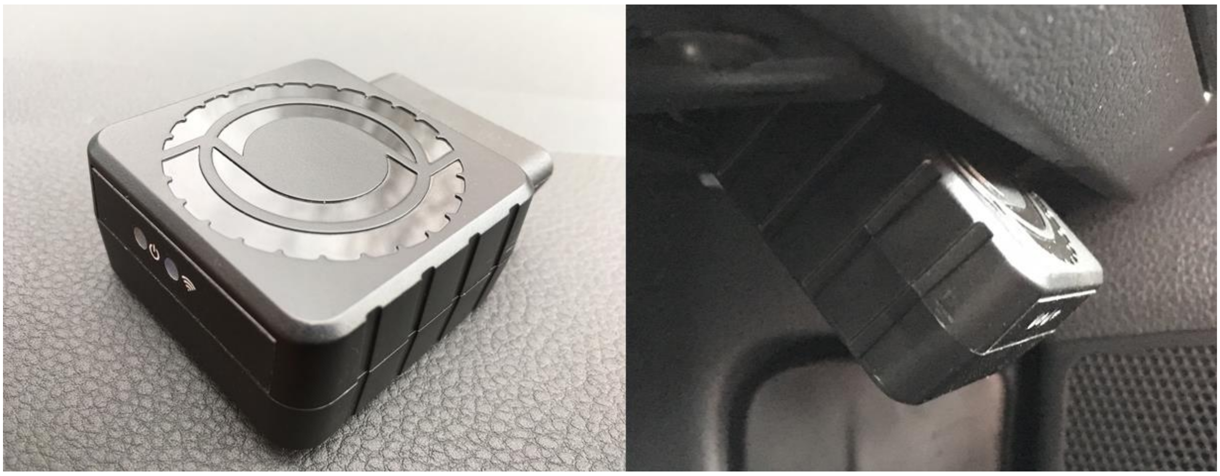

Figure 11: FleetCarma telematics dongle (left) and in situ in vehicle (right)

The devices:

- integrate with the FleetCarma web portal to allow real-time capture of vehicle status and location
- are compatible with all CAN and Legacy protocols dating back to 1996, and interface with J1979 OBD-II data
- are powered by the vehicle battery, with low power consumption
- automatically transmit encoded and encrypted data via the cellular SIM card[27]
- have an on-board backup capacity to store data locally in the event that there is poor cellular signal or a fault with the network; stored data are transmitted automatically once network connection is restored
- fit quickly and easily within the vehicle without obstructing the driver or the operation of the vehicle

A full specification of the 'C2' telematics device can be found in Appendix O.

The device will collect event-based data (e.g. at ignition on/off), and journey data every 10 seconds whilst the vehicle is in operation. The full list of data fields which will be collected is provided in Appendix P, and will include, for instance:

- Ignition on/off date & time
- Odometer readings (km)
- Liquid fuel level (for PHEV) (% of full)
- Vehicle speed (kph)
- IC engine speed (rpm) (for PHEV)

[27] Data will be pushed periodically via a secure FTP. All data will be verified.

- Battery State of Charge (SOC) (%)
- Battery current during journey (A)
- GPS Latitude & Longitude
- Charge start/end date & time
- Battery current during charging event (A)
- GPS location of charging event

In addition to the raw datasets, telematics data will be aggregated into journey logs and charge-event logs. These will contain derived data such as (for journeys) distance travelled and time duration of the journey, liquid fuel consumption, electrical energy consumption, mean journey speed, maximum journey speed; and for charge events, duration, energy delivered, start and finish battery SOC, and latitude and longitude of the charging event. Full details of the contents of these logs are given in Appendix P.

In the Consumer Update trial, participant-aggregated telematics data will be used in Supplementary Analyses:

- To identify any systematic differences in the ways participants use the three types of vehicles (e.g. was one type of vehicle systematically used (across the participant pool) less often, driven greater distances, driven faster, etc. than the others?)
- As vehicle-use variables that may be used in regression analyses to explore whether variations in the way participants used the vehicles are associated with variations in their willingness to consider having a BEV or a PHEV.

Telematics data will be transmitted wirelessly to FleetCarma's back-office servers; this will be pushed to EV Connect via a secure API and to TRL's secure FTP site at regular intervals for backup purposes. Summary datasets will also be extracted from FleetCarma's online portal to facilitate data checks during the trial and to facilitate analysis.

EV Connect will be responsible for cleaning and processing the data into the format required for data analysis (see section 3). The processed data will then be sent to TRL (and the other partners) for analysis via a secure FTP.

3 Data processing and analysis

This section describes how data from the questionnaires, the choice experiment and the vehicle telematics dongle will be processed and analysed in order to address the research questions.

Data will be processed having regard not only for its value within the CVEI project, but also for the value of the anonymised database for future research. Certain geographical data that is not needed within the CVEI project (either to address the Research Questions or to perform the Supplementary Analyses) but would enhance the value of the database for future research, will be added to the database prior to anonymization specifically for this latter purpose.

3.1 Data management

All data storage and handling will be performed in accordance with the International Standard for Information Security Management System (ISO 27001:2013). Full details about data privacy and protection are provided in section 4.5.

An overview of the key types of data which will be collected, along with the roles and responsibilities for cleaning, processing and analysis, is provided in Figure 12.

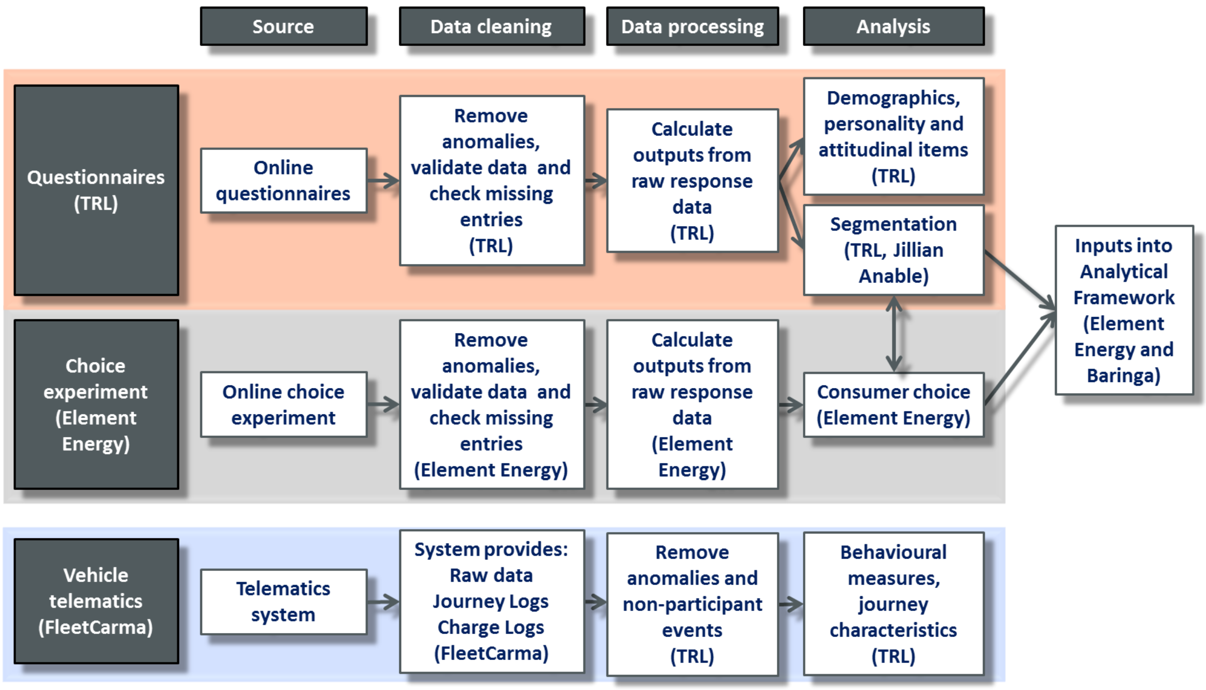

Figure 12: Overview of data management roles and responsibilities

On completion of the first recruitment survey, all participants will be assigned a Participant ID. All subsequent data collected will be linked to the Participant ID, rather than a participant's name or other personal details, in order to anonymise data.

3.2 Data processing

Data will be excluded for any participants who drop-out during the trial and fail to complete the full four day experience with each of the three vehicle types and all questionnaires (including the choice experiment). Data will also be excluded for participants who experience technical faults with the vehicle(s) and/or home chargepoint which are not resolved and result in loss of use of the vehicle for more than ½ a day; in these cases, replacement participants will be recruited to avoid loss of statistical power.

The various data sources (questionnaires, choice experiment and telematics) will be linked together using Participant ID numbers in order to provide a holistic and anonymised dataset.

Figure 13 shows a flow diagram illustrating the data collection and processing requirements for the Consumer Uptake Trial, including who is responsible at each stage of the process. Further details about this process are described in the following sections.

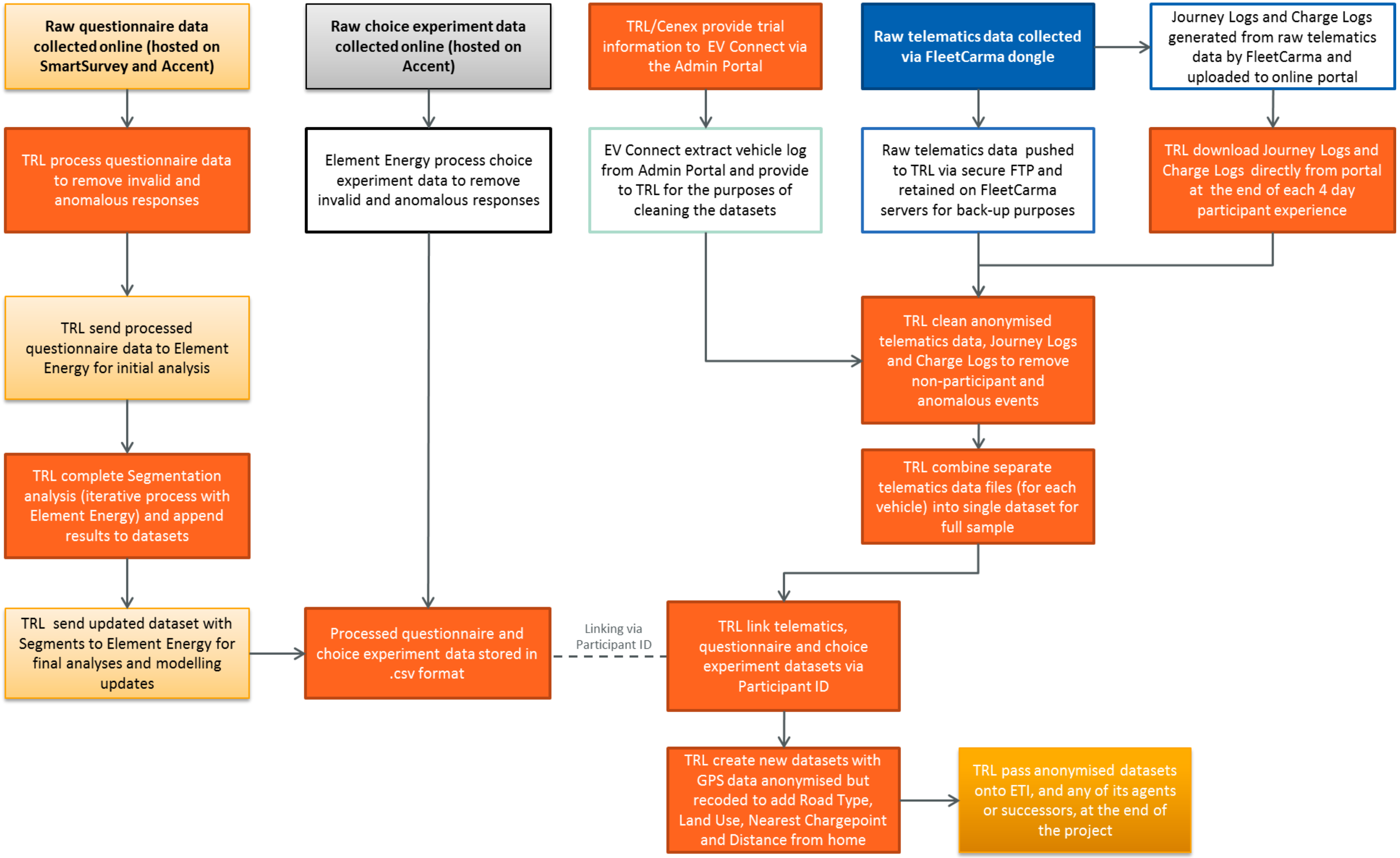

Figure 13: Flow chart showing procedure for collection and processing of data

3.2.1 Questionnaire data

The Pre-trial, Time Point 1 and Time Point 2 questionnaires will be hosted online by Accent. The Filter Survey questionnaires and the Interim questionnaires will be hosted online through TRL's corporate SmartSurvey account. Questionnaire data will be downloaded by TRL in electronic format. Each questionnaire will be recorded with the Participant ID to enable linking between the different questionnaires (e.g. Filter Surveys, Time Point 1 and Time Point 2) and to enable linking with other sources of data (e.g. telematics).

All questionnaire data will be fully cleaned by TRL, including checking for missing or invalid values and unusual patterns in the data. For example, if participants always answer the first option for each question in a particular set then it suggests they may not be answering honestly and openly; data will be excluded for such cases. The completion time for core questionnaires (Pre-trial, Time Point 1, Time point 2) will be logged by Accent. Average response times will be assessed for each questionnaire, and extreme outliers will be identified. Any outliers which are deemed to represent invalid responses will be removed (such as those which are completed unusually fast, or unusually slowly[28]).

3.2.2 Choice experiment data

Element Energy will clean and process the raw data from the choice experiment before undertaking the required consumer choice analyses. These analyses are described in more detail in section 2.9 and in response to the research questions outlined in section 3.3.

3.2.3 Telematics data

Telematics data will be provided by FleetCarma in three forms (see Appendix P):

- A raw dataset containing all data fields at the original sampling frequency
- A 'Journey Logs' dataset containing aggregated data for each journey
- A 'Charge Logs' dataset containing aggregated data for each charge event (BEV and PHEV only)

All datasets will be cleaned by TRL in order to remove data which do not represent valid participant use cases (see Figure 13). The cleaned datasets will be used by Element Energy for the battery state of health modelling and by Shell to supplement the data from the Consumer Charging Trial that Shell will use in its analysis of PHEV fuel utility factors (the fraction of total mileage carried out under electric vs ICE power).The cleaning process will include:

- Removing journeys less than 0.1km (100m) in distance or one minute in time (whichever is lesser) – this will remove instances where the driver turns the vehicle on

[28] Completion times will be captured for all questionnaires completed during piloting and during the trial. Using these data, an acceptable range of completion times will be defined based on the average completion time +/- three standard deviations – this range is expected to contain over 99% of completion times. The data from questionnaires which are completed in times outside this range will be interrogated further to assess their validity.

and off in order to check the charge, or moves the car in the driveway to enable recharging.

- Removing journeys carried out by TRL or Cenex staff as part of the vehicle handover process, or when the vehicle requires maintenance (i.e. non-participant events).

GPS coordinates during charge events will be anonymised by recoding the location data as either 'Home' or 'Away from home'. Repeated charge events which occur away from home will be identified using appropriate labels, e.g. Away from home 1, Away from home 2, etc, to enable analysis of journey patterns. For example, if a participant charged at work on multiple occasions, all charge events at this location would be given a single location label (e.g. Away from home 1).

GPS coordinates captured within journeys (i.e. in the raw journey data files) will also be anonymised and recoded (a full description of how this will be achieved is provided in the sections below.

3.2.3.1 Anonymisation of journey GPS data

Since it will be possible to identify a participant's home location from their GPS journey data, it is necessary that GPS data are anonymised prior to delivery to partners and the ETI. There is no prescribed method for handling spatial information, such as GPS data, under the Data Protection Act 1998. There are several options for anonymising GPS data; these are outlined in Table 15.

Table 15: Approaches for anonymising GPS data

		Description	Pros	Cons
1	Privacy zone anonymisation	This approach hides the section of a user's activity that starts or ends in the defined 'privacy zone' (i.e. their home) based on structured parameters (e.g. 500 metres around the home coordinates).	Completely removes the coordinates of a participant's home and the surrounding area.	Results in the removal of data. With enough journey data, the data points can be plotted and simple geometry can determine the radius and the centre of the privacy zone, potentially identifying the participant's home. More data will need to be removed in rural areas, as it will be tougher to create ambiguity when houses are sparse.

2	Normalisation of coordinates to zero	This approach resets the coordinates so that the participant's home is zero and all journey co-ordinates are in relation to this point.	Completely anonymises the participants' home coordinates.	Patterns of journey could theoretically be overlaid against road maps and once a fit is found this would identify the participant's start and end point (i.e. their home) and regular journey patterns.
3	Rotation Method with Normalisation	Employs option 2, and then rotates the coordinates by a set quantity (e.g 90 degrees).	Significantly strengthens the protection of participants' GPS data. Addresses the weakness of normalisation as it becomes more challenging to simply overlay to existing maps. It is relatively quick to implement and process, and allows links between journeys.	It would be possible to reverse the process if someone identified a major route, e.g. if a journey is sufficiently long, and then deduced the amount of rotation that had been applied. This could then be applied to the whole dataset, since all data are rotated by the same amount.
4	Randomised Rotation Method with Normalisation	Employs option 2, and then rotates the coordinates by a randomised quantity.	This makes linking common journeys on a single participant far more difficult than before, addressing a limitation of option 3.	Additional processing required.

In order to ensure protection of the participants' journey data, Option 4 will be used (Randomised Rotation Method with Normalisation), as it provides the most secure approach and requires no removal of data points.

Having regard to the potential value of the dataset for future research, it should be noted that there are limitations in the future use of these spatial data which result from the anonymisation process (see Aad & Niemi, 2010[29]). For example, transforming a set of participant journey data coordinates (e.g. normalisation of co-ordinates to zero) removes all information of points of interest, which may be a useful information component for future research areas. Future use of the data will be limited to journey patterns (e.g. A, to B, to C, to A) rather than identifying any appreciation of purpose based on coding with points of interest.

Because of these limitations associated with the anonymisation of GPS, certain additional spatial information will be coded in the journey dataset prior to anonymisation.

3.2.3.2 Pre-processing of journey GPS data

GPS coordinates in the raw journey data files will be processed to add value and provide potential for future analysis. The following information will be coded into the dataset:

- Road type
- Distance from nearest chargepoint
- Distance from home
- Land use

Further information regarding these fields is provided in the following sections.

Road Type

Ordnance Survey offer a free shape file product called "Open Roads" which classifies each road link by type.

https://www.ordnancesurvey.co.uk/opendatadownload/products.html

The shape file contains the centre line of each road in the country labelled with fields including "Class", "Formofway" and "Function". The available values for each field are shown below.

Class	Formofway	Function
A Road	Collapsed Dual Carriageway	A Road
B Road	Dual Carriageway	B Road
Classified Unnumbered	Roundabout	Local Access Road
Motorway	Shared Use Carriageway	Local Road
Not Classified	Single Carriageway	Minor Road
Unclassified	Slip Road	Motorway
		Restricted Local Access Road
		Secondary Access Road

The process will identify the nearest link for each recorded vehicle location, then copy the values associated with this link to the vehicle data file. The shape file is supplied as a set of 100km squares so that file sizes are manageable. As the process works through each journey file it will automatically load the relevant shape file then identify the nearest link. The distance

[29] Aad, I., & Niemi, V. (2010). NRC data collection and the privacy by design principles. Proc. of PhoneSense, 41-45.

from the vehicle position to the centre line of this link will also be stored. Journey files can be downloaded and batch processed periodically as data is collected. The data can also be combined into a database table if required.

Nearest Charging Point

Ordnance Survey has a free shape file product called "Local" which has a layer containing all of the charge point locations. The processing power required to locate the nearest charging point is negligible compared to identifying the nearest link in the road type file, and can be done as part of the same process. Ultimately values may only be needed for the start and end location of each journey. The straight line distance to the nearest charging point will be stored.

Distance travelled from home location

It is simple to calculate the straight line distance between the initial journey position and every other recorded position, and can be added as part of the above processing. The maximum value for each journey can then easily be extracted if required. If the home location of a participant is known then journeys can be filtered to ones which start at their home.

Land Use

The land use classification for each journey origin and destination can be established using a map from the data.gov.uk website.

https://data.gov.uk/dataset/oa-ew-bgc-with-rucoa11/resource/5da60e17-5d16-4b8a-9536-0e8c5313a407

The shape file download defines regions, and classifies them as shown below.

Land Use Classification (Field Name=Rucoa11nm)
Rural hamlets and isolated dwellings
Rural hamlets and isolated dwellings in a sparse setting
Rural town and fringe
Rural town and fringe in a sparse setting
Rural village
Rural village in a sparse setting
Urban city and town
Urban city and town in a sparse setting
Urban major conurbation
Urban minor conurbation

This process involves identifying the region to which each origin/destination point belongs - this can be done using MapInfo software. A separate table just containing journey start and end points will be created for this extra column.

3.3 Data analysis plan

3.3.1 Core analyses

The core analyses of the data from the Consumer Uptake Trial will address the Research Questions set out in section 1.3. A description of what data are required, how they will be analysed and what kinds of outputs will be produced in relation to each Research Question is provided in the following sections. In addition, a series of Supplementary Analyses will be performed to enhance interpretation of the findings; these are discussed in section 3.3.2.

3.3.1.1 How much does the potential All Electric Range (AER) of a BEV or PHEV influence willingness to consider adoption?

This research question will be addressed in the Choice Experiment using four levels of the attribute “Driving Range”: (For BEVs, 100/200/300/400 miles; for PHEVs, 10/20/40/60 electric miles plus 400 liquid fuel miles). The Choice Experiment will output a choice coefficient for BEV and PHEV range, representing the contribution of this attribute to vehicle choices. Since the contribution of purchase price will also be measured, the value that participants attribute to each extra mile of electric range will be calculated, and expressed in £/mile. Further information about the choice experiment attributes and how they will be analysed is provided in section 2.9 and section 3.4.7.

This analysis will be supplemented by findings from the Time Point 2 questionnaire which also explores how AER (ranging from 10 to 100 miles for a PHEV, and 50 to 300 miles for a BEV) impacts participants’ willingness to consider a BEV or PHEV as their main or second car.

An illustrative output from this analysis is shown in Figure 14.

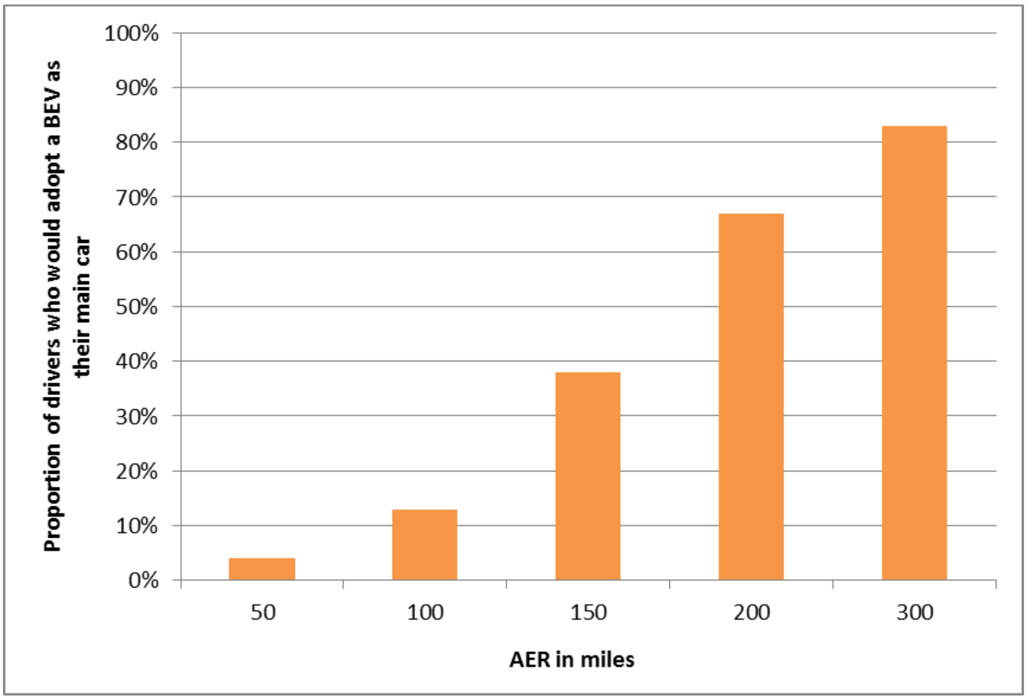

Figure 14: Influence of AER on BEV uptake (example output using fictitious data generated for illustrative purposes only)

Statistical comparisons using appropriate techniques for the data will be made to ascertain whether differences between the proportions of drivers who adopt given different values of AER are statistically significant (see section 3.4.3). This analysis will be repeated for BEVs as either a main car or a second car in the household, and for PHEVs (using smaller AER values). The same questions will be repeated at Time Points 1 and 2, enabling a comparative analysis to identify how far reduction in psychological distance through experience of use of both a BEV and a PHEV affects willingness to consider adoption of either type.

3.3.1.2 How much does the potential purchase cost of a BEV or PHEV influence willingness to consider adoption?

This research question will be addressed in the Choice Experiment using five levels of the attribute “Purchase Price” which will be pivoted on the price of each participant’s last main car purchase: (£10k/£11k/£12k/£13k/£14k if last car purchase <£15k; £16k/£18k/£20k/£22k/£24K if last car purchase between £15k and £25k, or if participant does not know; £24k/£27k/£30k/£33k/£36k if last car purchase > £25k). The Choice Experiment will output a choice coefficient for purchase price, representing the contribution of this attribute to vehicle choices. Further information about the choice experiment attributes and how they will be analysed is provided in section 2.9 and section 3.4.5.

3.3.1.3 How much does the potential running cost saving associated with using a BEV or PHEV influence willingness to consider adoption?

This research question will be addressed in the Choice Experiment using four levels of the attribute “Running cost” which will be pivoted on each participant’s annual mileage: (£500/£1000/£1500/£2000 if annual mileage < 15,000 miles; £1000/£2000/£3000/£4000 if annual mileage > 15,000 miles). The Choice Experiment will output a choice coefficient for running cost, representing the contribution of this attribute to vehicle choices. Since the contribution of purchase price will also be measured, the value that participants attribute to each extra £ saved annually in running costs will be calculated, and expressed in £/£ saved per year. Further information about the choice experiment attributes and how they will be analysed is provided in section 2.9 and section 3.4.7.

3.3.1.4 How much does the recharge time associated with a BEV or PHEV influence willingness to consider adoption?

This research question will be addressed in the Choice Experiment using three levels of the attribute “Rapid charge rate”: (additional 25/75/150 miles per 10 minute charge at a rapid charger). The rationale for focussing this attribute on recharge rate at rapid chargers (at public chargepoints, e.g. at motorway services) is given in section 2.9.

The Choice Experiment will output a choice coefficient for Rapid charge rate, representing the contribution of this attribute to vehicle choices. Since the contribution of purchase price will also be measured, the value that participants attribute to each extra mile range provided by 10 minutes of rapid charging will be calculated, and expressed in £/mile. Further information about the choice experiment attributes and how they will be analysed is provided in section 2.9 and section 3.4.7.

This analysis will be supplemented by findings from the Time Point 2 questionnaire which explores how the recharging time at slow chargers, such as a home charging point (ranging from 1 hour to 8 hours of charging time per 100 miles of range) impacts participants' willingness to consider a BEV or PHEV as their main or second car. An illustrative output from this analysis is shown in Figure 15.

Statistical comparisons using appropriate techniques for the data will be made to ascertain whether differences between the proportions of drivers who adopt given different values of recharging rate are statistically significant (see section 3.4.5). This analysis will be repeated for BEVs as either a main car or a second car in the household, and for PHEVs (using smaller AER values). The same questions will be repeated at Time Points 1 and 2, enabling a comparative analysis to identify how far reduction in psychological distance through experience of use of both a BEV and a PHEV affects willingness to consider adoption of either type.

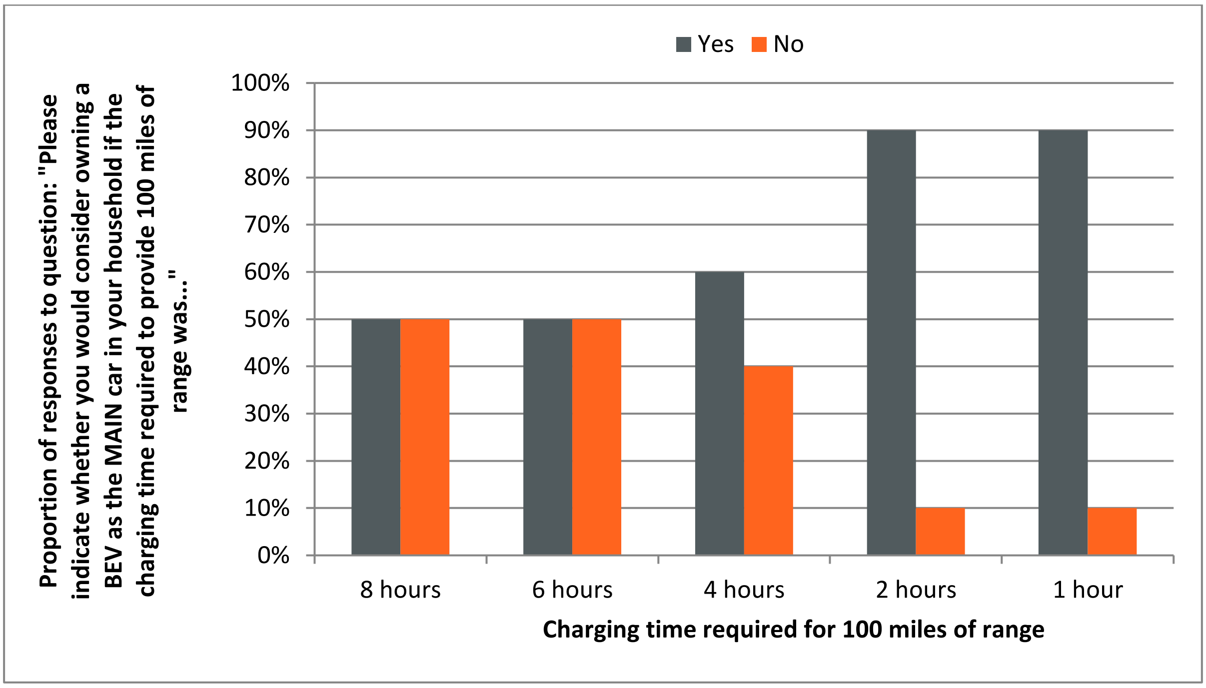

Figure 15: Influence of charging time on BEV uptake (example output using fictitious data generated for illustrative purposes only)

3.3.1.5 How much are personal characteristics (personality, innovativeness, liminality, self-congruity, driving style, demographic variables, etc.) predictive of willingness to consider adoption of a BEV or PHEV?

This Research Question will be addressed using regression modelling to estimate the contribution to the variance in willingness to consider having a BEV or PHEV (across the whole sample) that can attributed to different personal characteristics, such as personality, innovativeness, liminality, self-congruity, driving style, age, gender, etc. These data will be captured in the Pre-trial, Time Point 1 and Time Point 2 questionnaires (see section 2.8). Certain characteristics, such as driving style, will be measured using pre-existing scales that combine data from several questionnaire items. For instance, in the case of driving style, eight driving style scores will be calculated from 44 questionnaire items. Self-congruity (the degree of fit between the a person's identity, as reflected in self-reported personality traits, and the symbolic meaning of a product, as reflected in the personality profile attributed by the sample to a typical user of the product) will be calculated using the method of Skippon, et al (2016).

To achieve a statistically robust regression model, it is important to minimise collinearity between predictor variables –i.e. to avoid including variables that are correlated with one another. Analysis of these data will therefore involve a series of steps:

- **Correlation matrix**: a tabulated correlation matrix between the predictive variables (e.g. age, gender, personality, driving style etc.) and the outcome variables (willingness to consider a BEV / PHEV). This will enable the analysis team to identify significant correlations between the predictor variables and the outcome variables, and between predictor variables. Potential predictor variables that in fact show no statistical association with the outcome variables can be excluded from the regression analysis. Predictor variables that show significant correlation with both the outcome variables and other predictor variables can be combined using factor analysis.
- **Factor analysis**: a statistical technique used to reduce the number of individual variables provided by multi-item questionnaire scales and generate 'factors' which represent coherent sub-scales (see section 3.4.2). Such emergent factors may represent real underlying variables that exert a common influence on the effects of several predictor variables (subject to theoretical interpretation).
- **Logistic regression**: to assess the extent to which the most important personal characteristics and personal-situational variables (which are not highly correlated with each other) are predictive of willingness to adopt a BEV or PHEV (see section 3.4.4).

Further detail of these data analysis techniques is provided in section 3.4.

3.3.1.6 How much are personal-situational variables (e.g. income, annual mileage) predictive of willingness to consider adoption of a BEV or PHEV?

This Research Question will be addressed using regression modelling to estimate the contribution to the variance in willingness to consider having a BEV or PHEV (across the whole sample) that can attributed to different personal-situational variables, such as income and annual mileage. These data will be captured in the Pre-trial, Time Point 1 and Time Point 2 questionnaires (see section 2.8).

These data will be analysed in the same way as described in section 3.3.1.5 above; that is, by first identifying which personal-situational variables are most likely to be important predictors of willingness to adopt (using a correlation matrix), combining associated predictor variables using factor analysis, and then running multiple logistic regression to assess the relevant predictive power of those variables. It may prove appropriate to combine this analysis with that described section 3.3.1.5, i.e. including both personal and personal-situational variables in the same analytic process (for instance, if there turn out to be few predictor variables of either type that are significantly correlated with the outcome variables); the most appropriate analytic strategy will be decided by the analysis team on inspection of data.

3.3.1.7 What effect does varying the perceived level of access to public charging stations (e.g. density, type of location, type of charger) have on willingness to adopt BEVs or PHEVs?

This research question will be addressed in the Choice Experiment using four levels of the attribute "Destination charge point availability": (home only/home & work/ home & public/ home, work, & public) and four levels of the attribute "Rapid charge point coverage": (no rapid network/rapid charging sites every 20 miles on motorways and major A roads/rapid charging sites every 20 miles on all motorways and A roads/rapid charging sites every 20 miles on all motorways and A roads, and at a similar frequency as petrol stations on all other roads). The Choice Experiment will output choice coefficients for both destination charge point availability and Rapid charge point coverage, representing the contribution of these attributes to vehicle choices. The attribute "rapid charge point coverage" will be applied only to BEV choice options. Further information about the choice experiment attributes and how they will be analysed is provided in section 2.9 and section 3.4.7.

3.3.1.8 What effect does convenient access to public transport options for longer journeys have on willingness to consider adoption of a BEV?

This research question will be answered using responses to the following item in the Time Point 2 questionnaire:

- How important or unimportant would the following factors be if you were considering a Battery Electric Vehicle (BEV) for your household?

This will provide data on how important or unimportant mainstream consumers perceive a number of factors to be when considering whether or not to purchase a BEV or a PHEV; this list of factors includes 'convenient access to public transport'. The data will be reported as a frequency distribution of responses across the participant pool. A statistical comparison will also be carried out of the willingness to consider a BEV or a PHEV as a main or second car, for those who rate accept to public transport as an important factor versus those who do not. One hypothesis that these analyses will test is that convenient access to public transport is less important when considering adoption of a PHEV compared with a BEV, since the utility of a PHEV (currently) provides a greater maximum range.

In addition, this variable will be included in the Supplementary Analysis regression modelling.

3.3.1.9 What effect does the rate of depreciation of residual value have on willingness to consider adoption of a BEV or PHEV?

This research question will be answered using responses to an item in the Time Point 2 questionnaires. This item asks respondents to indicate how likely or unlikely they would be to adopt a BEV / PHEV in the next 5 years with varying levels of residual value depreciation. The levels are compared against a baseline for conventional cars; a 60% loss of value over 3 years assuming 10,000 miles per year[30]. An illustrative output from this analysis is shown in Figure 15.

[30] Depreciation for conventional cars estimated by the AA: http://www.theaa.com/car-buying/depreciation

Supporting analysis will also be performed using an additional item in the Time Point 2 questionnaire which assesses the impact of the varying levels of battery performance degradation on willingness to adopt a BEV or PHEV. This will inform understanding of the relative importance of loss of *value* and loss of *functionality* on PiV uptake.

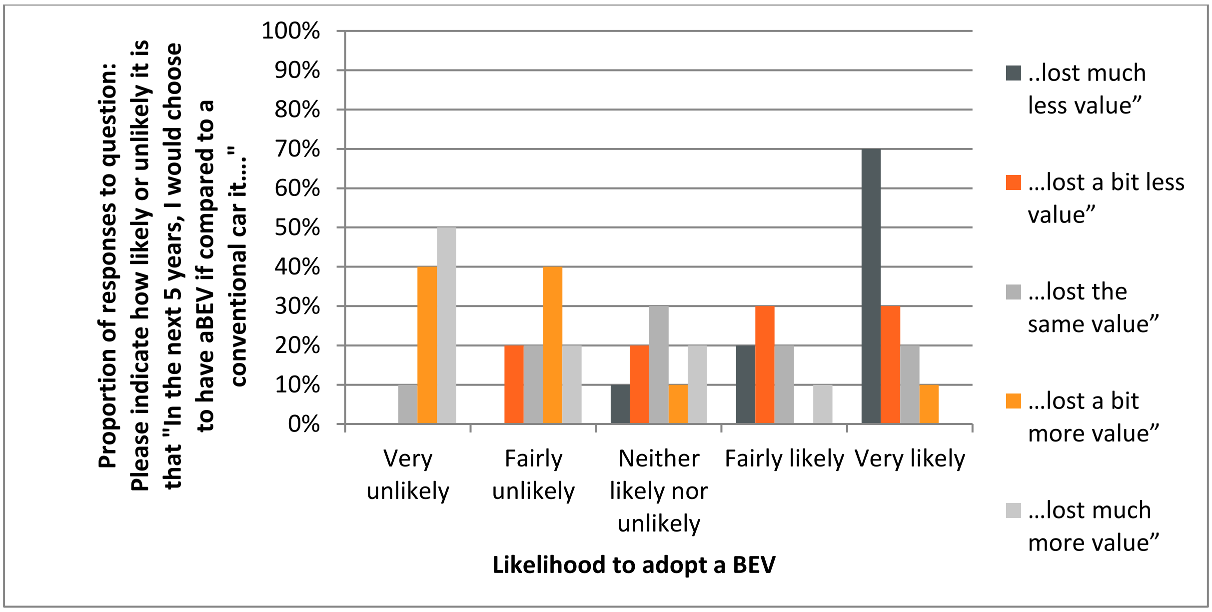

Figure 16: Influence of depreciation in residual value on BEV uptake (example output using fictitious data generated for illustrative purposes only)

3.3.1.10 *What effect does access to additional ULEV benefits (e.g. access to bus lanes, free congestion charge, free parking) have on willingness to consider adoption of a BEV or PHEV?*

This research question will be answered by capturing data in the Time Point 2 questionnaire on the influence of a number of ULEV benefits on mainstream consumers' willingness to adopt a BEV or PHEV. The ULEV benefits which will be investigated are:

- Discounted access to hire cars (e.g. for longer journeys)
- Discounted access to public transport
- Permission to drive in bus lanes
- Access to free parking
- Free access to congestion charge zones
- A free chargepoint for the home
- A government grant towards purchase price
- Free access to low emission zones / clean air zones
- Exemption from car tax (Vehicle Excise Duty)

This will provide data on the relative impact of the various ULEV benefits on likely uptake of PiVs. Statistical comparisons will be made to ascertain whether there are significant differences in the responses for BEVs and PHEVs; that is, to understand the relative importance of ULEV benefits when considering adoption of BEV versus a PHEV (see section 3.4.3). This will help to inform policy recommendations about the kinds of ULEV benefits which are most likely to have significant impacts on the uptake of PiVs in the future.

Supplementary analysis will also be performed to understand the extent to which perceived advantages of these types of ULEV benefits differ between sub-sets of the population. The ability to make robust statistical comparisons between these different groups will depend on the size of the groups.

3.3.1.11 What other factors might compensate users for lack of long-range mobility sufficiently for them to consider adoption of a BEV?

This research question will be answered using responses to the following item in the Time Point 2 questionnaire:

- How important or unimportant would the following factors be if you were considering a Battery Electric Vehicle (BEV) for your household?

The list of factors which will be considered and an example of the kind of output which this analysis will produce is shown in Figure 17 .

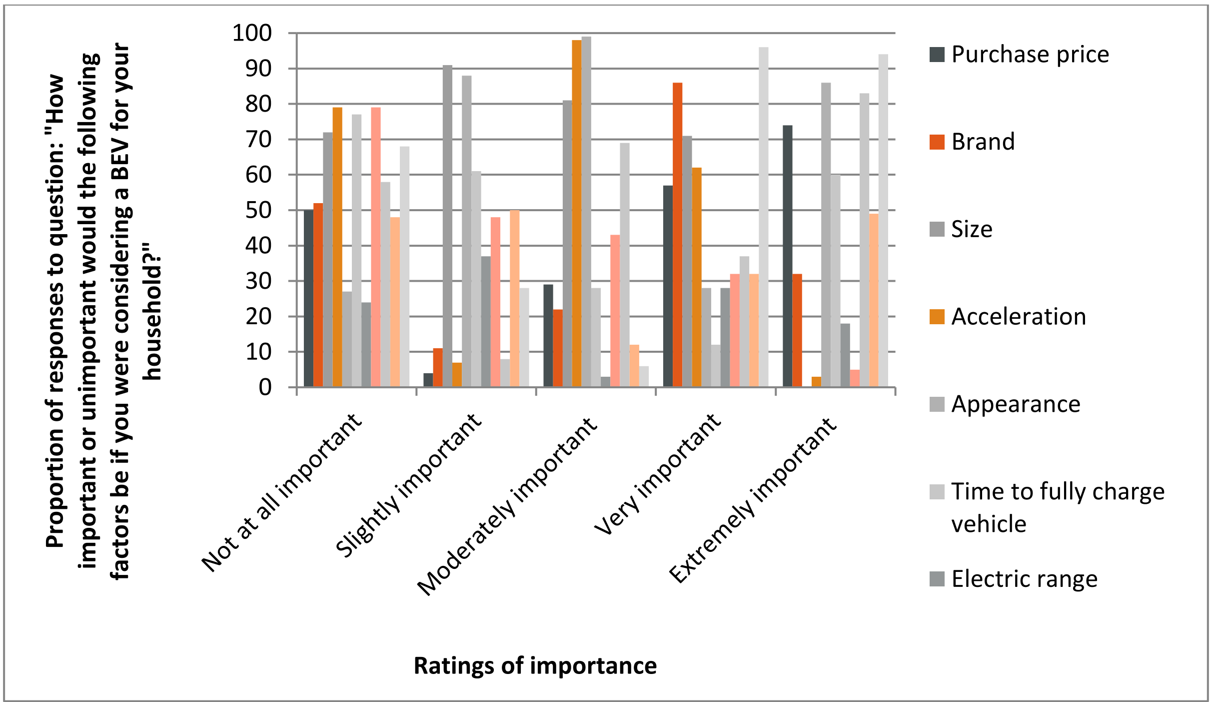

Figure 17: Importance of various factors for BEV uptake (example output using fictitious data generated for illustrative purposes only)

3.3.1.12 What effect does convenient access to a long-range vehicle (whether within the household or hired) for longer journeys have on willingness to consider adoption of a BEV?

This research question will be answered using responses to the item in the Time Point 2 questionnaire which is described in section 3.3.1.10 above. This question examines the impact of discounted access to hire cars for longer journeys on mainstream consumers' willingness to adopt a BEV.

Supplementary analysis will also be performed using an identical question which relates to the uptake of PHEVs; this will enable comparison of the relative importance of having access to a long-range vehicle on uptake of PHEVs and BEVs. A plausible hypothesis to test is that access to a long-range vehicle is less important when considering adoption of a PHEV compared with a BEV, since the utility of a PHEV (currently) provides a greater maximum range. Statistical comparisons will be made to ascertain whether there are significant differences in the responses for BEVs and PHEVs (see section 3.4.3).

3.3.2 Supplementary analyses

The project team will also carry out a number of supplementary analyses. In contrast to the outputs of the Choice Model, outputs from these analyses will not be directly incorporated in the CVEI Analytical Framework. However they will supplement the analyses carried out in respect of research questions 5 and 6, to provide a comprehensive, holistic analysis, using the full dataset, of the factors that influence mainstream consumers' willingness to consider having a BEV or a PHEV. This holistic analysis will provide an in-depth view of the reasons behind the answers to the key Research Questions.

They will include analyses that characterise the sample and test for various sample biases; analyses that measure the extent to which attitudes towards PiVs change after psychological distance from PiVs has been reduced by direct experience of using them; comparisons between attitudes towards BEVs and PHEVs; comparisons of the ways in which the three trial vehicles were used, to identify any systematic differences; comparisons between the ways the performance and driving experience of each type were rated by participants; and regression modelling to explore the extent to which variance in willingness to consider BEVs and PHEVs can be accounted for by participants' attitudes towards PiVs (measured from questionnaire responses), their usage behaviours with the different types of vehicles (measured from telematics data), and other factors not previously included in the regression analyses already outlined in the section above.

1) Summary statistics & sample characterisation

Prior to commencing any statistical analysis, the questionnaire and telematics data will be summarised. This will include, but is not limited to:

- A summary of the sample characteristics, including an assessment of how representative this is of the general driving population.
- A summary of the sample's vehicle ownership history and general travel patterns.
- A summary of the attitudes to BEVs/PHEVs, vehicle charging and likelihood of vehicle purchase.

Consideration will be given as to the best way to present this information, using charts and graphs where appropriate. For attitudinal items, diverging stacked bar charts will be used to visually present what proportion of the sample agree or disagree with specific questions. Figure 18 shows an example of this type of chart for the two questions: "How likely are you to purchase a BEV / PHEV in the future?".

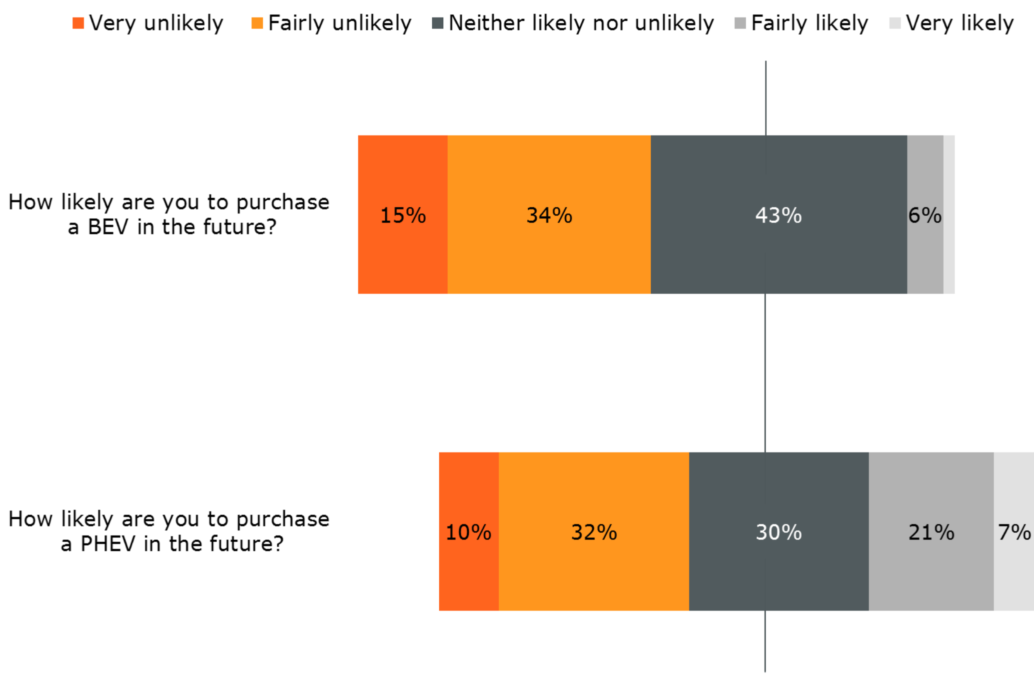

Figure 18: Example format of diverging stack bar charts (example output using fictitious data generated for illustrative purposes only)

2) Analysis of potential sample bias

An inter-group comparison will be made of the Time Point 1 willingness to consider of participants who complete the study versus those who drop out after Time Point 1 (those who drop out prior to Time Point 1 will be replaced). This will identify whether those dropping out were systematically biased in favour of or against adoption of PiVs compared with those who completed the study (note however that for ethical reasons, participants who withdraw have the right to withdraw ALL their data, including data collected before their withdrawal, without explanation).

Inter-group comparisons of willingness to consider will be made between participants recruited via the different recruitment channels. This will identify any systematic biases arising if one or more of the recruitment channels preferentially accesses people who are more or less predisposed to consider a PiV than the population as a whole.

3) Evaluation of Hawthorne effects

All field research is vulnerable to "Hawthorne" effects. This can bias findings due to participants changing behaviours, attitudes or preferences as a result of simply being involved in the research, rather than as a direct response to specific research conditions or stimuli. For this reason, this study has been designed to allow evaluation of the impact of Hawthorne effects.

The presence of Hawthorne effects will be examined by comparing participants' responses to items on willingness to consider having a BEV or PHEV in the Time point 1 questionnaire with those given in the Interim 1 questionnaire, after they have had experience with Vehicle 1.

Since the order in which participants experience the vehicles will be fully counterbalanced, a between-groups comparison will be performed; approximately one-third of the sample will have experienced the ICE, BEV or PHEV, respectively at the point where Interim 1 questionnaire is completed. Comparisons will be made to whether there is a difference in the magnitude of changes in responses between the ICE group and the BEV/PHEV groups. Any statistical differences in attitudes identified for the ICE group between these two time points will provide indication that participation in the trial alone is sufficient to result in a change in attitudes (that is, a "Hawthorne" effect), regardless of whether or not that participation includes experience with a PiV. If necessary, statistical techniques will be used to control for any bias associated with Hawthorne effects.

4) Assessment of the extent to which attitudes towards electric vehicles differed before and after experience of the vehicles

This will utilise data captured from the attitudinal items in the Time Point 1 and Time Point 2 questionnaires, and will be used to inform conclusions about the likely future uptake once BEVs and PHEVs are mainstream (i.e. once mainstream consumers are no longer psychologically distant from them). This supplementary analysis will help to answer a number of secondary research questions including; "How did drivers' perceptions change with experience of a BEV (or PHEV)?" and "Has experience of BEVs (or PHEVs) made drivers more or less likely to purchase these vehicles?"

An example output which could be produced from this analysis is shown in Table 16.

Table 16: Before/after comparison of likelihood to adopt a BEV as main car (example output using fictitious data shown for illustrative purposes only)

		After					Absolute difference
		Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely	
Before	Very unlikely	24	7	3	2	1	+13
	Fairly unlikely	26	28	10	3	0	-13
	Neither likely nor unlikely	15	27	19	8	0	-34
	Fairly likely	2	4	6	6	2	-10
	Very likely	0	1	1	1	3	-3

5) Comparisons between attitudes towards BEVs and PHEVs (after experience with both types of vehicle)

This will utilise data captured from the BEV- and PHEV-specific attitudinal items in the Time Point 1 and Time Point 2 questionnaires, and will be used to inform conclusions about the relative likely future uptake of these two types of vehicle types. This supplementary analysis will help to answer a number of secondary research questions including;

- Do driver's attitudes to and perceptions of BEVs and PHEVs differ?
- Are drivers more likely to purchase a BEV or PHEV (for a variety of AERs and charge times)?

These findings will also supplement those from the choice experiment.

An example output which could be produced from this analysis is shown in Table 17.

Table 17: Comparison of before/after change in likelihood to choose a BEV and PHEV as main and second car (example output using fictitious data shown for illustrative purposes only)

	Main car		Second car	
	BEV	PHEV	BEV	PHEV
Less likely after	42%	32%	25%	29%
Same after	40%	49%	47%	49%
More likely after	18%	18%	29%	22%

6) Comparisons between travel behaviour, vehicle usage and performance ratings for each of the three types of vehicle

This will utilise data captured from the Interim questionnaires which include items to ascertain evaluations of vehicle performance as well as feedback on participants' experience with charging the BEV and PHEV during the trial. Vehicle telematics data will also be used to understand differences in the characteristics of journeys made with each vehicle type, for example, average and maximum speeds, average fuel consumption, average journey distance, and driving style (proportions of hard acceleration and braking). Further analysis may also be possible using the raw telematics dataset, for example by examining the proportion of time within a journey spent travelling at different speeds.

This supplementary analysis will provide detail about how participants used the vehicles during the trial, and what their perceptions of the different vehicle types were. The results may therefore aid interpretation of differences in attitudes to PHEVs and BEVs, and may be used to inform future design requirements for PiVs.

This supplementary analysis will help to answer a number of secondary research questions including;

- Were there differences in travel behaviour (e.g. the number of journeys, average journey distance) between the three vehicles?
- Were there differences in driving style (e.g. average speed travelled or proportions of hard acceleration) between the three vehicles?
- Was there a difference in the accepted fuel level (e.g. journey start liquid fuel level) between the PHEV and ICE vehicles?
- How do the three vehicles compare on rated vehicle performance (e.g. vehicle acceleration, responsiveness, comfort and noise)?"
- How did drivers rate the experience of charging the BEV and PHEV?

Some example outputs which could be produced as part of this analysis are shown in the tables and figures below.

Table 18: Comparison of journey characteristics for each vehicle type (example output using fictitious data generated for illustrative purposes only)

	ICE	BEV	PHEV
Total journeys	1,902	2,095	2,003
Total distance (km)	23,858	19,951	22,458
Total journey time (hrs)	536	618	680
Average journeys per participant	10.0	10.8	11.0
Average journey distance (km)	12.5	9.5	12.0
Average journey time (mins)	16.9	17.7	17.0
Average speed (kph)	44.5	32.3	40.5

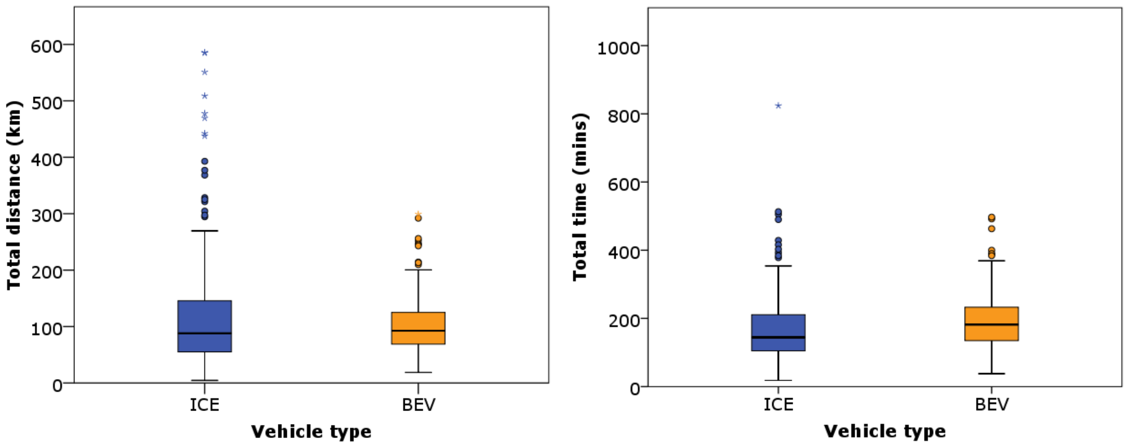

Figure 19: Graphical comparison of journey distances (left) and journey durations (right) between ICE and BEV (example output using fictitious data generated for illustrative purposes only)

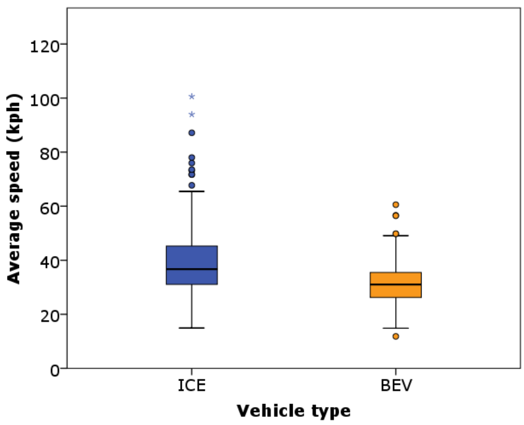

Figure 20: Graphical comparison of average speeds (kph) per journey travelled in ICE and BEV (example output fictitious data generated for illustrative purposes only)

7) Regression modelling

Regression modelling to explore the extent to which variance in willingness to consider BEVs and PHEVs can be accounted for by participants' attitudes towards PiVs (measured from questionnaire responses), their usage behaviours with the different types of vehicles (measured from telematics data), and other factors not previously included in the regression analyses already outlined in the section above. These analyses will supplement those described in sections 3.3.1.5 and 3.3.1.6 concerning the potential influence of personal and personal-situational variables, extending those analyses to a wider range of potential predictor variables. The same analytical approach will be used (repeated here for convenience):

To achieve a statistically robust regression model, it is important to minimise collinearity between predictor variables –i.e. to avoid including variables that are correlated with one another. Analysis of these data will therefore involve a series of steps:

- Correlation matrix: a tabulated correlation matrix between the predictive variables (e.g. age, gender, personality, driving style etc.) and the outcome variables (willingness to consider a BEV / PHEV). This will enable the analysis team to identify significant correlations between the predictor variables and the outcome variables, and between predictor variables. Potential predictor variables that in fact show no statistical association with the outcome variables can be excluded from the regression analysis. Predictor variables that show significant correlation with both the outcome variables and other predictor variables can be combined using factor analysis.
- Factor analysis: a statistical technique used to reduce the number of individual variables provided by multi-item questionnaire scales and generate 'factors' which represent coherent sub-scales (see section 3.4.4). Such emergent factors may represent real underlying variables that exert a common influence on the effects of several predictor variables (subject to theoretical interpretation).
- Logistic regression: to assess the extent to which the most important personal characteristics and personal-situational variables (which are not highly correlated with each other) are predictive of willingness to adopt a BEV or PHEV (see section 3.4.6).

Further detail of these data analysis techniques is provided in section 3.4.

3.4 Data analysis techniques

3.4.1 Segmentation

The aim of this segmentation analysis is to understand the characteristics of the sample population, including how they fit into consumer segments investigated in previous research (e.g. Anable *et al.*, 2011; DfT, 2016b). The previous segmentation analysis performed for the ETI's PiV project (Anable *et al.*, 2011) identified eight segments (proportion of sample categorised into each segment shown in parentheses):

1. Plug-in pioneers (2%)
2. Zealous optimists (13%)
3. Willing pragmatists (11%)

4. Anxious inspirers (16%)
5. Uninspired followers (19%)
6. Conventional sceptics (13%)
7. Image conscious rejectors (18%)
8. Company car drivers (8%)

A similar analysis carried out by Element Energy for the Department for Transport produced six segments (DfT, 2016b):

1. Innovators (2%)
2. Cost-conscious greens (20%)
3. Pragmatists (21%)
4. Unmet needs (19%)
5. Uninterested rejectors (20%)
6. Car-loving rejectors (17%).

There is significant overlap between these two segmentations, but the latter segmentation will be used for the Consumer Uptake Trial of this CVEI project, since this is used in ECCo. The analysis here will seek to assign participants to one or other of the 6 segments above.

Thus, this approach represents a 'confirmatory' cluster analysis methodology which aims to confirm (or reject) that the segments found in previous studies apply to the sample of mainstream consumers included in this study. This analysis will use data from the Pre-trial and Time Point 1 questionnaires. The analysis will assume that the number of clusters is fixed (at six to match with the DfT (2016b) segmentation) and that some characteristics of the clusters are partially known (the cluster centres will be estimated from the previous study). The solution will be tested for robustness (i.e. cluster integrity and stability) to ensure that the segments are applicable to this sample. If the solution is not robust, then it will not be possible to classify the Consumer Uptake Trial sample participants into the previously identified segments; although this is a highly unlikely outcome.

Previous analysis has provided clear evidence that Innovators' attitudes towards PiVs, in general and particularly towards ownership of a BEV or PHEV, are more positive than those of mainstream consumer segments. The intention of the Consumer Uptake Trial is to exclude Innovators by filtering out anyone who has previously had, currently has, or has had regular experience with a PiV (see section 2.2). The confirmatory cluster analysis will check the success of this approach by testing whether five or six segments are required; i.e. whether or not inclusion of the Innovator segment is required. If the Innovators segment is identified and assessed as being robust, then this will indicate that a subset of the sample is made up of Innovators.

The previous segments identified by DfT (2016b) do not disaggregate attitudes towards BEVs and PHEVs. The degree to which these differ will be explored as part of the analysis of the questionnaire data and statistical comparisons will be carried out to determine whether differences are significant (see section 3.4.3). If differences are identified then the impact these have on the segmentation will be discussed in the report.

The final solution resulting from the cluster analysis will be compared to the results of the previous study to determine if the size and composition of segments has shifted. In addition, some exploratory analysis of the data from the Time Point 2 questionnaire will be carried out to understand whether participants remain in the same segment before and after experience with the vehicles. This analysis will be used to inform whether an additional segment may have been created following experience of the vehicles. Due to the relatively small size of the sample, any new segments will not be derived statistically but will be created based on comparisons of the stability of participants within segments before and after experience of the vehicles, and some qualitative judgement.

The final solution will then be profiled to understand the characteristics of each segment including demographic information, environmental behaviours, likelihood to adopt PiVs, current travel behaviour, usage and attitudes to the trial vehicles.

3.4.2 Factor analysis and reliability measures

The questionnaires are made up of many attitudinal items which measure participants' attitudes and personality traits. For example, the driving style questions are made up of 44 items, each on a six-point scale from 'not at all' to 'very much', which provide information on self-reported driving style.

In order to reduce the number of variables to a more manageable number for statistical analysis, a data reduction technique called factor analysis will be applied to these items. This combines the information from a large number of similar items into a smaller set of factors. It does this by looking at the inter-correlations between items and identifying common groups. The resulting factors represent coherent subscales and can be used in subsequent analysis.

The reliability of these subscales will be confirmed using reliability measures such as Cronbach's alpha. A highly reliable scale implies that all the items collectively describe the same personality or behaviour. A scale is considered to have good internal consistency if the output from the reliability of the scale gives a Cronbach's alpha coefficient of 0.7 or higher.

To ensure that results are comparable between each of the questionnaires, the same factoring will be used for both the Time Point 1 and Time Point 2 questionnaires.

3.4.3 Statistical comparisons

Comparison of the factors will be conducted using repeated-measures[31] statistical methods. This will enable identification of differences in attitudes before and after experience of the three vehicles. Similar analyses will also be performed to identify differences in travel behaviour (e.g. average journey distance, or average speed) and the rating of vehicle performance (e.g. vehicle acceleration, responsiveness, comfort and noise) between each vehicle type.

These repeated-measures techniques will include (but may not be limited to):

[31] 'Repeated measures' or 'within-participants' analysis is required since participants' attitudes and behaviours are measured at multiple times at different time points.

- Analysis of Variance (ANOVA) or Generalised Estimating Equations (GEE)
- Paired t-tests or Wilcoxon matched-pairs tests
- Cochran's Q or the McNemar dichotomous variables test

Experienced statisticians will select the most appropriate statistical techniques for analysis of the various datasets collected during this trial. The techniques selected will depend on the characteristics of the data obtained. For example, parametric statistical tests such as ANOVA or t-tests rely on underlying assumptions about the distribution of the data; tests will be performed to check these assumptions before analysis is carried out. In addition, non-parametric tests are to be preferred for questionnaire items that produce ordinal rather than interval data – for instance Likert-type attitude items.

3.4.4 Regression

Regression modelling will be used to address the following research questions:

5. How much are personal characteristics (personality, innovativeness, liminality, self-congruity, driving style, demographic variables, etc.) predictive of willingness to consider adoption of a BEV or PHEV?
6. How much are personal-situational variables (e.g. income, annual mileage) predictive of willingness to consider adoption of a BEV or PHEV?

Regression modelling will also be used explore the extent to which variance in willingness to consider BEVs and PHEVs can be accounted for by participants' attitudes towards PiVs (measured from questionnaire responses), their usage behaviours with the different types of vehicles (measured from telematics data), and other factors not included in the regression analyses that address the research questions above.

A correlation matrix will first be computed to assess the relationships between the predictive variables (e.g. personal characteristics such as age, gender and personality, or personal-situational variables such as income or mileage) and the outcome variables (willingness to consider a BEV or PHEV). This will enable identification of the key variables which are highly correlated with the outcome variables; these are likely to be better predictors than variables which are not significantly correlated. This approach will also enable identification of multicollinearity; that is, where two or more predictor variables are highly correlated with one another.

Insertion of large numbers of highly correlated predictor variables (i.e. with high multicollinearity) is unlikely to result in a regression model which provides informative conclusions of the impact of personal characteristics on willingness to adopt. Initial analysis of the relationships between variables will therefore inform the methodology for multiple logistic regression, ensuring it is robust and relevant.

Logistic regression, which is used when the dependent variable is categorical, will be used to determine the extent to which a smaller sub-set of the most important predictor variables (which are not highly correlated with one another) are significant predictors of willingness to adopt a BEV or PHEV. The analysis will use responses to the question: "In the next 5 years, I would choose to have an electric car …as my main car" as the dependent (outcome) variable and will employ a stepwise approach to assess which variables best predict the answer to this question.

For this analysis, the predictor variables need to be expressed as single scalar values for each participant. For example, although variables can be extracted such as speed, trip length, etc. from the telematics data, time-resolved individual data points from the telematics outputs cannot be used directly in the regression analyses; they must be aggregated in the form of single scalar values per participant. There are many derived parameters which could be used in the analysis. For example, time-resolved speed data could be aggregated into mean speed over all the trips made by a participant, trip lengths could be aggregated as mean trip length and total distance travelled, etc. The same is true for GPS data, which are both time-resolved and spatially-resolved. It is proposed to calculate two variables from the GPS data to include in the regression analyses: (1) mean distance from home, which may affect experience of range anxiety, and so potentially be predictive of willingness to consider having a PiV and of aspects of charging behaviour; (2) fraction of total journey distance spent on urban roads, where EVs are more efficient, so range is longer (depending on data sources available for road type, a proxy for “urban road” may have to be used). Note that it likely that both (1) and (2) will be correlated with other predictor variables being measured (trait neuroticism and cautious driving style scale for (1), mean speed for (2)).

3.4.5 Choice experiment

The results of the choice experiment will be analysed with the statistical package NLogit to derive choice parameters for each of the attributes. It is proposed that each participant is mapped to one of the consumer segments from DfT (2016b) based on their answers to the Time Point 2 questionnaire (completed before the choice experiment). The sample size is too small to carry out an exploratory segmentation analysis, however, this method will allow the willingness to pay values for each consumer segment to be derived and compared with those found in DfT (2016b) to allow testing of how attitudes may have changed after PiV experience.

Subject to the statistical robustness of the outputs, the new choice coefficients for each consumer can be incorporated into ECCo (and the Analytical Framework) to simulate how mainstream consumer purchasing behaviour may change in the future once PiVs achieve mainstream status and psychological distance is reduced.

A detailed discussion of the analysis of the choice experiment results will form part of Deliverable D5.2.

4 Project Management

4.1 Team structure

The project team for Stage 2 draws upon a wealth of experience and expertise in research, policy, regulation, economics, energy supply, distribution, low carbon energy and vehicles, charging infrastructure, fuels, consumer usage, behaviour and adoption.

As lead partner, TRL is the Prime Contractor to ETI. The organisations brought together have the capacity and competence to fulfil Stage 2 of this project. The overall structure of the Stage 2 team and the roles of key individuals are outlined in Figure 21.

The project will also utilise the services of a number of suppliers. These will include:

- **Rolec** will supply Mode 2 charging sockets on dedicated circuits, and associated electrical installation services, to ensure participants in Consumer Uptake Trial can charge their vehicles safely from their home
    - **ChargedEV** (a trading name of Hybrid Energy Solutions Ltd, company registration no. 09666725) will be subcontracted by Rolec to provide electrical installation services.
- **VW Group Leasing (VGL)** via **VW Financial Services (VWFS)** will provide lease vehicles for the purposes of the trial (11 VW Golf 1.4 TSI GT Editions, 11 VW e-Golfs and 11 VW Golf GTEs).
- **FleetCarma** will provide the vehicle telematics system to deliver the required data for the trial.
- **Accent Limited** will provide online hosting services for the questionnaire and choice experiment elements of the trial.
    - Recruitment surveys (Filter Survey 1 and Filter Survey 2) will be hosted by **SmartSurvey**

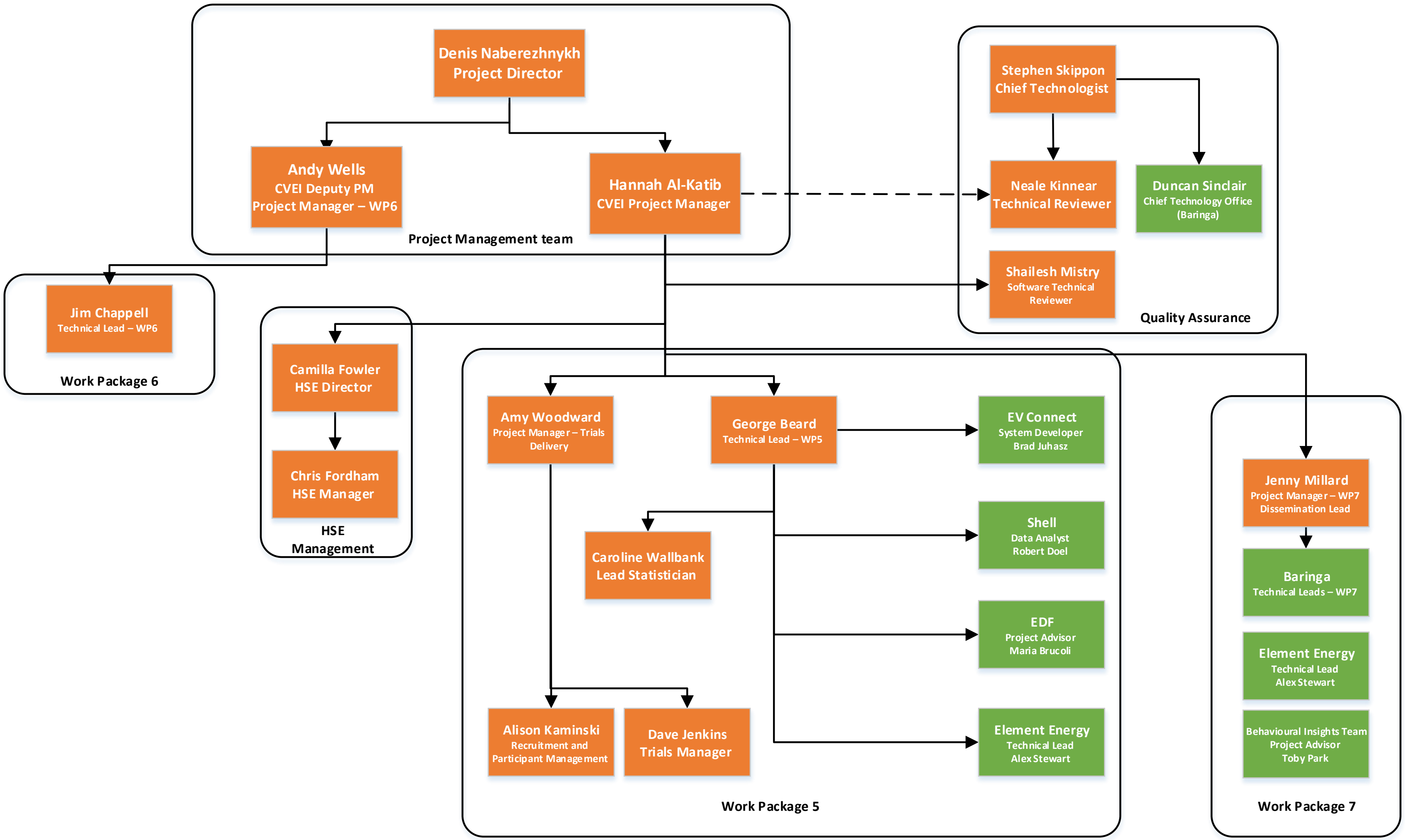

Figure 21: CVEI Stage 2 project team structure

4.2 Health, safety and environment

During the initial design phase of Stage 2, the project team developed a Health, Safety and Environment (HSE) Plan. The objective of preparing an HSE Plan is to ensure the protection of the people involved in the project, or those who could be affected by it, the environment, and project or company assets. This will be achieved by adopting and implementing the highest possible design standards to mitigate potential HSE issues and to ensure that all risks are reduced As Low As Reasonably Practicable (ALARP). The Plan also ensures compliance with necessary HSE legislation including The Construction (Design and Management) (CDM) Regulations 2015.

The project team developed the HSE Plan during the design stage of the project is to ensure:

- all Health, Safety and Environmental requirements are addressed at the early concept and design stage;
- the trial complies with all relevant Health and Safety Laws and Environmental Laws; and
- the project has clearly defined roles and responsibilities in relation to the management of health, safety and the environment.

In accordance with the requirements of the contract, TRL, as Principal Designer and Client, has prepared the project pre-construction stage HSE Plan in accordance with The CDM Regulations 2015. The HSE Plan was prepared for the construction and removal stages and describes the project's objectives, scope, and methodology as well as TRL's approach to HSE.

During the design phase the HSE Team has worked closely with the Project Management team, WP5 Lead and the Trial Logistics Manager to ensure that HSE considerations are fully integrated into the trial design. The HSE Team have also engaged with relevant project partners, in particular Cenex, Rolec (the preferred chargepoint supplier) and ChargedEV (the Principal Contractor and chargepoint installer) to make sure that there is sufficient coordination between project partners so that HSE is managed consistently throughout the project. Full details of the project's approach to managing health, safety and environment are described in the HSE Plan.

4.3 Research ethics

Ethical approval is required for all projects using human participants. This includes all projects that involve observation of human participants or collection of information from them or about them. It also includes projects that require access to information on identifiable individuals that is already held by TRL or another organisation. Projects in which human beings participate in other ways – for example, by being subjected to experimental situations or driving instrumented vehicles – are also covered.

TRL has a rigorous ethics procedure informed by EPSRC's Guide to Good Practice in Science and Engineering Research. All staff at TRL are required to comply with ethical guidelines to protect and enhance the ethical and professional reputation of research activities performed by TRL. The standard of this ethical procedure is designed to satisfy the ethical standards of relevant professional bodies, government and other clients, and other funding bodies.

The TRL ethics process is summarised in Figure 22 below. TRL projects involving human participants are first formally assessed by the Project Manager and Technical Reviewer using a simple ethics checklist. Proposals that appear to follow recognised ethical principles will then be judged by a "light touch" internal Mini Ethics Panel. Potentially problematic projects require approval from the TRL Research Ethics Committee. The TRL Research Ethics Committee involves an external participant and also monitors the decisions of the Mini Ethics Panels.

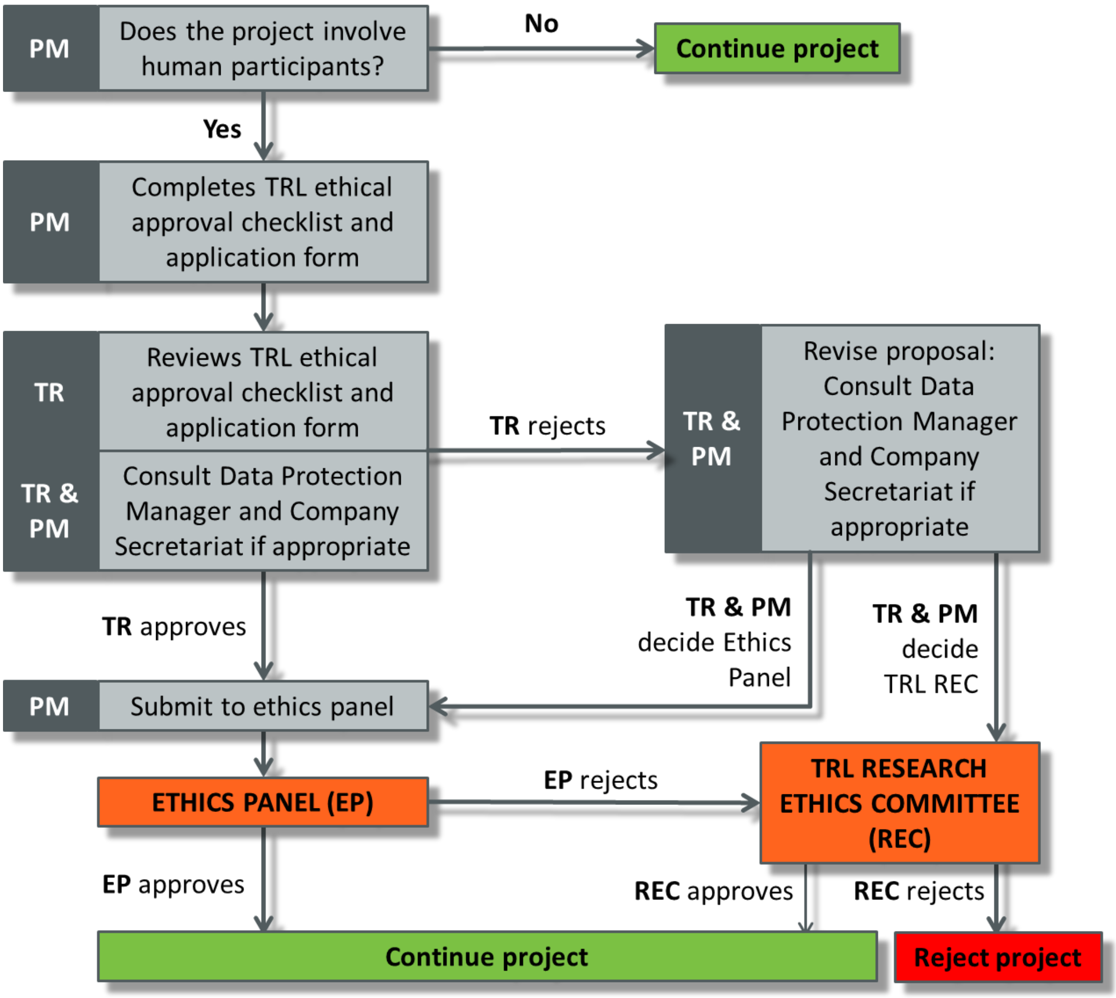

Figure 22: TRL Ethics Process

The Chair of the TRL Ethics committee was consulted with and has confirmed that the “Mini Ethics Panel” pathway will be used for the Project. A first round of ethics approval was undertaken as part of Stage 1. During March 2017 TRL Chief Scientist Dr Alan Stevens, project Technical Reviewer Dr Neale Kinnear, and Project Manager Hannah Al-Katib and Deputy Project Manager Andy Wells undertook a further Mini Ethics Panel review of the proposed trial design and research instruments. The panel were satisfied that the project met ethical requirements and gave its approval for the project to continue.

4.4 Project risks

TRL maintains a Risk Register for the CVEI project which tracks risk probability, proximity and resulting impact on Health & Safety, Data Protection, time, quality and cost should the risk occur. A function of the probability, proximity and maximum impact is used to provide a Risk Rating for each risk. Based upon the Risk Rating, the frequency at which the risk must be reviewed by the Project Management team is calculated. The Risk Register sets out avoidance and mitigation measures for each risk.

If a Risk is escalated to an Issue then the following items are tracked within the Issues tab in the Risk Register:

- Detail of Issue
- Impact Issue will have
- Issue Severity
- Assigned to action
- Date assigned
- How will this be resolved
- Date last reviewed
- Date to resolve by
- Date Issue Resolved
- Change Request ID if this is confirmed as Change in scope.

Alongside the Risks and Issues, the Risk Register also tracks dependencies between tasks and deliverables.

The Project Management team provides a monthly project report to the ETI's Project Manager, in which all Risks and Issues are reported.

4.5 Data privacy and protection

The full details of the management of data privacy and protection for the CVEI project is captured in the document "Managing Data Protection" submitted to the ETI separately to this deliverable D5.1. This section provides a condensed overview of how data privacy and protection will be managed in the Uptake Trial.

4.5.1 What data will be collected?

TRL regards the lawful and sensitive treatment of personal information as critical to the success of TRL's operations, and has implemented formal procedures since 1988. TRL's Data Protection and Information Security Policy covers TRL's obligations under the Data Protection Act, Freedom of information Act and Environmental Information Regulations. TRL's Procedures comply with the information security standard ISO/IEC 27000 and reflect government publications such as the Data Handling Procedures in Government Report and the Data Sharing Review. They also comply with the Cross Government Actions: Minimum Mandatory Measures as outlined by the Cabinet Office.

Table 19 provides an overview of the data that will be collected during the Consumer Uptake Trial. The project will only collect and use Personal Information for the purposes of delivering the CVEI project. Consent will be obtained from participants, as outlined in section 2.2.

Table 19: Data to be collected during the project and purpose

Type of Data	Source	Purpose
Contact, personal details, driving history (Name; DoB; Address; Sex; Email address; status of driving license; vehicle ownership)	Filter Survey 1	To communicate with the participant during recruitment and during the trial. To determine whether the participant meets the basic requirements of the trial. To enable analysis on the basis of demographics to answer the project research questions.
Personal demographics; Travel habits; Household profile	Filter Survey 2	To determine whether the participant meets the full requirements of the trial. To enable analysis on the basis of demographics, travel habits and household profile to answer the project research questions.
Consent to participate; participant signature	Signed consent form	To ensure the participant understands and accepts the terms of participation in the trial, and to maintain a record of that consent.
Attitudinal responses Personal options and choice selection	Questionnaires / Choice experiment	To enable analysis to answer the project research questions (see section 2.8).
Actual travel patterns Fuel state (inc. charge)	On vehicle data capture	To understand mainstream consumer vehicle usage patterns (see section 2.10).

4.5.2 Who will have access to the data?

Table 20 below (page 121) summarises which organisations will have access to the various data collected over the course of the project. Partners will only have access to data required for the achievement of the Tasks set out in the contract and necessary for the achievement of project objectives. Data will be anonymised wherever possible whilst permitting the required data analysis to answer the research questions and provide reporting and insight to the ETI.

The TRL project team will have access to data through the project SharePoint site. Access to the SharePoint site is restricted to project team members only. All data will be stored in the project area. Databases of participants will be password protected within this SharePoint area as a further data protection safeguard.

Following completion of Filter Survey 1, each participant will be assigned a Participant ID. All subsequent data collected will be linked to the Participant ID, rather than a participant's name or other personal details, in order to anonymise data.

Personal contact details of the participants will only be shared with Cenex if the participant will be managed by Cenex. Cenex will not have access to the personal contact details of participants who will be managed by TRL.

EV Connect will undertake data cleaning of vehicle telematics. This data will be linked to a participant ID, not the participant's name or other personal details. These processed datasets will then be passed to TRL for analysis.

TRL will also share the datasets with Baringa, Element Energy and Shell for analysis. Baringa and Element Energy will have access to processed and anonymised vehicle telematics data. This data will be linked to a participant ID, not the participant's name or other personal details.

Shell will have access to processed and anonymised vehicle telematics. This data will be linked to a participant ID, not the participant's name or other personal details.

TRL will be responsible for data cleaning of questionnaire data. Element Energy will be responsible for cleaning of choice experiment data.

The ETI will have access to questionnaire and telematics data (linked together via Participant IDs). This will be provided on an encrypted hard-disk and delivered to the ETI by-hand, along with a document setting out who is permitted to access the data and for what purpose.

Table 20: Proposed data structures and intended content of the anonymised data

Who has access? P = Personal data X = Not personal data

Data Source	Type of Data	How collected?	TRL	Cenex	Rolec	ChargedEV	EV Connect	FleetCarma	Baringa/ Element	Shell	Accent	SmartSurvey
Filter Survey 1	Name; DoB; Address; Sex; Email address status of driving license; vehicle ownership	SmartSurvey online questionnaire	P									
Filter Survey 2	Personal demographics; Travel habits; Household profile	SmartSurvey online questionnaire	P									
Contact information	Name; Address; Email; Phone No.	Filter Survey 1	P	P		P						P
Consent form	Consent to participate; participant signature	Information letter	P									
Questionnaires	Attitudinal responses, personality scales, purchasing decisions, trial feedback	Online questionnaire tool	X								X	
Choice Experiment	Personal options and choice selection	Online questionnaire tool	X						X		X	
On vehicle data capture (including GPS)	Actual travel patterns Fuel state (inc. charge)	Vehicle telematics	P				X[1]	P	X[1]	X[1]		
On chargepoint data capture	Actual charging patterns	Chargepoint	X		X		X		X			

Notes:
1 GPS coordinate information will be removed by TRL, where required, replaced with location coding such as “home”, “away from home 1”, “away from home 2” etc.

4.5.3 What will happen to the data at the end of the project?

Table 21 outlines the protocol for each partner at the end of the project. TRL will confirm to the ETI at the end of the project that personal information has been destroyed in accordance with this protocol.

Table 21: End of project protocol for data

Partner	What will happen to data held?
TRL	All personal data will be destroyed at the end of the project. Questionnaire and telematics data (linked together via Participant IDs) will be shared with the ETI as part of the final deliverables for the project and stored by TRL for seven years for audit purposes, in accordance with the Stage 2 contract between the ETI and TRL.
Cenex	All data held will be destroyed at the end of the project.
EV Connect	All data held will be passed to TRL and destroyed at the end of the project.
Rolec	Personal information will be held for 12 months after chargepoint installation, for warranty purposes. Data will then be destroyed.
FleetCarma	All data held will be passed to TRL and destroyed at the end of the project.
Baringa	All data held will be destroyed at the end of the project.
Element Energy	All data held will be destroyed at the end of the project.
Shell	All data held will be destroyed at the end of the project.
ETI	Anonymised data will be passed to the ETI at the end of the project to allow further analysis. All data held by the ETI will be stored securely. Anonymised data may be shared with ETI Members. No personal information will be provided to the ETI without the prior written consent of the ETI, and in accordance with the principle that access to personal information will not be provided to any party other than as required for the delivery of the trials.

4.5.4 What processes are in place for managing data protection?

4.5.4.1 TRL's data protection processes

Charmaine Mills, TRL's Quality Assurance Manager, will have overall responsibility for data protection on the project. Charmaine will undertake a minimum of two audits of data protection on the project, to confirm that systems and processes are being observed and the project is operating in accordance with this document.

Hannah Al-Katib, Project Manager, will have overall responsibility to ensure that the roll-out and implementation of the systems and processes set-out in this document is undertaken across all relevant staff within TRL and in partner organisations.

All data will be stored and shared securely in ways which are fully compliant with TRL Code of Practice for Handling Personal and Sensitive Information, which is compliant with the Data Protection Act 1998 and ISO 27001.

The Code of Practice demonstrates TRL's ability to control data and enforces mechanisms to allow TRL to control and protect information that may be personal, sensitive or protectively marked. Section 8 of the TRL Code of Practice for Handling Personal and Sensitive Information describes the process of undertaking a Privacy Impact Assessment (PIA) this states, inter-alia:

> *"A Privacy Impact Assessment is a risk assessment to determine the impact and mitigating actions due to the loss of confidentiality, integrity or availability of personal information used in corporate applications or research projects. For projects, this process will complement the project risk register. The Head of Compliance will assist the Information Asset Owner (IAO), usually the Project Manager or project lead, with the creation and maintenance of any PIA. Each PIA includes:*
>
> ** An assessment of the Information risk*
>
> ** The appropriate level of protection*
>
> ** A defined review period*
>
> ** Sign off by the IAO and the Compliance Manager. "*

The TRL Integrated Management System and TRL Information Security Management System specify the company policies, procedures, risk management, safe working methods and guidance in direct response to the requirements and the TRL certification to ISO 9001, 14001, 18001 and 27001 standards and seek to demonstrate its commitment to continual improvement.

Electronic data will be stored in TRL's secure project area on SharePoint. The project SharePoint area is restricted to staff who require access for the project. Within the SharePoint area, specific folders and databases containing personal information will be further locked-down and password-protected so that only those staff members requiring them for recruitment, charge-point installation management, and participant management purposes have access. During the project, any physical data generated will be stored in TRL's Crowthorne House office, in locked cabinets.

Where vehicle hand-overs are undertaken by Cenex, physical copies of paperwork will be stored in Cenex's offices in locked cabinets and transferred in person to TRL at the end of each trial; electronic paperwork will be transferred between Cenex and to TRL via the secure Cobweb (external SharePoint) system. Where vehicle hand-overs are undertaken at the off-site location close to TRL, physical copies of paperwork will be returned to TRL by TRL staff members, to be stored in locked cabinets. Where the timing of immediate transfer of physical paperwork to TRL is impractical, TRL will provide a locked cabinet on-site at the storage location to which only TRL has keys. Electronic paperwork will be uploaded to TRL's SharePoint system on-site. Cenex does not need to store any personal data electronically on Cenex's systems.

TRL's compliance team undertakes regular audits in order to ensure compliance by project teams with TRL's protocols and procedures. TRL will undertake data protection audits of the project, including some subcontractors, at the following points (as a minimum):

(i) An initial review, for the uptake trial, covering Rolec's installations, TRL and Fleet Carma only, in May 2017; and

(ii) A more comprehensive review, after the start of the charging trial, in August 2017.

Any data protection issues or breaches identified during the trials will be immediately reported to the Project Manager. This will include actual or suspected breaches of:

- the Data Protection Laws;
- TRL's(or any subcontractor's) data protection policies or protocols; and
- any accidental or unauthorised access to Personal Information.

The Project Manager will promptly report to the ETI the issue and will inform TRL's Compliance Manager and, if necessary, the Mini Ethics Panel to agree appropriate actions to manage the issue. The Project Manager will fully inform the ETI of any data protection matters or issues as specified in the Contract.

4.5.4.2 Rolec's and Charged EV's data protection processes

TRL has reviewed Rolec's data protection processes as part of the Supplier Information Questionnaire, which all suppliers must complete. As part of this, Rolec has provided TRL with copies of its data protection policy and ISO 27001 certification.

Rolec's installation contractor (ChargedEV) will be provided with the contact details of participants in order to be able to install chargepoints in participants' homes and maintain warranty of the installations. Participant details necessary for installation will be provided to ChargedEV by TRL via the secure Cobweb (exteral SharePoint) system. TRL will require permission from participants to share their contact details with ChargedEV prior to doing so.

ChargedEV will retain the contact details of individuals for a period of 12 months, as the warranty for the installation of the chargepoint will transfer to the participant on completion of the trial. Thereafter contact information will be destroyed.

4.5.4.3 Cenex's data protection processes

TRL has reviewed Cenex's data protection processes as part of the Supplier Information Questionnaire, which all suppliers must complete. Cenex is registered under the Data Protection Act, and has named senior staff responsible for data security across the company. They ensure that customer information, including personal information is collected, held and maintained in a secure and confidential manner. Cenex will dispose of project data safely and securely at the end of the project.

The details of participants managed by Cenex will be provided to Cenex by TRL via the secure Cobweb (exteral SharePoint) system. Cenex will return any electronic copies of paperwork from participants to TRL via the Cobweb system.

4.5.4.4 FleetCarma's data protection processes

FleetCarma's platform is hosted within a secure Microsoft Azure cloud. The Azure Security Center provides continuous security-health monitoring.

Azure uses industry-standard protocols to encrypt data in transit as it travels between devices and Microsoft datacentres, and as it moves within datacentres and data at rest in Azure Storage. Capabilities include:

- Protection for data in transit and at rest, including encryption for data, files, applications, services, communications, and drives.
- Support for and use of numerous encryption mechanisms, including SSL/TLS, IPsec, and AES.
- Configuration support for BitLocker Drive Encryption for sensitive information.
- Access to data by Azure support personnel requires explicit permission and is granted on a "just in time" basis that is logged and audited, then revoked after completion of the engagement.

Further information on the Azure system's security processes are detailed at the following URL: https://docs.microsoft.com/en-us/azure/security/azure-security-services-technologies

Confirmation of the system's compliance with the Privacy Shield and Safe Harbor Frameworks is set out in the following URL: https://privacy.microsoft.com/en-US/microsoft-eu-us-privacy-shield.

The FleetCarma dongle device, which plugs into the OBD II port of the vehicle, has a very small data storage capability. This is only used if sufficient mobile coverage cannot be obtained to send information to the FleetCarma back-office. Once the mobile signal has been re-established, the data stored is transmitted to the FleetCarma back-office and deleted from the dongle device.

4.5.4.5 EV Connect's data protection processes

Data Security

Communication between FleetCarma, EV Connect and TRL has established that EV Connect's systems and software for this project can be operated without requiring the explicit GPS coordinates of any participant's home charge point to be provided to EV Connect. Data from the charge event, recorded from the chargepoint via Rolec's cloud to EV Connect, will be used to determine plug-in and plug-out events in order to trigger interaction with the participant via the mobile phone App when required.

EV Connect's platform is hosted within a Virtual Private Cloud (VPC) at Amazon Web Services (AWS). All key services are load-balanced among geographically distributed redundant servers located in the US-Oregon and US-Virginia data centres.

All user access to the VPC is strictly controlled and login credentials are limited to specific trusted personnel using pre-shared keys (no username / passwords). External to internal communication to the VPC is managed by a Sophos firewall which monitors and performs domain, traffic type and packet filtering. All communications are handled over HTTPS secured by SSL SHA-256 encryption.

Servers with specific, non-externally facing tasks and business logic are isolated in a subnet to prevent any external access and function under their own unique set of security and access rules.

EV Connect's platform utilizes a MongoDB (noSQL) database which is not susceptible to database insertion attacks.

EV Connect is currently undergoing penetration ("Pen") testing as part of its internal security procedures, and will provide documentation of the results of this audit upon completion.

AWS Data Centre Security

All of AWS's data centres are state of the art, utilising innovative architectural and engineering approaches. Amazon has many years of experience in designing, constructing, and operating large-scale data centres. This experience has been applied to the AWS platform and infrastructure. AWS data centres are housed in nondescript facilities.

- **Physical Access** - physical access is strictly controlled both at the perimeter and at building ingress points by professional security staff utilising video surveillance, intrusion detection systems, and other electronic means.
- **Personnel Access** - authorised staff must pass two-factor authentication a minimum of two times to access data centre floors. All visitors and contractors are required to present identification and are signed in and continually escorted by authorised staff. AWS only provides data centre access and information to employees and contractors who have a legitimate business need for such privileges. When an employee no longer has a business need for these privileges, his or her access is immediately revoked, even if they continue to be an employee of Amazon or Amazon Web Services. All physical access to data centres by AWS employees is logged and audited routinely.
- **Fire Detection and Suppression** - automatic fire detection and suppression equipment has been installed to reduce risk. The fire detection system utilises smoke detection sensors in all data centre environments, mechanical and electrical infrastructure spaces, chiller rooms and generator equipment rooms. These areas are protected by either wet-pipe, double-interlocked pre-action or gaseous sprinkler systems.
- **Power** - the data centre electrical power systems are designed to be fully redundant and maintainable without impact to operations, 24 hours a day, and seven days a week. Uninterruptible Power Supply (UPS) units provide back-up power in the event of an electrical failure for critical and essential loads in the facility. Data centres use generators to provide back-up power for the entire facility.
- **Climate and Temperature** - climate control is required to maintain a constant operating temperature for servers and other hardware, which prevents overheating and reduces the possibility of service outages. Data centres are conditioned to maintain atmospheric conditions at optimal levels. Personnel and systems monitor and control temperature and humidity at appropriate levels.
- **Management** - AWS monitors electrical, mechanical, and life support systems and equipment so that any issues are immediately identified. Preventative maintenance is performed to maintain the continued operability of equipment.
- **Storage Device Decommissioning** - when a storage device has reached the end of its useful life, AWS procedures include a decommissioning process that is designed to prevent customer data from being exposed to unauthorized individuals. AWS uses the techniques detailed in DoD 5220.22-M ("National Industrial Security Program

Operating Manual ") or NIST 800-88 ("Guidelines for Media Sanitization") to destroy data as part of the decommissioning process. All decommissioned magnetic storage devices are degaussed and physically destroyed in accordance with industry-standard practices.

AWS is certified against four ISO standards:

- ISO 27001: Information Security Management Systems (ISMS)
- ISO 27017: Cloud-specific security control guidance
- ISO 27018: Protection of Personally Identifiable Information
- (PII) in public clouds
- ISO 9001: Quality management systems

AWS is also audited and certified against the Service Organization Control (SOC) standards:

- SOC – 1 (commonly referred to as SSAE16, ISAE 3402, or SAS 70)
- SOC – 2
- SOC – 3

Identification of an individual

EV Connect's back office system does not require the name, address, or contact details of any participant. The system will operate with a participant ID number only. Where required for the trial, TRL will link a participant ID with a vehicle ID and chargepoint ID using EV Connect's portal.

Where the EV Connect system requires an email address (such as for mobile App log-in) this will be a fictitious email address simply for the purpose of the trials, such as: participantID@cvei.evconnect.com. This will be forwarded by TRL's systems, thus only requiring TRL to have the real email address.

Transferring data outside of the EEA

Data transfer between vehicle telematics FleetCarma and EV Connect, and chargepoint telematics and EV Connect will be via Secure HTTP.

TRL has previously transferred data to the United States. This process was managed under the U.S.-Swiss Safe Harbor Framework and the TRL Code of Practice for Handling Personal and Sensitive Information was followed.

TRL's Head of Risk, Compliance & Business Improvement has reviewed the EU-US Privacy Shield principles and has confirmed that TRL complies with them. EV Connect and FleetCarma have provided confirmation to TRL that they will fully comply with the EU-US Privacy Shield arrangements. In addition, EV Connect has agreed to adhere to TRL's Code of Practice for the duration of the CVEI project.

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6 List of appendices in Part 2

The following appendices to this study plan are provided in Part 2 of Deliverable 5.1.

D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

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RPN3873

PROJECT REPORT

CVEI Stage 2

Deliverable D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Part 2 – Appendices for the Consumer Uptake Trial

Report details

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Quality approval:			
H Al-Katib (Project Manager)		S Skippon (Technical Reviewer)	

Disclaimer

This document is provided to the ETI under, and is subject to the terms of, the Energy Technologies Institute's Agreement for the Consumers, Vehicles and Energy Integration (CVEI) Project – Stage 2.

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5.0	06/09/17	Fifth version delivered to client	HAK/GB	SS
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6.1	22/09/17	Revised version delivered to client	GB	AW

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Preface

The purpose of the Consumers, Vehicles and Energy Integration (CVEI) project is to investigate challenges and opportunities involved in transitioning to a secure and sustainable low carbon vehicle fleet. The project explores how the integration of vehicles with the energy supply system can benefit vehicle users, vehicle manufacturers and those involved in the supply of energy.

The objective of the project is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. In addition to developing new knowledge and understanding, the project aims to develop an integrated set of analytical tools that can be used to model future market scenarios in order to test the impact of future policy, industry and societal choices.

This report is “Deliverable 5.1: Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials” for Stage 2 of the CVEI project.

There are four parts to this report:

- Part 1:Consumer Uptake Trial Study Plan
- Part 2: Appendices to Consumer Uptake Trial Study Plan (this document)
- Part 3: Consumer Charging Trials Study Plan
- Part 4: Appendices to Consumer Charging Trials Study Plan

This document covers Part 2, the Appendices to the Consumer Uptake Trial Study Plan. The other parts of Deliverable 5.1 are provided in separate documents.

The contents of this document provide example copies of the materials which will be used throughout the trial (such as recruitment adverts, questionnaires, and the Participant Information Pack).

Appendix A Recruitment adverts

A.1 Flyers

What will I have to do?

You will need to trial one or more vehicles as part of your everyday driving.

Who is the research for?

The research will be undertaken by TRL.

When will it be?

Trials will take place between April and December 2017.

What do I get for my time?

If you take part in the trial you will receive **at least £200** and will also be entered into a prize draw for the chance to **win a further £2,500**, as a thank you from us for taking part.

Am I suitable?

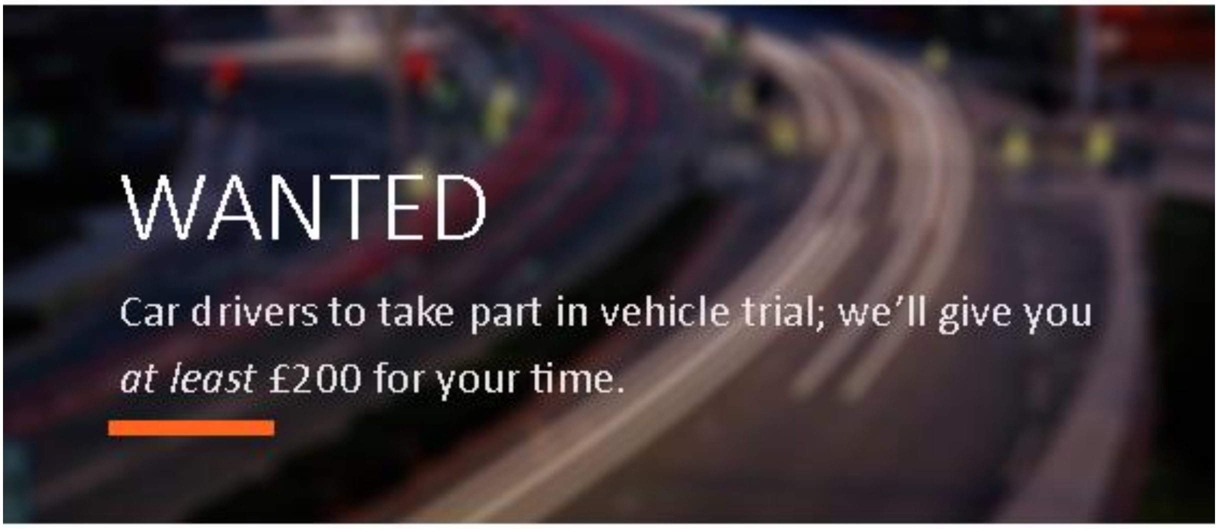
We are looking for car drivers of all ages who have held a valid UK licence for more than two years.

How do I sign up?

All you need to do is complete a short survey by using the QR code or visit [insert URL] to register your interest.

TRL is the global centre for innovation in transport and mobility. It provides world-leading research, technology and software solutions for surface transport modes and related markets of automotive, motorsport, insurance and energy. More information can be found at www.trl.co.uk

THE FUTURE OF TRANSPORT



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We are looking for car drivers of all ages who have held a valid UK licence for more than 2 years.

How do I sign up?

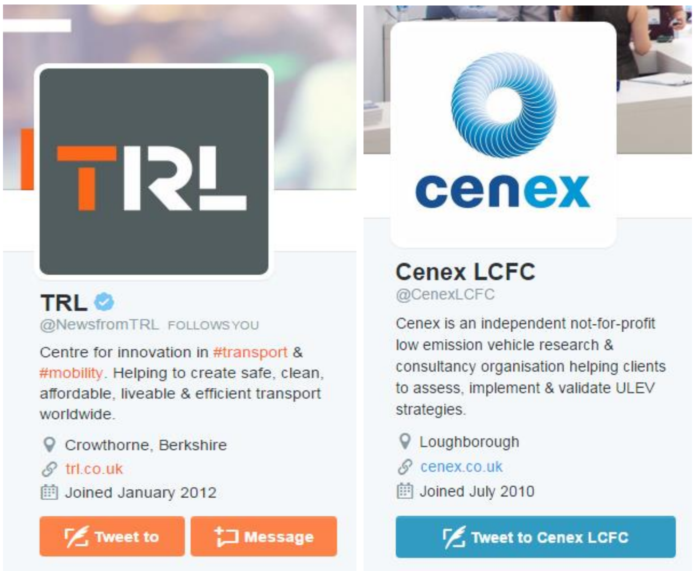
All you need to do next is complete a short survey by using the QR code or visit [insert URL] to register your interest.

TRL is the global centre for innovation in transport and mobility. It provides world-leading research, technology and software solutions for surface transport modes and related markets of automotive, motorsport, insurance and energy. More information can be found at www.trl.co.uk

A.2 Social media adverts

A.2.1 Twitter

TRL's "@NewsfromTRL" Twitter account (with over 3,000 followers) and Cenex's "@CenexLCFC" Twitter account (with around 800 followers) will be used to advertise the trial and invite prospective participants to register their interest by completing Filter Survey 1. Example Tweets which will be posted are shown in Figure 1 below.



Research needs you! We're looking for volunteers to take part in a vehicle trial [**Insert URL**]

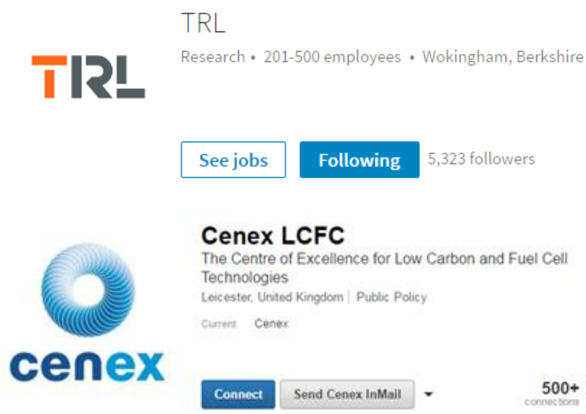
Volunteer for our latest #research trial and we'll give you at least £200 for your time [**Insert URL**]

Car drivers wanted! We're looking for drivers to take part in vehicle trial [**Insert URL**]

Figure 1: Example Twitter adverts

A.2.2 LinkedIn

TRL's LinkedIn page has over 5,000 followers; this will also be used to advertise the trial and invite prospective participants to register their interest by completing Filter Survey 1. Example posts are shown in Figure 1 below.



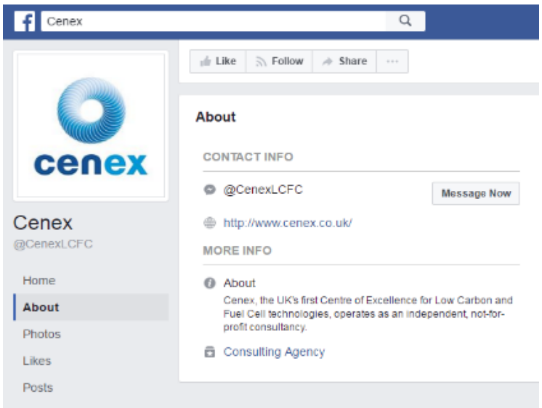
We're looking for volunteers to take part in a vehicle research trial; participants will get at least £200 for their time. Please register your interest here! [**Insert URL**]

Car drivers wanted! We're looking for drivers to take part in cutting-edge vehicle research. Please register your interest here! [**Insert URL**]

Figure 2: Example LinkedIn adverts

A.2.3 Facebook

Cenex's Facebook page (www.facebook.com/CenexLCFC) will be used to post adverts. An example advert is shown in Figure 3 below.



We're looking for drivers who would be willing to trial one or more vehicles as part of their everyday driving.

If you take part in the trial you will receive at least £200 as compensation and will also be entered into a prize draw with a chance to win a further £2,500 as a thank you from us for taking part.

We are looking for car drivers of all ages who have held a valid UK licence for more than 2 years. If you are interested in taking part you will need to complete a short survey: **[Insert URL]**

Figure 3: Example Facebook advert

A.3 Adverts on TRL website

TRL's website (www.trl.co.uk) will also be used to post adverts about the Consumer Uptake Trial. The website provides opportunity for more information to be given to prospective participants than the limited space available with posts on Twitter and LinkedIn. An example advert from a separate research project is shown in Figure 4 below, for illustrative purposes.

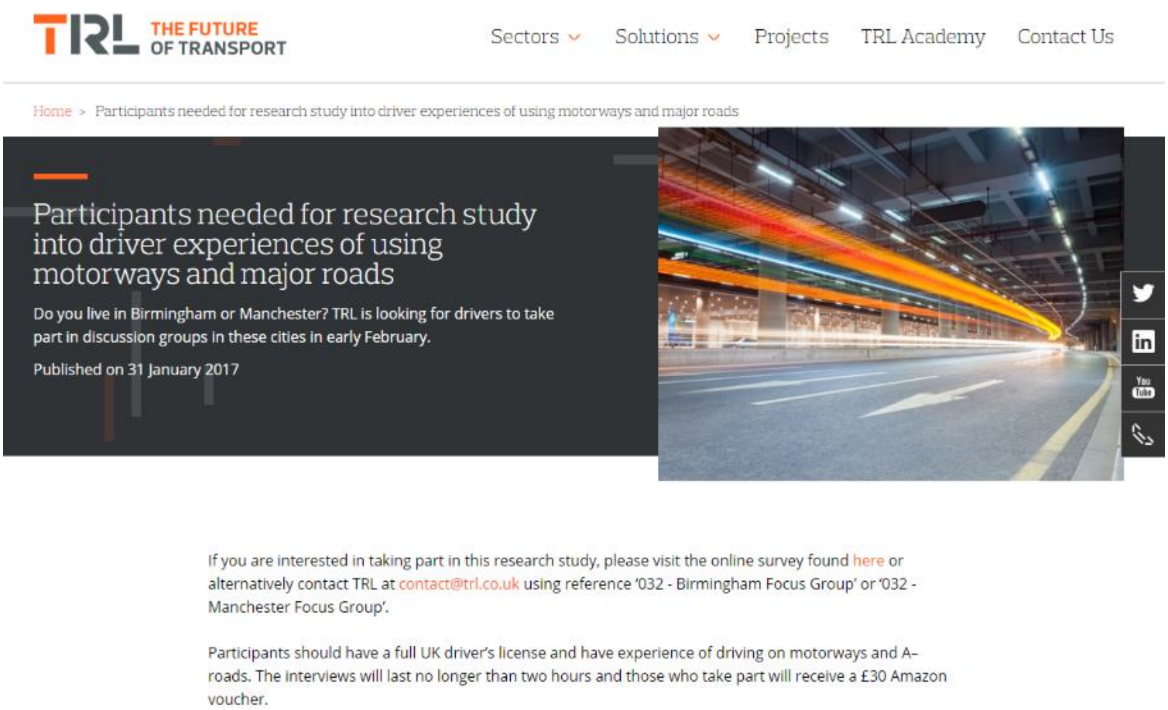


Figure 4: Example research advert posted on TRL website

A.4 Email adverts for participants on TRL participant database

TRL has a participant database of over 2,000 volunteers who have agreed to be contacted about participating in future TRL projects. An email containing a copy of the flyer and a link to Filter Survey 1 will be emailed to all participants on the database. An example email is shown in Figure 5 below.

Dear [Name]

You have previously indicated that you would be interested in being contacted for TRL research. We are contacting you as we are currently recruiting for a new study which may be of interest.

For more information about the trial and how to get involved, click on the link below. This will take you to an online information sheet and recruitment survey.

[**Insert URL**]

Kind regards,

TRL

Figure 5: Example email to be sent to participants on TRL participant database

A.5 Email for flyer distribution

An email containing a copy of the flyer will be emailed to organisations in the advertising database. An example email is shown in Figure 5 below.

Dear Sir/Madam,

I am contacting you on behalf of TRL (the UKs Transport Research Laboratory). We are currently recruiting participants for a vehicle trial.

[**Insert flyer**]

It would be greatly appreciated if you could share the attached flyer within your organisation by posting it on your intranet and/or notice boards.

If you would like any additional information, please email vehicletrials@trl.co.uk.

Kind regards,

TRL

Figure 6: Example email to be sent to with flyer

Appendix B Recruitment screening questionnaires

B.1 Filter Survey 1

B.1.1 Participant information

Thank you for taking an interest in this research.

The research will involve you trialling one or more vehicles during your everyday driving. Trials will take place between Aprils and December 2017.

Participants who take part in the trial will receive at least £200 as compensation for participating and will also be entered into a prize draw with a chance to win a further £2,500 as a thank you for taking part.

When you click next at the bottom of this page, you will be taken to a short survey where we will ask you a few questions about yourself and your driving patterns. This will allow us to see if you might fit with the needs of this research.

Your response to this survey will register your interest and we will then contact you about your potential involvement in the trial and provide you with more information.

All data collected through this survey will be stored securely and will not be used for any purposes other than this research.

If you have any questions, please email vehicletrials@trl.co.uk using "Vehicle trial - Recruitment step 1" as the subject line and we will get back to you as soon as possible.

B.1.2 Survey

B.1.2.1 Driving history

1. How long have you held a valid UK driving licence?

- Less than 2 years [Skip logic: End survey]
- 2 – 4 years
- 4 – 6 years
- 6 – 8 years
- 8 – 10 years
- 10+ years

2. **How many penalty points do you have on your driving licence? (this information is required for insurance purposes and will be subject to a DVLA check if you are selected to participate in the trial)**

- 0
- 1
- 2
- 3
- 4 [Skip logic: End survey]
- 5+ [Skip logic: End survey]

3. **Have you had any at fault claims within the last 3 years?**

- Yes [Skip logic: End survey]
- No

4. **How often do you drive?**

- Every day
- Almost every day
- Once every two or three days
- About once a week [Skip logic: End survey]
- About once a fortnight [Skip logic: End survey]
- About once a month [Skip logic: End survey]
- Less than once a month [Skip logic: End survey]

5. **Are you currently a car owner? (e.g. outright purchase, lease, hire-purchase, personal contract purchase)** [Single answer]

- Yes
- No [Skip logic: End survey]

If you own more than one car, please answer the following questions about your main car i.e. the car you use most often.

6. **Is your car a company car? (i.e. a car provided by your organisation)** [Single answer]

- Yes [Skip logic: End survey]
- No

7. **Do you have access to off street parking (private driveway, carport, or garage) for your car?** [Single answer]

- Yes
- No [Skip logic: End survey]

8. **Have you owned or regularly driven (i.e. more than once per year) a Battery Electric Vehicle (e.g. the Nissan Leaf) or a Plug-in Hybrid Electric Vehicle (e.g. Toyota Prius Plug-in Hybrid) within the last 5 years?** [Single answer]

- Yes [Skip logic: End survey]
- No

9. **Do you intend to acquire an electric vehicle in the next 6 months?**

- Yes [Skip logic: End survey]
- No

B.1.2.2 Information about you

10. **What is your postcode?**

Please complete in two boxes below. For example, if your postcode is RG40 3GA, you would write RG40 in the first box, and 3GA in the second box.

Please be assured that this information will only be used for this research.

11. **Please provide us with your… Age**

- 19-24 [Skip logic: If answered 19-24 for this question and >0 for Q2, end survey]
- 25-29
- 30-34
- 35-39
- 40-44
- 45-49
- 50-54
- 55-59
- 60-64
- 65-69
- 70+

12. Gender

- Male
- Female
- Other
- Prefer not to say

13. Please provide your current contact details so that we can contact you about the trial and provide you with more information.

First name	
Last name	
Contact number	
Email address	

B.1.2.3 End

Thank you for taking the time to complete this survey!

We will contact you soon with more information.

B.2 Filter Survey 2

B.2.1 Participant information

Thank you for taking an interest in this research. The answers you provided in survey 1 indicate that you may be a good fit with the needs of the research; we just need a little bit more information before we can formally invite you to participate.

What is involved in the research?

The research is made up of two separate trials:

Trial 1 aims to understand the views and opinions of the general public towards vehicles including petrol vehicles, plug-in hybrid electric vehicles (which have both a petrol engine and a re-chargeable electric powertrain) and fully battery electric vehicles (which have a re-chargeable electric powertrain only). Trial participants will be asked to use each of the three vehicles for four days (in back-to-back slots over a 12 day period) for their regular day-to-day journeys in replacement of their current car. This trial will take place between the end of April and September 2017.

Trial 2 aims to understand electric vehicle usage and charging. Participants will be given either a plug-in hybrid electric car or a battery electric car (dependent on suitability) for a period of 8 weeks to use for their day-to-day journeys. This trial will take place between July and December 2017.

For both trials, we will arrange for a chargepoint to be installed at participants' homes (free of charge). These can be kept by participants or removed after the trial.

Participants will only be able to take part in **one** of the two trials.

Remind me why I should participate?

By participating in this research you will gain direct experience of using modern vehicles for your everyday driving needs, providing valuable data for a project that is at the forefront of the future of transport.

Participants will receive £200 as compensation for participating in Trial 1, or up to £250 as compensation for participating in Trial 2. All participants who take part in the trial will also be entered into a prize draw with a chance to win a further £2,500 as an additional thank you for taking part.

What is this survey for?

This short survey will allow us to see whether you are suitable for one of the trials as well as gather some further necessary information. It should only take a few minutes to complete.

All data collected through this survey will be stored securely and will not be used for any purposes other than this research.

If you have any questions, please email vehicletrials@trl.co.uk using "Vehicle trial - Recruitment step 2" as the subject line and we will get back to you as soon as possible.

B.2.2 Survey

Please enter your unique reference number. This can be found in the email inviting you to complete this survey.

B.2.2.1 Trial interests

1. **Which trial(s) are you interested in participating in?** [Single answer]

- Either
- Trial 1 (using three different vehicles for 4 days each)
- Trial 2 (using a fully battery electric vehicle or plug-in hybrid electric vehicle for 8 weeks)

2. **Looking at the list below, which best describes your current living arrangements?** [Single answer]

- Home owner
- Tenant
- House share
- Living with parents
- Other (please describe):

3. **For the trial you will need a vehicle chargepoint installed where you live. Are you willing to have one installed (subject to the permission of the homeowner)?**

- Yes
- No

* As mentioned on the information page, this will be free of charge and can be uninstalled after the trial if requested.

B.2.2.2 Your car(s)

4. **How many cars are registered to your address?**

5. **How many licensed drivers are there in your household?**

If you own multiple cars, please answer the following questions about your <u>main</u> car (i.e. the one you drive most often).

6. Which of the car types listed below best describes your main car?

	**Mini** e.g. Hyundai i10, Volkswagen up!	☐
	**Supermini** e.g. Ford Fiesta, Vauxhall Corsa, Volkswagen Polo	☐
	**Lower Medium** e.g. Ford Focus, Vauxhall Astra, Volkswagen Golf	☐
	**Upper Medium** e.g. BMW 3 Series, Vauxhall Insigna, Audi A4	☐
	**Executive** e.g. Mercedes- Benz C Class / E Class, BMW 5 Series	☐
	**Luxury** e.g. Mercedes- Benz S Class, Jaguar XJ, Mercedes- Benz SL	☐
	**Specialist Sports** e.g. Audi TT, Mercedes- Benz SLK, Volkswagen Scirocco	☐

	**Dual Purpose** e.g. Kia Sportage, Range Rover Evoque, Honda CR-V	☐
	**MPV** e.g. Vauxhall Zafira, Ford C-Max, Ford B-Max, Ford S-Max	☐

7. **How many people typically drive this car?**

8. **What is your approximate annual mileage?**

- Less than 5,000
- 5,000 – 7,500
- 7,501 – 10,000
- 10,001 – 12,500
- 12,501 – 15,000
- 15,001 – 20,000
- 20,001 – 30,000
- More than 30,000

9. **How often do you make a journey that is over 80 miles long?** [Single answer]

- Every day
- Almost every day
- Once every two or three days
- About once a week
- About once a month
- A few times a year
- Once a year at most
- Almost never

B.2.2.3 Domestic energy information

10. Do you have an Android or iOS (Apple) smart phone?

- Yes
- No

11. Is your household electricity supply on an Economy 7 tariff or a pre-paid card energy meter? [Single answer]

- Yes
- No

12. Does your household have solar panels that provide electricity to the home supply (Photovoltaic solar panels)? [Single answer]

- Yes
- No

B.2.2.4 End

Thank you for taking the time to complete this survey!
We will contact you soon with more information.

Appendix C Vehicle comparison table

Type	ICE	BEV	PHEV
Model name	Golf GT Edition	e-Golf	Golf GTE
Model year	2016	2017	2017
Style	Hatchback	Hatchback	Hatchback
Engine	1.4 TSI ACT (petrol)	Electric motor	1.4 TSI (petrol)
Gearbox	7 speed auto DSG	Direct drive	6 speed auto DSG
Colour	Reflex silver	Tungsten silver	Tungsten silver
Decal	N/A	Blue trim in front grille	Blue trim in front grille
Doors	5	5	5
Wheels	18" alloy	16" alloy	17" alloy
Wheel design	10-spoke alloys, silver calipers	5-spoke alloys, silver calipers	5-spoke alloys, blue calipers
Number of seats	5	5	5
Seat design	Sports seats	Sports seats	Sports seats
Seat fabric	Cloth - black	Cloth - black	Cloth – black with blue stitching
Power (PS)	150 @ 5000rpm	136 @ 3000rpm	204 @ 5000rpm
Acceleration (0-62) (s)	8.2	9.6	7.6
Top speed (mph)	134	93	138
Fuel tank capacity (litres)	50	n/a	40
Fuel economy (mpg)	58.9 (combined)	n/a	156.9 (combined)
Emissions (CO_2 g/km)	113	0	40
Units to charge (kWh) (nominal capacity)	n/a	35.8	8.7
Maximum AER	n/a	186	31
Expected AER	n/a	175	25
Charge time (AC) 2.3kW (hrs)	n/a	17	3.75
Charge time (AC) 3.6kW (hrs)	n/a	10.5	2.25
Charge time (DC) for 80% (hrs)	n/a	0.75	n/a
Adaptive cruise control	✓	✓	✓
Nav/radio	✓	✓	
Front and rear parking sensors	✓	✓	✓
LED headlights		✓	✓
Remote central locking	✓	✓	✓
Front and rear electric windows	Front only	✓	✓
Heated rear windscreen	✓	✓	✓
Bluetooth	✓	✓	✓
ABS	✓	✓	✓
Curtain airbags	✓	✓	✓

ESC	✓	✓	✓
Perimeter and interior alarm	✓	✓	✓
Climate control	✓	✓	✓
Heated and adjustable door mirrors	✓	✓	✓
Electronic parking brake	✓	✓	✓
Sunroof	✓		
Central arm rest	✓	✓	
Cup holders	✓	✓	✓
Retractable cover for cup holders	✓	✓	
Touchscreen infotainment system	✓	✓	✓
Hard buttons on side of infotainment system	✓		
Capacitive touch sensitive buttons on side of infotainment system		✓	✓
Digital display dash instruments			✓
Analog display dash instruments	✓	✓	

Appendix D Participant Information Pack

D.1 Information letter

Participant Information Letter – Vehicle Trial

Thank you for your interest in this project. We really value your time and input, which will make an important contribution to this research.

The aim of the trial is to provide you with real life experience of three different vehicles and to gather data about how you use the vehicles and your opinions.

As well as being given the opportunity to use three different cars, you will receive **£200** for taking part in the study and you will be entered into a prize draw to win **£2,500**. You may withdraw from the trial at any point.

This letter explains what you will need to do before, during and after the trial:

When?	What will I have to do?
Before the trial	• Complete the consent form for participating in the trial confirming you agree to the requirements for taking part • Undergo a driving licence check through the DVLA website • Provide a consent form and driving licence check for an additional driver (if you require) • Have a dedicated socket installed in your home for safe charging of the trial vehicles
During the trial	• Replace your car with three trial vehicles for four days each • Collect and return each vehicle to TRL • Drive the vehicles responsibly • Charge each vehicle at least twice • Complete questionnaires at the start and between each vehicle handover
After the trial	• Return the vehicle • Complete the final questionnaire • Decide whether you would like to keep the socket

What will I have to do before the trial?

Complete the consent form for participating in the trial

You have been sent a web link to an online consent form, which you will need to complete to take part in the trial. The consent form makes sure you understand all of the requirements for taking part in the trial, and confirms that you agree to all of them. The requirements are explained in this letter and the insurance summary sheet.

If you have any queries regarding the insurance policy or any of the trial requirements, please do not hesitate to contact the research team (vehicletrials@trl.co.uk or 01344 70014).

Undergo a driving licence check through the DVLA website

Before we hand over the vehicle, you will be required to supply us with your driving licence details and an authorisation code so we can check your licence with the DVLA (please see https://www.gov.uk/view-driving-licence). This allows us to check that your licence is valid with the DVLA in order to add you to the vehicle insurance for the duration of the trials. To obtain the authorisation code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence. Click here or type https://www.gov.uk/view-driving-licence into your browser to obtain the authorisation code. You will be required to provide us with this code as part of your online consent form.

Provide a consent form and driving licence check for an additional driver

We expect you to be the main driver of the trial vehicles and you will be the only person automatically added to the insurance. However, **you may add one other person** in your household to the insurance if they also require use of the vehicles during the trial period. You would need to provide their driving licence details and the authorisation code from the DVLA and they will need to complete an additional driver consent form. They will also be required to meet minimum eligibility criteria for insurance (please see the insurance summary sheet).

Have a dedicated socket installed in your home for safe charging of the trial vehicles

For safety purposes, we require you to agree to the installation of a dedicated 3-pin socket to be fitted to your property to charge the electric vehicles. If you do not own the property, you will need to seek permission from the homeowner.

The socket must be fitted in a suitable location (i.e. a location that would allow you to charge the trial vehicle without the charging cable passing over land which is not an exclusive part of your property, such as a public footway). For example, the socket might be fitted in your garage or to the side of your house near where you park your car.

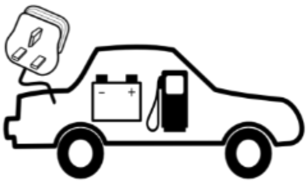
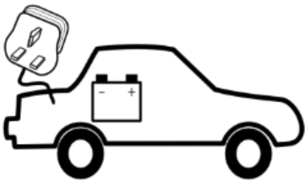
The socket and installation will be provided by Rolec Ltd (an approved electric vehicle chargepoint provider) and Rolec's installation partner, ChargedEV. This process will be managed and paid for by TRL. We will put you in contact with ChargedEV to arrange a convenient time for installation of the socket.

What will I have to do during the trial?

Replace your car with three trial vehicles for four days each

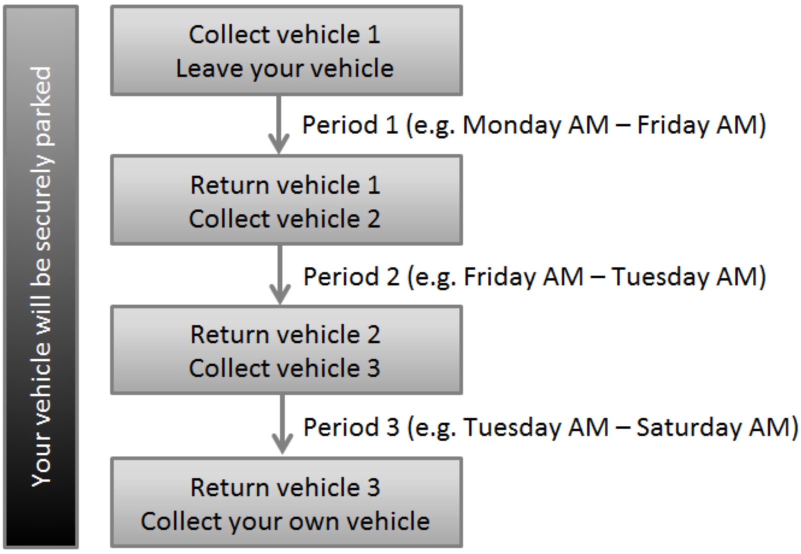
The trial requires that we replace your current car with each of the three vehicles listed below for four days each. You will be asked to use the trial vehicles for your regular day-to-day journeys.

Vehicles you will drive:

VW Golf hatchback	**Conventional vehicle** with a petrol engine	
VW Golf GTE hatchback	**Plug-in Hybrid Electric Vehicle (PHEV) -** which has both a petrol engine and an electric motor	
VW e-Golf hatchback	**Battery Electric Vehicle (BEV)** which has an electric motor only	

Collect and return each vehicle to TRL/Cenex

You will be required to come to either TRL's office in Crowthorne or Cenex in Loughborough (dependant on your location) to collect and return each vehicle. While you are using the trial vehicles, you will be asked to leave your own vehicle with us, which we will store in a secure parking facility.



We will contact you to arrange vehicle hand-over times (between the hours of 07:30 and 20:00 to suit your availability).

Each vehicle hand-over session should take approximately 1-1.5 hours.

During each hand-over session, we will:

- talk you through the vehicle controls and how to charge the vehicle (where applicable);
- accompany you on a short familiarisation drive to ensure that you feel comfortable with each vehicle and with how to charge the vehicle safely (if applicable);
- answer any questions you may have.

Your safety during the trial is our priority. At vehicle handover, we will provide you with an in-vehicle information pack containing:

- the vehicle manufacturer's guidance documents;
- what to do in an emergency;
- who to contact in the event of an issue or incident; and
- details of breakdown cover.

What do I need to bring when I collect the vehicle?

When you collect the first vehicle, please remember to bring:	✓
Your driving licence (and photographic ID if you have a paper licence only);	
An additional form of ID with proof of address (e.g. utility bill or bank statement)	
Signed Vehicle Possession Consent Form	
Any corrective eyewear you require for driving (e.g. contact lenses, glasses)	
Bank Details claim form	
The driving licence, authorisation check code and additional proof of address for one other driver, should you wish them to be insured on the vehicle (subject to restrictions outlined in this letter).	

Drive the vehicles responsibly

You will be required to drive the vehicle responsibly and legally, not smoke in the vehicle, and return the vehicle in the same condition as you received it. As the driver of the vehicle, you are liable for any driving offences, penalties and fines (including parking fines) incurred whilst you are in possession of the vehicle.

If, during the trial, you have any issues with the vehicle or charging equipment that cannot be resolved using information in the in-vehicle information packs, ***please stop using the vehicle and charging equipment and contact us as soon as possible.***

Charge each vehicle at least twice

We will ask you to charge each electric vehicle at least twice during the four days that you use it, which can be done at your home using the dedicated socket or at other locations such as at work or public chargepoints (a charging card will be supplied with the vehicle to provide access to public chargepoints).

When charging at home, you will be responsible for paying for your electricity use. You will also be responsible for paying for the fuel you use in the petrol and Plug-in Hybrid Electric vehicle. Since this is a trial, please note that you will not be able to use vehicle manufacturer specific smartphone apps to interact with the vehicles and the charging equipment.

Complete questionnaires

You will be asked to complete the following questionnaires during the trial:

- Pre-collection questionnaire (30-45 mins): completed online in your own time before you collect the first vehicle.
- Interim questionnaires (10-15 mins): completed at vehicle hand-over after experience with each vehicles.
- Final questionnaire (30-45 mins): completed online in your own time after experience with all vehicles.

What will I have to do after the trial?

Please ensure that the vehicle is returned with as much charge as possible and/or with the same fuel level as when you received the vehicle.

Following the trial, the socket can be kept and re-used (e.g. for plugging in gardening equipment). Using the sockets for any purpose other than charging the vehicles should only be undertaken once the trial is complete. Alternatively, you can have the socket removed (at no cost to you) if you prefer.

What data will we collect and how will we manage it?

Questionnaires

We will collect your questionnaire data (see above), linked to your participant ID. This will not be linked to your name and questionnaire data will be anonymised.

Vehicle data collection

All vehicles used in this study will have telematics[1] devices fitted to them to collect a variety of data while you use them. The data will be collected for research purposes only (it will not be used to make any assessment of your driving). Data which will be collected include GPS (geographical coordinate) data and data about journey distances, journey duration, vehicle speed, charging events and fuel/battery consumption.

Data protection

All information obtained about you for this project will be kept private in compliance with the Data Protection Act. Information related to fair processing of your data (in line with the Data Protection Act) is provided below:

Who is the data controller?	The Transport Research Laboratory (TRL)
Who can you contact regarding your data?	The TRL research team on 01344 770014
How will your data be used and what is the likely outcome of its use?	The data will be used to understand people's use of and interactions with different types of vehicles. It will also be used to understand participants' attitudes towards and perceptions of these vehicles. Results will be used to inform future policy recommendations related to personal transport and the energy system.
Who else will use your data? • Your address and contact details will be passed to ChargedEV in order to arrange installation of a chargepoint at your home. • If you are collecting vehicles from Cenex, your personal details will be passed to Cenex in order for them to undertake DVLA driving licence checks. • Vehicle telematics data will be collected by FleetCarma and passed onto TRL for data analysis purposes. Data retained by FleetCarma will be securely erased at the end of the project. • Vehicle telematics data, questionnaire data and all other personal data will be stored securely and anonymised (you will be assigned a participant ID number and data will only be linked to that number and never directly to your personal details).	

[1] Telematics refers to the collection of vehicle data, such as speed, distance, and fuel consumption.

- Anonymised data (from telematics and questionnaires) will be shared with our project partners (Element Energy, Baringa, EV Connect and Shell) for data analysis purposes.
- Data will be shared with our client (the Energy Technologies Institute) and its agents and successors at the end of the project.
- The results of the study will be shared with our client (the Energy Technologies Institute) and its agents and successors and project partners (Element Energy, Baringa EV Connect and Shell). Results are likely to be published (your identity or personal information will never be disclosed in the published results).

What happens next?

If you are happy to take part in the trial, please complete the online consent form (link given within the covering email). When we receive the completed consent form, one of our researchers will contact you to arrange the chargepoint installation and your vehicle exchange timetable.

If you have any questions, concerns or issues which are not covered by the information provided in this letter or the in-vehicle information packs, please do not hesitate to contact the research team on 01344 770014, who will be available between 9am and 5pm Monday to Friday (excluding public holidays) to answer any questions or queries.

Please remember that you may withdraw from this study at any point.

Many thanks,

The Research Team

D.2 Insurance summary sheet

Insurance Summary Sheet

What are the policy details?

The insurance cover for this trial is **comprehensive** and is provided by Aviva. The insurance includes cover for accidental damage to the vehicle, fire and theft cover and third party cover (cover for injury to other people or damage to their property).

The vehicle can be used for **social, domestic purposes and leisure purposes only**. This does include journeys between your home and your place of work. The vehicle is insured only for Class 1 business use; that is, you can use the vehicle to travel to meetings, but you cannot use the vehicle for any other business travel which is classed as the purpose of your work.

Who is covered by the insurance?

In order to be insured for this trial, **you must confirm that you**:

- are aged **at least 19 years old**;
- have held a **full UK driving licence for at least 2 years;**
- have had **no "at fault" accidents** (where a collision was deemed your fault) within the last 3 years; and
- have received **no penalty points if you are under 25 *OR* no more than 3 penalty points if you are aged 25 and over.**

Only named driver(s) are covered by this insurance policy. You must complete the consent form and undergo a DVLA licence check in order to be a named driver. You will be automatically added to the insurance policy, but please note that **no other driver is insured to drive the vehicle** unless confirmed by TRL prior to the trials. If someone claims to have their own insurance cover, it will **not** provide cover for driving this vehicle while it is being used as part of a trial.

You may add one other person in your household to the insurance if they also require use of the vehicle(s) during the trial period. They will be required to meet minimum eligibility criteria described above, complete the additional driver consent form and undergo a DVLA licence check.

Your responsibilities as the driver

You are responsible for driving safely, responsibly and legally, as well as maintaining the condition of the vehicle for the duration of the trial. You, as the driver of the vehicle, are **liable for any driving offences, penalties and fines (including parking fines)** incurred whilst you are in possession of the vehicle.

In the event of accidental damage, theft or fire damage, **you as the driver will be responsible for paying an excess of £250 per claim if you are aged 25 or over or £500 per claim if you are under 25 years old. Should TRL have to make a claim for any damage to the vehicle following the trial, you will be responsible for paying the excess amount.** If the incident is proven to have been caused by another party and the excess is recovered from them, we will reimburse you for the amount of excess that you paid, once the claim has been settled by the other party's insurer. You will be responsible for ensuring that full details of the accident and the other party are passed to TRL in the event of such a claim; and for cooperating with and providing information to TRL's insurers in order to process the claim effectively.

What to do in the event of a collision or breakdown

During vehicle handover, you will be given a booklet detailing what you should do in the event of a collision or breakdown. This provides you with a step-by-step guide on what to do and contains the necessary forms you will need to complete.

In the event of a collision:

1. Call 999 if anyone is injured or the road is blocked / damaged.
2. Call Aviva claims line immediately from the scene on 0800 246 876 (this is a free 24 hour number)
3. If the vehicle cannot be driven and needs to be recovered, please call Driverline on 0844 2091 962 to arrange suitable recovery.
4. Once it is safe to do so, please also inform TRL of the incident on 01344 770014, or vehicletrials@trl.co.uk

In the event of a breakdown:

1. For all breakdowns, in the first instance call Driverline on 0844 2091 962 to arrange suitable recovery.
2. Once it is safe to do so, please also inform TRL of the breakdown on 01344 770014, or vehicletrials@trl.co.uk

D.3 Forms

The following forms will be hosted online; participants will be provided with a link to the forms via email.

D.3.1 Main consent form

Please complete this consent form once you have read the materials in the Participant Information Pack and delete YES or NO as appropriate in the spaces provided:

Have you been given enough information about this study, as well as an opportunity to ask questions?	Yes / No
Do you understand that you may withdraw from the study at any time without having to give reason for withdrawing?	Yes / No
Do you understand that only you (and any others registered and whose driving licence has been checked by TRL/Cenex[2] and the DVLA) are insured to drive the vehicles?	Yes / No
Do you accept that as the main driver, you are responsible for ensuring that any additional person in the household who will drive the vehicle has had their driving licence checked by by TRL/Cenex and the DVLA?	Yes / No
Do you accept the terms and conditions of the insurance documentation?	Yes / No
Do you understand that you are responsible for the condition of the vehicle for the duration of the trial, and may be liable to pay insurance excess for any claims in the event of a collision or damage?	Yes / No
Do you understand that TRL/Cenex has **not** provided you with any driver training and you are expected to drive safely, responsibly and legally?	Yes / No
Do you understand that you are liable for any driving offences and fines (including parking fines) associated with the vehicle during the trial period?	Yes / No
Do you understand that you cannot smoke in the vehicle and agree not to do so?	Yes / No
Do you confirm that the installed charging socket is to be used only with the trial vehicles and for no other purpose, until after the trial is complete?	Yes / No
Do you (or the person who owns your home) consent to installation of a dedicated charging socket at your home?	Yes / No

[2] One location will be deleted as required; applies throughout this form.

I confirm that the information I have given is correct to the best of my knowledge and agree to inform you of any changes to the information that I have provided to you that could affect participation in the trial?	Yes / No
Do you consent to TRL passing on your contact details to Cenex for the purposes of arranging vehicle collection?[3]	Yes / No
Do you consent to TRL passing on your contact details to ChargedEV for the purposes of installing the electric vehicle chargepoint?	Yes / No
Do you consent to TRL passing on your data to the Energy Technologies Institute (and any of its agents and successors) at the end of the project for the purposes of the research project?	Yes / No
Do you consent to GPS geographical coordinate information being collected by FleetCarma through the onboard telematics device in the vehicle?	Yes / No
Do you confirm that you are not an employee of TRL, Cenex or the ETI?	Yes / No

YOU SHOULD ONLY AGREE TO TAKE PART IN THIS STUDY IF YOU ANSWER 'YES' TO ALL OF THE ABOVE QUESTIONS

Are you happy to take part in this study?

☐ Yes, I consent to take part in the study

☐ No, I do not consent to take part in the study

PLEASE PROVIDE US WITH:

Your driving licence number	
Your DVLA authorisation check code, obtained from: https://www.gov.uk/view-driving-licence (please note that in order to obtain the code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence)	

[3] Will be included for Cenex participants only

D.3.2 Vehicle possession consent form

For this trial, TRL are leasing the trial vehicles from Volkswagen. Therefore, we require all participants to comply with the lease agreements. Please complete this form to confirm that you are willing to comply with this agreement and bring it with you to the vehicle handover, deleting YES or NO as appropriate in the spaces provided:

Statement:	**I agree**
You do not/will not own the vehicle. You are not allowed to attempt to sell, lease or hire the vehicle to anyone else.	Yes / No
You may not make any changes to the vehicle without TRL's prior agreement or interfere with the workings of the vehicle.	Yes / No
You will return the vehicle to TRL/Cenex in the same condition that you received it, whether you complete the trial or not.	Yes / No
You will not use the vehicle illegally, and you will not use the vehicle to commit any illegal activity.	Yes / No
You will not use the vehicle for the purposes of making money. The only business purpose you may use the vehicle for is your normal commute to work or travelling to meetings. You will not use the vehicle for work if the work activity requires you to drive (for example as a taxi or delivery service).	Yes / No
You will not display any forms of advertising, signs or other forms of display or promotion on the vehicle for any purpose	Yes / No
You will not use the vehicle to enter into any form of motorsport or competition.	Yes / No
You will not take the vehicle outside of the United Kingdom.	Yes / No
You may not use the vehicle to secure any loan or agreement.	Yes / No
You will make sure that you carry out necessary safety checks before driving the vehicle such as screen wash, oil, water and anti-freeze levels. TRL will undertake these checks before providing you with the vehicle, but you are responsible for these checks during your possession of the vehicle.	Yes / No

If you do not comply with any of the above requirements, you are responsible for any costs required by TRL to return the vehicle in to the state in which you received it, or the costs of replacing the vehicle.

Signed	
Date	

D.3.3 Additional driver form

Any additional drivers who wish to be added to the vehicle insurance for the duration of the trial must complete and return the following form. It is the responsibility of the main participant to pass on any relevant information about the vehicle and chargepoint operation, the responsibilities as a driver, and the terms and conditions of the vehicle insurance.

Do you understand that only you (and any others registered and whose driving licence has been checked by TRL/Cenex[4] and the DVLA) are insured to drive the vehicles?	Yes / No
I confirm that the information I have given is correct to the best of my knowledge and agree to inform you of any changes to the information that I have provided to you that could affect participation in the trial?	Yes/No
Do you accept the terms and conditions of the insurance documentation?	Yes / No
Do you understand that you cannot smoke in the vehicle and agree not to do so?	Yes / No
Do you consent to the collection of vehicle data for the purposes of this research, including the collection of GPS data and data about journey distances, journey duration, vehicle speed, charging events and fuel/battery consumption?	Yes / No
Do you consent to vehicle data being shared with the project partners (Element Energy, Shell, EV Connect and Baringa) for the purposes of the project analysis?	Yes / No
Do you consent to TRL passing on your data to the Energy Technologies Institute (and any of its agents and successors) at the end of the project for the purposes of the research project?	Yes / No

YOU SHOULD ONLY AGREE TO TAKE PART IN THIS STUDY IF YOU ANSWER 'YES' TO ALL OF THE ABOVE QUESTIONS

Are you happy to take part in this study?

☐ Yes, I consent to take part in the study

☐ No, I do not consent to take part in the study

[4] One location will be deleted as required; applies throughout this form.

PLEASE PROVIDE US WITH:

Your driving licence number	
Your DVLA authorisation check code, obtained from: https://www.gov.uk/view-driving-licence (please note that in order to obtain the code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence)	

Appendix E Researcher protocol

CVEI Consumer Uptake Trial: Researcher protocol

This protocol details the standardised vehicle handover process which will be used for the Consumer Uptake Trial.

Pre-trial stage

a) Once Rolec have confirmed safe installation of the chargepoint, confirm the date and time of the participant's arrival for the first handover by email or phone.
b) Send a reminder that they need to bring with them:
   I. Driving licence (and photographic ID if they have a paper licence only) and their DVLA authorisation check code, obtained from here: https://www.gov.uk/view-driving-licence
   II. Additional form of ID with proof of address (such as utility bill or bank statement)
   III. Any corrective eyewear they require for driving (e.g. contact lenses, glasses)
   IV. Driving licence, authorisation check code and additional proof of address for any other drivers they wish to be insured on the vehicle
c) The participant should have received the Participant Information Pack and completed the online consent form to signal that they are fully signed up to the trial. Before the participant arrives, check that they have done this, and that they have completed the Pre-trial questionnaire.
d) If any are missing, have a copy with you for the participant to complete, or if there is time, send a reminder email to the participant to complete online before they arrive.
e) Ensure that you have a high-visibility jacket for yourself and for the participant when they arrive.
f) Ensure that you have read and understood the "In-vehicle information pack" including the vehicle and charging guides for safe use of the vehicle and charging equipment.
g) Ensure that you are familiar with the vehicle controls and have read and understood the user guides, charging guides and vehicle checklists.
h) Ensure that you are familiar with how to carry out licence, eyesight and vehicle checks.
i) Ensure that the vehicle condition check has been performed and recorded as safe for handover.
j) Ensure that you have read and understood the project risk assessment.
k) Ensure that you have read and understood the TRL (and/or Cenex where applicable) policies and procedures, particularly on lone working, safe driving, working hours, fatigue and alcohol and drugs.
l) Ensure that you have read and understood the requirements for accident, incident and near miss reporting in line with the Project Incident Protocol (PIP).
m) Ensure that you have a means of contacting the Trial Manager, or other suitable persons on the trials team and any designated emergency contacts.

Handover 1: participant arrives to collect Vehicle 1

a) On arrival at the trial headquarters (TRL or Cenex), the participants will be met by the Trial Manager, a researcher from the team or yourself. If working alone, you should follow the lone working procedure and inform/phone a colleague to confirm the start of car collection or drop-off process and how long you expect to be with the participant.

b) Direct participants to the secure parking area (where their personal vehicles will be stored for the duration of the trial) and ensure the following:
   a. Their vehicle is parked in safe location to avoid conflict with other site users
   b. There is sufficient space around the vehicle to carry out a walk-around check.

c) Once the participant is out of their vehicle, provide them with a high visibility jacket to wear.

d) Accompany the participant on a walk-around of their personal vehicle to record the existing condition of the vehicle. Use the Vehicle condition form to record of the following:
   1. Participant name and number
   2. A summary of the condition of the vehicle (inside and outside)
   3. Any damage to the vehicle (inside and outside)
   4. The mileage of the vehicle
   5. Fuel level
   6. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

e) Ask the participant to sign the form confirming the current condition of their vehicle.

f) Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

g) Take the keys to the participant's vehicle and add a key tag with the vehicle details. Store the keys in the secure location specified by the Trials Manager.

h) Ask the participant for their driving licence and check code. Verify the licence details online at https://www.gov.uk/check-driving-information

Enter the last eight characters from the driving licence and the "check code" in the relevant boxes.

i) Ensure the licence is valid and meets trial requirements. Repeat the check for any additional driver in the household where the participant provides a copy of their driving licence

j) If the driving licence does not meet the requirements of the trial, the participant cannot take part.

***In the event that the licence does not meet the requirements of the trial**, alert the Trial Manager to the situation and the participant will be notified that they will not be able to take part in the trial by the Trial Manager.*

k) Ask the participant for the additional form of ID with proof of address (and additional photo ID if their licence is paper only). Scan copies of all ID items, including their driving licence (and that of any additional driver), and save in the secure project area.

l) Check the participant's eyesight using a test vehicle registration plate. This must be undertaken in a safe location and the participant must be standing 20 metres from the plate (there should be a mark on the ground). If they are unable to successfully pass this test they will not be allowed to drive the vehicle. Give them the option of either not participating in the trial or returning at a later time and trying again with their corrective eyewear. If they have their corrective eyewear with them, re-test their eyesight whilst they are wearing the corrective eyewear. If the participant still cannot read the vehicle registration plate then they cannot take part in the trial.

   ***In the event that the participant can no longer take part in the trial**, alert the Trial Manager to the situation and the participant will be notified that they will not be able to take part in the trial by the Trial Manager. The participants should receive a £10 cash payment as compensation for travel expenses to the handover site.*

m) Check whether the participant has completed the Time Point 1 questionnaire. If they have not, ask them to complete it now.

n) Show the participant to the trial briefing presentation area. Tell the participant that this presentation will cover the background information about the trial, what is expected of the participant and a comprehensive health and safety briefing. Indicate that if they have any questions they should ask these in the briefing presentation.

o) Whilst the participant is in the briefing, ensure that you have stored the following in the specified secure areas:

   1. Vehicle condition form
   2. Any photos of the participant's personal vehicle
   3. Copies of the participant's driving licence and proof of address, and the driving licence for an additional driver, if applicable.
   4. The participant's personal vehicle keys

p) Make sure you have identified who your assigned participant is, their participant number and which vehicle they are to be assigned as per the checklist.

PARTICIPANT ARRIVAL CHECKLIST	Tick
1. Consent forms completed	
2. Pre-trial questionnaire completed	
3. Time Point 1 questionnaire completed	
4. Buddy informed as per lone working procedure (if working alone)	
5. Participant's vehicle parked in a safe and secure location	
6. Hi-vis for yourself and participant	
7. Inspection of participant's personal vehicle	
8. Collection of participant's vehicle keys	
9. Driving licence check and ID check	
10. Additional driver licence check (if applicable)	
11. Eyesight check	
12. Participant has had trial briefing presentation	
13. All ID, photos and forms scanned and stored securely	

Vehicle 1 handover

a) At the end of the briefing presentation meet your assigned participant. Confirm their participant number with them.

b) Check with them whether they have any further questions following the presentation, and answer any questions they have using the supplementary information you have.

c) Ensure the participant is wearing a high visibility jacket and take them to the trial vehicle that they will be using. Ensure the vehicle is parked in a safe location for a walk round (and charging demonstration if necessary). If it is not, inform the Trial Manager and request that the vehicle is moved to a safe location.

d) Accompany the participant on a walk-around of the trial vehicle they have been assigned to record the existing condition of the vehicle. Use the Vehicle condition form to record of the following:

   1. Participant name and number
   2. A summary of the condition of the vehicle (inside and outside)
   3. Any damage to the vehicle (inside and outside)
   4. The mileage of the vehicle
   5. Fuel level (if applicable)
   6. Battery charge level (if applicable)
   7. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

e) Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

f) Check that all key equipment in the vehicle is present:

1. Vehicle handbook/manual
2. In-vehicle information pack
3. First aid kit
4. Locking wheel nut
5. Hi-vis vest
6. Charging cables (where applicable)

Static familiarisation with the vehicle

a) Show the participant the vehicle key and the purpose of each button. **Be sure to explain that the vehicle has keyless entry. The button on the door handle locks/unlocks the door if the key is in the vicinity of the vehicle.**

b) Give the participant the vehicle key and ask them to unlock the vehicle.

c) Show the participant how to adjust the driver's seat before they get into the vehicle.

d) Ask the participant to get into the driver's seat and set up their own driving position (seat position, steering wheel, mirrors). Assist them as necessary.

e) Show the participant where the main controls and features can be found and how to operate them. This information is provided in the basic controls document.

Main controls checklist	Tick
Lights and main beam	
Fog lights	
Indicators	
Windscreen wipers & wash	
Wing mirror adjustment	
Electric windows	
Bonnet release	
Boot release	
Fuel filler release (if applicable)	
Vehicle charging port access (if applicable)	

f) Demonstrate to the participant how to turn on the vehicle (show them the 'Vehicle Guide' in the 'In-Vehicle Information Pack' at this point and talk them through it). All vehicles are <u>automatic</u> transmission.

For PHEV or BEV: With the right foot on the foot brake, press the power button/turn the key, and then remove foot from brake. Indicate to the participant that even though it is silent, the car engine is now on.

For Petrol: Demonstrate the normal start procedure is like a conventional car (see Vehicle guide for instructions).

g) Show the participant that when the vehicle is in 'P' (for Park) the vehicle will not move. Demonstrate the parking brake (see Vehicle guide for instructions). Then show the participant how to work the gear selector.

h) **For PHEV or BEV:** you need to show them the features and controls unique to these vehicles (the in-vehicle fuel and power displays of battery SOC and range) as per the Vehicle guide document. **Show the participant the 'Charging Guide' in the 'In-Vehicle Information Pack' at this point and talk them through it**. Whilst you are talking them through, you then need to show them:

  1. How to access the charging port on the vehicle.
  2. Locating the charging cable.
  3. How to safely plug in the charging cable at both the vehicle *and* the charge point.
  4. How to safely remove the charging cable on completion of charging.
  5. Explain that it is important to use safe connections to charge the vehicle only (i.e. the installed charge point at their home or a dedicated PiV chargepoint).

i) **For PHEV or BEV:** Inform the participant of the AER of the vehicle and the likely impact when operating it under various driving conditions (e.g. urban driving vs. motorway driving). This is included in the 'Vehicle Guide' in the 'In-Vehicle Information Pack'.

j) **Petrol or PHEV:** point out that the vehicle has a full tank of fuel. **If the participant has a BEV or PHEV** vehicle, point out the SOC (it will be at least 80%, if it is not then inform the Trial Manager). **Tell participants that they are required to return the vehicle with the same amount of fuel, and where relevant, as much charge as possible.**

Familiarisation drive

a) Once you have completed the static vehicle familiarisation exercise with the participant, ask them if they are ready to undertake a short familiarisation drive. If they are not ready, continue the static vehicle familiarisation exercise until they are comfortable to take the familiarisation drive.

b) Tell the participant that you will accompany them on the familiarisation drive and direct them.

c) Indicate that the drive is for the comfort of the participant to ensure they are comfortable with the operation of the vehicle. They are not being assessed. Specify that if they feel uncomfortable after their first loop, the familiarisation drive can be extended or if they feel unable to drive, they can stop in a safe place and you will drive the vehicle back.

d) With the participant driving, and you in the passenger seat, take them on the following familiarisation drive. This is an opportunity for you, the researcher, to check that the participant's driving is safe (and legal). If you feel uncomfortable with the participant's style of driving then the familiarisation drive may be stopped and you may take over as the driver and return with the participant to the trial headquarters. Alternatively if the participant does not feel they can continue to drive, you should drive the participant back to the trial headquarters. On your return to the trial headquarters, alert the Trial Manager to the situation.

TRL site instructions

1. Drive off the 'TRL' site (over the bridge and down to the roundabout with Nine Mile Ride).
2. **Turn left** at the roundabout onto **Nine Mile Ride**.
3. Carry on to the next roundabout and then **turn left** onto **Old Wokingham Road**.
4. Drive on for about 0.7 miles, past the old TRL site (note that there is the potential for construction traffic at this site and warn the participant in advance) and then turn left onto **Brookers Row**.
5. At the next junction, **turn left** on to **Bracknell Road.**
6. Continue ahead for a short while, then **bear left and merge** on to **Foresters Way.**
7. Stay in the **left hand lane** up to the roundabout.
8. At the roundabout, **turn left** on to **Nine Mile Ride.**
9. Continue ahead to the next roundabout. If the participant is happy then **turn left** back onto the **TRL site.** If the participant would like to do another lap, **continue straight** at the next roundabout and refer to Step 3 above for further directions.

Cenex site instructions

1. Head out of the multi-storey car park and turn right (across duel carriage way on campus)
2. Drive up **University Road** to the T-junction, and **turn right** (University Road)
3. At the roundabout take the **3rd exit**, passing through the security barriers. You are no longer on university property (normal speed restrictions apply)
4. Proceed along **Holywell Way** for 150 meters
5. At the **roundabout take the second exit** (turn right)
6. Proceed down **A512 Ashby Road** for 500 meters
7. Keep in the left lane and **turn left onto Schofield Road** at the traffic lights

8. Continue along **Schofield Road** and at the mini roundabout go **straight ahead onto Thorpehill**
9. Follow **Thorpehill** round to the right, where it changes name to **Alan Moss Road**
10. At the roundabout take the **third exit onto A6004**
11. Keep in the right-hand lane and at the roundabout take the **third exit back onto A512 Ashby Road**
12. Stay on **A512 Ashby Road** for 1.4km
13. **Turn right** at the turn off prior to the roundabout onto **Holywell Way**
14. Pass through the security barriers. You are now on university property (15mph speed restriction applies)
15. At the roundabout turn right onto **University Road**
16. Take the **second left** (University Road)
17. After 100m **turn left** into the multi-storey car park

In-vehicle information pack

a) Once the participant has completed a successful familiarisation drive, issue them with the full 'In-Vehicle Information Pack' (which should already be in the vehicle). Inform the participant that this contains all the information they should need during the trial. Remind them that this includes the 'Vehicle Guide' and 'Charging Guide' that you have already talked them through when they were getting familiar with the vehicle.

b) Run through each document with the participant. In addition to the documents the participant has already seen there is the 'Polar+ Charging Guide' which gives more information on finding and using public charging.

c) The In-vehicle information pack also contains the information they need in the event of a breakdown or accident. The VW Driverline information sheet contains the details for what they should do in the event of a breakdown and the Aviva accident guidance booklet tells them what to do in the event of an accident.

d) It is important to remind the participant that:

    1. In the event of an emergency they should call 999
    2. In the event of a breakdown, in addition to the VW Driverline, they should also contact TRL to report the incident.
    3. In the event of an accident, they should first follow the Aviva accident guidance booklet and then report the incident to the VW Driverline and to TRL.
    4. They have agreed to the trial insurance requirements and are therefore liable for any driving offences, penalties and fines including parking fines incurred whilst you are in possession of the vehicle; are responsible for paying the initial excess in the event of an insurance claim; and are responsible for the condition of the vehicle during the trial. This is detailed in the Insurance Details in the 'In-Vehicle Information Pack'.

e) Run through the FAQ's sheet. This contains the details on what to do when returning vehicles. Check whether the participant has any further questions. If they do, point them to the relevant guidance document in the 'In-Vehicle Information Pack'.

Final consent

a) On completion of all briefing and handover activities, ask the participant whether they have any questions. Once all questions have been answered, ask them to sign a consent form.

b) Check-out the vehicle on the admin portal noting the Participant ID and the Vehicle ID.

c) Remind the participant that they should use Vehicle 1 for their normal day-to-day journeys for a period of four days and return Vehicle 1 to TRL/Cenex at a pre-arranged time at the end of that period.

d) If the participant is happy, they can now leave the trial headquarters with trial vehicle.

Handover 1 checklist	Tick
1. Vehicle Guide (a simple guide on how to use the vehicle).	
2. Charging Guide (if applicable)	
3. Polar+ Public Charging Guide (if applicable)	
4. VW Driverline information sheet and card	
5. Insurance details	
6. Aviva accident guidance booklet	
7. FAQs	
8. Consent form completed and signed	
9. Scan and save vehicle condition forms and photos (Participant vehicle and Vehicle 1)	
10. Email vehicle condition forms to participant (Participant vehicle and Vehicle 1)	

Return of Vehicle 1

a) Meet the participant at the pre-arranged time at the trial headquarters. Have a high-visibility jacket for both you and the participant. Take the vehicle condition form signed at handover with you specifying the condition of the vehicle at the start of the trial.

b) Prior to undertaking a walk-around you must ensure that it is safe to do so and the vehicle is parked in a safe location. Accompany the participant on a walk-around of the vehicle and interior inspection to check the condition of the returned trial vehicle against the condition of the vehicle when it was taken away. Mark (using a different colour of pen) the following down on the form:
   1. Participant name and number
   2. A summary of the condition of the vehicle (inside and outside)
   3. **Any damage to the vehicle (inside and outside)**
   4. The mileage of the vehicle
   5. Fuel level (if applicable)
   6. Battery charge level (if applicable)
   7. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

c) If there is any damage to the vehicle, ask the participant to provide an explanation of how the damage occurred on the Vehicle condition form, being as detailed as they can. Inform the participant that if the damage to the vehicle requires repair, then the participant will be notified that they may be liable for any costs up to the agreed maximum excess.
Alert the Trials Manager if necessary.

d) Ask the participant to sign the form, indicating that they agree with the description of the vehicle condition. Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

e) Check all the original equipment is still with the vehicle. This includes:
   1. Vehicle handbook/manual
   2. In-vehicle information pack
   3. First aid kit
   4. Locking wheel nut
   5. Hi-vis vest
   6. Charging cables (where applicable)

f) Check that the participant has not left any personal items in the vehicle.

g) Once this is complete, check-in the vehicle to the Admin Portal noting the Participant ID and the Vehicle ID.

Interim questionnaire 1

a) Ask the participant to complete an 'Interim 1 Questionnaire' on a designated computer/tablet at the trial headquarters.
b) Upon completion of this questionnaire, give the participant a cash payment of £20. Ensure that they sign the receipt of payment form to indicate that they have received the payment.

Vehicle return checklist	Tick
1. Vehicle condition inspection	
2. Equipment check: • Vehicle handbook/manual • In-vehicle information pack • First aid kit • Locking wheel nut • Hi-vis vest • Charging cables (where applicable)	
3. Check for personal items in vehicle	
4. Completed Interim 1 questionnaire	
5. Participant payment	
6. Signing of participant payment form	
7. Scan and save vehicle condition form	
8. Email vehicle condition form to participant	

Vehicle 2 handover

a) The process for the handover of Vehicle 2 follows the same structure as for Vehicle 1, including a familiarisation drive.

b) On completion of all briefing and handover activities, the participant will be given the opportunity to ask any questions. Once all questions have been answered, the participant must complete and sign a consent form (for this vehicle).

c) Check-out the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID.

d) Remind the participant that they should use Vehicle 2 for their normal day-to-day activities for a period of four days and return Vehicle 2 to TRL/Cenex at a pre-arranged time at the end of that period.

Handover 2 checklist	Tick
1. Vehicle Guide (a simple guide on how to use the vehicle).	
2. Charging Guide (if applicable)	
3. Polar+ Public Charging Guide (if applicable)	
4. VW Driverline information sheet and card	
5. Insurance details	
6. Aviva accident guidance booklet	
7. FAQs	
8. Consent form completed and signed	

Return of Vehicle 2

a) The process for the return of Vehicle 2 will follow the same structure as for Vehicle 1

Interim questionnaire 2

a) Ask the participant to complete an 'Interim 2 questionnaire' on a designated computer/tablet at the trial headquarters.
b) Upon completion of this questionnaire, give the participant a cash payment of £20. Ensure that they sign the receipt of payment form to indicate that they have received the payment.

Vehicle return checklist	Tick
a) Vehicle condition inspection	
b) Equipment check: • Vehicle handbook/manual • In-vehicle information pack • First aid kit • Locking wheel nut • Hi-vis vest • Charging cables (where applicable)	
c) Check for personal items in vehicle	
d) Completed Interim 1 questionnaire	
e) Participant payment	
f) Signing of participant payment form	

Vehicle 3 Handover

a) The process for the handover of Vehicle 3 will follow the same structure as for Vehicle 1 and 2, including the vehicle familiarisation drive.

b) On completion of all briefing and handover activities, the participant will be given the opportunity to ask any questions. Once all questions have been answered, the participant must complete and sign a consent form (for this vehicle).

c) Check-out the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID.
d) Remind the participant that they should use Vehicle 3 for their normal day-to-day activities for a period of four days and return Vehicle 3 to TRL/Cenex at a pre-arranged time at the end of that period.

Handover 2 checklist	Tick
1. Vehicle Guide (a simple guide on how to use the vehicle).	
2. Charging Guide (if applicable)	
3. Polar+ Public Charging Guide (if applicable)	
4. VW Driverline information sheet and card	
5. Insurance details	
6. Aviva accident guidance booklet	
7. FAQs	
8. Consent form completed and signed	

Return of Vehicle 3

a) The process for the return of Vehicle 3 will follow the same structure as for Vehicles 1 and 2.

Interim questionnaire 3

a) Ask the participant to complete an ‘Interim 3 questionnaire’ on a designated computer/tablet at the trial headquarters.
b) Upon completion of this questionnaire, give the participant a cash payment of £20. Ensure that they sign the receipt of payment form to indicate that they have received the payment.

Vehicle return checklist	Tick
a) Vehicle condition inspection	
b) Equipment check: • Vehicle handbook/manual • In-vehicle information pack • First aid kit • Locking wheel nut • Hi-vis vest • Charging cables (where applicable)	
c) Check for personal items in vehicle	
d) Completed Interim 1 questionnaire	
e) Participant payment	
f) Signing of participant payment form	

Participant close-out/ debrief

a) Once the participant has completed the 'Interim 3 questionnaire' collect their keys from the secure location and accompany the participant back to their personal vehicle. You need to have a high visibility vest or jacket for both you and the participant to wear, plus the original 'Vehicle condition form' completed at the beginning of the trial.

b) Accompany the participant on a walk-around of their personal vehicle to record the condition of the vehicle. Use the original vehicle condition form to check the following, noting any changes:

   1. A summary of the condition of the vehicle (inside and outside)
   2. Any damage to the vehicle (inside and outside)
   3. The mileage of the vehicle
   4. Fuel level
   5. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

   If the participant highlights anything they are unhappy with, i.e. new damage, alert the Trial Manager and they will notify the participant that an investigation will be undertaken and that TRL will organise and cover the costs of any repairing of damage that is required.

c) If there are no changes in the vehicle condition, ask the participant to sign the form confirming the condition of their vehicle.

d) Log the date and time of collection of the participant's personal vehicle on the Vehicle condition form.

e) Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

f) Notify the participant that the final questionnaire will be sent to them by email within one week and that upon completion they will receive £100.

g) Provide the participant with a BACS form to complete in order for the money to be transferred to them. Inform them that this BACS transfer will take place within 4 weeks of their completed questionnaire being received.

h) Tell the participant that they will be sent a debrief letter by email which will confirm payment of the £100 as compensation for their time. This letter will confirm what will happen to their data and where the findings of the research will be published.

i) Thank the participant and direct them on how to safely depart the trial headquarters.

Appendix F Specification for Mode 2 charging sockets

The WallPod: EV Ready Mode 2 charging socket from Rolec Ltd will be installed in participants' homes for the purposes of the Consumer Uptake Trial. The specification for this charging socket is shown in Figure 7 below.

WallPod: EV Ready Features

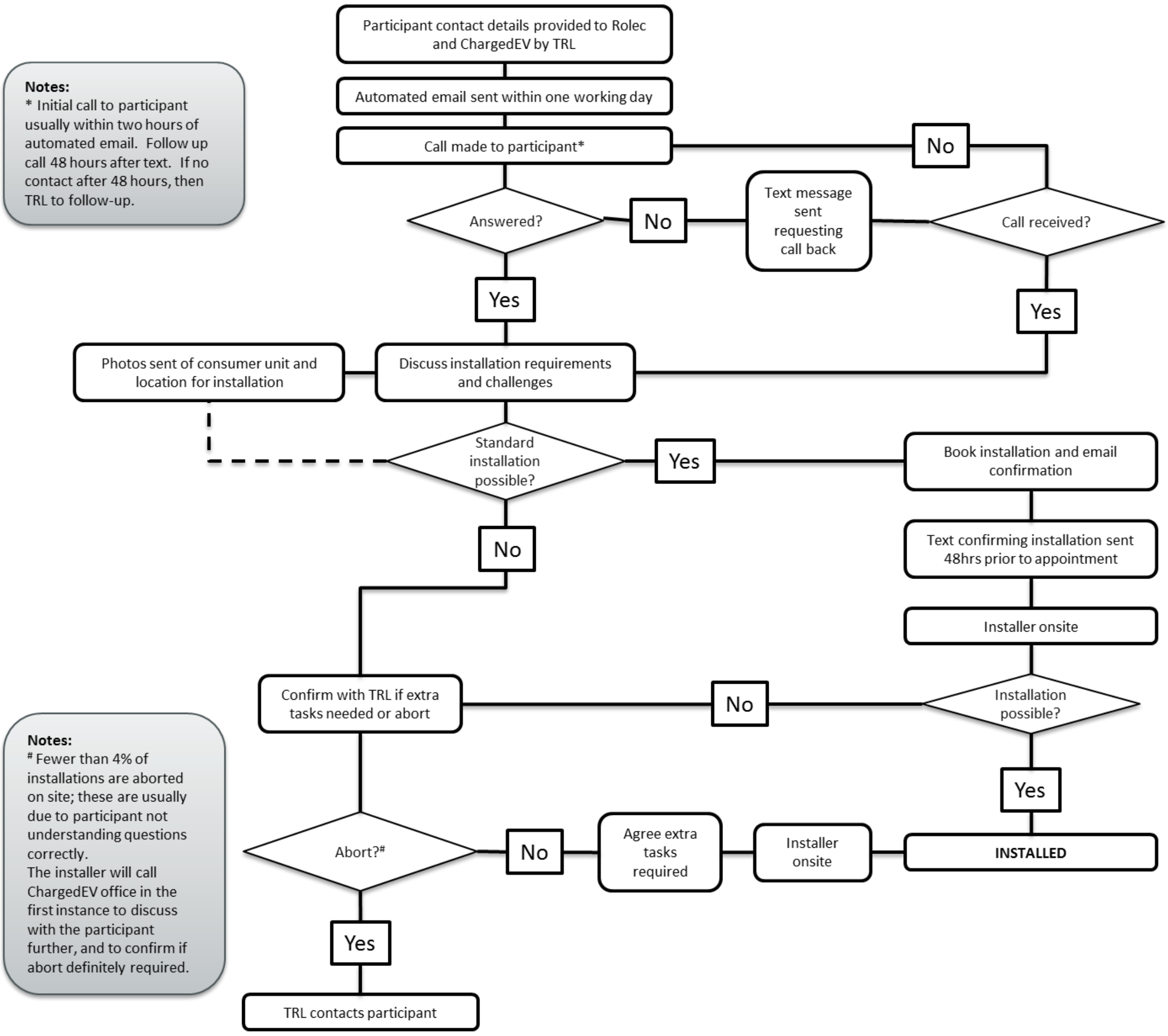
- Satisfies Planning requirements for EV charging
- Costs from as little as £70.00 + VAT
- Doubles up as an outdoor rated 13amp maintenance socket ideal for home/garden maintenance, charging mobility scooters and electric bikes, etc.
- Charges the EV in Mode 2 format
- Is designed to be future proof and easily upgradable to full Mode 3 fast charging format (upgrade kits available throughout the UK wholesaler network)
- Includes overload and fault current protection (RCBO)
- This modern, attractive unit is available in a variety of colours including brick-matchingterracotta/brown
- Can be surface or cavity mounted
- Has been certificated by the BSI as safe to use in the domestic environment
- Easy to install and maintain

SPECIFICATIONS

Mechanical	• Warm white base unit (other colours available upon request) • Green service pods (other colours available upon request) • IP65 Category 1 weather proof rating to BS EN 60529 Certification • BSI Certificated to BS EN 60335-1 for safe home use • Manufactured in compliance with BS7671 Wiring Regulations • Compliant with IET EV regulations • Corrosion resistant • Operating temperature: - 30C to +50C • Glow wire rating tested to IEC 60695-2-13 • Flame retardant to UL94 flame rating at V2 for 1.5mm and 3.0mm
Electrical	• 13amp domestic socket protected by an IP65 rated access door • Built-in 16amp, 30 mA RCBO accessible via an IP65 rated access door providing overload and fault current protection • 230V AC/50Hz • Full internal wiring – ready to install
Options	• Optional access door locking facility • Optional built-in Class 1 kWh meter • Optional built-in time clock for electricity management • Optional corporate branding (colours, logo badge, etc.) • Alternative mounting solutions (wall plate, post, plinth, etc.)
Payment & Access Options	• Electrical key switch control

Figure 7: Specification for Rolec WallPod: EV Ready Mode 2 charging socket

Appendix G Rolec / ChargedEV installation process



Appendix H Rolec Chargepoint Portal

Rolec Ltd, the chargepoint supplier for this project, will provide the research team with access to their online chargepoint management portal. This will allow TRL to keep track of where chargepoints have been installed, any problems with the chargepoints, and a high-level view of how the chargepoints are being used. Example screenshots from Rolec's generic host portal are shown below; the portal will be adapted for the purposes of this project so only relevant information is displayed.

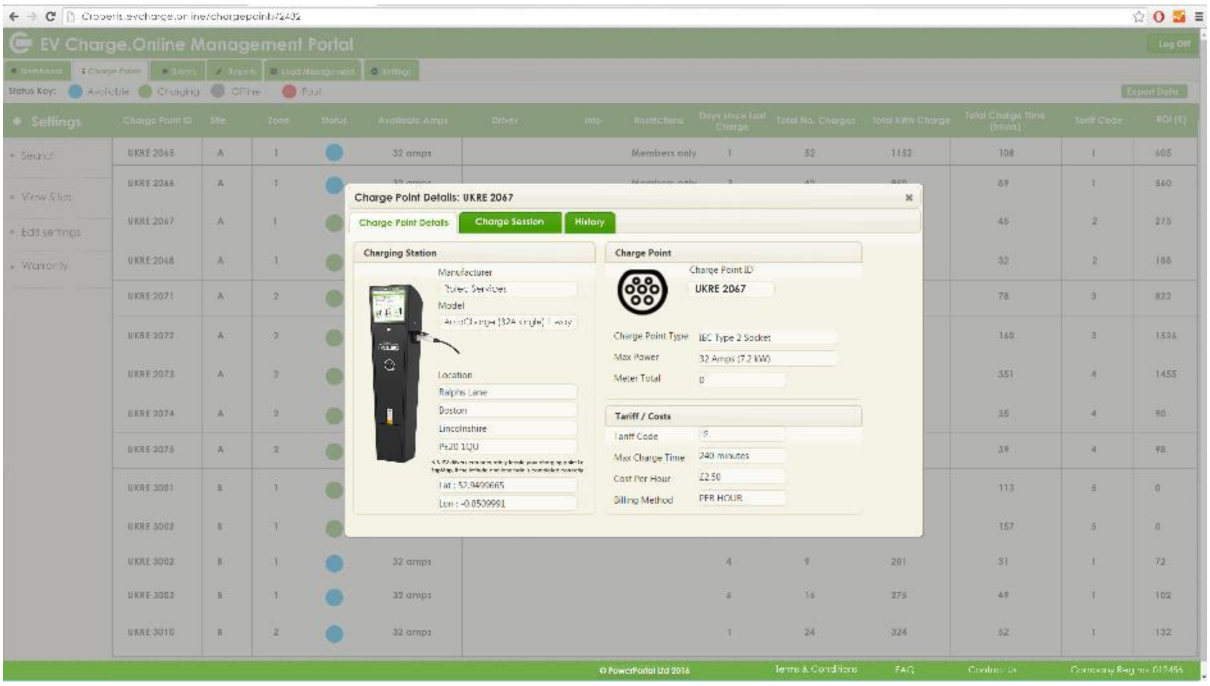


Figure 8: Example screenshot from Rolec host portal – Chargepoint view

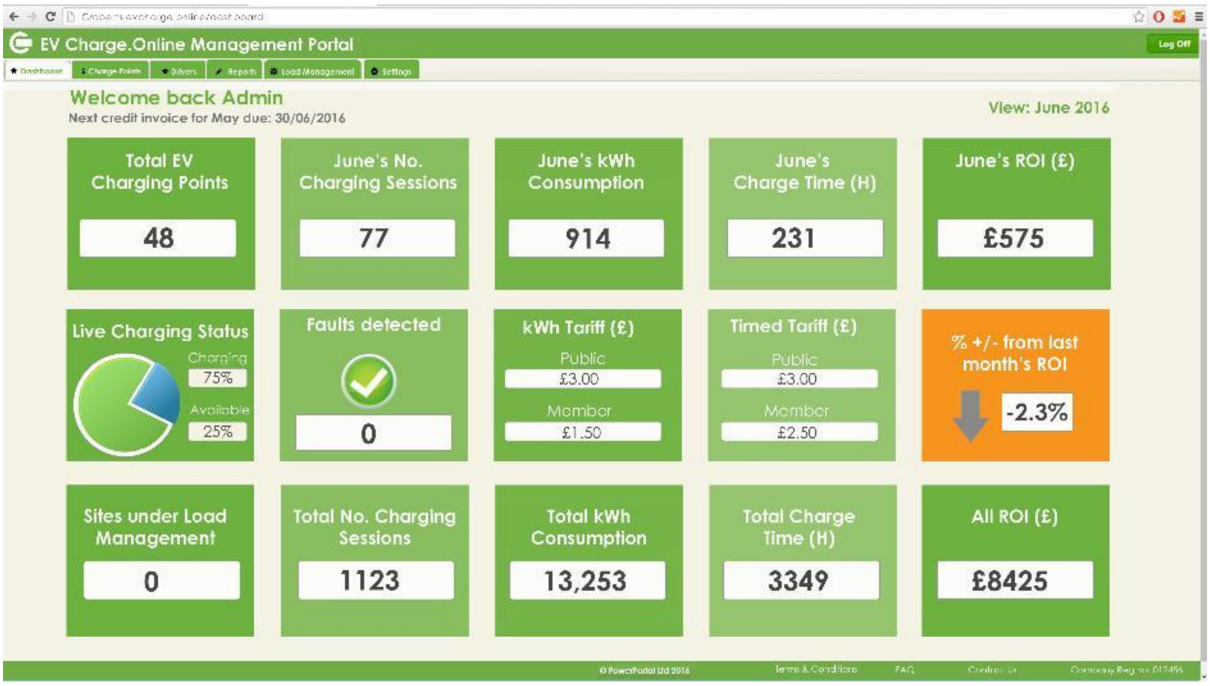


Figure 9: Example screenshot from Rolec host portal – Dashboard view

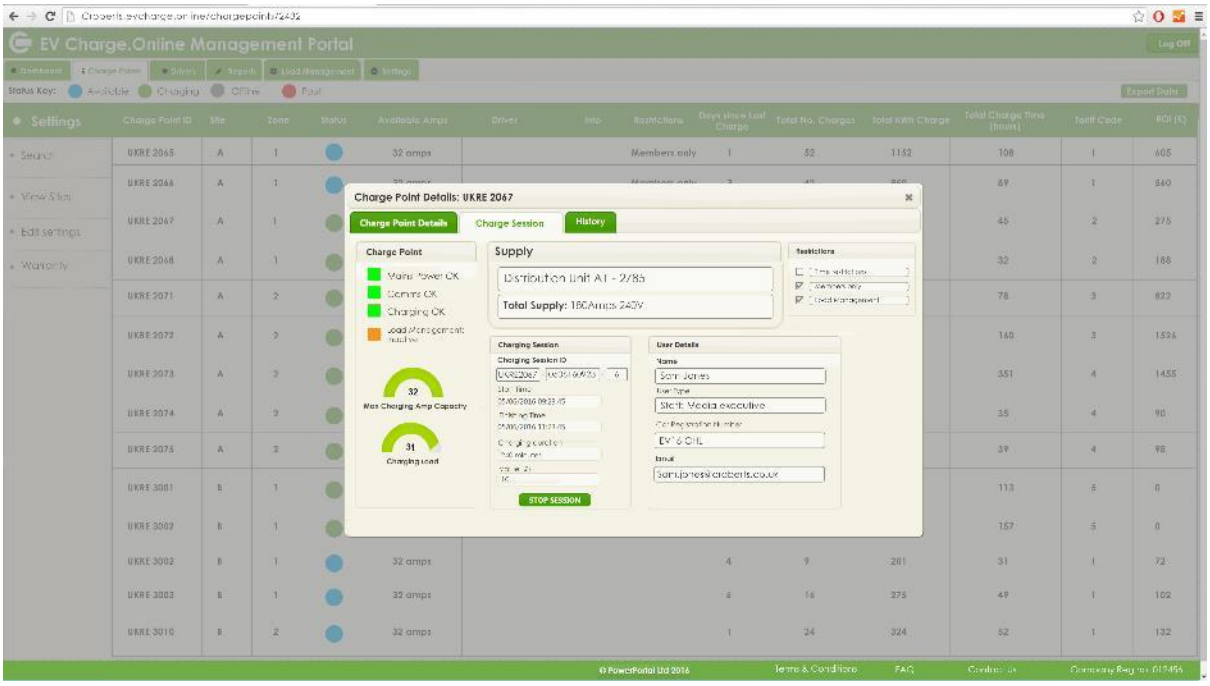


Figure 10: Example screenshot from Rolec host portal – Charge session view

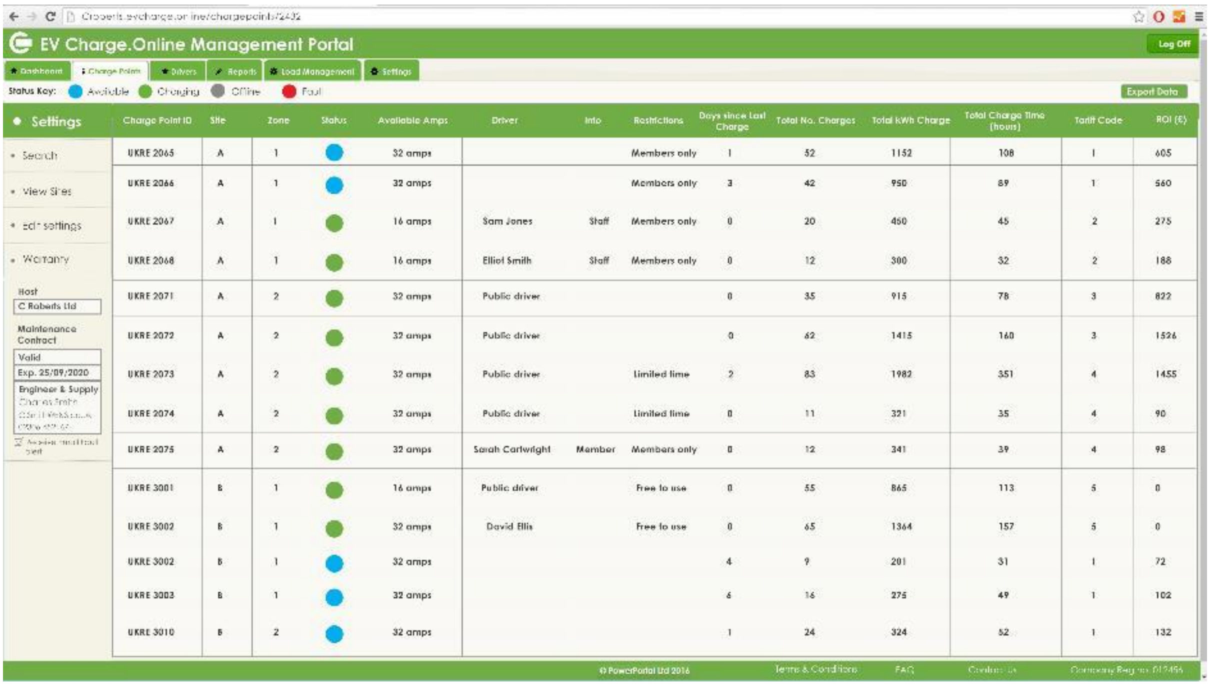


Figure 11: Example screenshot from Rolec host portal – Data view

Appendix I Slide Pack for briefing participants at handover 1

Introduction

- Welcome to TRL
- Health and Safety

3

The Trial: Purpose of trial

- To provide you with real life experience of three different vehicles
- To understand how you use the vehicle and what your opinions are

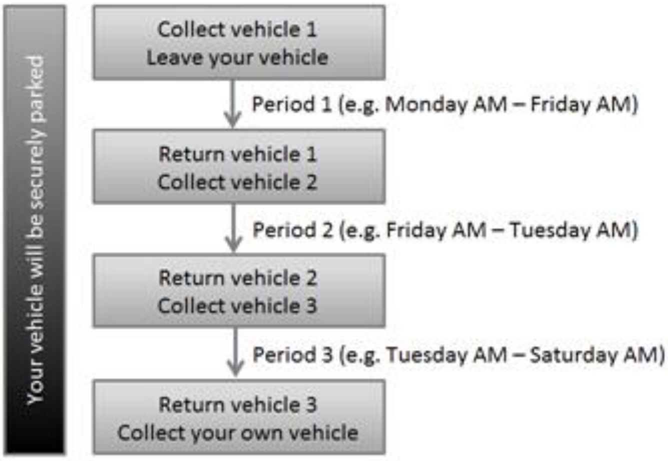
4

The Trial: What you have to do

- Use each of the three trial vehicles
- Use for your regular day-to-day journeys (at least once per day)
- Charge the vehicle at least twice (Hybrid and Electric only)
- Complete some questionnaires

5

The Trial: Format



6

The Trial: Vehicles

- VW Golf hatchback (petrol only)
- VW Golf GTE hatchback (Plug-in Hybrid Electric Vehicle – PHEV – petrol and battery)
- VW e-Golf hatchback (Battery Electric Vehicle – BEV – battery only)

7

The Trial: Data collection and protection

- Telematics ‘dongle’ fitted (please don’t remove)

- Data for research purposes only
- All data fully anonymised
- No data will be linked to you as an individual

8

In-vehicle information packs

- Vehicle user and charging guidance documents - **Please read!**

- What to do in case of emergency or breakdown

- Anything not covered? Contact us!

9

Insurance

- **Only** named drivers are insured to drive the vehicles
- You must tell us of **anyone** else who needs to drive the trial vehicles
  - Up to 1 other person in your household can be added to the insurance

10

Insurance continued

Taking part in this trial, you must accept the terms and conditions of the insurance documentation:

- You are responsible for the condition of the vehicle for the duration of the trial
- Excess of £250 (£500 if under 25) for any claim made
- You are responsible for any driving offences, fines or penalty points incurred

11

Breakdown

- **Volkswagen Driverline** card and information sheet
- **0844 2091 962 - save to phone!**
- One number for everything – 24/7
- Please inform TRL as well

12

Accidents

- 999 if serious or injuries
- Insurance provided by **Aviva**- Call **Fleetline 0800 246 876** and follow instructions in the information booklet
- **Call Volkswagen Driverline** to let them know
- **Contact TRL** as soon as possible

13

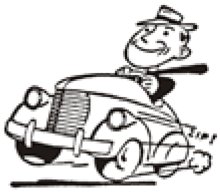
Technical issues with chargepoint

- **Contact TRL** as soon as possible
- TRL will reimburse any taxi costs incurred in the event that the vehicle has not been charged adequately due to a technical fault with chargepoint

14

What will happen today

- ID check and eyesight test ✓
- Vehicle familiarisation exercise (including charging where applicable)
- Run through vehicle information packs
- Final consent forms to sign
- Leave with your first vehicle



14

Your responsibilities

- **Detailed in the consent forms, read carefully**
- **Look after the vehicle**
- Drive safely, responsibly and legally
- Liable for any driving offences and fines, including parking fines
- Inform TRL of any changes to your information

15

And finally

You are free to withdraw from the study at any time without having to give reason. If you wish to withdraw please contact us.

Thank you for listening, any questions?

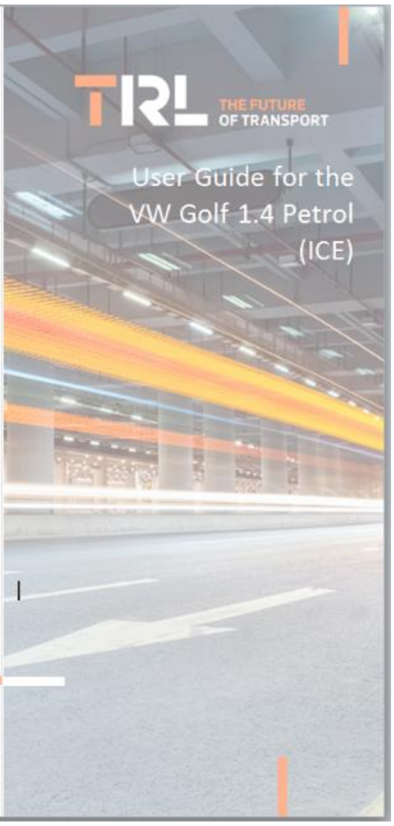
18

Appendix J In-vehicle Information Pack

J.1 ICE vehicle guide (VW Golf 1.4 Petrol)

t +44 [0]1344 770014
e vehicletrials@trl.co.uk
w trl.co.uk

TRL Crowthorne House, Nine Mile Ride
Wokingham, Berkshire, UK, RG40 3GA



The VW Golf GT 1.4 petrol has an automatic gearbox (accelerator and brake pedal only) and is operated in the same way as any other conventional petrol vehicle.

This guide explains some of the key features of this vehicle. Please see the vehicle manufacturer's handbook in the glovebox for more detailed information about these and any other features of the vehicle.

Operating the parking brake

The electronic parking brake is the equivalent of a conventional handbrake. Always switch this on when the vehicle is parked.

To release the electronic parking brake, pull away in either Drive or Reverse mode (the electronic parking brake will auto-release) OR:

1. Switch the ignition on
2. Press the brake pedal, and then press the button
3. Release the brake pedal and press the accelerator slightly (the yellow light in the lever will go out and the red symbol on the instrument panel will go out)

To put the electronic parking brake on, pull up and hold the button (the yellow light in the lever will come on and the red symbol on the instrument panel will illuminate).

Auto Hold

The Auto Hold function holds the vehicle as detects that the vehicle is not moving and the brake pedal is released. The green symbol on the instrument panel will light up to show that the vehicle is being held on the service brake.

When the driver presses the accelerator, the Auto Hold function will release the electronic parking brake.

Operating modes

The driver can choose from 5 driving modes:

- Comfort
- Normal
- Sport
- Race
- Eco
- Individual

The driving mode can be changed while the vehicle is stationary or when in motion by touching the MODE button (in the Infotainment system display) until the desired driving mode is selected. Please see the vehicle manufacturer's handbook for more detail of each mode.

Key points to remember

The vehicle manufacturer's handbook (in the glovebox) should be your first point of call if you are unsure of any of the switches, controls or menus in the vehicle. Here are some key points to consider:

- If a red symbol / warning lamp appears on the dashboard while you are moving, pull over safely and do not continue driving. Contact **VW's Driverline on 0844 2091 962** for assistance and then inform TRL.
- Do not attempt to repair or adapt the vehicle. If the vehicle is in need of repair, call **VW's Driverline on 0844 2091 962** for breakdown assistance. Please also inform **TRL on 01344 770 014**.

J.2 BEV vehicle guide (VW e-Golf)

Dashboard

When the ignition is switched on, the trip computer and electric vehicle information will be displayed in the centre of the dashboard. This will include the battery charge level and the approximate range available.

The left dial is the 'power meter' and shows the current level of energy being used or regenerated. The right dial is the speedometer.

The dashboard provides a lot of information, so please read the vehicle manufacturer's handbook to familiarise yourself with it. The following key symbols to be aware of appear below the 'power availability' display:

	Battery is low (remaining range is approximately 20 miles). Charge as soon as possible.
	Charging cable is connected to vehicle charge port. Disconnect the charging cable & store it in the boot of the vehicle before driving.
	Brake pedal is released.
	Parking brake is engaged.
	Error. Stop the vehicle in a safe place as soon as possible and switch off the motor. If the error persists, please contact **Driverline** for assistance.

Switching the vehicle off

1. Bring the vehicle to a complete stop by pressing and holding down the brake pedal, whilst shifting the transmission into P (Park)
2. Apply the parking brake (see 'Operating the parking brake')
3. Turn the vehicle key towards you

Key points to remember

The vehicle manufacturer's handbook (in the glovebox) should be your first point of call if you are unsure of any of the switches, controls or menus in the vehicle. Here are some key points to consider:

- Using B on the selector lever results in higher energy recuperation from braking. This means that the vehicle is charging whilst you brake. This should be used with caution, as it can impact the braking performance.
- If a red symbol / warning lamp appears on the dashboard while you are moving, pull over safely and do not continue driving. Contact **VW's Driverline on 0844 2091 962** for assistance and then inform TRL.
- Do not attempt to repair or adapt the vehicle. If the vehicle is in need of repair, call **VW's Driverline on 0844 2091 962** to arrange repair of the vehicle. Please also inform **TRL** of any faults **on 01344 770 014**

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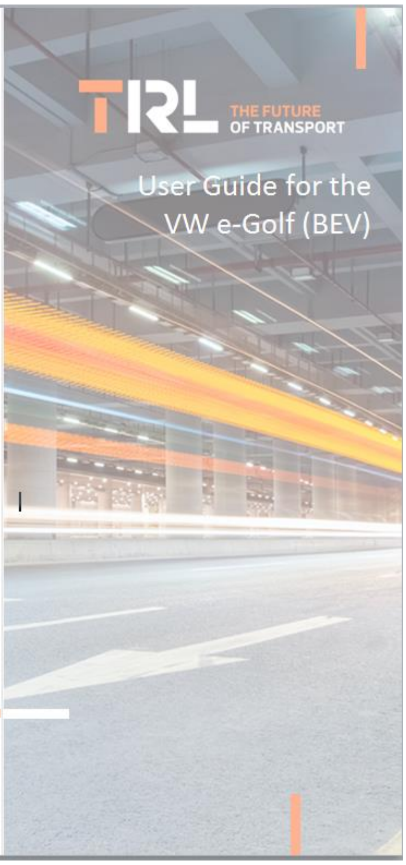

The VW e-Golf is a battery electric vehicle (BEV), which means the motor is powered only by electricity. The vehicle is driven like an automatic: it has an accelerator and brake pedal only.

This guide explains some of the key features of this vehicle. Please see the vehicle manufacturer's handbook in the glovebox for more detailed information about these and any other features of the vehicle.

Before you use the vehicle

- If the vehicle has been charging, ensure that the vehicle is disconnected from the chargepoint and that the charging cable is safely stowed in the boot (please refer to the charging guide provided in the In-vehicle Information Pack for further information about charging)
- Familiarise yourself with the dashboard and controls, as they differ to a conventional vehicle. Refer to the vehicle manufacturer's handbook for further information

Starting the vehicle

1. Insert the key and turn once (ignition is switched on, steering column lock is released)
2. To activate the electric motor, press the brake pedal and hold it down whilst you:
   a) Check the transmission is in Park (P) or Neutral (N)
   b) Turn and hold the key once more until the text message **READY** lights up on the instrument panel
   c) Release the key (the needle in the power display will move from **OFF** to **0**)
   d) Move the selector lever to position D (Drive) / B (regenerative Braking) / R (Reverse). See the 'Tips' section below for more details

3. Switch off the electronic parking brake (see 'Operating the parking brake') and release the brake pedal (please be aware that when both brakes are released, the vehicle will start to move forward)
4. Press the accelerator pedal to start moving the vehicle

Operating the parking brake

The electronic parking brake is the equivalent of a conventional handbrake. Always switch this on when the vehicle is parked.

To release the electronic parking brake, pull away in either Drive or Reverse mode (the electronic parking brake will auto-release) OR:

1. Switch the ignition on
2. Press the brake pedal, and then press the (P) button
3. Release the brake pedal and press the accelerator slightly (the yellow light in the lever will go out and the red (P) symbol on the instrument panel will go out)

To put the electronic parking brake on, pull up and hold the (P) button (the yellow light in the lever will come on and the red (P) symbol on the instrument panel will illuminate).

Operating modes

The driver can choose from 3 modes:

- Standard Drive
- Eco
- Eco+

These options progressively conserve battery usage by limiting the engine's power, dulling the throttle response and limiting the air-conditioning. Eco+ is the most efficient mode.

Electric range

The maximum range stated by the vehicle manufacturer is 186 miles (see charging specification in BEV Charging Guide for further details). The actual range you achieve depends on many factors and may be lower than the manufacturer's stated maximum range. Actual range is impacted by:

- Personal driving style (e.g. rapid acceleration will drain the battery faster than gentle acceleration; longer braking distances and gradual slowing will improve regenerative braking).
- Usage conditions (the range will be reduced in particularly high or low temperatures, with poor road conditions, when driving up hills or when driving at high speeds [e.g. on motorways]).
- Use of driver-controlled electrical features (e.g. air conditioning or heating).

J.3 PHEV vehicle guide (VW Golf GTE)

Dashboard

When the ignition is switched on, the trip computer and electric vehicle information will be displayed in the centre of the dashboard. This will include the battery charge level and the approximate range available.

The left dial is the 'powermeter' and shows the current level of energy being used or regenerated. The right dial is the speedometer.

The dashboard provides a lot of information, so please read the vehicle manufacturer's handbook to familiarise yourself with it. The following key symbols to be aware of appear below the 'power availability' display:

	Battery is low (remaining range is approximately 20 miles). Charge as soon as possible.
	Charging cable is connected to vehicle charge port. Disconnect the charging cable & store it in the boot of the vehicle before driving.
	Brake pedal is released.
	Parking brake is engaged.
	Error. Stop the vehicle in a safe place as soon as possible and switch off the motor. If the error persists, please contact **Driverline** for assistance.

Switching the vehicle off

1. Bring the vehicle to a complete stop by pressing and holding down the brake pedal, whilst shifting the transmission into P (Park)
2. Apply the parking brake (see 'Operating the parking brake')
3. Turn the vehicle key towards you

Key points to remember

The vehicle manufacturer's handbook (in the glovebox) should be your first point of call if you are unsure of any of the switches, controls or menus in the vehicle. Here are some key points to consider:

- Using B on the selector lever results in higher energy recuperation from braking. This means that the vehicle is charging whilst you brake. This should be used with caution, as it can impact the braking performance.
- If a red symbol / warning lamp appears on the dashboard while you are moving, pull over safely and do not continue driving. Contact **VW's Driverline on 0844 2091 962** for assistance and then inform TRL.
- Do not attempt to repair or adapt the vehicle. If the vehicle is in need of repair, call **VW's Driverline on 0844 2091 962** to arrange repair of the vehicle. Please also inform **TRL** of any faults **on 01344 770 014.**

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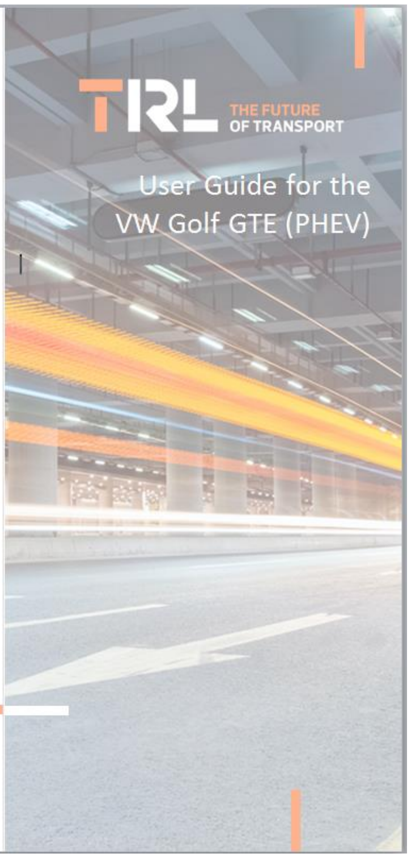

The VW Golf GTE is a plug-in hybrid electric vehicle (PHEV), which means it is powered by both electricity and petrol. The vehicle has an automatic gearbox (accelerator and brake pedal only).

This guide explains some of the key features of this vehicle. Please see the vehicle manufacturer's handbook in the glovebox for more detailed information about these and any other features of the vehicle.

Before you use the vehicle

- If the vehicle has been charging, ensure that the vehicle is disconnected from the chargepoint and that the charging cable is safely stowed in the boot (please refer to the charging guide provided in the In-vehicle Information Pack for further information about charging)
- Familiarise yourself with the dashboard and controls, as they differ to a conventional vehicle. Refer to the vehicle manufacturer's handbook for further information

Starting the vehicle

1. Insert the key and turn once (ignition is switched on, steering column lock is released)
2. To activate the electric motor, press the brake pedal and hold it down whilst you:
   a) Check the transmission is in Park (P) or Neutral (N)
   b) Turn and hold the key once more until the text message **READY** lights up on the instrument panel
   c) Release the key (the needle in the power display will move from **OFF** to 0)
   d) Move the selector lever to position D (Drive) / B (regenerative Braking) / R (Reverse). See the 'Tips' section below for more details

3. Switch off the electronic parking brake (see 'Operating the parking brake') and release the brake pedal (please be aware that when both brakes are released, the vehicle will start to move forward)
4. Press the accelerator pedal to start moving the vehicle

Operating the parking brake

The electronic parking brake is the equivalent of a conventional handbrake. Always switch this on when the vehicle is parked.

To release the electronic parking brake, pull away in either Drive or Reverse mode (the electronic parking brake will auto-release) OR:

1. Switch the ignition on
2. Press the brake pedal, and then press the (P) button
3. Release the brake pedal and press the accelerator slightly (the yellow light in the lever will go out and the red (P) symbol on the instrument panel will go out)

To put the electronic parking brake on, pull up and hold the (P) button (the yellow light in the lever will come on and the red (P) symbol on the instrument panel will illuminate).

Operating modes

The driver can choose from 3 modes:

- E-MODE (electric mode only; uses combustion engine as little as possible)
- Hybrid mode (uses the electric and combustion engines equally)
- Battery charge mode (recharges the battery using the petrol engine whilst in motion)

Press the E-MODE button to toggle between the E-MODE and Hybrid modes.

The battery charge mode can be enabled only by pressing the corresponding function button in the Infotainment system. To return to hybrid mode, press the corresponding function button in the Infotainment system again.

Electric range

As stated by the vehicle manufacturer, the maximum range when using the electric motor only is 31 miles and the maximum range when using electric and petrol combined (hybrid) is 580 miles. The actual range you achieve depends on many factors and may be lower than the manufacturer's stated maximum range. Actual range is impacted by:

- Personal driving style (e.g. rapid acceleration will drain the battery faster than gentle acceleration; longer braking distances and gradual slowing will improve regenerative braking).
- Usage conditions (the range will be reduced in particularly high or low temperatures, with poor road conditions, when driving up hills or when driving at high speeds [e.g. on motorways]).
- Use of driver-controlled electrical features (e.g. air conditioning or heating).

J.4 BEV charging guide (VW e-Golf)

Step-by-step guide to public charging

TRL have partnered with POLAR Plus to provide you with free access to a wide variety of public charge points. To see the locations of POLAR Plus charge points, please visit https://polar-network.com/map

1. The vehicle must be unlocked and will only charge if:
    a) The gear selector is in position P (Park)
    b) The electronic parking brake is switched on
    c) The engine is turned off
2. Plug the Mode 3 cable into the vehicle
3. Place your POLAR Plus card / key fob over the chargepoint's reader and hold for a few seconds.

4. Follow the instructions on the chargepoint screen. There are 3 modes available:
    a) Slow charging (up to 3kW, 6-8 hours overnight)
    b) Fast charging (7-22kW, 3-4 hours)
    c) Rapid charging units (43-50kW)

5. Blue LED lights will flash, identifying the socket to be used. Lift the flap of the selected socket.
6. Plug the cable into the socket, ensuring it is fully inserted. The LED lights will turn to green to indicate the charging has started. The plug will now be locked until charging is terminated.

To stop charging

1. Place the POLAR Plus card / key fob over the chargepoint's reader. The LED lights will turn blue and the plug will be unlocked.
2. Unplug the cable from the chargepoint and close the flap.
3. Unplug the cable from vehicle and store it in the boot.

If you need help using a charge point or are unsure of what to do, visit www.polar-network.com or call POLAR on 0330 016 5126 (open 24/7).

Key points to remember

- Always visually inspect equipment for any damage prior to use. Never use damaged equipment, including cables
- Never attempt to alter or repair cables or other electrical components. If equipment is damaged, contact TRL, who will repair or replace the equipment
- Only charge the vehicle using the following chargepoints
    - The Rolec Wallpod installed at your home
    - A POLAR Plus public chargepoint
    - Another dedicated electric vehicle chargepoint (e.g. at your workplace)
- Never charge the vehicle through any other normal domestic 3-pin socket
- Never charge the vehicle via an extension cable
- Always ensure that the 3-pin socket is switched off before disconnecting the charging cable.
- Do not work on the vehicle (repair, clean etc) during charging
- Never let anybody stay in the vehicle while the vehicle is charging
- Always disconnect the charging cable completely from the vehicle before activating the electric motor
- Only use charging cables supplied in your vehicle, or cables supplied at charging stations
- Always stow your charging cable in the bags provided in the boot
- If the plug cannot be removed after unlocking the vehicle, unlock the vehicle while holding the immediate charging button, located within the battery charge port.

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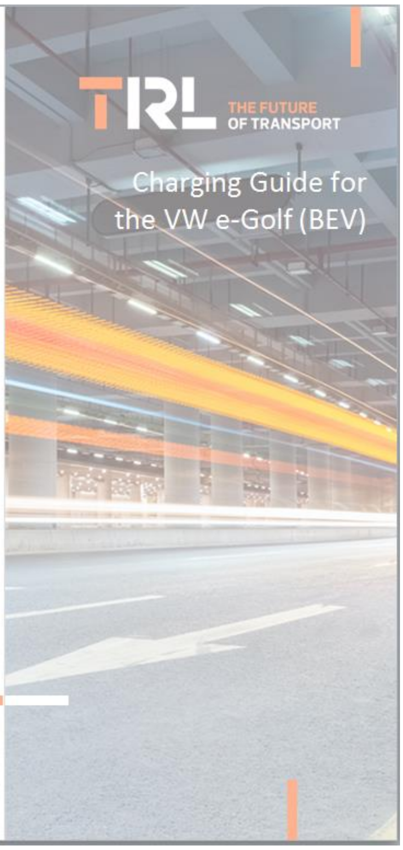


Charging specifications

Manufacturer reported specifications:

Nominal Capacity, i.e. units to full charge (kWh)	35.8
Maximum electric range (miles)	186
Expected electric range (miles)	175
Time to full charge using 3-pin socket (hours)	17
Time to full charge using EV-specific socket (hours)	10.5
Time to 80% charge (DC) (hours)	0.75

Rolec Wallpod

The EV Ready unit provided by Rolec is easy to use. *Do not under Any circumstances use any other Domestic power sockets at home, other than the one that has been installed for you.*

Indicator status lights on socket:

Flashing blue	Ready for charging (no cable plugged in)
Fixed blue	Cable is plugged in, but not charging
Fixed green	Charging in progress (cable plugged in)
Flashing red	Fault indicated. Switch off the unit at the source, wait 20 seconds, then switch the unit back on again to see if the fault has cleared itself. If the fault persists, please call Rolec for assistance (see below).

IF YOU HAVE ANY PROBLEMS WITH YOUR ROLEC CHARGER, PLEASE CALL **01205 724754**.

Getting to know your vehicle

It is recommended that you read the vehicle manufacturer's handbook (in the glovebox) before charging. The handbook should also be referred to if any warning / indicator lights or text messages are shown on the instrument panel.

Where is the charge port on the vehicle?
The charge port is on the driver's side of the vehicle.

How do I open the charge port?

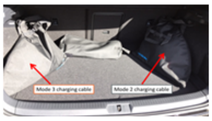
Unlock the vehicle and press on the flap of the charge port.

What do the indicator status lights on the vehicle mean?

Solid green	Charging complete
Flashing green	Battery is charging
Temporary yellow	Charging cable is connected and has been detected
Solid yellow	Charging cable has been unlocked automatically or no mains voltage has been detected
Flashing yellow	Vehicle transmission is not in P (Park)
Solid red	Charging cable may not be locked. Check the cable is plugged in correctly
Flashing red	Battery is not charging due to an error. If the error persists, please call Driverline for assistance.

Charging cables

Two types of charging cable can be found in the boot of the vehicle:



- The Mode 2 charging cable is for charging at home (it has a 3-pin plug which is compatible with the Rolec Wallpod installed at your home)
- The Mode 3 charging cable is for charging at a public chargepoint or other electric vehicle specific socket (e.g. at your workplace)

Step-by-step guide to charging at home

1. The vehicle must be unlocked and will only charge if:
    a) The gear selector is in position P (Parked)
    b) The electronic parking brake is switched on
    c) The engine is turned off
2. Locate the Mode 2 charging cable.

3. Open the battery charge port cover, attach the charging plug into the vehicle and then insert the other end into the charging socket
4. The remaining charging period will be shown on the instrument panel in the vehicle. The vehicle will continue charging until it reaches 100% or until you stop it by unplugging
5. To unplug the vehicle:
    a) *Firstly*, switch off the power supply at the socket
    b) *Secondly*, remove the plug from the vehicle

    It is important that you carry out the two steps in this order.
6. Store the cable in the boot of the vehicle and close the flap on the vehicle's charge port

J.5 PHEV charging guide (VW Golf GTE)

Step-by-step guide to public charging

TRL have partnered with POLAR Plus to provide you with free access to a wide variety of public charge points. To see the locations of POLAR Plus chargepoints, please visit https://polar-network.com/map

1. The vehicle must be unlocked and will only charge if:
    a) The gear selector is in position P (Park)
    b) The electronic parking brake is switched on
    c) The engine is turned off
2. Plug the Mode 3 cable into the vehicle

3. Place your POLAR Plus card / key fob over the chargepoint's reader and hold for a few seconds.

4. Follow the instructions on the chargepoint screen. There are 3 modes available:
    a) Slow charging (up to 3kW, 6-8 hours overnight)
    b) Fast charging (7-22kW, 3-4 hours)
    c) Rapid charging units (43-50kW) – **these are not compatible with the trial vehicles.**

5. Blue LED lights will flash, identifying the socket to be used. Lift the flap of the selected socket.
6. Plug the cable into the socket, ensuring it is fully inserted. The LED lights will turn to green to indicate the charging has started. The plug will now be locked until charging is terminated.

To stop charging

1. Place the POLAR Plus card / key fob over the chargepoint's reader. The LED lights will turn blue and the plug will be unlocked.
2. Unplug the cable from the chargepoint and close the flap.
3. Unplug the cable from vehicle and store it in the boot.

If you need help using a charge point or are unsure of what to do, visit www.polar-network.com or call POLAR on 0330 016 5126 (open 24/7).

Key points to remember

- Always visually inspect equipment for any damage prior to use. Never use damaged equipment, including cables
- Never attempt to alter or repair cables or other electrical components. If equipment is damaged, contact TRL, who will repair or replace the equipment
- Only charge the vehicle using the following chargepoints
    - The Rolec Wallpod installed at your home
    - A POLAR Plus public chargepoint
    - Another dedicated electric vehicle chargepoint (e.g. at your workplace)
- Never charge the vehicle through any other normal domestic 3-pin socket
- Never charge the vehicle via an extension cable
- Always ensure that the 3-pin socket is switched off before disconnecting the charging cable.
- Do not work on the vehicle (repair, clean etc) during charging
- Never let anybody stay in the vehicle while the vehicle is charging
- Always disconnect the charging cable completely from the vehicle before activating the electric motor
- Only use charging cables supplied in your vehicle, or cables supplied at charging stations
- Always stow your charging cable in the bags provided in the boot
- If the plug cannot be removed after unlocking the vehicle, unlock the vehicle while holding the immediate charging button, located within the battery charge port.

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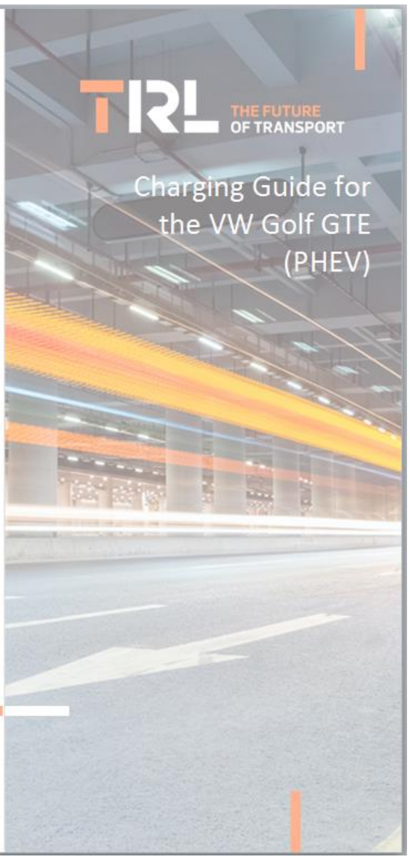


Charging specifications

Manufacturer reported specifications:

Nominal Capacity, i.e. units to full charge (kWh)	8.7
Maximum electric range (miles)	31
Expected electric range (miles)	25
Time to full charge using 3-pin socket (hours)	3.75
Time to full charge using EV-specific socket (hours)	2.25
Time to 80% charge (DC) (hours)	n/a

Rolec Wallpod

The EV Ready unit provided by Rolec is easy to use. *Do not under any circumstances use any other domestic power sockets at home, other than the one that has been installed for you.*

Indicator status lights on socket:

Flashing blue	Ready for charging (no cable plugged in)
Fixed blue	Cable is plugged in, but not charging
Fixed green	Charging in progress (cable plugged in)
Flashing red	Fault indicated. Switch off the unit at the source, wait 20 seconds, then switch the unit back on again to see if the fault has cleared itself. If the fault persists, please call Rolec for assistance (see below).

IF YOU HAVE ANY PROBLEMS WITH YOUR ROLEC CHARGER, PLEASE CALL **01205 724754**.

Getting to know your vehicle

It is recommended that you read the vehicle manufacturer's handbook (in the glovebox) before charging. The handbook should also be referred to if any warning / indicator lights or text messages are shown on the instrument panel.

Where is the charge port on the vehicle?
The charge port is at the front under the VW badge in the radiator grille.

How do I open the charge port?

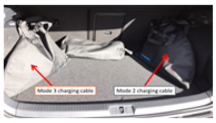
Unlock the vehicle and press on the flap of the charge port (you may have to push quite hard on the right-hand side of the badge).

What do the indicator status lights on the vehicle mean?

Solid green	Charging complete
Flashing green	Battery is charging
Temporary yellow	Charging cable is connected and has been detected
Solid yellow	Charging cable has been unlocked automatically or no mains voltage has been detected
Flashing yellow	Vehicle transmission is not in P (Park)
Solid red	Charging cable may not be locked. Check the cable is plugged in correctly
Flashing red	Battery is not charging due to an error. If the error persists, please call Driverline for assistance.

Charging cables

Two types of charging cable can be found in the boot of the vehicle:



- The Mode 2 charging cable is for charging at home (it has a 3-pin plug which is compatible with the Rolec Wallpod installed at your home)
- The Mode 3 charging cable is for charging at a public chargepoint or other electric vehicle specific socket (e.g. at your workplace)

Step-by-step guide to charging at home

1. The vehicle must be unlocked and will only charge if:
    a) The gear selector is in position P (Parked)
    b) The electronic parking brake is switched on
    c) The engine is turned off
2. Locate the Mode 2 charging cable.

3. Open the battery charge port cover, attach the charging plug into the vehicle and then insert the other end into the charging socket
4. The remaining charging period will be shown on the instrument panel in the vehicle. The vehicle will continue charging until it reaches 100% or until you stop it by unplugging
5. To unplug the vehicle:
    a) *Firstly,* switch off the power supply at the socket
    b) *Secondly,* remove the plug from the vehicle

    It is important that you carry out the two steps in this order.
6. Store the cable in the boot of the vehicle and close the flap on the vehicle's charge port

J.6 Guidance for breakdowns or incidents

WHAT TO DO IN THE EVENT OF A BREAKDOWN OR INCIDENT

KEY NUMBERS

- **999** in an **emergency.** If on a motorway and you can see an emergency phone, use this to summon assistance, otherwise use a motorway marker post to help the emergency services to locate you
- **VW's Driverline** on **0844 2091 962** for all issues relating to breakdown, tyres, and glass
- **Aviva's claims line** on **0800 246 876** in the event of an incident
- **TRL** on **01344 770 014** to report any breakdowns or incidents once it is safe to do so

BREAKDOWNS

- Do not attempt to fix the vehicle yourself
- If safe to do so, park the vehicle off the road and use the hazard warning lights to alert other drivers.
- For all breakdowns, in the first instance call **VW's Driverline** on **0844 2091 962** to arrange suitable recovery
- Once it is safe to do so, please also inform **TRL** of the breakdown by calling **01344 770 014,** or by emailing vehicletrials@trl.co.uk

Breakdown on a motorway

- Pull onto the hard shoulder or try and reach the nearest Emergency Refuge Area (ERA). If this is not possible, stop as far to the left as possible.
- Exit the vehicle from the passenger side. It is safer not to wait in the vehicle, as the biggest danger is from passing vehicles – you should try to stand at least 1.2m behind the safety barrier in a position to the rear of your vehicle so you can face oncoming traffic.
- If you can see an emergency phone, use this to summon assistance, otherwise use a motorway marker post to help the emergency services to locate you.

Tyre-related breakdown

- Do not attempt to fix or change the tyre yourself. However, if you are in an emergency situation, there is a tyre pump in the boot.

INCIDENTS

- In the event of an accident, no matter how trivial, the driver must stop and stay calm. Call **999** if anyone is injured or the road is blocked / damaged.
- Do not attempt to tackle a fire; contact the emergency services.
- Accidents involving injuries to people, dogs, livestock or horses must be reported to police as soon as possible or within 24 hours.
- Under no circumstances should the driver discuss the cause of, or blame for an accident with the other party or parties involved or with any person.
- Use the **Incident Reporting Form** within the yellow **Motor Accident Guide** produced by Aviva (in the glovebox of your vehicle). Use this form to try to obtain information such as:
  - Names and addresses of other drivers/owners of other vehicles
  - Other persons involved and any witnesses.
  - Details of vehicle types and registration numbers
  - Insurance company names (and policy details if possible)
- Comprehensive insurance is provided to you by Aviva and in the event of a collision please call their claims line immediately on **0800 246 876**.
- Once it is safe to do so, please also inform **TRL** of the incident by calling **01344 770 014**, or by emailing vehicletrials@trl.co.uk

J.7 Post-familiarisation consent form

Please complete this form after you have completed the familiarisation drive, deleting YES or NO as appropriate in the spaces provided:

Have you had an opportunity to drive the vehicle?	Yes / No
Do you feel comfortable to drive the vehicle unaccompanied?	Yes / No
Have you been given manufacturer guidance for safe operation of the vehicle?	Yes / No
Have you been given manufacturer guidance for safe charging of the vehicle (if applicable)?	Yes / No
Do you understand that it is your responsibility to read the manufacturer's guide?	Yes / No
Are you satisfied that you have enough information to allow you to drive and charge the vehicle safely?	Yes / No
Do you understand that you must notify TRL by telephone within 24 hours in the event of a breakdown or accident?	Yes / No
Have you been given contact details in case of breakdown or emergency?	Yes / No
Do you understand that, whilst you are welcome to discuss use of the vehicle with friends and family, you should not post comments or blogs about your trial experience online?	Yes / No

Signed	
Date	

Appendix K Questionnaires

The following questionnaires are provided in a separate document: see 'Consolidated questionnaires appendix'.

K.1 Pre-trial questionnaire

K.2 Time point 1 questionnaire

K.3 Interim questionnaire 1

K.4 Interim questionnaire 2

K.5 Interim questionnaire 3

K.6 Time point 2 questionnaire

Appendix L Choice experiment supporting information

L.1 Literature review

This literature review builds upon the comprehensive review carried out during the previous choice experiment and update of ECCo for DfT (Element Energy for DfT 2015). This literature review attempts to identify all choice experiments published since 2015 which explore consumer attitude towards plug-in vehicles. To achieve this three distinct strategies were employed:

- Generation of citation maps, using Thomson Reuters' Web of Knowledge (webofknowledge.com), for all choice experiment studies found during Element Energy for DfT (2015).
- Literature search of Science Direct (www.sciencedirect.com) and Taylor & Francis Online (www.tandfonline.com) using the following search terms:

Search field 1
stated preference
(stated OR discrete) AND choice
choice AND (model OR survey OR experiment)
consumer AND (preference OR behaviour OR attitude OR perception)
"willingness to pay" OR willingness-to-pay
design + (space OR game)

AND

Search field 2
(plug OR electric OR "alternative fuel") AND (car OR vehicle)

- 'Snowballing': reviewing the sources referenced in the studies identified during this process

This process identified 62 results of interest which were then systematically reviewed to evaluate their relevance to the design of the choice experiment. From these 62 results, 12 additional choice experiments that took place since Element Energy for DfT (2015) were identified.

Table 1: Review of all relevant choice experiment studies that were identified in the literature (* denotes study identified during (Element Energy for DfT 2015))

	Purchase price	Fuel cost	O&M cost	Range	Charging time	Fuel availability	Emissions	Performance	Policy incentives
(Hackbarth & Madlener 2013)*	X	X		X	X	X	X		X
(Jensen et al. 2013)*	X	X		X		X	X	X	
(Glerum et al. 2014)*	X	X	X						
(Hoen & Koetse 2014)*	X		X	X	X	X			X
(Jensen et al. 2014)*	X	X		X	X	X	X		
(Kim et al. 2014)*	X	X		X	X	X		X	
(Tanaka et al. 2014)*	X	X		X		X	X		
(Valeri & Danielis 2015)	X		X	X		X		X	
(Bahamonde-Birke & Hanappi 2016)	X	X	X	X		X		X	X
(Axsen et al. 2015)	X	X		X	X				
(Krause et al. 2016)	X	X		X	X				
(Dumortier et al. 2015)	X	X		X			X		
(Ida et al. 2014)	X	X		X		X	X		
(Rudolph 2016)	X	X				X			X
(Langbroek et al. 2016)	X			X		X			X
(Jacobs et al. 2016)	X			X	X			X	
(Helveston et al. 2015)	X	X		X	X			X	
(Shin et al. 2015)	X	X				X			
(Lieven 2015)						X			X
(Element Energy for ETI 2011)	X		X	X	X	X	X	X	
(Element Energy for H2M, 2012)	X	X		X		X	X	X	
(Element Energy for DfT 2015)	X	X		X	X	X			

L.2 Choice experiment items

This section presents the script for the pre-information shown to trial participants before they answer the Uptake Trial Choice Experiment questions.

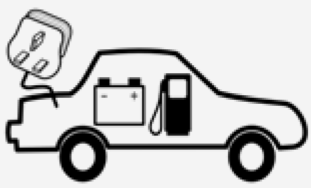
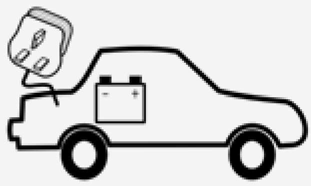
L.2.1 Information on Electric Cars

In this last section of the survey, we would like you to imagine that you are buying a new car. In each question, you will be given information on three types of cars:

- **A battery electric car**
- **A plug-in hybrid electric car**
- **A petrol / diesel car** – this is similar to most cars on sale today

Based on the information given, we will then ask you to choose which one you would buy as your new car.

However, before we begin we would like to remind you about the characteristics of plug-in vehicles, which use electricity to power the wheels some or all the time, and are recharged by plugging in to an electricity supply. Please read the information in the table below:

Non-plug-in (conventional) vehicles	**Plug-in Vehicles (PiVs)**	
Conventional Petrol / Diesel Vehicle	**Plug-in Hybrid Electric Vehicle (PHEV)**	**Battery Electric Vehicle (BEV)**
		
Typically powered by **petrol/ diesel only.**	A Plug-in Hybrid Electric car has both **a petrol/diesel engine and an electric motor powered by a battery**. The battery can be **charged by plugging it into a normal electrical socket** (like you have at home) or **dedicated charging point**, as needed. The battery can also be charged when the engine is running. **If you run out of charge you can continue driving** as long as there is petrol or diesel in the tank. The car will use the electric motor whenever possible to save fuel, but also uses power from the	A Battery Electric car is **powered only by a battery**. The battery is **charged by plugging it into a normal electrical socket** (like you have at home) or **dedicated charging point**, as needed. **No petrol or diesel is required**; once you run out of electrical charge in the battery you will no longer be able to operate the vehicle.

	petrol/diesel engine when required. Please note that **this is different from a conventional hybrid car (e.g. Toyota Prius)**, which does not need to (and cannot) be plugged into an electrical socket to charge the battery. A Plug-in Hybrid Electric car can travel much further under electric power than a conventional hybrid.	

Here is some more detailed information about the two types of electric car:

	Plug-in Hybrid Electric car	**Battery Electric car**
Vehicle operation	• No manual gear changes i.e. drives like an automatic car	• No manual gear changes i.e. drives like an automatic car
Maintenance	• Less frequent than a petrol/diesel car, because the electric motor reduces the wear on the engine and the brakes	• Less frequent than a petrol/diesel car, because the electric motor has fewer parts than a petrol or diesel engine
Recharging	• A full charge at home takes 2-4 hours, though the battery can be partially charged without damaging it	• A full charge at home takes 5-10 hours, though the battery can be partially charged without harming the battery • Some battery electric cars can charge at 'rapid chargers', which will recharge the battery significantly faster
Noise level	• Almost no engine noise when driving on battery power • Similar to a petrol/diesel car when the battery is depleted	• No engine noise when driving • The electric motor is much quieter that the engine in a petrol/diesel car
Environmental impact	• Overall emissions lower than a petrol/diesel car, even including the emissions from generating electricity, provided it is regularly charged	• Overall emissions lower than a petrol/diesel car, even including the emissions from generating electricity • Zero emissions from the car itself

L.2.2 Choice Experiment

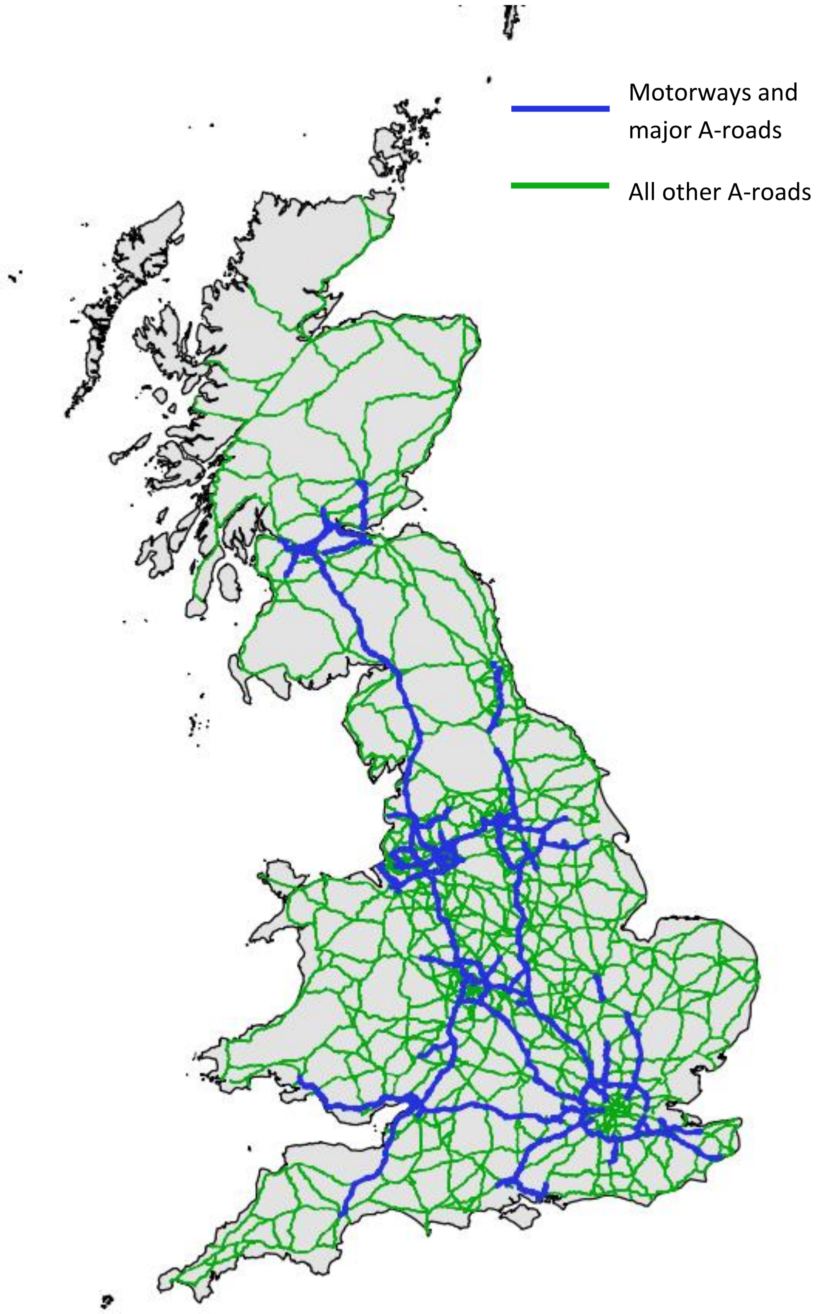
For the following questions, we would like you to imagine that you are buying a new car. In each question you will be given information on three types of cars:

- **A battery electric car**
- **A plug-in hybrid electric car**
- **A petrol/ diesel car** – this is similar to most cars on sale today

We would like you to read the information about each car, and tell us which one you would choose if you had to pick one of them as your new car. **The descriptions of the cars will change in each question, so you will need to read the information each time before making your choice.**

For each question, you will be given the following information about the cars:

Purchase price	This is the cost to buy the car in pounds, including VAT.
Running cost	This is the total annual running cost of the car based on your annual mileage that you told us earlier. This includes all ongoing costs such as refuelling and/or recharging costs, servicing, insurance and road tax
Driving range	This is the distance you can drive with a full battery and/or petrol tank until you need to recharge or refuel. Each choice will include the 'official' range as stated by the car manufacturer in the car specifications. This range is measured under laboratory conditions. The real-life range will vary depending on driving style, speed, external temperature, topography and type of road. For example, range while driving on highways (70 mph) can be as low as half the 'official' range. In low-speed urban environments, range is typically closer to the official range but will fall in stop-start traffic. **You will therefore also be shown (in brackets) the average range under real-life conditions, as suggested by the manufacturer. This includes a combination of urban and highway driving, and is typically based on the average range achieved by their customers.**
Local charge point availability (e.g. for shopping, driving to work or into town)	You will be told whether charging points are available at the workplace or in public car parks or parking spaces so that you can recharge during local journeys **Please assume that you always have access to a charging point at home, either in your garage/driveway or in a dedicated parking space outside your home**
Rapid charge points for long distance journeys (i.e. on motorways and/or major roads)	Rapid charge points charge batteries significantly faster than home charge points. In the choice questions, to illustrate the number of charging points available, one of three hypothetical scenarios will be presented, showing the coverage of rapid charging sites: • Rapid charging sites every 20 miles on motorways and major A roads (equivalent to rapid charge points at all motorway services) • Every 20 miles on motorways and **all** A roads

	• Rapid charging network has Every 20 miles on motorways and all A roads, and at a similar frequency to petrol stations on all other roads For illustration, this map shows what we mean by motorways & major A roads (blue), as well as all remaining A roads (green).  **Please assume that charge point operators will install enough charge points at each location to avoid queues for charging bays.**

	You will also be shown how much extra driving range a rapid charge would add for every 10 minutes of charging. In a plug-in hybrid car, you would normally refuel with petrol/diesel at petrol stations to carry out long journeys

L.2.2.1 Example Question

Here is an example question with 3 hypothetical cars. Please read the information carefully and answer the question at the bottom.

For this and all the following choice questions, please assume that other aspects of the cars, such as safety, specification, build quality, depreciation rate and so on are the same for all the cars.

	Petrol/ diesel car (A)	***Plug-in hybrid electric car (B)***	***Battery electric vehicle (C)***
Purchase price	**£20,000**	**£22,000**	**£24,000**
Annual running cost	**£1000** per year	**£500** per year	**£750** per year
Official driving range (average real-life range)	**400 (300)** miles	**20 (13) miles in electric mode,** 400 (300) miles using petrol engine	**200 (130) miles**
Destination Charge point availability at trip destinations	Refuel at petrol stations	Charging available at **your home and workplace**	Charging available at **your home, workplaces** and in **public car parks / spaces**

Rapid charge points for long distance journeys	Refuel with petrol/diesel at any petrol station	Refuel with petrol/diesel at any petrol station for long journeys	Rapid charging sites **every 20 miles on motorways and major A roads** (i.e. at all motorway services) Rapid charging provides an additional **75 miles** of driving range for every 10 minutes of charging

If you could choose between these three cars, which one would you choose?

☐ ☐ ☐

If you had to choose between the plug-in hybrid and battery electric car, which one would you choose?

☐ ☐

After this example, you will be presented with the first choice question. The descriptions of the cars will change in each question, so please remember to read the information each time before making your choice.

Appendix M Vehicle condition form

VEHICLE CONDITION FORM

Participant ID	Vehicle ID	Vehicle reg.	Colour

CHECKLISTS

Condition check:	Collection Good condition? **√ or X**	Return Good condition? **√ or X**	Notes
Wheels and Tyres			
Glass			
Interior			
Seatbelts			
Body work			
Lights			

Equipment and document check

Equipment and document check:	Collection Present? **√ or X**	Return Present? **√ or X**	Notes
Charging cable with conventional plug			
Charging cable with mode 3 connector			
First aid kit (complete)			
Yellow jacket			
Warning triangle			
Locking wheel nut			
Owner's manual			
Vehicle information pack			
Driverline booklet			
Polar Plus Charging card			
Telematics Dongle			

ASSESSMENT OF VEHICLE AT COLLECTION

Researcher	Date	Mileage

Fuel level (if applicable):

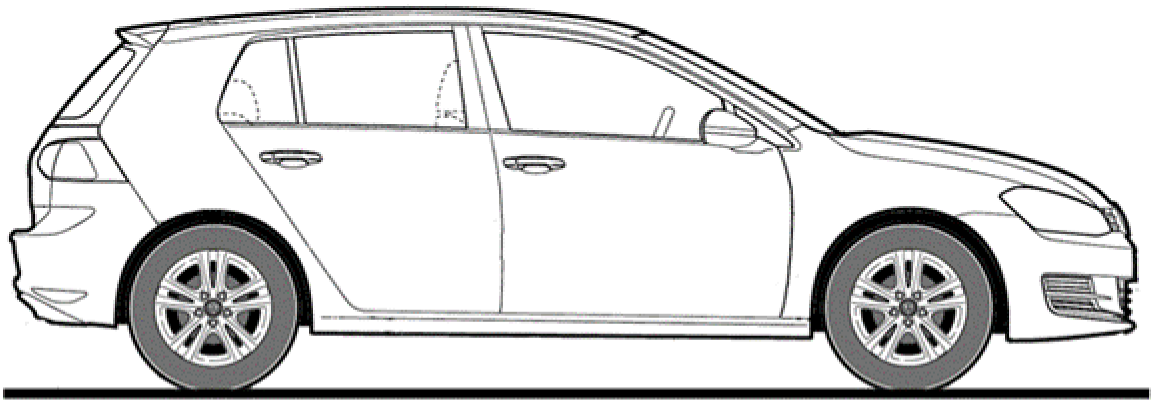
Empty	1/4	1/2	3/4	Full

Charge level (if applicable):

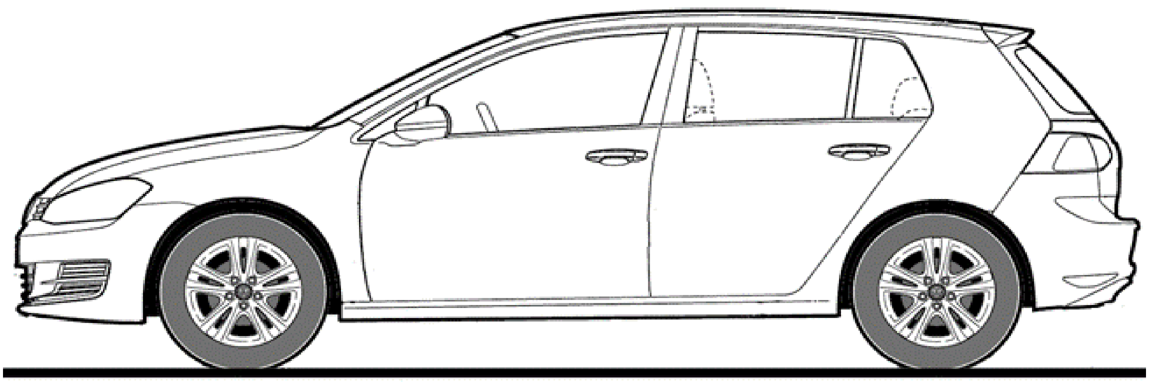
Empty	1/4	1/2	3/4	Full

Indicate any marks, scratches or damage on the vehicle on the corresponding pictures below. Add notes if necessary. **Participant and researcher to both sign on satisfactory completion of inspection.** Take photos of any damage.

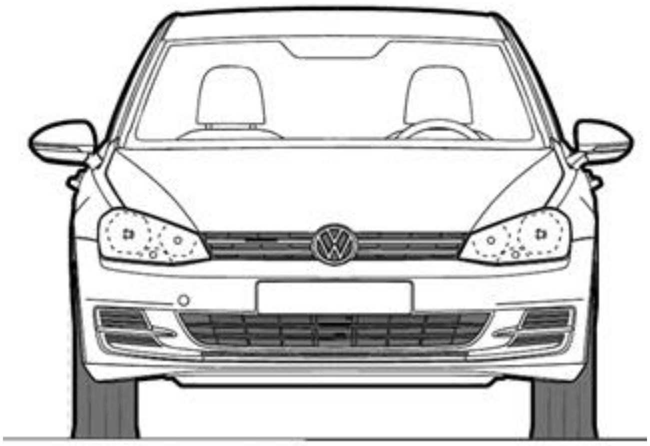
Driver's side:



Passenger side:



Front:



Rear:

Notes:

____

Declaration:

I have inspected the above vehicle and agree that:

- **The equipment indicated is present**
- **The only damage is that which is marked or noted in this form**

Participant signature:____ Date:_________________

Researcher signature:____ Date:________________

ASSESSMENT OF VEHICLE AT RETURN

Researcher	Date	Mileage

Fuel level (if applicable):

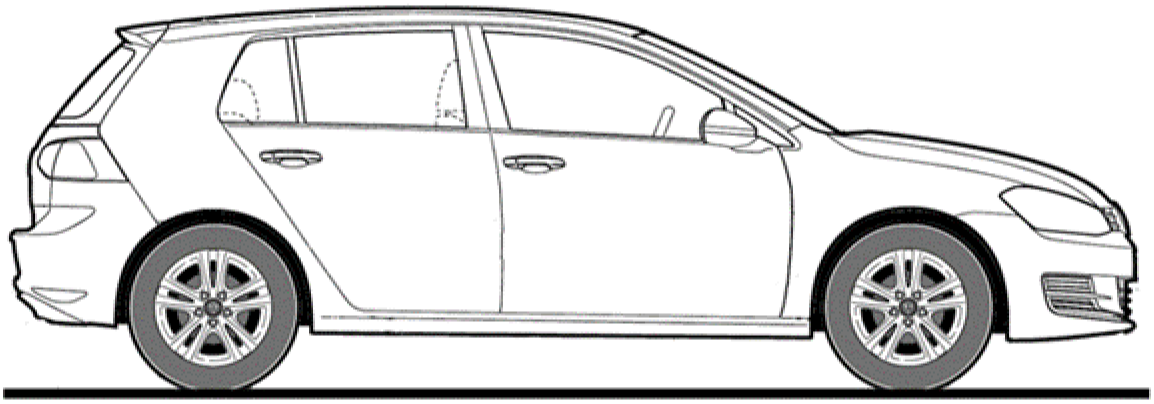
Empty	1/4	1/2	3/4	Full

Charge level (if applicable):

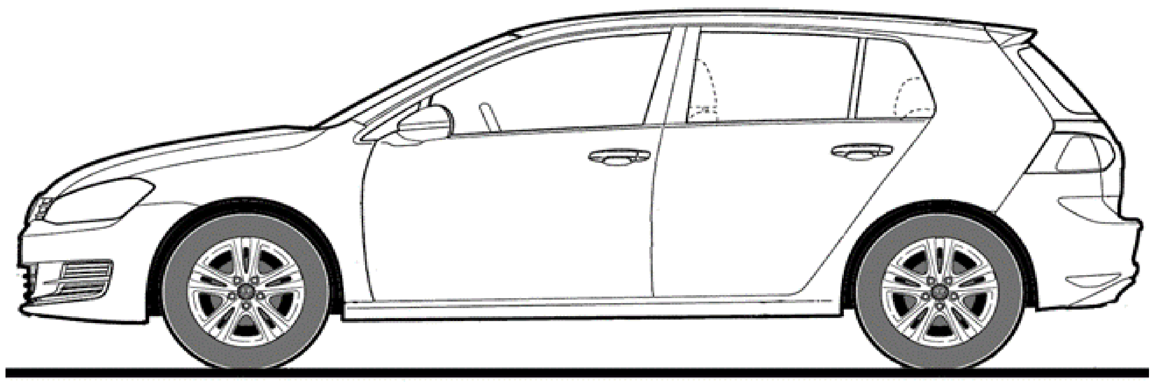
Empty	1/4	1/2	3/4	Full

Indicate any marks, scratches or damage on the vehicle on the corresponding pictures below. Add notes if necessary. **Participant and researcher to both sign on satisfactory completion of inspection**

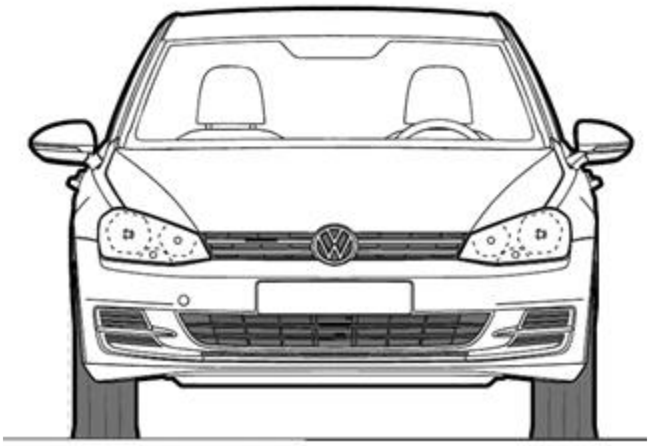
Driver's side:



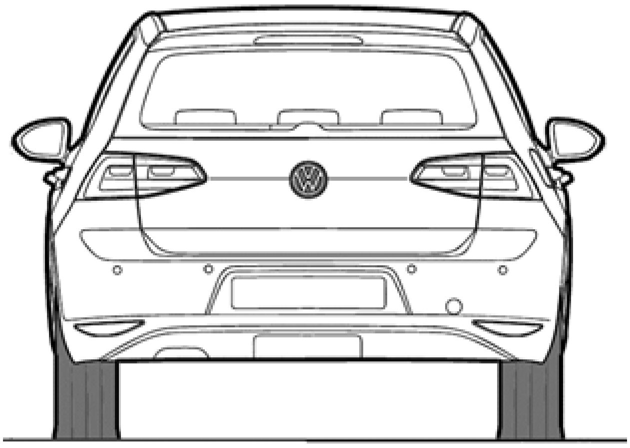
Passenger side:



Front:



Rear:



Notes:

____
____
____
____
____
____
____

Declaration:

I have inspected the above vehicle and agree that:

- **The equipment indicated is present**
- **The only damage is that which is marked or noted in this form**

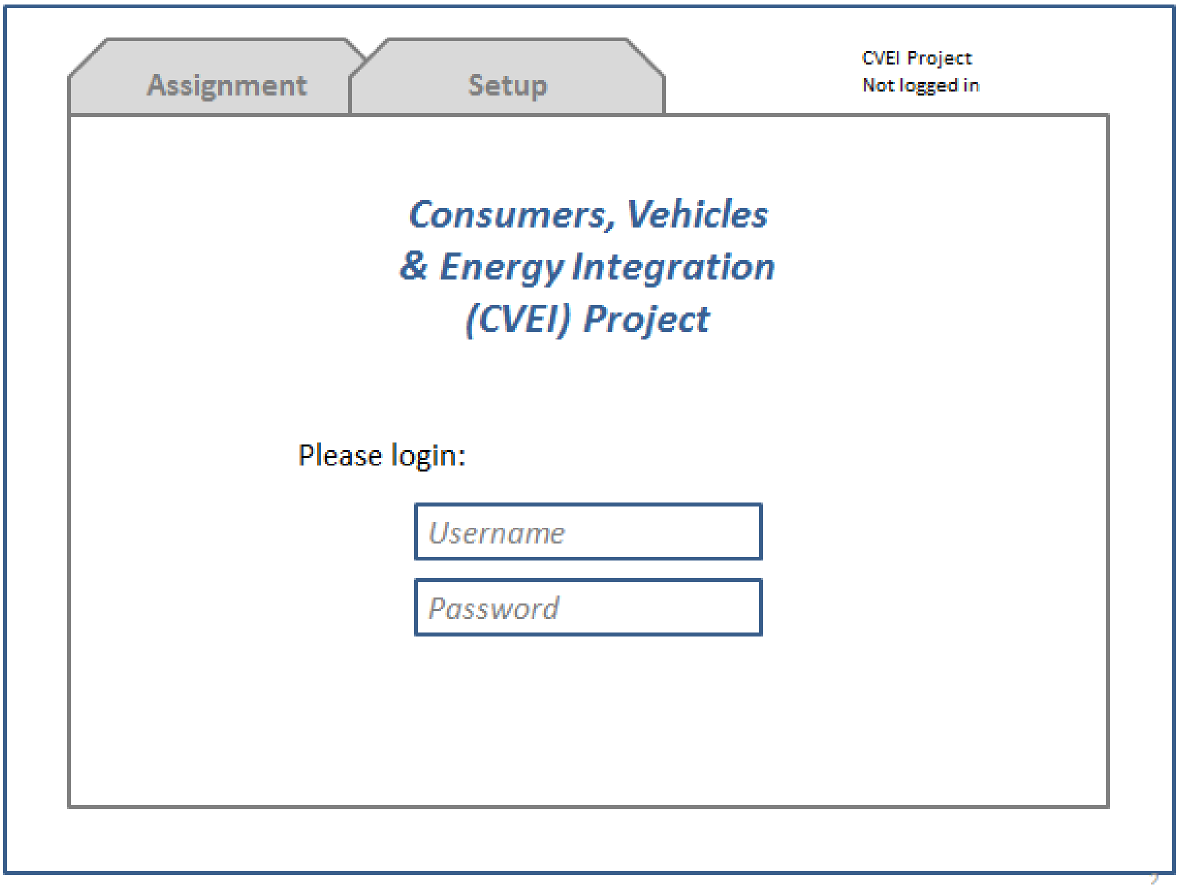
Participant signature:____ Date:_________________

Researcher signature:____ Date:________________

Appendix N Design for Admin Portal

TRL Admin Portal User Interface

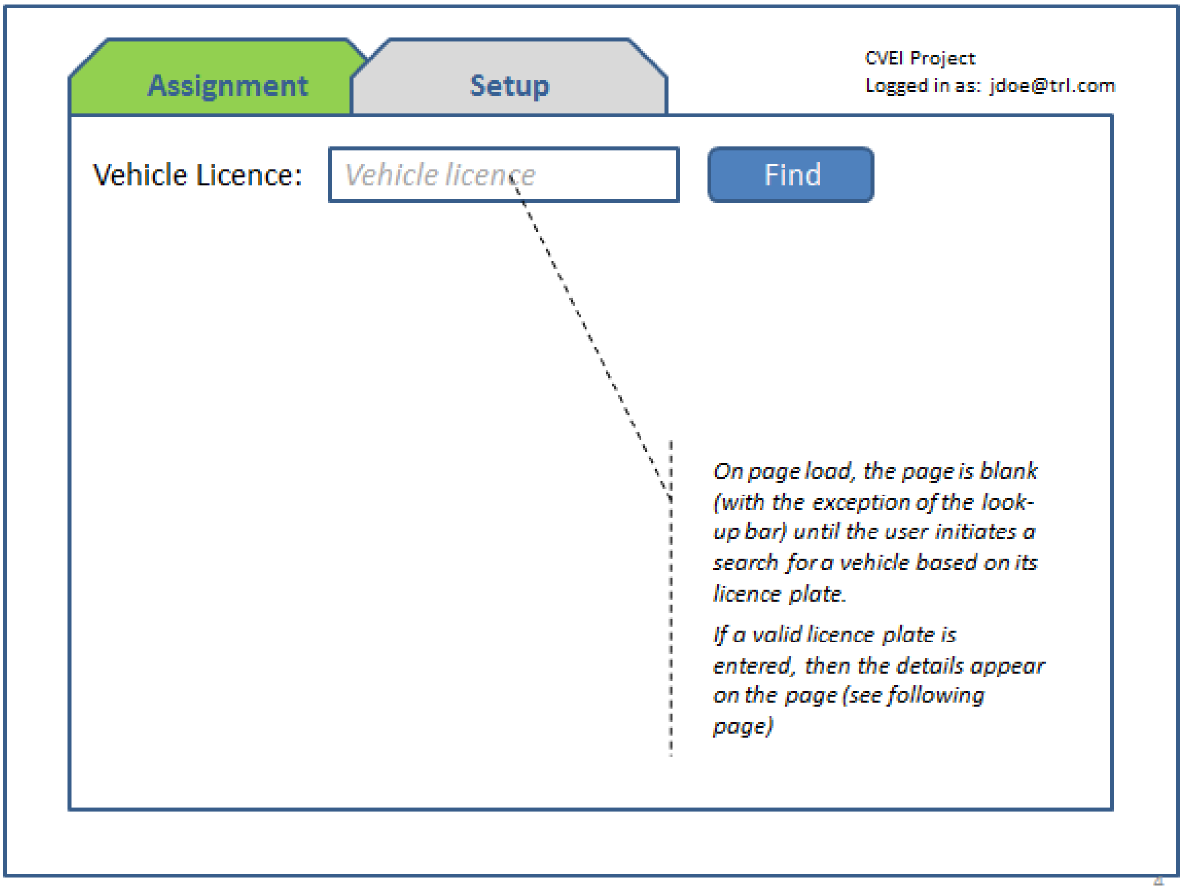
Log on page



Notes on Login

- Only accounts with Org Operator access or greater are allowed to login to the portal
  - No driver access
  - No customer support access

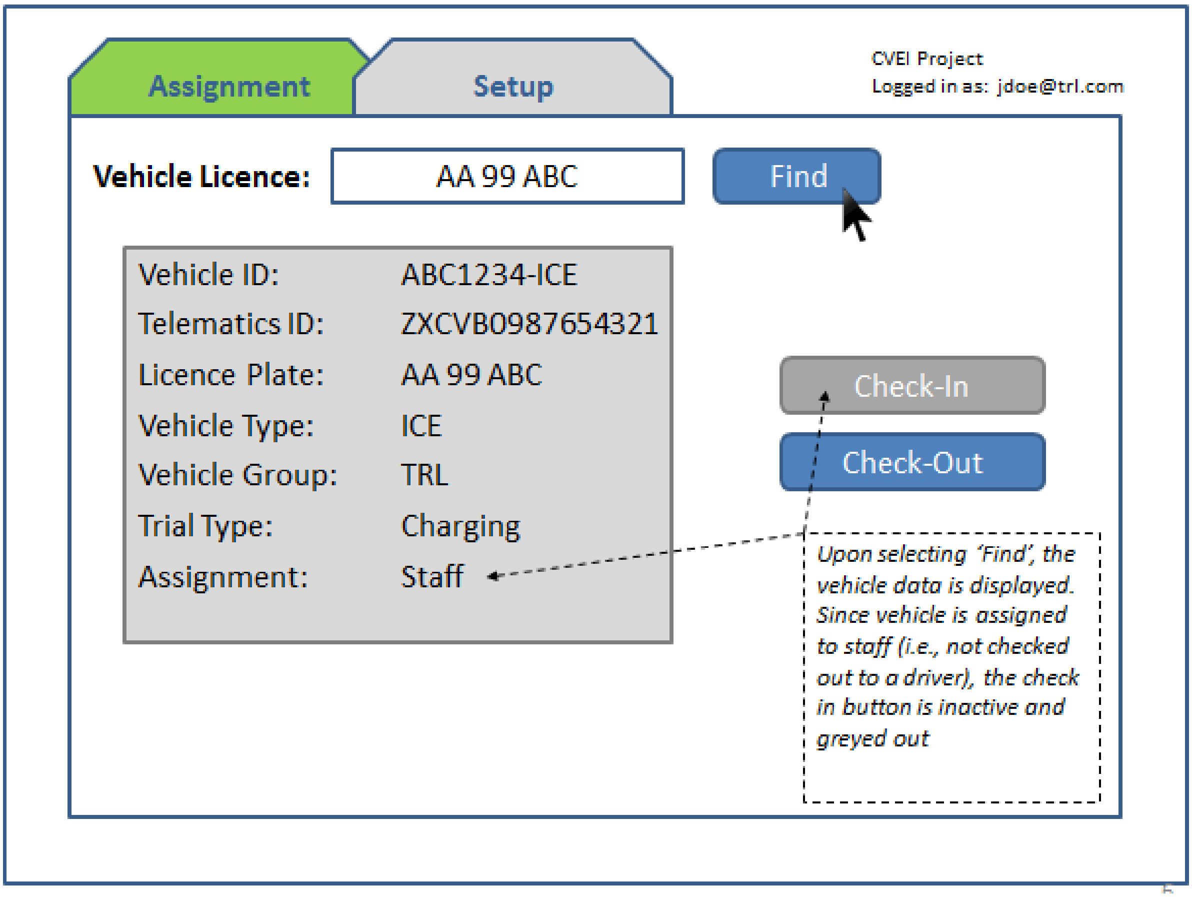
Assignment Tab: When page loads



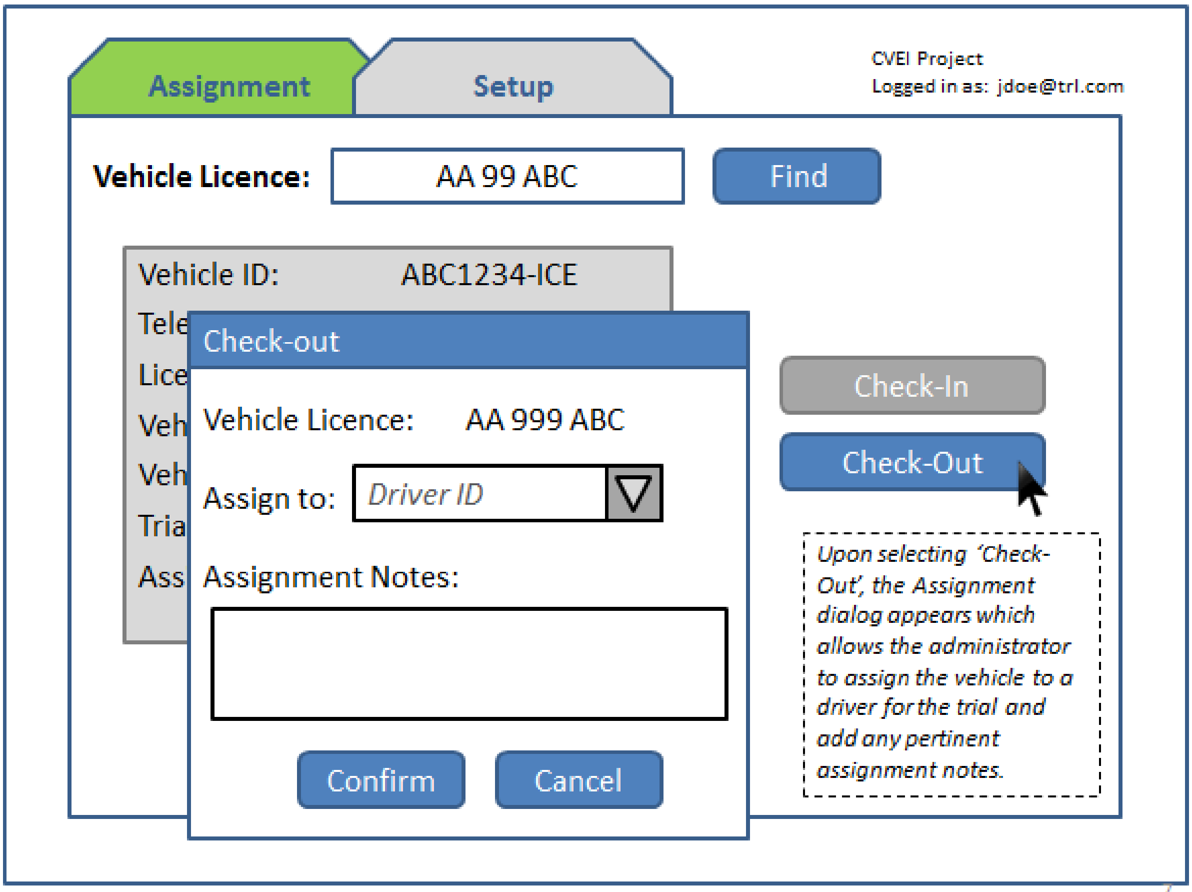
Notes on Look-Up

- The look-up field should actively search for vehicles that match the licence plate being entered in the field.
- The listing of licence plates should be sequential alphanumerically
- The look-up algorithm should disregard spaces in the licence plate number
  - E.g., AA 123 ABC is treated the same as AA123ABC
- If no vehicle exists with the entered licence plate, then the field should say, “no match found” or similar message.

Assignment Tab: Vehicle look-up



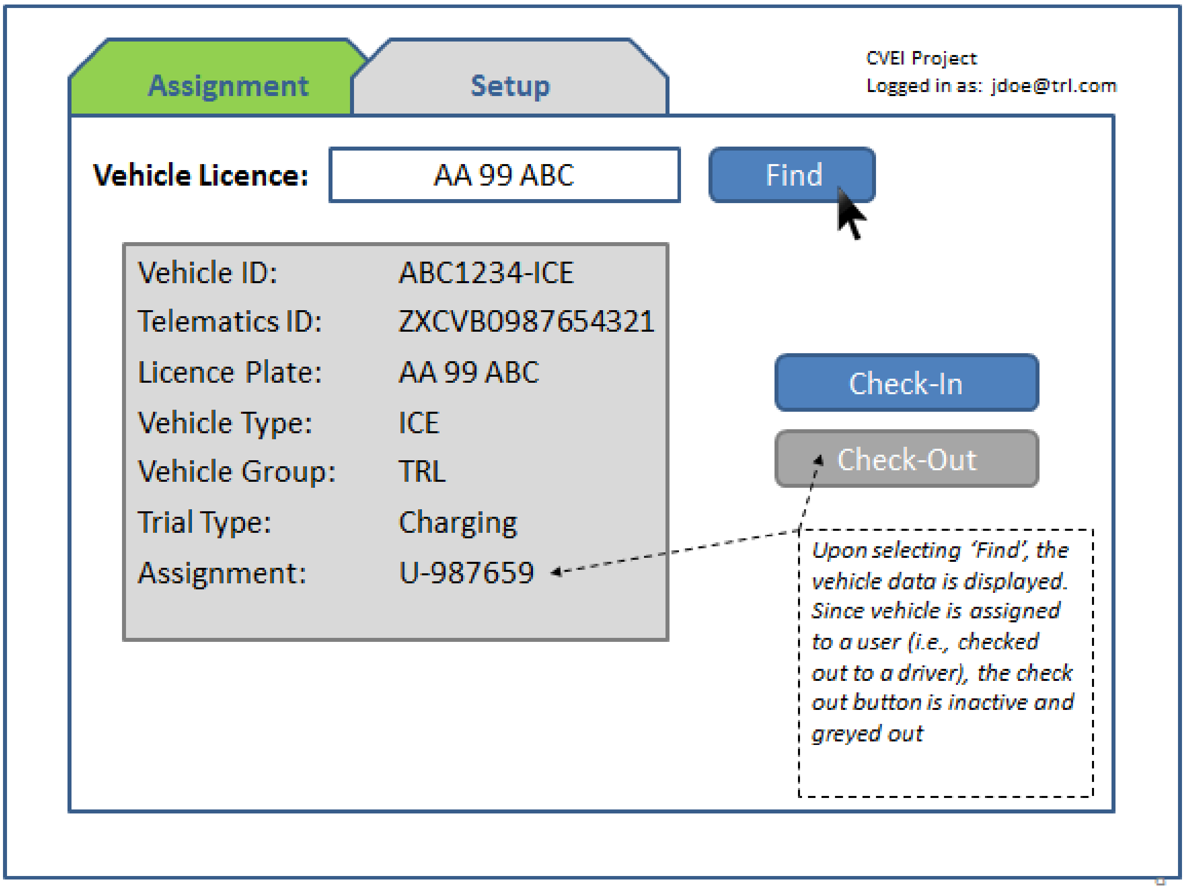
Assignment Tab: Vehicle check-out / driver assignment



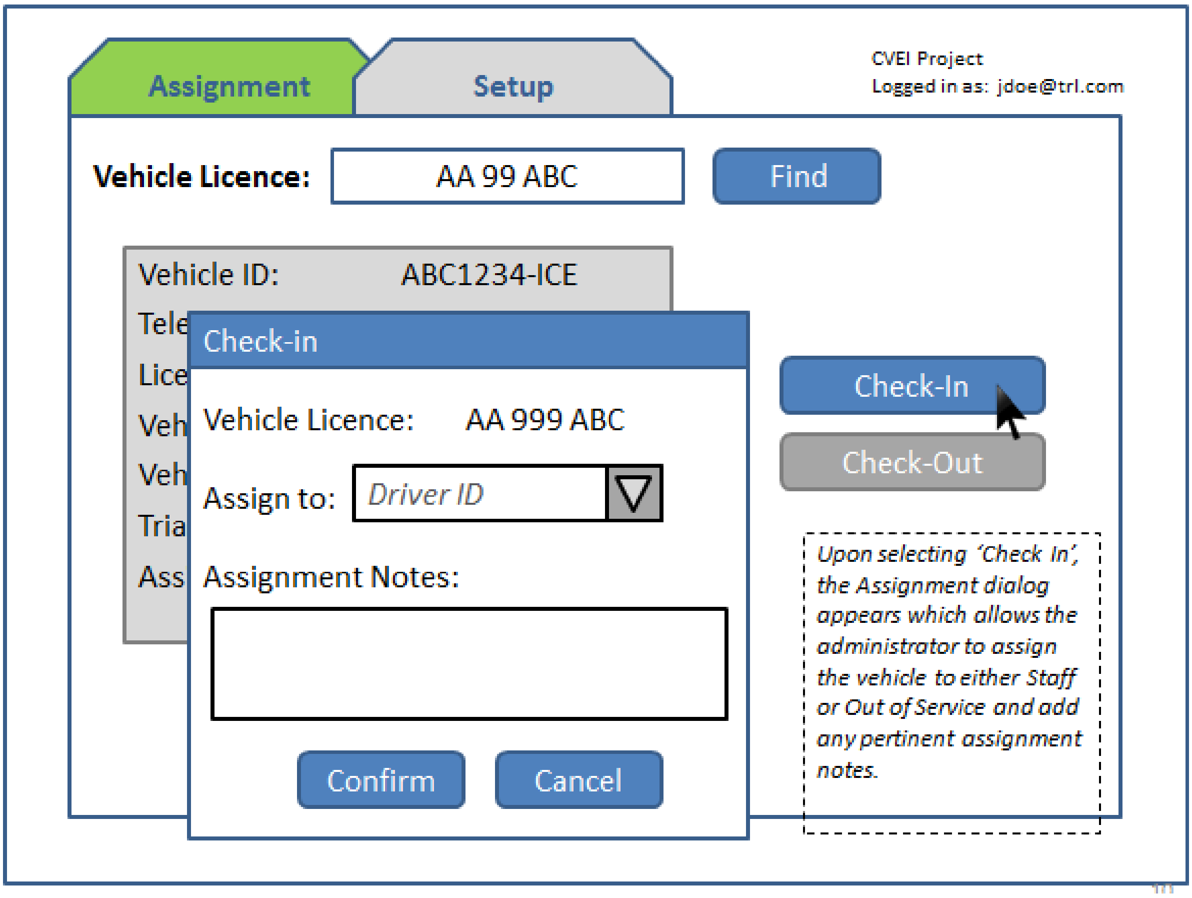
Notes on Check-Out

- Only vehicles that are currently assigned to 'Staff' or 'Out of Service', may be assigned to a Driver
- If the vehicle that is looked up is currently assigned to a driver, then the Check-Out button is grey and disabled
- If the vehicle that is looked up is currently assigned to Staff, then the Check-In button is grey and disabled
- Only drivers that are not currently assigned to a Vehicle will appear in the Driver ID drop down menu
- As there will be 450+ driver IDs, the driver IDs must be arranged in sequential alphanumeric order
- An entry in the Assignment Notes field is not required for completion of the form.
- When a vehicle is assigned via the Check-Out form and the form is submitted, the underlying vehicle information is updated to reflect the vehicle assignment / check-out
- The system will capture the state change in a log file which includes event type (check-out), date/time stamp, vehicle ID, user ID, assignment notes (if any)

Assignment Tab: Vehicle check-in



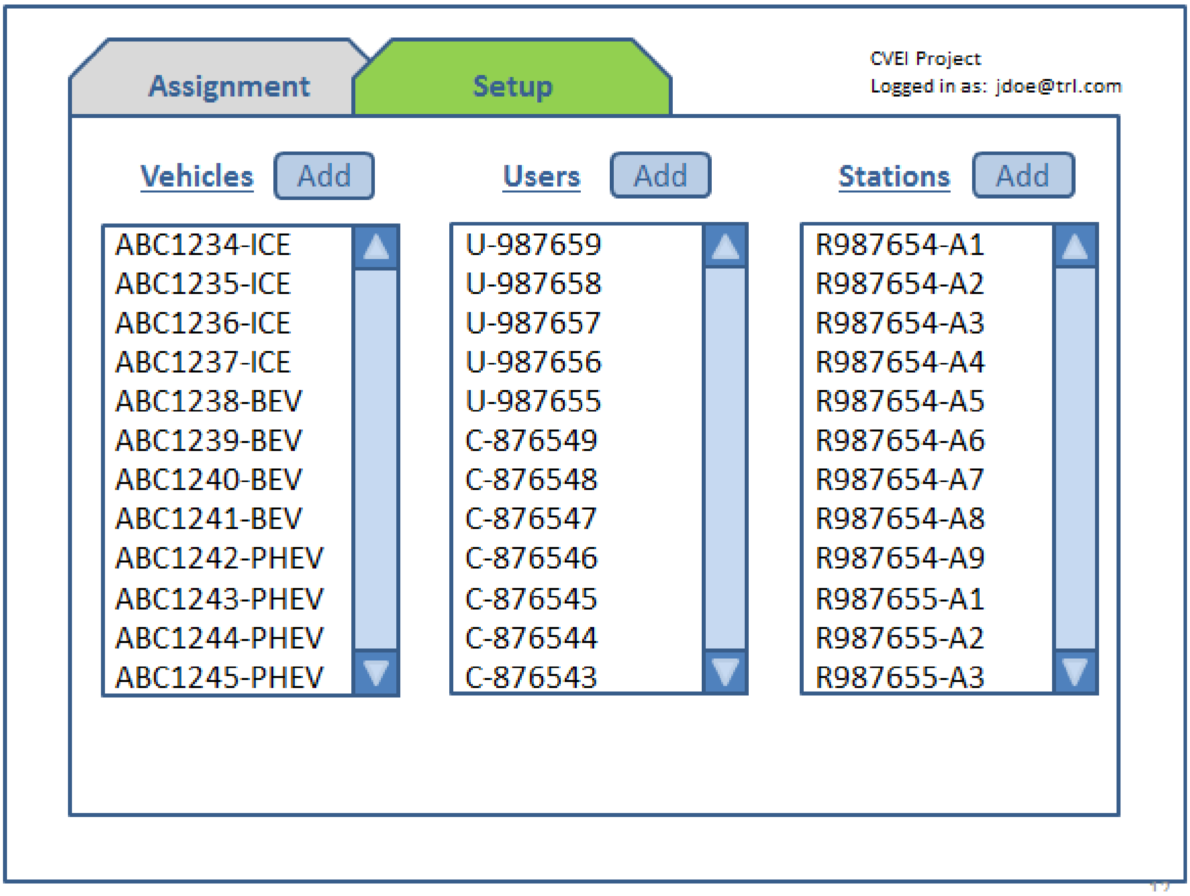
Assignment Tab: Vehicle check-in / Staff or Out of Service assignment



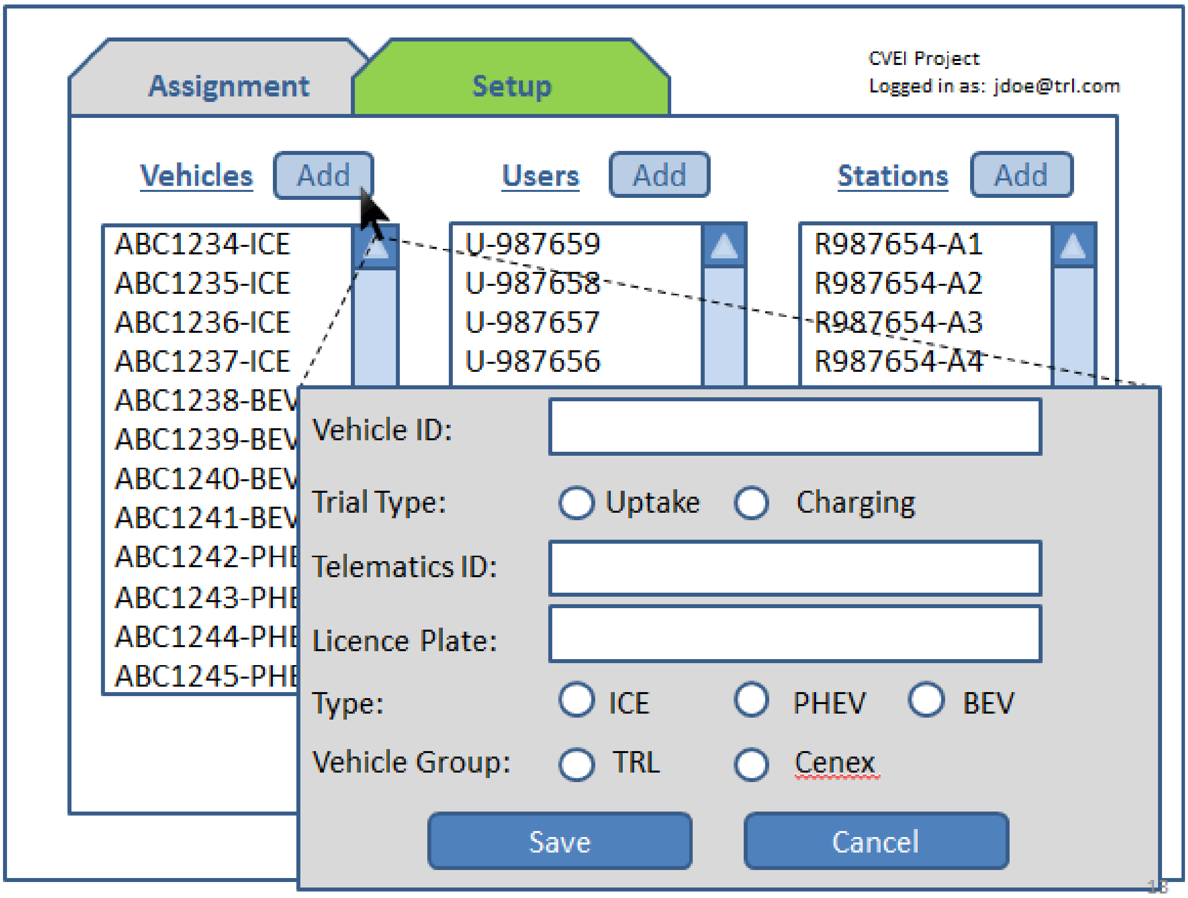
Notes on Check-In

- Only vehicles that are currently assigned to a User, may be checked in
- If the vehicle that is looked up is currently assigned to a driver, then the Check-Out button is grey and disabled
- If the vehicle that is looked up is currently assigned to Staff, then the Check-In button is grey and disabled
- The only 'drivers' that will appear in the Check-in dialog box are "Staff" and "Out of Service"
- An entry in the Assignment Notes field is not required for completion of the form.
- When a vehicle is assigned via the Check-In form and the form is submitted, the underlying vehicle information is updated to reflect the vehicle assignment / check-out
- The system will capture the state change in a log file which includes event type (check-in), date/time stamp, vehicle ID, assigned to (Staff or OoS), assignment notes (if any)

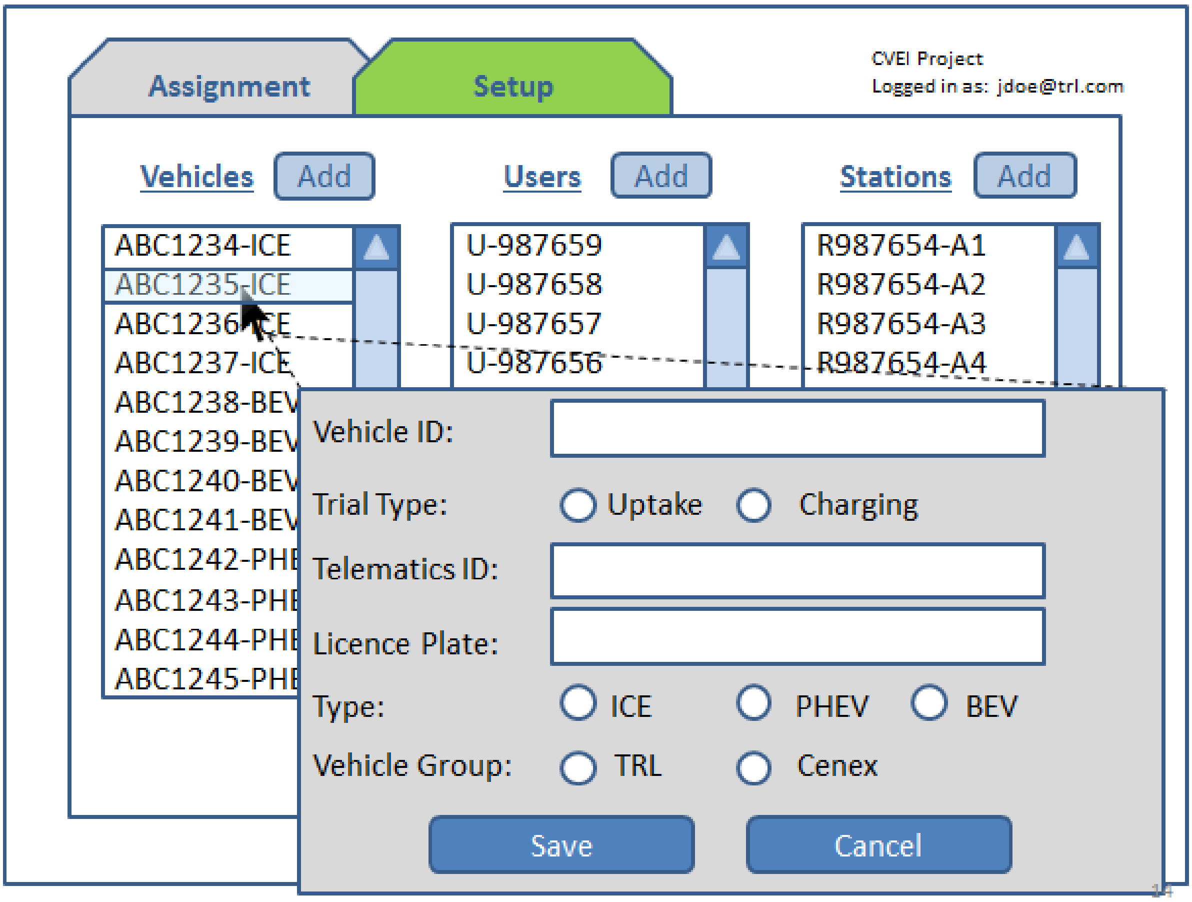
Setup Tab


Assignment
Setup
CVEI Project
Logged in as: jdoe@trl.com
Vehicles
Add
Users
Add
Stations
Add
ABC1234-ICE
ABC1235-ICE
ABC1236-ICE
ABC1237-ICE
ABC1238-BEV
ABC1239-BEV
ABC1240-BEV
ABC1241-BEV
ABC1242-PHEV
ABC1243-PHEV
ABC1244-PHEV
ABC1245-PHEV
U-987659
U-987658
U-987657
U-987656
U-987655
C-876549
C-876548
C-876547
C-876546
C-876545
C-876544
C-876543
R987654-A1
R987654-A2
R987654-A3
R987654-A4
R987654-A5
R987654-A6
R987654-A7
R987654-A8
R987654-A9
R987655-A1
R987655-A2
R987655-A3

Add new vehicle



Edit existing vehicle



Fields in Vehicle Form

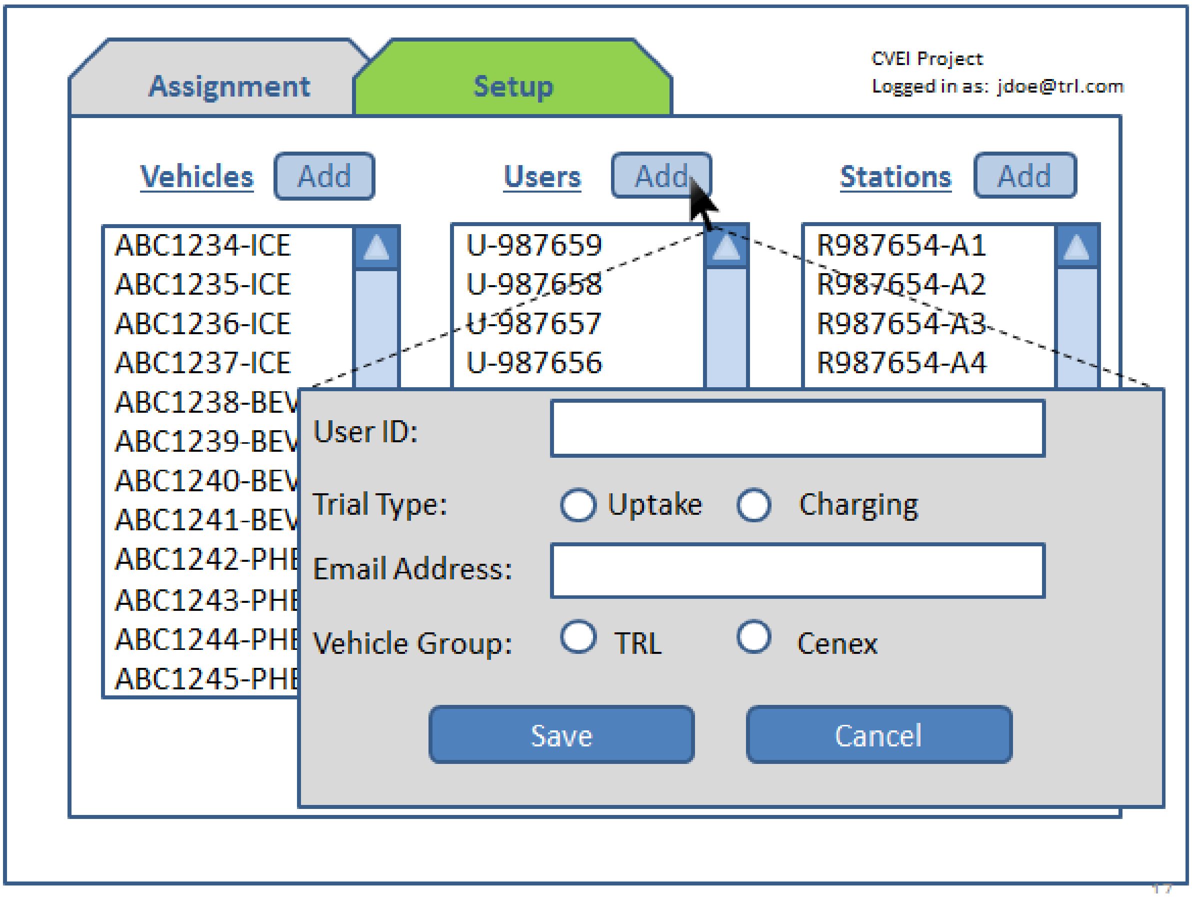
All fields are required

Field	Input format	Options (if applicable)
Vehicle ID	Text	
Trial Type	Check box	Uptake/Charging
Telematics ID	Text	
Licence Plate	Text	
Type	Check box	ICE/PHEV/BEV
Vehicle Group	Check box	TRL/Cenex

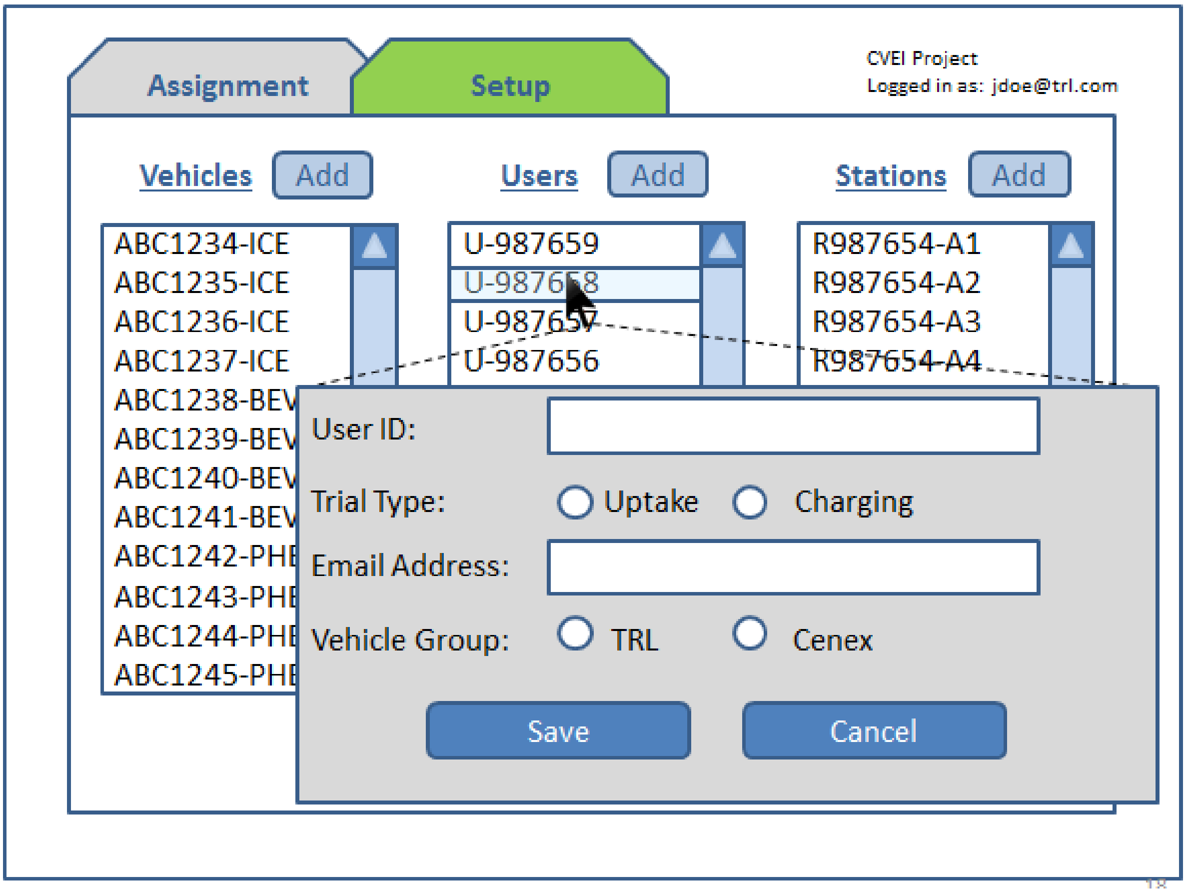
Notes on Vehicle Form

- When a new vehicle is created or an existing vehicle is edited, the system shall capture a log which includes event type (new/edit), date/time stamp, all fields in form

Add new user


Assignment
Setup
CVEI Project
Logged in as: jdoe@trl.com
Vehicles
Add
Users
Add
Stations
Add
ABC1234-ICE
ABC1235-ICE
ABC1236-ICE
ABC1237-ICE
ABC1238-BEV
ABC1239-BEV
ABC1240-BEV
ABC1241-BEV
ABC1242-PHE
ABC1243-PHE
ABC1244-PHE
ABC1245-PHE
U-987659
U-987658
U-987657
U-987656
R987654-A1
R987654-A2
R987654-A3
R987654-A4
User ID:
Trial Type:
Uptake
Charging
Email Address:
Vehicle Group:
TRL
Cenex
Save
Cancel

Edit existing user



Fields in User Form

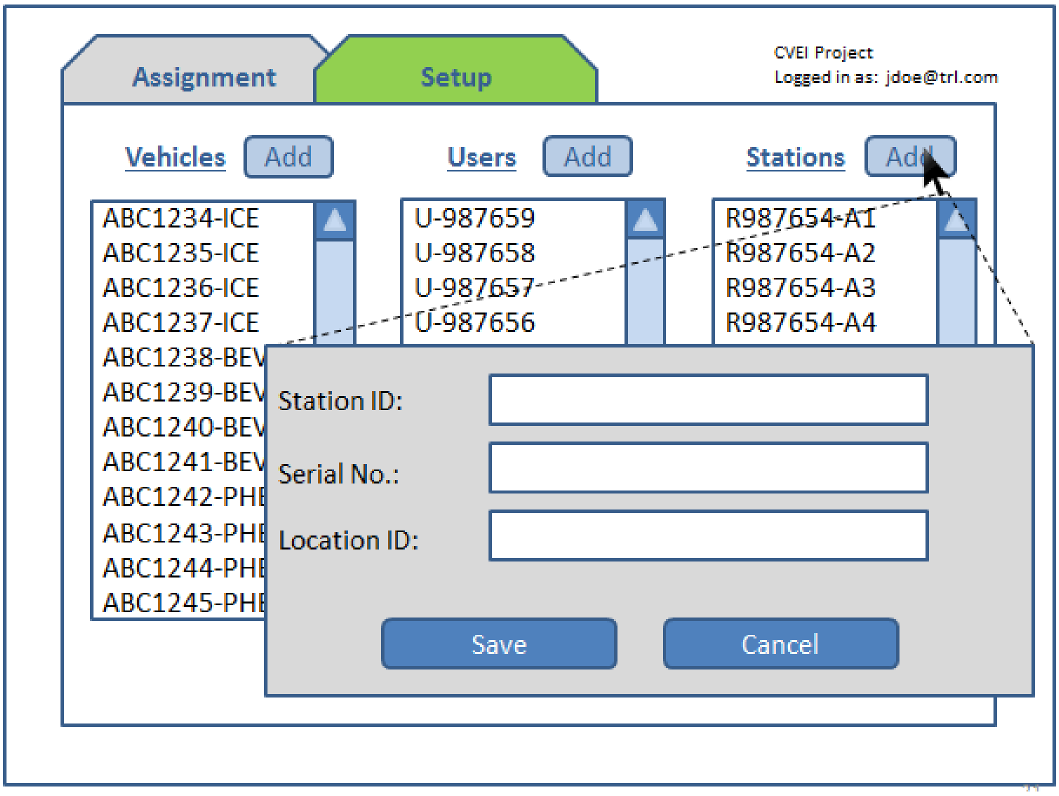
All fields are required unless otherwise noted

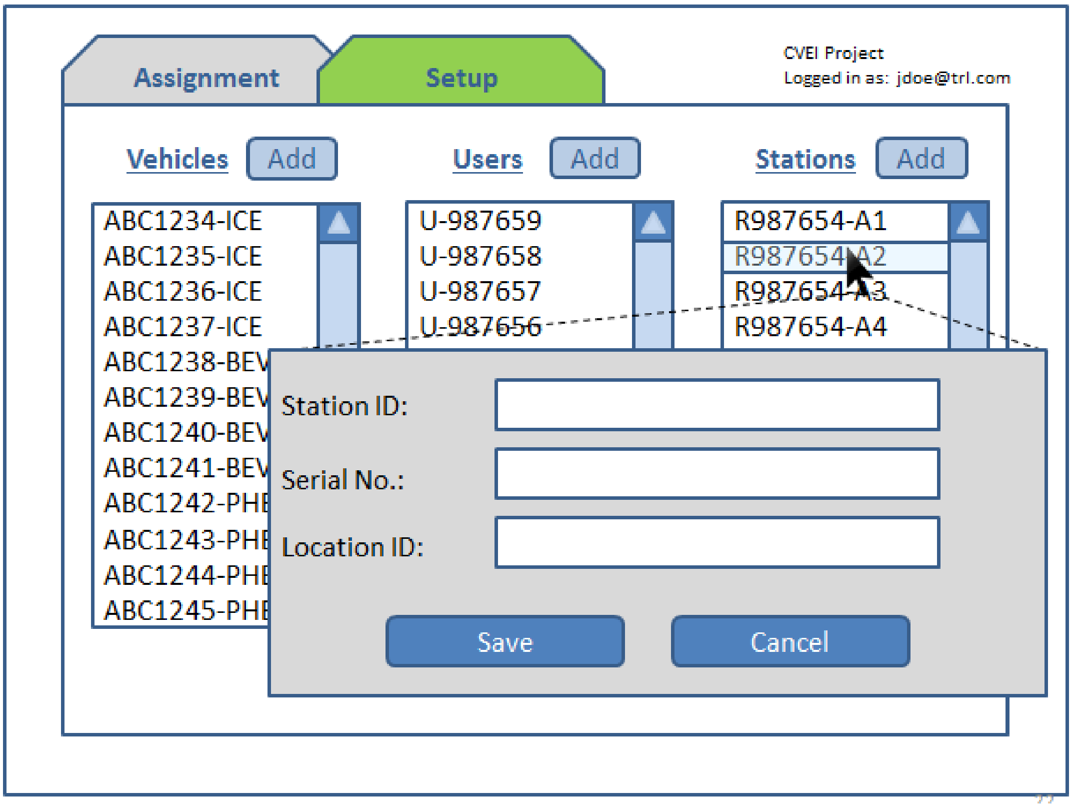
Field	Input format	Options (if applicable)
User ID	Text	
Trial Type	Check box	Uptake/Charging
Email Address	Text	
User Group	Check box	TRL/Cenex

Notes on User Form

- When a new user is created or an existing user is edited, the system shall capture a log which includes event type (new/edit), date/time stamp, all fields in form

Add new station





Fields in Station Form

All fields are required unless otherwise noted

Field	Input format	Options (if applicable)
Station ID	Text	
Serial No.	Text	
Location ID	Text	(Optional)

Notes on Station Form

- When a new Station is created or an existing Station is edited, the system shall capture a log which includes event type (new/edit), date/time stamp, all fields in form

Appendix O FleetCarma telematics device specification

FleetCarma **C2**

A plug-and-play vehicle telematics solution.

The FleetCarma C2 is a lightweight cellular data logger that clips into the OBD-II port and supports both conventional and electric vehicles.

Features

- Integrates with FleetCarma web portal for real-time vehicle status & location, along with historical energy, location, and vehicle diagnostics
- Electric vehicle support including trip & charging data, real-time state-of-charge, and smart charging capability
- Interfaces with J1979 OBD-II data
- Includes logging of GPS coordinates, speed, and elevation
- Low power consumption (extreme sleep: 2mA)
- Supports proprietary and enhanced signals (i.e. vehicle odometer)
- Compatible with all CAN and Legacy protocols dating back to 1996

Installation

- Simple integration by plugging into the OBD-II diagnostic port
- Automated setup via VIN retrieval

Connectivity

- High speed 3G cellular modem with support in over 150 countries

Dimensions

- 51.4mm x 62mm x 26mm / 2" x 2.4" x 1"

www.fleetcarma.com 1.800.975.2434 fleetcarma

Appendix P Telematics datasets

P.1 Raw data

P.1.1 Journey files

For each journey undertaken, a raw data file will be pushed from the FleetCarma dongle to TRL's Secure Server via an FTP. At the top of the worksheet in each raw data file, the following information will be coded:

--Meta Data--		
Start Time(UTC)	LoggerName	Vin
XX/XX/XXXX XX:XX:XX	XXXX-XXXX	XXXXXXXXX

This provides:

- The VIN for the vehicle
- The FleetCarma telematics unit ID number ('LoggerName')
- The start time and date of the journey

This information will enable cross-referencing with information entered into the Admin Portal in order to identify the participant for whom the data file relates.

Separate files will be generated for each journey – these will be combined into a single, holistic raw dataset by TRL in order to facilitate analysis (see section 3.2 of Part 1 of D5.1).

Each column in the data file provides a unique data field and each row represents a new recording during the journey. For example, the 'Vehicle speed [kph]' column will contain a new speed reading every 1 second during the journey. A screenshot showing an example file is provided in Figure 12. The key columns – all the data that will be used within the project - are listed in

Table 2, along with the sampling frequency and recording precision, and a short description on what journey data fields are provided. Note that some data fields reported in the raw data files from FleetCarma (such as NumberOfSatellites) have no relevance to the project so these are omitted from

Table 2. Also, the meanings of some of FleetCarma's column names are not intuitive; these have been changed in Table 2 to make them more immediately meaningful. Finally, the example file shown in Figure 12 is iluustrative only and was not recorded within the project; the intervals between timestamped rows do not correspond to the sampling intervals to be used in this trial; those are shown in

Table 2.

Aggregated data for all journeys will also be provided in the Journey Logs which will be downloaded from the FleetCarma online portal (see Appendix P.2).

Table 2: Raw journey data

Column/ information in data file	Description	Units	Sampling interval (s)	Precision (decimal places)	Data fields provided / derived from column
Start Time (MetaData)	Start time and date of the journey	N/A	N/A	N/A	• Ignition on date & time
LoggerName (MetaData)	Unique telematics unit ID	N/A	N/A	N/A	• Enables linking to Participant ID
VIN (MetaData)	Vehicle Identification Number	N/A	N/A	N/A	• Enables linking to Participant ID
Timestamp(ms)	Timestamp (ms) for each row in dataset	Milliseconds	N/A	0	• Timestamp of data recordings in the file • Ignition off date & time (last row in column)
Odometer[kilometers]	Odometer reading (km)	km	30	0	• Odometer at start of journey (first row in column) • Odometer at end of journey (last row in column) • Journey distance travelled (current Odometer – starting Odometer) (all rows)
Vehicle Speed[kph]	Vehicle speed (kph)	kph	1	0	• Vehicle speed
RPM	Engine speed (PHEV)	Rev/min	1	0	• Engine speed • PHEV driving mode (when combined with battery current)
ABS_LOAD	Absolute Engine Load (normalized air mass per intake stroke)	% of cylinder displacement	1	0	• Specific fuel consumption
Fuel Level [%]	Fuel tank level as a percentage of the maximum nominal tank capacity:	%	10	5	• % liquid fuel level at ignition on (first row in column)

	The Golf GT Edition (ICE) has a 50 litre tank capacity. The Golf GTE (PHEV) has 40 litre tank capacity.				• % liquid fuel level at ignition off (last row in column) • % liquid fuel level during journey (all rows)
HV Battery Current[A]	DC Electrical current measured at the high voltage battery terminal in amps. + is defined as charging the battery. – is discharging the battery.	Amps	1	5	• Maximum C-rate (HV Battery Current * HV Battery Voltage)
HV Battery Voltage[V]	DC electrical voltage measured at the high voltage battery terminal in volts. This number will always be positive, and will remain within a consistent range.	Volts	1	5	• Maximum C-rate (HV Battery Current * HV Battery Voltage)
HV Battery SOC[%]	State of Charge (SOC) (%)	%	10	0	• State of Charge (SOC) at ignition on (first row in column) • State of Charge (SOC) at ignition off (last row in column) • State of Charge (SOC) during journey (all rows)
HV Battery Temperature[degC]	High-voltage battery pack temperature (°C)	Degrees Celcius	60	1	• Battery pack temperature
OAT[DegC]	Ambient temperature (°C)	Degrees Celcius	60	0	• Ambient temperature during journey
Is Driving[bool]	Represents a 1 or a 0 to indicate	N/A	1	0	• Indicator of driving status (1 = ignition on, 0 = ignition off)

	if the vehicle is driving				
Latitude[deg]	Latitude GPS coordinates	Degrees	10	5	• Location (GPS co-ordinates) of start of journey (first row in column) • Location (GPS co-ordinates) of end of journey (last row in column) • Journey route (GPS co-ordinates) (all rows)
Longitude[deg]	Longitude GPS coordinates	Degrees	10	5	• Location (GPS co-ordinates) of start of journey (first row in column) • Location (GPS co-ordinates) of end of journey (last row in column) • Journey route (GPS co-ordinates) (all rows)

--Meta Data--															
Start Time(UTC)	LoggerName	Pck	Vin												
05/16/2017 07:14:39	5160-09C8														
--Raw Data--															
Timestamp(ms)	Altitude[m]	C2 Input Voltage[V]	Fuel Level Input[%]	HDOP	HV Battery Current[A]	HV Battery SOC[%]	HV Battery Temperature [degC]	HV Battery Voltage[V]	Is Driving [bool]	Latitude [deg]	Longitude [deg]	NumberOf Satellites	OAT[DegC]	Odometer [kilometer s]	Vehicle Speed[k m/h]
900	62.70000076	13.228	0	1.06	0	0	0	0	1	51.3834	-0.783448	11	0	0	0
1200	62.70000076	13.228	0	1.06	0	20	0	0	1	51.3834	-0.783448	11	0	0	0
1300	62.70000076	13.228	0	1.06	0	20	0	346.5	1	51.3834	-0.783448	11	0	0	0
1400	62.70000076	13.228	0	1.06	-1.099975586	20	0	346.5	1	51.3834	-0.783448	11	0	0	0
1600	62.70000076	13.228	0	1.06	-1.099975586	20	0	346.5	1	51.3834	-0.783448	11	0	287	0
1800	62.70000076	13.228	0	1.06	-1.099975586	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
2000	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
3300	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
3400	62.70000076	13.228	72.15686	1.06	-1.300048828	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
5500	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
6500	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
8500	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
9600	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
11600	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
13700	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
14800	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
16800	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
18900	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
20000	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
22100	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
24200	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
25200	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
26200	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
27200	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
28300	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
29400	62.70000076	13.228	72.15686	1.06	-0.700073242	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
30400	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0

Figure 12: Screenshot showing example raw telematics journey data file

P.1.2 Charge files

As with the journey data, for each charging event, a raw data file will be pushed from the FleetCarma dongle to TRL's Secure Server via an FTP. At the top of the worksheet in each raw data file, the following information will be coded:

--Meta Data--				
Start Time(UTC)	Charge Latitude[deg]	Charge Longitude[deg]	LoggerName	Vin
XX/XX/XXXX XX:XX:XX	XX.XXXXX	XX.XXXXX	XXXX-XXXX	XXXXXXXXX

This provides:

- The VIN for the vehicle
- The FleetCarma telematics unit ID number ('LoggerName')
- The start time and date of the charge
- The location of the charge (GPS coordinates)

This information will enable cross-referencing with information entered into the Admin Portal in order to identify the participant for whom the data file relates.

Separate files will be generated for each charge – these will be combined into a single, holistic raw dataset by TRL in order to facilitate analysis (see section 3.2 of Part 1 of D5.1).

Each column in the data file provides a unique data field and each row represents a new recording during the charge. For example, the 'HV Battery SOC[%]' column contains a new SOC reading every 120 seconds during the charge. The key columns are listed in Table 3, along with the sampling frequency and recording precision, and a short description on what charge data fields are provided. A screenshot showing an example data file is provided in Figure 13.

Aggregated data for all charge events will also be provided in the Charge Logs which will be downloaded from the FleetCarma online portal (see Appendix 0).

Table 3: Raw charge data

Column/ information in data file	Description	Units	Sampling frequency (s)	Precision (number of decimal places)	Data fields provided
Start Time (MetaData)	Start time and date of the charge	N/A	N/A	N/A	• Charge start date & time
LoggerName (MetaData)	Unique telematics unit ID	N/A	N/A	N/A	• Enables linking to Participant ID
VIN (MetaData)	Vehicle Identification Number	N/A	N/A	N/A	• Enables linking to Participant ID
Timestamp(ms)	Timestamp (ms) for	Milliseconds	N/A	0	• Timestamp of data recordings in the file

	each row in dataset				• Charge end date & time (last row in column)
HV Battery Current[A]	DC Electrical current measured at the high voltage battery terminal in amps. + is defined as charging the battery. – is discharging the battery.	Amps	1	5	• Battery current during the charge
HV Battery Voltage[V]	DC electrical voltage measured at the high voltage battery terminal in volts. This number will always be positive, and will remain within a consistent range.	Volts	1	5	• Battery voltage during the charge
HV Battery SOC[%]	State of Charge (SOC) (%)	%	120	0	• State of Charge (SOC) at charge start (first row in column) • State of Charge (SOC) at charge end (last row in column) • State of Charge (SOC) during charge (all rows)
HV Battery Temperature[degC]	High-voltage battery pack temperature (°C)	Degrees Celcius	60	1	• Battery pack temperature

Is Charging[bool]	Represents a 1 or a 0 to indicate if the vehicle is charging	N/A	1	0	• Indicator of charging status (1 = charge flowing into battery, 0 = no charge flowing into battery)
Latitude[deg]	Latitude GPS coordinates	Degrees	300	5	• Location (GPS co-ordinates) of charge event
Longitude[deg]	Longitude GPS coordinates	Degrees	300	5	• Location (GPS co-ordinates) of charge event

--Meta Data--											
Start Time(UTC)	Charge Latitude[deg]	Charge Longitude[deg]	LoggerName	Pck	Vin						
05/16/2017 07:40:56	51.38352194	-0.7836025	5160-09C8								
--Raw Data--											
Timestamp(ms)	Altitude[m]	C2 Input Voltage[V]	HDOP	HV Battery Current[A]	HV Battery SOC[%]	HV Battery Temperature [degC]	HV Battery Voltage [V]	Is Charging [bool]	Latitude [deg]	Longitude [deg]	NumberOf Satellites
400	81.5	13.27799988	0.790000021	0	0	0	0	1	51.3835	-0.783644	12
700	81.5	13.27799988	0.790000021	0	31.5	0	0	1	51.3835	-0.783644	12
800	81.5	13.27799988	0.790000021	0	31.5	0	352.2	1	51.3835	-0.783644	12
900	81.5	13.27799988	0.790000021	8.59997559	31.5	0	352.2	1	51.3835	-0.783644	12
1400	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
2900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
3900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
4000	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
6000	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352	1	51.3835	-0.783644	12
6100	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
7000	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
9200	81.5	13.27799988	0.790000021	9	31.5	22.5	352.2	1	51.3835	-0.783644	12
10200	81.5	13.27799988	0.790000021	9	31.5	22.5	352	1	51.3835	-0.783644	12
11200	81.5	13.27799988	0.790000021	9	31.5	22.5	352.2	1	51.3835	-0.783644	12
11300	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
12200	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
16500	81.5	13.27799988	0.790000021	9	31.5	22.5	352	1	51.3835	-0.783644	12
17600	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352	1	51.3835	-0.783644	12
18600	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
21900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
22900	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
23800	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.7	1	51.3835	-0.783644	12
24000	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.7	1	51.3835	-0.783644	12
24800	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
25900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
26900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
27100	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12

Figure 13: Screenshot showing example raw telematics charge data file

P.2 Journey Logs

This dataset contains aggregated data per journey which will be processed by FleetCarma uploaded to their online portal. Data from each vehicle will be downloaded from the portal by TRL at the end of each participant’s 4-day trial experience. The data are detailed and described in

Table 4. A screenshot showing an example data file is provided in Figure 14.

Table 4: Aggregated journey data ('Journey Logs')

Data field (column heading)	Units	Example data	Sampling frequency	Precision (number of decimal places)	Description
TripId	N/A	5697782	1 per journey	N/A	Unique ID for each journey; different journeys saved on different rows within the dataset
Date	Date/time	February 27 2017 06:12:16 AM	1 per journey	N/A	Start date and time for each journey
Duration	HH:MM:SS	00:33:12	1 per journey	HH:MM:SS	Total duration of journey (ignition on to ignition off)
Trip distance	Km	18.74	1 per journey	2	Total distance of journey (ignition on to ignition off)
Fuel consumed	Litres	0.8	1 per journey	2	Total fuel consumed during journey
Fuel consumption	L/100km	24.91	1 per journey	2	Average fuel consumption in journey (this is calculated in the portal by dividing the number of miles driven by the total gallons of petrol used)
Electricity consumed	kWh	0.27	1 per journey	1	Total electricity used during journey
Energy consumption	Wh/km	1367	1 per journey	2	Average electricity consumption in journey
Start SOC	%	15	1 per journey	2	Vehicle SOC at start of journey
End SOC	%	9.5	1 per journey	2	Vehicle SOC at end of journey
Ambient temperature	°C	44.6	1 per journey	1	Average ambient temperature during journey
Average speed	kph	33.87	1 per journey	1	Average speed during journey
Max speed	kph	71.46	1 per journey	1	Maximum speed reached during journey
EV-Fraction	%	27	1 per journey	2	Proportion of time during journey in which PHEV was powered by the electric motor as compared to the ICE (PHEV only)
Auxiliary load	kWh	0	1 per journey	2	Amount of energy consumed from the battery for non-driving functions, such as HVAC (PHEV and BEV only)
% Hard Acceleration	%	15	1 per journey	0	Total percentage of all acceleration events that are classified as "hard" acceleration.
% Hard Braking	%	17	1 per journey	2	Total percentage of all braking events that are classified as "hard" braking.

% Time Idle	%	10%	1 per journey	0	Percentage of time during the journey in which the vehicle was idling (engine turned on but stationary) (PHEV or ICE)
Number of Idle Events	Count	0	1 per journey	0	The count of the total number of idling sessions, where the engine was operating but the vehicle was stationary for more than 60 seconds continuously (PHEV or ICE)

TripId	Date	Duration	Trip Distance (mi)	Starting Odometer (mi)	Ending Odometer (mi)	Fuel Consumed (gal)	Fuel Consumption (MPG)	Electricity Consumed (kWh)	Total Energy Consumption (MPGeq)	Start SOC	End SOC	Ambient Temperature (°F)	Average Speed (MPH)	Max Speed (MPH)	EV-Fraction	Auxiliary Load (kW)	% Hard Acceleration	% Hard Braking	% Time Idle	Number of Idle Events
6392615	May 17 2017 08:17:33 AM	00:12:12	2.55	182.68	185.79	0.1	44.46	0.65	33	80.5	71.5	59	12.54	53.44	78	0.2	8	4	22%	0
6386662	May 16 2017 06:28:31 PM	00:09:47	0	182.68	182.68	0		0.05		81	80.5	66.2	0	0		0.33			99%	0
6386545	May 16 2017 06:17:00 PM	00:10:51	1.82	180.82	182.68	0	158.8	0.49	70	88	81	68	10.07	36.66	83	0.17	20	11	42%	0
6384896	May 16 2017 04:19:00 PM	00:01:06	0	180.82	180.82	0		0.01		88	88	68	0	0		0.36			98%	0
6384876	May 16 2017 04:09:54 PM	00:08:44	2.76	178.33	180.82	0	138.05	0.69	68	98.5	88	68	18.94	47.85	87	0.07	28	7	16%	0
6381794	May 16 2017 10:41:05 AM	00:02:58	0.09	178.33	178.33	0		0.09		100	98.5	71.6	1.91	9.32	100	0.41	0	0	24%	0
6381389	May 16 2017 08:14:39 AM	00:01:21	0	178.33	178.33	0		0.01		20	20	64.4	0	0		0.31			95%	0
6381374	May 16 2017 07:51:40 AM	00:18:22	8.81	169.63	178.33	0.3	32.74	1.47	28	43	20	60.8	28.8	72.08	55	0.09	16	13	11%	0
6381347	May 16 2017 07:39:26 AM	00:05:12	0.43	169.01	169.63	0		0.43		50	43.5	60.8	5.01	26.72	96	1.03	0	19	43%	0
6376891	May 15 2017 08:06:36 PM	00:01:10	0	169.01	169.01	0		0.01		50.5	50.5	64.4	0	0		0.45			93%	0
6376743	May 15 2017 08:01:28 PM	00:01:13	0	169.01	169.01	0		0.02		50.5	50.5	62.6	0.09	1.24	100	0.98	0	0	63%	0
6376723	May 15 2017 07:50:33 PM	00:10:14	2.09	166.53	169.01	0.1	20.43	-0.25	22	46	50.5	59	12.27	38.53	8	-0.18	4	4	20%	0
6376505	May 15 2017 07:34:13 PM	00:08:07	1.24	165.28	166.53	0.1		-0.13		44	46	60.8	9.15	27.34	26	-0.14	13	5	18%	0
6376280	May 15 2017 07:06:14 PM	00:17:24	2.94	162.18	165.28	0.2	15.65	-0.33	17	39.5	44	59	10.12	35.42	11	-0.21	11	5	31%	0
6373930	May 15 2017 05:43:44 PM	00:05:27	1.45	160.94	162.18	0	6084.22	0.38	124	46	41	60.8	15.93	32.31	99	0.25	16	19	11%	0
6373756	May 15 2017 05:11:08 PM	00:26:47	10.76	150.37	160.94	0	14547.18	3.67	98	100	46	62.6	24.11	72.7	100	0.17	11	11	19%	0
6369619	May 15 2017 01:06:28 PM	00:01:13	0.09	149.75	150.37	0		0.05		42.5	42	59	4.26	13.05	100	0.26	0	0	16%	0
6369785	May 15 2017 01:06:28 PM	00:01:13	0.09	149.75	150.37	0		0.05		42.5	42	59	4.26	13.05	100	0.26	0	0	16%	0
6368625	May 15 2017 12:59:48 PM	00:02:06	0.03	149.75	149.75	0		0.03		43	42.5	59	0.94	8.7	100	0.27	0	0	71%	0
6350446	May 12 2017 05:38:42 PM	00:01:17	0.09	149.75	149.75	0		0.05		44	43	62.6	3.98	10.56	100	0.29	0	0	17%	0
6346061	May 12 2017 09:47:03 AM	00:15:48	6.11	143.54	149.75	0	869.76	1.85	99	70	44	57.2	23.21	45.98	99	0.05	12	28	6%	0
6338457	May 11 2017 04:32:07 PM	00:19:42	5.92	137.94	143.54	0	16004.67	1.78	111	96.5	70	64.4	18.03	45.36	100	0.18	18	23	15%	0
6316578	May 09 2017 01:45:52 PM	00:01:16	0	137.94	137.94	0		0.01		97	96.5	53.6	0	0		0.42			93%	0
6316575	May 09 2017 01:43:35 PM	00:02:15	0	137.94	137.94	0		0.01		97	97	53.6	0	0		0.38			96%	0
6282321	May 05 2017 02:16:03 PM	00:07:55	0	137.94	137.94	0		0.04		97.5	97	71.6	0	0		0.32			99%	0
6261584	May 03 2017 05:47:53 PM	00:01:27	0.06	137.94	137.94	0		0.14		100	98	48.2	2.67	11.18	100	1.55	0	0	29%	0
6258241	May 03 2017 01:05:35 PM	00:13:36	5.77	131.73	137.94	0	15613.21	2.31	84	68.5	36	50	25.48	42.25	99	0.08	9	26	2%	0
6250865	May 02 2017 06:29:09 PM	00:14:12	5.93	126.14	131.73	0	2674.17	1.99	97	97	68.5	55.4	25.07	45.36	99	0.04	9	21	2%	0
6208537	April 27 2017 06:57:46 PM	00:01:50	0.17	125.52	126.14	0		0.19		100	97	48.2	5.49	15.53	100	0.91	0	0	20%	0
6205829	April 27 2017 03:26:15 PM	00:06:51	2.54	123.03	125.52	0	286.11	0.96	68	80	66.5	50	22.24	49.09	97	0.16	26	21	7%	0
6205731	April 27 2017 03:15:55 PM	00:06:08	1.91	121.17	123.03	0	643.9	0.92	63	94.5	80.5	48.2	18.64	41.01	98	0.18	4	25	6%	0
6148106	April 21 2017 03:23:19 PM	00:06:01	0	121.17	121.17	0		0.1		96.5	95	59	0.02	1.86	100	0.9	0	0	96%	0
6128184	April 19 2017 05:40:21 PM	00:03:12	0.21	121.17	121.17	0		0.14		98.5	96.5	62.6	4.02	16.78	100	0.53	0	0	46%	0

Figure 14: Screenshot showing example Journey Log data file

P.3 Charge Logs

This dataset contains aggregated data per journey which will be processed by FleetCarma and uploaded to their online portal. Data from each vehicle will be downloaded from the portal by TRL at the end of each participant's 4-day trial experience. The data are detailed and described in Table 5. A screenshot showing an example data file is provided in Figure 15.

Table 5: Aggregated charge data ('Charge Logs')

Data field (column heading)	Units	Example data	Sampling frequency	Precision (number of decimal places)	Description
Charge Session ID	N/A	871004	1 per charge event	N/A	Unique ID for each charge session; different charge sessions saved on different rows within the dataset
Start Date	Date/time	February 27 2017 09:35:50 AM	1 per charge event	N/A	Start date and time for each charge session
Duration	HH:MM:SS	00:03:31	1 per charge event	HH:MM:SS	Total duration of charge session (charge start to charge stop)

Charging Power	N/A	2	1 per charge event	0	Power output of the charger, categorised in levels (Level 2 is a 270 V charger; Level 3 is a DC Fast Charger)
Charger Energy	kWh	0.2	1 per charge event	2	The total amount of energy the vehicle gains during the charging session
Charger Loss	kWh	0.02	1 per charge event	2	The total amount of energy lost during charging due to heat and other factors
Start SOC	%	60	1 per charge event	1	Vehicle SOC at start of charge session
End SOC	%	62.5	1 per charge event	1	Vehicle SOC at end of charge session
Latitude	Deg	51.3836	1 per charge event	4	Latitude GPS coordinates of charge session
Longitude	Deg	-0.7833	1 per charge event	4	Longitude GPS coordinates of charge session

ChargeSessionId	Start Date	Duration	Charging Power	Charger Energy (kWh)	Charger Loss (kWh)	Start SOC (%)	End SOC (%)	Latitude	Longitude
978313	May 17 2017 07:57:54 AM	01:13:56	2	4.19	0.44	15	67	51.3835	-0.7835
977210	May 16 2017 02:54:41 PM	01:13:35	2	4.17	0.45	8	59.5	51.3835	-0.7835
969064	May 10 2017 08:51:54 AM	01:55:13	2	6.44	0.67	19.5	100	51.3835	-0.7836

Figure 15: Screenshot showing example Charge Log data file

Appendix Q Participant debrief letter

Dear XXX,

Thank you for taking part in our vehicle trials. We really appreciate your time and effort and hope you have enjoyed taking part.

Now that the trial is completed you should have received your final payment. If you have not yet received it please contact vehicletrials@trl.co.uk to let us know.

Your contribution to this project will contribute to policy making in the future. The project is due to end mid-2018, and the project reports will be made publically available following approval from our client, the Energy Technologies Institute (ETI).

All of the data and information obtained during this study will be kept private and the findings will be shared with our client. While the findings will be published, your identity will never be revealed in the results.

If you have any further questions please do not hesitate to contact us either by email at: vehicletrials@trl.co.uk or by phone on: 01344 770 014.

We would like to thank you again for your participation,

Kind regards,

The TRL research team

Deliverable D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

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RPN3873

PROJECT REPORT

CVEI Stage 2

Deliverable D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Addendum to Part 2

Appendix K: Questionnaires for Consumer Uptake Trial

Pre-trial questionnaire

Participant ID: _________

What is this questionnaire?
This Pre-Trial Questionnaire is the first in a series of questionnaires which we will ask you to complete as part of this trial. This questionnaire is designed to collect background information about you.

How long will it take to complete?
It will take approximately 25 minutes to complete.

What do you need from me?
Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

How to complete the questionnaire
Please use the at the bottom of each page to go forward. As soon as you do this your answer is saved.
If you need to go back, please use the button.

If you leave the survey idle for a while, you will be logged out automatically, but don't worry, your answers will be saved so long as you have completed a question by pressing the forward button

What other questionnaires will I have to complete for this trial?
A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

Questionnaire	Progress
Pre-trial questionnaire	In progress (this questionnaire)
Time point 1 questionnaire	To be completed 1 week before collecting first vehicle
Interim questionnaire 1	To be completed on return of first vehicle
Interim questionnaire 2	To be completed on return of second vehicle
Interim questionnaire 3	To be completed on return of third vehicle
Time point 2 questionnaire	To be completed 1 week after return of third vehicle

Thank you for taking part in this research. Your participation is extremely important.

Section 1: General background

1. Please indicate your <u>highest</u> educational qualification.

Start at the top of the list and select the first one you come to that applies to you.

Please tick one box only

- ☐ University Higher Degree (e.g. MSc; PhD) or Chartered status
- ☐ First degree level qualification (e.g. BA; BSc; PGCE)
- ☐ Diploma in higher education (HNC, HND, Nursing or Teaching qualification - excluding PGCE)
- ☐ A Level; AS Level: NVQ Level 3; GNVQ Advanced or equivalent
- ☐ GCSE; CSE, NVQ levels 1&2; GNVQ Foundation & Intermediate or equivalent
- ☐ None of the above

2. Please indicate your employment status.

Please tick one box only

- ☐ Employed full-time
- ☐ Employed part-time
- ☐ Self employed
- ☐ Unemployed and seeking work
- ☐ Looking after family or home / not seeking work
- ☐ Long term sick or disabled
- ☐ Maternity leave
- ☐ Retired
- ☐ In full-time education
- ☐ Other (please specify): ____________________________

3. Please indicate your TOTAL HOUSEHOLD income from all sources BEFORE tax and other deductions.

Household refers to you, your partner and/or family. If you share a property with others (e.g. a house share) then do not include them in your answer.

Please tick one box only

- ☐ Up to £9,999 per year (£199 per week)
- ☐ £10,000 to £19,999 per year (£200 - £389 per week)
- ☐ £20,000 to £29,999 per year (£390 - £579 per week)
- ☐ £30,000 to £39,999 per year (£580 - £769 per week)
- ☐ £40,000 to £49,999 per year (£770 - £969 per week)
- ☐ £50,000 to £74,999 per year (£970 - £1,449 per week)
- ☐ £75,000 to £99,999 per year (£1,450 – £1,959 per week)
- ☐ £100,000 to £149,999 per year (£1,960 - £2939 per week)
- ☐ £150,000 or more per year (£2,940 or more per week)
- ☐ Prefer not to say

4. Which of the following best describes your relationship status.

- ☐ Single
- ☐ Married / In a Civil partnership
- ☐ Cohabiting
- ☐ Separated / Divorced
- ☐ Widowed
- ☐ Other, please specify: ___________________________

5. Do you currently…

- ☐ Live alone
- ☐ Live with family/partner
- ☐ Live with other tenants
- ☐ Other, please specify: ___________________________

Section 2: Your household and cars

6. Including you, how many people in the following age groups live in your household?

Household refers to you, your partner and/or family. If you share a property with others (e.g. a house share) then do not include them in your answer.

- ☐ Under 2 years old __________
- ☐ 2 years – 16 years __________
- ☐ 17 years – 29 years __________
- ☐ 30-years – 39 years __________
- ☐ 40-years – 49 years __________
- ☐ 50-years – 64 years __________
- ☐ 65 + years __________

7. How many of the following cars are kept in this household?

Household refers to you, your partner and/or family. If you share a property with others (e.g. a house share) then do not include them in your answer.

a. Private cars ____________

b. Company cars ____________

[Please logic Q8-10 to offer the number of columns given as the sum of 7a + 7b.]

[If 7b=0, don't ask about private /company in Q8]

8. Please select the option below that best matches the size/type of car, for each car in your household.
[Alternative text if 7a+7b=1: Please select the option below that best matches the size/type of your car.]
It is important that your answer for "Main Car" refers to the car that you use most of the time. We will refer to your 'Main Car' in future questions so please think about this car when answering. Please select the option below that best matches the size/type of your car. If you are unsure, please choose the option you feel is the closest fit to your car.

[Please logic to offer the number of columns given as the sum of 7a + 7b.]

	Main Car *the one that you are using most often*	**Car 2**	**Car 3**	**Car 4**	**Car 5**
 Mini e.g. Hyundai i10, Volkswagen up!	☐	☐	☐	☐	☐
 Supermini e.g. Ford Fiesta, Vauxhall Corsa, Volkswagen Polo	☐	☐	☐	☐	☐
 Lower medium e.g. Ford Focus, Vauxhall Astra, Volkswagen Golf	☐	☐	☐	☐	☐
 Upper medium	☐	☐	☐	☐	☐

e.g. BMW 3 Series, Vauxhall Insigna, Audi A4					
 Executive e.g. Mercedes-Benz E Class, BMW 5 Series, Jaguar XF	☐	☐	☐	☐	☐
 Luxury e.g. Mercedes-Benz S Class, Jaguar XJ	☐	☐	☐	☐	☐
 Specialist sports e.g. Audi TT, Mercedes- Benz SLK	☐	☐	☐	☐	☐
 Dual purpose / 4X4 e.g. Kia Sportage, Range Rover Evoque, Honda CR-V	☐	☐	☐	☐	☐
 MPV e.g. Vauxhall Zafira, Ford C-Max, VW Touran	☐	☐	☐	☐	☐
Is this a private (P) or a company (C) car?	Private / Company	Private / Company	Private / Company	Private / Company	Private / Company

Including you, where appropriate, how many drivers regularly use this car? (i.e. use it at least once per week)	____	____	____	____	____
What is the approximate proportion of time that you typically use this car compared to the other drivers in the household? *For example, you may be driving this car about 80% of the time and the rest (20%) would be shared among others (e.g. your partner or children).* **[Auto-fill boxes to sum to 100%]**	You _ ___% Others __%	You _ ___% Others __%	You _ ___% Others __%	You _ ___% Others __%	You _ ___% Others __%

9. For each of the cars you have identified above, please indicate the method you used to purchase the vehicle.
[Alternative text if 7a+7b=1: Please indicate the method you used to purchase your vehicle.]
[Please logic to offer the number of columns given as the sum of 7a + 7b.]

Please tick one box on each line	Main Car	Car 2	Car 3	Car 4	Car 5
Outright purchase	☐	☐	☐	☐	☐
Personal lease (Contract hire)	☐	☐	☐	☐	☐
Salary-sacrifice company lease scheme	☐	☐	☐	☐	☐
Hire Purchase (PCH)	☐	☐	☐	☐	☐
Personal Contract Purchase (PCP)	☐	☐	☐	☐	☐
Company car	☐	☐	☐	☐	☐
Don’t know	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

DP: allow only one response per column

10. For each of the cars you have identified above, please indicate roughly how many miles YOU have driven each car in the past 12 months
[Alternative text if 7a+7b=1: Please indicate roughly how many miles YOU have driven in your car in the past 12 months]
[Please logic to offer the number of columns given as the sum of 7a + 7b.]

Please tick one box on each line	Main Car	Car 2	Car 3	Car 4	Car 5
0 miles	☐	☐	☐	☐	☐
1 - 5,000 miles	☐	☐	☐	☐	☐
5,001-10,000 miles	☐	☐	☐	☐	☐
10,001-15,000 miles	☐	☐	☐	☐	☐
15,001-20,000 miles	☐	☐	☐	☐	☐
20,001-25,000 miles	☐	☐	☐	☐	☐
25,001-30,000 miles	☐	☐	☐	☐	☐
30,001-35,000 miles	☐	☐	☐	☐	☐
Above 35,000 miles	☐	☐	☐	☐	☐

DP: allow only one response per column

11. In what year did you acquire your Main Car (i.e. the car that you use the most often)?

[Alternative text if 7a+7b=1: In what year did you acquire your Main Car?]

[dropdown menu “pre-1980” to 2017]

Don’t know

12. When you got your Main Car, how old was it approximately:

- ☐ Less than 1 year old
- ☐ 1-2 years old
- ☐ More than 2 years old
- ☐ Don’t know

13. What was the value of your Main Car when you acquired it?

Less than £5,000	£5,000-£10,000	£10,001-£15,000	£15,001-£20,000	£20,001-£25,000	£25,001-£30,000	£30,001-£35,000	£35,001–£40,000	More than £40,000	Don't know
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. How important or unimportant were the following factors when choosing your Main Car?

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Purchase price	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Size	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐
Appearance	☐	☐	☐	☐	☐
Fuel economy	☐	☐	☐	☐	☐
Running costs	☐	☐	☐	☐	☐
CO2 emissions	☐	☐	☐	☐	☐
Other, please tick box and specify _____	☐	☐	☐	☐	☐

15. On average, how many miles per gallon (mpg) do you get in your Main Car in real world driving?

10 mpg or less	11 – 20 mpg	21 – 30 mpg	31 – 40 mpg	41 – 50 mpg	51 – 60 mpg	61 – 70 mpg	71 or more mpg	Don't know
☐	☐	☐	☐	☐	☐	☐	☐	☐

16. How satisfied or dissatisfied are you with the fuel economy / mpg of your Main Car?

Very dissatisfied	Quite dissatisfied	Neither satisfied nor dissatisfied	Quite satisfied	Very satisfied
☐	☐	☐	☐	☐

17. Generally speaking, which one of the following statements best describes your role when it comes to choosing a car for your household?

Please tick one box only

- ☐ I alone decide which car(s) to buy
- ☐ I have the main say, but take others' views into account
- ☐ I have an equal say in which car(s) to buy
- ☐ I have some influence, but someone else has the main say
- ☐ I have no say in which car(s) is/are bought
- ☐ I only decide about the car that I will drive, but have no/little influence regarding vehicles which are driven by other household members

Section 3: Your journeys

18. Do you commute to a workplace or place of education by driving a car?

- ☐ Yes
- ☐ No [Skip logic: Go to Q21]

19. On how many days a week do you typically drive to work?

[Dropdown 1-7] days per week

20. What is the typical ONE WAY distance of your journey from home to work?

___________ miles

21. Thinking about a typical week in your life, please answer the following as best as you can?

a. My typical car driving mileage on a weekday is: ____________ miles

b. My typical car driving mileage on a day at the weekend is: ____________ miles

22. How often do you make journeys that are longer than 50 miles each way?

Please tick one box only

- ☐ More than 3 times a week
- ☐ 2 or 3 times per week
- ☐ Once per week
- ☐ Once every two weeks
- ☐ Once per month
- ☐ Once every 2 to 3 months
- ☐ 1-2 times per year
- ☐ Never

23. In a regular week, roughly, what percentage of your driving do you do in the following areas/road types:

Please select a percentage from the drop down menu

[Drop down options with auto-calculate. Three boxes must sum to 100%]

- ☐ Urban areas (town, city)
- ☐ Rural areas (e.g. out of town, country road)
- ☐ Motorway

24. Which of these services do you have convenient access to from your home:

Please tick all that apply

- ☐ bus
- ☐ train
- ☐ tube/tram
- ☐ None of these [DP: not with any other code]

25. For all journeys combined, in an average year, how frequently have you used each type of transport?

Please tick one box on each line

	Never	Less than once per month	1-3 days per month	About 1 day per week	2-4 days per week	5-7 days per week
household car as a driver	☐	☐	☐	☐	☐	☐
household car as a passenger	☐	☐	☐	☐	☐	☐
local bus, tram, tube	☐	☐	☐	☐	☐	☐
train	☐	☐	☐	☐	☐	☐
bicycle (on the road)	☐	☐	☐	☐	☐	☐
walk to/from a destination	☐	☐	☐	☐	☐	☐
scooter/motorcycle	☐	☐	☐	☐	☐	☐
taxi	☐	☐	☐	☐	☐	☐
car from a car club	☐	☐	☐	☐	☐	☐

26. Are you a member of any car clubs that enable you to book access to a car when you need one (e.g. City Car or Zipcar)?

- ☐ Yes
- ☐ No
- ☐ I don't know

27. Are you a current user of any on-demand transport services such as Uber?

- ☐ Yes
- ☐ No
- ☐ I don't know

28. How frequently do you use smartphone apps to plan your journeys? DP: Single code

Never	Rarely	Occasionally	Regularly	Always
☐	☐	☐	☐	☐

29. What proportion of the mileage which you drive in a car is for business/work trips (not including commuting, i.e. travelling to and from work)? DP: Single code

None	1-20%	21-40%	41-60%	61%-80%	81-100%
☐	☐	☐	☐	☐	☐

Section 4: Owning and driving a car

30. To what extent do you agree or disagree with the following statements?

This section lists a number of statements to do with owning and driving a car. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
I couldn't manage without a car	☐	☐	☐	☐	☐
I would like to own a larger or faster car	☐	☐	☐	☐	☐
I find driving can be stressful sometimes	☐	☐	☐	☐	☐
I tend to buy the same type/ size of car (e.g. small car, family estate)	☐	☐	☐	☐	☐
I tend to stick to the same brand of car (e.g. Ford, Toyota, Nissan)	☐	☐	☐	☐	☐
Driving gives me a chance to express myself	☐	☐	☐	☐	☐
If I could, I would gladly do without a car	☐	☐	☐	☐	☐
I would pay more for a car with lower running costs	☐	☐	☐	☐	☐
A car provides status and prestige	☐	☐	☐	☐	☐
I enjoy driving on my own	☐	☐	☐	☐	☐
It doesn't matter to me which type of car I drive	☐	☐	☐	☐	☐
I don't like driving	☐	☐	☐	☐	☐
Getting good fuel economy out of my car gives me satisfaction	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
You can tell something about a person by what car he/she has	☐	☐	☐	☐	☐
My car says something about who I am	☐	☐	☐	☐	☐
I like to drive just for the fun of it	☐	☐	☐	☐	☐
When I feel fuel prices are getting too high, I try and reduce the amount I drive	☐	☐	☐	☐	☐

31. To what extent do the following statements describe you?

This section lists a number of statements concerning how people drive. Please read each statement carefully and indicate the extent to which each statement describes you.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

[Please highlight (e.g. bold) or note the difference (e.g. in instructions) in response options from previous question]

	Not at all	Very little	Little	Modera te	Much	Very much
I often do relaxing activities while driving	☐	☐	☐	☐	☐	☐
I often purposely closely follow other drivers	☐	☐	☐	☐	☐	☐
I often beep my horn or 'flash' the car in front as a way of expressing my frustration	☐	☐	☐	☐	☐	☐
I feel I have control over driving	☐	☐	☐	☐	☐	☐
I often drive through traffic lights that have just turned red	☐	☐	☐	☐	☐	☐

	Not at all	Very little	Little	Modera te	Much	Very much
I usually enjoy the sensation of driving on the limit (dangerously)	☐	☐	☐	☐	☐	☐
On a clear motorway, I usually drive at or a little below the speed limit	☐	☐	☐	☐	☐	☐
While driving I try to relax myself	☐	☐	☐	☐	☐	☐
When I am in a traffic jam and the lane next to mine starts to move, I try to move into that lane as soon as possible	☐	☐	☐	☐	☐	☐
Driving usually makes me feel frustrated	☐	☐	☐	☐	☐	☐
I often daydream to pass the time while driving	☐	☐	☐	☐	☐	☐
I often swear at other drivers	☐	☐	☐	☐	☐	☐
When a traffic light turns green and the car in front of me doesn't get going, I just wait for a while until it moves	☐	☐	☐	☐	☐	☐
I drive cautiously	☐	☐	☐	☐	☐	☐
Sometimes lost in thought or distracted, I fail to notice someone waiting at a zebra crossing/pedestrian	☐	☐	☐	☐	☐	☐
In a traffic jam, I think about ways to get through the traffic faster	☐	☐	☐	☐	☐	☐
When a traffic light turns green and the car in front of me doesn't get going immediately, I try to urge the driver to move on	☐	☐	☐	☐	☐	☐
At a junction where I have to give right-of-way to oncoming traffic, I simply wait patiently for traffic to pass	☐	☐	☐	☐	☐	☐

	Not at all	Very little	Little	Modera te	Much	Very much
When someone tries to pull in front of me on the road I drive in an assertive way in order to prevent it	☐	☐	☐	☐	☐	☐
I often fix my hair and/or makeup while driving	☐	☐	☐	☐	☐	☐
I am often distracted or preoccupied, and suddenly realise that the vehicle ahead has slowed down, and I have to slam on the brakes to avoid a collision	☐	☐	☐	☐	☐	☐
I like to take risks while driving	☐	☐	☐	☐	☐	☐
I base my behaviour on the motto "better safe than sorry"	☐	☐	☐	☐	☐	☐
I like the thrill of flirting with death and disaster	☐	☐	☐	☐	☐	☐
It worries me when driving in bad weather	☐	☐	☐	☐	☐	☐
I often meditate while driving	☐	☐	☐	☐	☐	☐
Lost in thoughts I often forget that my lights are on full beam until flashed by another motorist	☐	☐	☐	☐	☐	☐
When someone does something on the road that annoys me, I flash them with the full beam	☐	☐	☐	☐	☐	☐
I get a thrill out of breaking the law	☐	☐	☐	☐	☐	☐
I often misjudge the speed of an oncoming vehicle when overtaking	☐	☐	☐	☐	☐	☐
I feel nervous while driving	☐	☐	☐	☐	☐	☐
I get impatient during rush hour	☐	☐	☐	☐	☐	☐
I feel distressed while driving	☐	☐	☐	☐	☐	☐

	Not at all	Very little	Little	Modera te	Much	Very much
I often intend to switch on the windscreen wipers, but switch on the lights instead, or vice versa	☐	☐	☐	☐	☐	☐
I often attempt to drive away from traffic lights in third gear (or in neutral or park in an automatic car)	☐	☐	☐	☐	☐	☐
I often plan my route badly, so that I hit traffic that I could have avoided	☐	☐	☐	☐	☐	☐
I often use muscle relaxation techniques while driving	☐	☐	☐	☐	☐	☐
I plan long journeys in advance	☐	☐	☐	☐	☐	☐
I often nearly (or actually) hit something due to misjudging my gap in a parking space	☐	☐	☐	☐	☐	☐
I feel comfortable while driving	☐	☐	☐	☐	☐	☐
I am always ready to react to unexpected manoeuvres by other drivers	☐	☐	☐	☐	☐	☐
I tend to drive cautiously	☐	☐	☐	☐	☐	☐
I often beep my horn at others	☐	☐	☐	☐	☐	☐
I usually enjoy the excitement of dangerous driving	☐	☐	☐	☐	☐	☐

Section 5: New technology

32. To what extent do you agree or disagree with the following statements?

This section lists a number of statements concerning new technology. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
I like to buy new and different technologies	☐	☐	☐	☐	☐
I am not the type of person that needs to be the first to have the newest technology	☐	☐	☐	☐	☐
I generally know more than other people about new technology	☐	☐	☐	☐	☐
I am usually among the first to try new technology	☐	☐	☐	☐	☐
New technology excites me	☐	☐	☐	☐	☐
I often seek out information about new cars	☐	☐	☐	☐	☐
I don’t like to be the first to drive cars with the latest technology	☐	☐	☐	☐	☐
I tend to decide on what car to buy by relying on the opinions of friends who have already tried them	☐	☐	☐	☐	☐
When I am choosing a car, I find myself spending a lot of time checking out different models	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Prior to buying a new car, I seldom consult my friends/ family	☐	☐	☐	☐	☐
I often influence other people's opinions about cars	☐	☐	☐	☐	☐
When other people are choosing a car to buy, they turn to me for advice	☐	☐	☐	☐	☐
I like magazines / websites about new cars	☐	☐	☐	☐	☐
I am not the sort of person that looks to experience driving different cars	☐	☐	☐	☐	☐
I would prefer my car to be fuelled by something other than petrol or diesel	☐	☐	☐	☐	☐
I prefer my car to be distinctive in style so that it stands out	☐	☐	☐	☐	☐

Section 6: The environment

33. To what extent do you agree or disagree with the following statements?

This section lists a number of statements regarding your personal travel. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I like travelling in a car	☐	☐	☐	☐	☐
People should be allowed to use their cars as much as they like, even if it causes damage to the environment	☐	☐	☐	☐	☐
I find travelling by car can be stressful sometimes	☐	☐	☐	☐	☐
Being environmentally responsible is important to me as a person	☐	☐	☐	☐	☐
For the sake of the environment, car users should pay higher taxes	☐	☐	☐	☐	☐
Environmental threats such as global warming have been over exaggerated	☐	☐	☐	☐	☐
It is important to build more roads to reduce congestion	☐	☐	☐	☐	☐
I like travelling by bus	☐	☐	☐	☐	☐
I would like to travel by car more often	☐	☐	☐	☐	☐
The government should take more of a lead in protecting the environment, even if people don’t like it	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The way I drive says a lot about the kind of person I am	☐	☐	☐	☐	☐
I am actively trying to use my car less	☐	☐	☐	☐	☐
Reducing my car use would make me feel good	☐	☐	☐	☐	☐
There are no practical alternatives to most of the car trips I make	☐	☐	☐	☐	☐
I would be willing to pay higher taxes on car use if I knew that the revenue would be used to support public transport	☐	☐	☐	☐	☐
When I am getting ready to go out, I usually don't think about how I am going to travel, I just get in my car	☐	☐	☐	☐	☐
I would only travel by bus if I had no other choice	☐	☐	☐	☐	☐
The car I own says a lot about the kind of person I am	☐	☐	☐	☐	☐
I am quite flexible about what types of transport I use	☐	☐	☐	☐	☐
I am not interested in reducing my car use	☐	☐	☐	☐	☐
It would be easy for me to reduce some of my car use	☐	☐	☐	☐	☐

34. To what extent do you agree or disagree with the following statements?

This section lists a number of statements regarding the environment. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Most people I know do their bit for the environment these days	☐	☐	☐	☐	☐
Being environmentally responsible is an important part of who I am	☐	☐	☐	☐	☐
It's not worth me doing things to help the environment if others don't do the same	☐	☐	☐	☐	☐
I feel a moral obligation to reduce my emission of greenhouse gases	☐	☐	☐	☐	☐
What I do in life doesn't make any real difference to the environment	☐	☐	☐	☐	☐
I am not the type of person to worry about being 'green'	☐	☐	☐	☐	☐
The so called 'environmental crisis' has been greatly exaggerated	☐	☐	☐	☐	☐
Sometimes I feel under pressure to say that I am doing more to help the environment than I am	☐	☐	☐	☐	☐
I am worried that the world is running out of oil	☐	☐	☐	☐	☐
Reducing my car's environmental impact would make me feel good	☐	☐	☐	☐	☐
Reducing my car's environmental impact would be good for society	☐	☐	☐	☐	☐
I would be willing to pay more for a car if I knew it was less harmful to the environment	☐	☐	☐	☐	☐
I would not buy a particular car just because it is environmentally friendly	☐	☐	☐	☐	☐
People should be allowed to use their car as much as they like	☐	☐	☐	☐	☐

THANK YOU – THAT IS THE END OF THIS SURVEY

We will send you a link to the next survey 7-10 days before you are due to collect the first trial vehicle.

If you have any comments about this questionnaire then please note them here:

Time Point 1 questionnaire

Participant ID: _________

What is this questionnaire?

This Time Point 1 Questionnaire forms part of a series of questionnaires which we will ask you to complete as part of this trial. This questionnaire is designed to capture information on your opinions and perceptions of different types of electric vehicle.

How long will it take to complete?

It will take approximately 25 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

Before starting the questionnaire please take a little time to familiarise yourself with the information on the next page about different types of vehicles. You will be asked for your views on these vehicles in the questionnaire.

How to complete the questionnaire

Please use the at the bottom of each page to go forward. As soon as you do this your answer is saved.

If you need to go back, please use the button.

If you leave the survey idle for a while, you will be logged out automatically, but don't worry, your answers will be saved so long as you have completed a question by pressing the forward button

To restart the questionnaire at the same stage, simply click the original link that was sent to you.

What other questionnaires will I have to complete for this trial?

A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

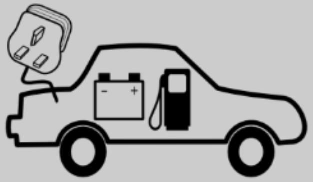
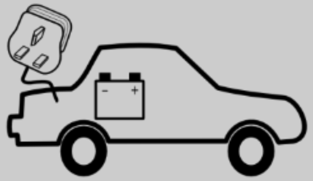
Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	In progress (this questionnaire)
Interim questionnaire 1	To be completed on return of first vehicle
Interim questionnaire 2	To be completed on return of second vehicle
Interim questionnaire 3	To be completed on return of third vehicle
Time point 2 questionnaire	To be completed 1 week after return of third vehicle

Thank you for taking part in this research. Your participation is extremely important.

Types of electric vehicles and definitions for this questionnaire

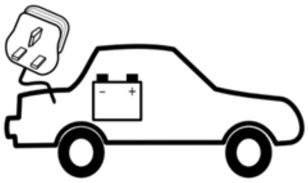
In this questionnaire we will ask you about your views of types of plug-in vehicles (PiVs). This table provides a summary of the differences between plug-in vehicles and non-plug-in (conventional) vehicles that you will be used to.

[table on following page – present on one page online]

Non-plug-in (conventional) vehicles		**Plug-in Vehicles (PiVs)**	
Conventional vehicle	**Hybrid Electric Vehicle (HEV)**	**Plug-in Hybrid Electric Vehicle (PHEV)**	**Battery Electric Vehicle (BEV)**
			
Typically powered by petrol / diesel only.	A non-plug-in Hybrid Electric Vehicle (HEV) has a petrol / diesel engine and an electric motor powered by a small battery. The battery gets charged when the engine is running. It does not need to (and cannot) be plugged in to an electrical socket to charge the battery. Battery power is mainly used at lower speeds, like when in traffic; this improves fuel consumption.	A Plug-in Hybrid Electric Vehicle (PHEV) is like a conventional HEV with both a petrol / diesel engine and an electric motor. BUT, the battery can be charged by plugging it in to a normal electrical socket (like you have at home) or dedicated charging point, as needed. The battery also gets charged when the engine is running. If you run out of charge you can continue driving as long as there is petrol or diesel in the tank. The car will use the electric motor whenever possible to save fuel, but also uses power from the petrol / diesel engine when required.	A Battery Electric Vehicle (BEV) is powered only by a battery. The battery is charged by plugging it in to a normal electric socket (like you have at home) or dedicated charging point, as needed. No petrol or diesel is required; once you run out of electrical charge in the battery you will no longer be able to operate the vehicle.

Section 1: Battery Electric Vehicles (BEVs)

This section will ask you about Battery Electric Vehicles (BEVs) only. Please think specifically about BEVs when answering the questions. If you need a reminder about what a BEV is then please click on the blue “i” icon where you see it and a description will pop-up. Here is an example [icon]



1. **To what extent do you agree or disagree with the following statements?**
   Please tick one box on each line to rate your agreement or disagreement with the statement
   [RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The chances of breaking down in a BEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to ‘refuel’ at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
BEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a BEV would give me a ‘feel good factor’ because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of BEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a BEV	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Having to remember to plug in a BEV would put me off buying one	☐	☐	☐	☐	☐
A BEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a BEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a BEV	☐	☐	☐	☐	☐
Adapting to charging a BEV would be difficult for me	☐	☐	☐	☐	☐
If I had a BEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a BEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a BEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a BEV	☐	☐	☐	☐	☐
When driving a BEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a BEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel would make me more likely to buy a BEV	☐	☐	☐	☐	☐

2. **The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.**
   These statements are not about you; instead please imagine the kind of person who would drive a BEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
   Please tick one box on each line
   [RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

3. **To what extent do you agree or disagree with the following statements about BEVs?**

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs are a very exciting new technology	☐	☐	☐	☐	☐
BEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
BEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
BEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
BEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
BEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
BEVs are too new to be reliable	☐	☐	☐	☐	☐
BEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
BEVs perform better than a conventional car	☐	☐	☐	☐	☐
BEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
BEVs are good for the environment	☐	☐	☐	☐	☐
are pleasant to drive	☐	☐	☐	☐	☐
BEVs are impractical	☐	☐	☐	☐	☐
BEVs are a really good idea	☐	☐	☐	☐	☐
BEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
BEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
BEVs offer environmental benefits	☐	☐	☐	☐	☐
BEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐
BEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
BEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
BEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
BEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
BEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
BEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
BEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
BEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
BEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

Q3a Over the next 5 years, do you expect to be …

- ○ …a one car household
- ○ …a two car household
- ○ ...a three or more car household

[Response to inform skip logic for all second car questions in TP1]

4. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a <u>Battery Electric Vehicle (BEV)</u> …

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

5. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if it had a range when fully charged of:**
Please choose 'yes' or 'no' for each row

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

6. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as a SECOND car in your household if it had a range when fully charged of:**
Please choose 'yes' or 'no' for each row,

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

7. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if the charging time required to provide 100 miles of range was:**
   Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

8. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the SECOND car in your household if the charging time required to provide 100 miles of range was:**
   Please choose 'yes' or 'no' for each row,

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

9. **How important or unimportant would the following factors be if you were considering a *Battery Electric Vehicle (BEV)* for your household?**

   Please tick one box on each line

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Purchase price	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Size	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐
Appearance	☐	☐	☐	☐	☐
Time to fully charge vehicle	☐	☐	☐	☐	☐
Electric range	☐	☐	☐	☐	☐
Running costs	☐	☐	☐	☐	☐
Built-in satellite navigation system	☐	☐	☐	☐	☐
Hands-free Bluetooth phone connectivity	☐	☐	☐	☐	☐
Cruise control	☐	☐	☐	☐	☐
Automatic rain-sensing windscreen wipers	☐	☐	☐	☐	☐
Rate of depreciation of vehicle value	☐	☐	☐	☐	☐
Convenient access to public transport	☐	☐	☐	☐	☐
Access to an alternative vehicle in your household	☐	☐	☐	☐	☐
Please add any other factors that would be important to you that are not listed					

10. **Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a *Battery Electric Vehicle (BEV)* in my household if I got… :** [RANDOMISE ORDER]

    Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…discounted access to hire cars (e.g. for longer journeys)”	☐	☐	☐	☐	☐
…discounted access to public transport”	☐	☐	☐	☐	☐
..permission to drive in bus lanes”	☐	☐	☐	☐	☐
…access to free parking”	☐	☐	☐	☐	☐
…free access to congestion charge zones”	☐	☐	☐	☐	☐
…a free chargepoint for my home”	☐	☐	☐	☐	☐
…a government grant towards purchase price”	☐	☐	☐	☐	☐
…free access to low emission zones / clean air zones	☐	☐	☐	☐	☐
…exemption from car tax (Vehicle Excise Duty)	☐	☐	☐	☐	☐

11. The average conventional car which does 10,000 miles per year will be worth around <u>40% of its original value</u> after 3 years.

Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) in my household if after 3 years it was worth…

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
...20% of its value" (faster depreciation than conventional car)	☐	☐	☐	☐	☐
…30% of its value"	☐	☐	☐	☐	☐
…40% of its value" (same rate of depreciation as conventional car)	☐	☐	☐	☐	☐
…50% of its value"	☐	☐	☐	☐	☐
…60% of its value" (slower depreciation than conventional car)	☐	☐	☐	☐	☐

12. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a <u>Battery Electric Vehicle (BEV)</u> in my household if after three years it lost… :

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
..none of its original electric range"	☐	☐	☐	☐	☐
…10% of its original electric range"	☐	☐	☐	☐	☐
…20% of its original electric range"	☐	☐	☐	☐	☐
…30% of its original electric range"	☐	☐	☐	☐	☐

13. How informed do you currently feel about Battery Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

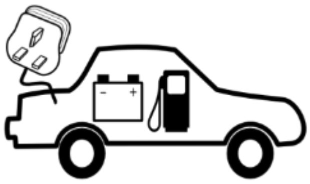
☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 2: Plug-in Hybrid Electric Vehicles (PHEVs)

This section will ask you about Plug-in Hybrid Electric Vehicles (PHEVs) only. Please think specifically about PHEVs when answering the questions. If you need a reminder about what a PHEV is then please click on the blue “i” icon and a description will pop-up. Here is an example [insert icon].



14. To what extent do you agree or disagree with the following statements?
Please tick one box on each line to rate your agreement or disagreement with the statement
[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The chances of breaking down in a PHEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to ‘refuel’ at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
PHEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a PHEV would give me a ‘feel good factor’ because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of PHEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a PHEV	☐	☐	☐	☐	☐
Having to remember to plug in a PHEV would put me off buying one	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A PHEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a PHEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a PHEV	☐	☐	☐	☐	☐
Adapting to charging a PHEV would be difficult for me	☐	☐	☐	☐	☐
If I had a PHEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a PHEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a PHEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a PHEV	☐	☐	☐	☐	☐
When driving a PHEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a PHEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel as often would make me more likely to buy a PHEV	☐	☐	☐	☐	☐

15. **The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.**

These statements are not about you; instead please imagine the kind of person who would drive a PHEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
Please tick one box on each line
[RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

16. To what extent do you agree or disagree with the following statements about PHEVs?
Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PHEVs are a very exciting new technology	☐	☐	☐	☐	☐
PHEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
PHEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
PHEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
PHEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
PHEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
PHEVs are too new to be reliable	☐	☐	☐	☐	☐
PHEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
PHEVs perform better than a conventional car	☐	☐	☐	☐	☐
PHEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
are good for the environment	☐	☐	☐	☐	☐
PHEVs are pleasant to drive	☐	☐	☐	☐	☐
PHEVs are impractical	☐	☐	☐	☐	☐
PHEVs are a really good idea	☐	☐	☐	☐	☐
PHEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
PHEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
PHEVs offer environmental benefits	☐	☐	☐	☐	☐
PHEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐
PHEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐
PHEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PHEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
PHEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
PHEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
PHEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
PHEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
PHEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
PHEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

17. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a <u>Plug-in Hybrid Electric Vehicle (PHEV) …</u>

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely

…as my main car”	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car”**	☐	☐	☐	☐	☐

18. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if it had an electric driving range when fully charged of:

Please choose 'yes' or 'no' for each row

	Yes	**No**
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

19. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as a SECOND car in your household if it had an electric driving range when fully charged of:**

Please choose 'yes' or 'no' for each row, or

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

20. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if the charging time required to provide 100 miles of electric driving range was:

Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

21. Show if Q7a+Q7b >1. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the SECOND car in your household if the charging time required to provide 100 miles of electric driving range was:**

Please choose 'yes' or 'no' for each row,

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

22. How important or unimportant would the following factors be if you were considering a *Plug-in Hybrid Electric Vehicle (PHEV)* for your household?

Please tick one box on each line

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Purchase price	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Size	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐
Appearance	☐	☐	☐	☐	☐
Time to fully charge vehicle	☐	☐	☐	☐	☐
Electric range	☐	☐	☐	☐	☐
Running costs	☐	☐	☐	☐	☐
Built-in satellite navigation system	☐	☐	☐	☐	☐
Hands-free Bluetooth phone connectivity	☐	☐	☐	☐	☐
Cruise control	☐	☐	☐	☐	☐
Automatic rain-sensing windscreen wipers	☐	☐	☐	☐	☐
Rate of depreciation of vehicle value	☐	☐	☐	☐	☐
Convenient access to public transport	☐	☐	☐	☐	☐
Access to an alternative vehicle in your household	☐	☐	☐	☐	☐
Please add any other factors that would be important to you that are not listed					

23. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a *Plug-in Hybrid Electric Vehicle (PHEV)* in my household if I got… [RANDOMISE ORDER]

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…discounted access to hire cars (e.g. for longer journeys)”	☐	☐	☐	☐	☐
…discounted access to public transport”	☐	☐	☐	☐	☐
..permission to drive in bus lanes”	☐	☐	☐	☐	☐
…access to free parking”	☐	☐	☐	☐	☐
…free access to congestion charge zones”	☐	☐	☐	☐	☐
…a free chargepoint for my home”	☐	☐	☐	☐	☐
…a government grant towards purchase price”	☐	☐	☐	☐	☐
…free access to low emission zones / clean air zones	☐	☐	☐	☐	☐
…exemption from car tax (Vehicle Excise Duty)	☐	☐	☐	☐	☐

24. **The average conventional car which does 10,000 miles per year will be worth around 40% of its original value after 3 years.**

Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) in my household if after 3 years it was worth…

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
...20% of its value" (faster depreciation than conventional car)	☐	☐	☐	☐	☐
…30% of its value"	☐	☐	☐	☐	☐
…40% of its value" (same rate of depreciation as conventional car)	☐	☐	☐	☐	☐
…50% of its value"	☐	☐	☐	☐	☐
…60% of its value" (slower depreciation than conventional car)	☐	☐	☐	☐	☐

25. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) in my household if after three years it lost…

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
..none of its original electric range"	☐	☐	☐	☐	☐
…10% of its original electric range"	☐	☐	☐	☐	☐
…20% of its original electric range"	☐	☐	☐	☐	☐
…30% of its original electric range"	☐	☐	☐	☐	☐

26. How informed do you currently feel about Plug-in Hybrid Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 3: Next vehicle purchase

27. When do you next intend to buy your next car?

☐ Within the next year

☐ Between 1 and 2 years from now

☐ Between 2 and 5 years from now

☐ More than 5 years from now

☐ Not sure/don’t know

28. Do you expect to buy your car:

☐ Brand new (Less than 1 year old)

☐ Nearly new (1-2 years old)

☐ Used (More than 2 years old)

☐ Not sure / don’t know

Section 4: Plug-in Vehicle charging

29. Are you aware of EV charging opportunities at any of the following locations that are either local to you or on routes you drive regularly?

Please select all that apply.

- ☐ My workplace
- ☐ A supermarket
- ☐ A retail store or retail estate
- ☐ A shopping mall
- ☐ A restaurant
- ☐ A gym/recreation facility or community centre
- ☐ An on-street parking bay
- ☐ A fee-charging car park (e.g. NCP)
- ☐ A government building
- ☐ A religious or spiritual building
- ☐ A motorway service area
- ☐ Other: ___________________
- ☐ I have never seen an electric vehicle recharge station

THANK YOU – THAT IS THE END OF THIS SURVEY

If you have any comments about this questionnaire then please note them here.

Interim 1 questionnaire

Participant ID: _________ Date: ________________

What is this questionnaire?

This Interim Questionnaire 1 forms part of a series of questionnaires which we will ask you to complete as part of this trial. This questionnaire is designed to capture feedback on the vehicle which you were using over the last four days.

How long will it take to complete?

It will take approximately 5-10 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

What other questionnaires will I have to complete for this trial?

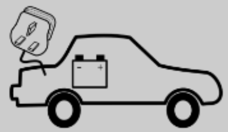
A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	**Completed**
Interim questionnaire 1	In progress (this questionnaire)
Interim questionnaire 2	To be completed on return of second vehicle
Interim questionnaire 3	To be completed on return of third vehicle
Time point 2 questionnaire	To be completed 1 week after return of third vehicle

Thank you for taking part in this research. Your participation is extremely important.

Types of electric vehicles and definitions for this questionnaire

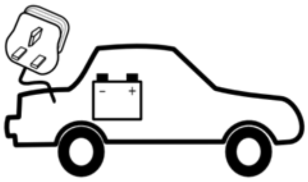
This table is a reminder of the differences between plug-in vehicles and non-plug-in (conventional) vehicles that you will be used to.

Non-plug-in (conventional) vehicles		**Plug-in Vehicles (PiVs)**	
Conventional vehicle	**Hybrid Electric Vehicle (HEV)**	**Plug-in Hybrid Electric Vehicle (PHEV)**	**Battery Electric Vehicle (BEV)**
			

Typically powered by petrol / diesel only.	A non-plug-in Hybrid Electric Vehicle (HEV) has a petrol / diesel engine and an electric motor powered by a small battery. The battery gets charged when the engine is running. It does not need to (and cannot) be plugged in to an electrical socket to charge the battery. Battery power is mainly used at lower speeds, like when in traffic; this improves fuel consumption.	A Plug-in Hybrid Electric Vehicle (PHEV) is like a conventional HEV with both a petrol / diesel engine and an electric motor. BUT, the battery can be charged by plugging it in to a normal electrical socket (like you have at home) or dedicated charging point, as needed. The battery also gets charged when the engine is running. If you run out of charge you can continue driving as long as there is petrol or diesel in the tank. The car will use the electric motor whenever possible to save fuel, but also uses power from the petrol / diesel engine when required.	A Battery Electric Vehicle (BEV) is powered only by a battery. The battery is charged by plugging it in to a normal electric socket (like you have at home) or dedicated charging point, as needed. No petrol or diesel is required; once you run out of electrical charge in the battery you will no longer be able to operate the vehicle.

Section 1: Battery Electric Vehicles (BEVs)

This section will ask you about Battery Electric Vehicles (BEVs) only. Please think specifically about BEVs when answering the questions.



1. **Please indicate how likely or unlikely it is that:**

   "In the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) as my car"

Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
☐	☐	☐	☐	☐

2. **Please indicate whether you would consider owning a *__Battery Electric Vehicle (BEV)__* as the MAIN car in your household if it had a range when fully charged of:**
   Please choose 'yes' or 'no' for each row

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

3. **Please indicate whether you would consider owning a *__Battery Electric Vehicle (BEV)__* as the MAIN car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

4. **Please indicate how likely or unlikely it is that:**

"In the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) as my SECOND car"

Select N/A if you do not expect to need more than one car in your household in the next 5 years.

Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely	N/A
☐	☐	☐	☐	☐	

5. **Please indicate whether you would consider owning a *__Battery Electric Vehicle (BEV)__* as a SECOND car in your household if it had a range when fully charged of:**
Please choose 'yes' or 'no' for each row
[Do NOT show if participant responded N/A to Q4]

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

6. Please indicate whether you would consider owning a _Battery Electric Vehicle (BEV)_ as the SECOND car in your household if the charging time required to provide 100 miles of range was:

Please choose 'yes' or 'no' for each row

[Do NOT show if participant responded N/A to Q4]

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

7. How informed do you currently feel about Battery Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

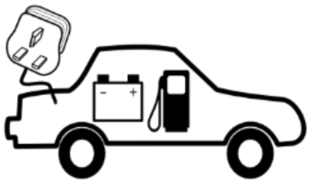
☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 2: Plug-in Hybrid Electric Vehicles (PHEVs)

This section will ask you about Plug-in Hybrid Electric Vehicles (PHEVs) only. Please think specifically about PHEVs when answering the questions.



8. Please indicate how likely or unlikely it is that:

"In the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) as my car"

Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
☐	☐	☐	☐	☐

9. Please indicate whether you would consider owning a *__Plug-in Hybrid Electric Vehicle (PHEV)__* as the MAIN car in your household if it had a range when fully charged of:

Please choose 'yes' or 'no' for each row

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

10. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if the charging time required to provide 100 miles of range was:

Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

11. Please indicate how likely or unlikely it is that:

"In the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) as my SECOND car"

Select N/A if you do not expect to need more than one car in your household in the next 5 years.

Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely	N/A
☐	☐	☐	☐	☐	

12. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as a SECOND car in your household if it had a range when fully charged of:

Please choose 'yes' or 'no' for each row

[Do NOT show if participant responded N/A to Q11]

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

13. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the SECOND car in your household if the charging time required to provide 100 miles of range was:

Please choose 'yes' or 'no' for each row

[Do NOT show if participant responded N/A to Q11]

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

14. How informed do you currently feel about Plug-in Hybrid Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 3: Next vehicle purchase

15. When do you next intend to buy your next car?

- ☐ Within the next year
- ☐ Between 1 and 2 years from now
- ☐ Between 2 and 5 years from now
- ☐ More than 5 years from now
- ☐ Not sure/don’t know

16. Do you expect to buy your car:

- ☐ Brand new (Less than 1 year old)
- ☐ Nearly new (1-2 years old)
- ☐ Used (More than 2 years old)
- ☐ Not sure / don’t know

Section 4: Experience with the vehicle

17. Please rate the performance of the car you used in the study.
Please read the following example before answering the next set of questions below.

Example:

Please rate the acceleration from 0 mph to 20 mph (of the car you have just handed back):

When giving your answer, please start with the verbal expression, "Very low", "Moderate", etc., and then choose a number. If your perception of the acceleration from 0 to 20mph was "very low", rate it as 1. If your perception of the acceleration from 0 to 20 mph was "high", rate it as 5, and so on.

Please answer using your own perception of the acceleration from 0 to 20 mph, and not what you think other people might think of it, or what you think the answer "ought" to be. Please be as honest as possible and try not to under-estimate or over-estimate the acceleration.

Thinking of the vehicle you have just returned, please rate each aspect of the vehicle's performance, by selecting one number on the scale provided.

Acceleration from 0 mph to 20 mph											
Not at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Responsiveness to the accelerator pedal											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Noise level when cruising											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Acceleration from 50mph to 70mph											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Noise level when stationary (e.g. at traffic lights)											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Sportiness of noise when accelerating											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Smoothness when cruising											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Power											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Acceleration from 30mph to 50mph											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of safety when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high

0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of comfort when driving the car											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of enjoyment when driving the car											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Overall performance											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10

18. In the last four days, roughly what percentages of journeys were you…
Please enter a percentage for each

... were you the driver of the vehicle? _____%
... was someone else the driver of the vehicle? _____%

Total _____%

[Drop down options with auto-calculate]

19. Please select the type of vehicle that you have just returned

☐ Conventional Vehicle

☐ BEV (e-Golf)

☐ PHEV (Golf GTE)

[only present the following if BEV (e-Golf) or PHEV (Golf GTE) selected]

20. Did you ever forget to charge the vehicle during the trial?

- ☐ Yes
- ☐ No

21. How many times did you charge the vehicle at home?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

[only present Q22-Q26 if Q21 > 0]

22. How convenient or inconvenient did you find charging the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very inconvenient and 10 is very convenient

[Adjustable scale from 1-10]

23. How safe or unsafe did you feel when *plugging* in the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

24. How safe or unsafe did you feel when *unplugging* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

25. How easy or difficult was it to *plug-in* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

26. How easy or difficult was it to *unplug* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

27. How many times did you charge the vehicle at a public charge point?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

[only present Q28-Q32 if Q27 > 0]

28. How convenient or inconvenient did you find charging the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very inconvenient and 10 is very convenient

[Adjustable scale from 1-10]

29. How safe or unsafe did you feel when *plugging* in the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

30. How safe or unsafe did you feel when *unplugging* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

31. How easy or difficult was it to *plug-in* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

32. How easy or difficult was it to *unplug* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

33. How many times did you charge at each of the follow locations?

	0	1	2	3	4	5+
Work	☐	☐	☐	☐	☐	☐
At the home of friends or family	☐	☐	☐	☐	☐	☐

34. How many times did you charge the vehicle at another location?

Please specify below.

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5+

Thank you for completing this questionnaire.

Please inform the researcher that you are finished.

Interim 2 questionnaire

Participant ID: _________ Date: ________________

What is this questionnaire?

This Interim Questionnaire 2 forms part of a series of questionnaires which we will ask you to complete as part of this trial. This questionnaire is designed to capture your feedback on the vehicle which you were using over the last four days.

How long will it take to complete?

It will take approximately 5 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

What other questionnaires will I have to complete for this trial?

A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	**Completed**
Interim questionnaire 1	**Completed**
Interim questionnaire 2	In progress (this questionnaire)
Interim questionnaire 3	To be completed on return of third vehicle
Time point 2 questionnaire	To be completed 1 week after return of third vehicle

Thank you for taking part in this research. Your participation is extremely important.

Section 1: Experience with the vehicle

1. **Please rate the performance of the car you used in the study.**
   Please read the following example before answering the next set of questions below.

   Example:

   Please rate the acceleration from 0 mph to 20 mph (of the car you have just handed back):

When giving your answer, please start with the verbal expression, "Very low", "Moderate", etc., and then choose a number. If your perception of the acceleration from 0 to 20mph was "very low", rate it as 1. If your perception of the acceleration from 0 to 20 mph was "high", rate it as 5, and so on.

Please answer using your own perception of the acceleration from 0 to 20 mph, and not what you think other people might think of it, or what you think the answer "ought" to be. Please be as honest as possible and try not to under-estimate or over-estimate the acceleration.

Thinking of the vehicle you have just returned, please rate each aspect of the vehicle's performance, by selecting one number on the scale provided.

Acceleration from 0 mph to 20 mph											
Not at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Responsiveness to the accelerator pedal											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Noise level when cruising											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10

Acceleration from 50mph to 70mph											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Noise level when stationary (e.g. at traffic lights)											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Sportiness of noise when accelerating											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Smoothness when cruising											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Power											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Acceleration from 30mph to 50mph											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of safety when driving the car											
None at all	Extreme ly low	Very low	Low	Modera te		High		Very High			Extreme ly high

0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of comfort when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of enjoyment when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Overall performance											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

2. **In the last four days, roughly what percentages of journeys were you… Please enter a percentage for each**

... were you the driver of the vehicle? _____%
... was someone else the driver of the vehicle? _____%

Total _____%

[Drop down options with auto-calculate]

3. **Please select the type of vehicle that you have just returned**

☐ Conventional Vehicle

☐ BEV (e-Golf)

☐ PHEV (Golf GTE)

[only present the following if BEV (e-Golf) or PHEV (Golf GTE) selected]

4. Did you ever forget to charge the vehicle during the trial?

- ☐ Yes
- ☐ No

5. How many times did you charge the vehicle at home?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

[only present Q6-Q10 if Q5 > 0]

6. How convenient or inconvenient did you find charging the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very inconvenient and 10 is very convenient

[Adjustable scale from 1-10]

7. How safe or unsafe did you feel when *plugging* in the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

8. How safe or unsafe did you feel when *unplugging* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

9. How easy or difficult was it to *plug-in* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

10. How easy or difficult was it to *unplug* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

11. How many times did you charge the vehicle at a public charge point?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

[only present Q12-Q16 if Q11 > 0]

12. How convenient or inconvenient did you find charging the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very inconvenient and 10 is very convenient

[Adjustable scale from 1-10]

13. How safe or unsafe did you feel when *plugging* in the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

14. How safe or unsafe did you feel when *unplugging* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

15. How easy or difficult was it to *plug-in* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

16. How easy or difficult was it to *unplug* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

17. How many times did you charge at each of the follow locations?

	0	1	2	3	4	5+
Work	☐	☐	☐	☐	☐	☐
At the home of friends or family	☐	☐	☐	☐	☐	☐

18. How many times did you charge the vehicle at another location?

Please specify below.

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5+

Thank you for completing this questionnaire.

Please inform the researcher that you are finished.

Interim 3 questionnaire

Participant ID: _________ Date: ________________

What is this questionnaire?

This Interim questionnaire 3 forms part of a series of questionnaires which we will ask to complete as part of this trial. This questionnaire is designed to capture your feedback on the vehicle which you were using over the last four days.

How long will it take to complete?

It will take approximately 5 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

What other questionnaires will I have to complete for this trial?

A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	**Completed**
Interim questionnaire 1	**Completed**
Interim questionnaire 2	**Completed**
Interim questionnaire 3	In progress (this questionnaire)
Time point 2 questionnaire	To be completed 1 week after return of third vehicle

Thank you for taking part in this research. Your participation is extremely important.

Section 1: Experience with the vehicle

1. **Please rate the performance of the car you used in the study.**
   Please read the following example before answering the next set of questions below.

   Example:

   Please rate the acceleration from 0 mph to 20 mph (of the car you have just handed back):

When giving your answer, please start with the verbal expression, "Very low", "Moderate", etc., and then choose a number. If your perception of the acceleration from 0 to 20mph was "very low", rate it as 1. If your perception of the acceleration from 0 to 20 mph was "high", rate it as 5, and so on.

Please answer using your own perception of the acceleration from 0 to 20 mph, and not what you think other people might think of it, or what you think the answer "ought" to be. Please be as honest as possible and try not to under-estimate or over-estimate the acceleration.

Thinking of the vehicle you have just returned, please rate each aspect of the vehicle's performance, by selecting one number on the scale provided.

Acceleration from 0 mph to 20 mph											
Not at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Responsiveness to the accelerator pedal											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Noise level when cruising											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Acceleration from 50mph to 70mph											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Noise level when stationary (e.g. at traffic lights)											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Sportiness of noise when accelerating											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Smoothness when cruising											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Power											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Acceleration from 30mph to 50mph											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of safety when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high

0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of comfort when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of enjoyment when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Overall performance											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

2. In the last four days, roughly what percentages of journeys were you… Please enter a percentage for each

... were you the driver of the vehicle? _____%
... was someone else the driver of the vehicle? _____%

Total _____%

[Drop down options with auto-calculate]

3. Please select the type of vehicle that you have just returned

☐ Conventional Vehicle

☐ BEV (e-Golf)

☐ PHEV (Golf GTE)

[only present the following if BEV (e-Golf) or PHEV (Golf GTE) selected]

4. Did you ever forget to charge the vehicle during the trial?

- ☐ Yes
- ☐ No

5. How many times did you charge the vehicle at home?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

[only present Q6-Q10 if Q5 > 0]

6. How convenient or inconvenient did you find charging the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very inconvenient and 10 is very convenient

[Adjustable scale from 1-10]

7. How safe or unsafe did you feel when *plugging* in the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

8. How safe or unsafe did you feel when *unplugging* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

9. How easy or difficult was it to *plug-in* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

10. How easy or difficult was it to *unplug* the vehicle at home?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

11. How many times did you charge the vehicle at a public charge point?

- ☐ 0

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

[only present Q12-Q16 if Q11 > 0]

12. How convenient or inconvenient did you find charging the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very inconvenient and 10 is very convenient

[Adjustable scale from 1-10]

13. How safe or unsafe did you feel when *plugging* in the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

14. How safe or unsafe did you feel when *unplugging* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very unsafe and 10 is very safe

[Adjustable scale from 1-10]

15. How easy or difficult was it to *plug-in* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

16. How easy or difficult was it to *unplug* the vehicle at a public charge point?

Please respond by rating on a scale of 1-10, where 1 is very difficult and 10 is very easy

[Adjustable scale from 1-10]

17. How many times did you charge at each of the follow locations?

	0	**1**	**2**	**3**	**4**	**5+**
Work	☐	☐	☐	☐	☐	☐

At the home of friends or family	☐	☐	☐	☐	☐	☐

18. How many times did you charge the vehicle at another location?

Please specify below.

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5+

Thank you for completing this questionnaire.

Please inform the researcher that you are finished.

Time Point 2 questionnaire

Participant ID: _________

Please answer the following question before completing the Time Point 2 questionnaire.

Over the next 5 years, do you expect to be …

- …a one car household
- …a two car household
- ...a three or more car household

[Response to inform skip logic for all second car questions in TP2]

What is this questionnaire?

This Time Point 2 Questionnaire is the final questionnaire that we will ask you to complete as part of this trial. This questionnaire is designed to capture information on your opinions and perceptions of different types of electric vehicle.

How long will it take to complete?

It will take approximately 30 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

Before starting the questionnaire please take a little time to remind yourself of the information on the next page about different types of vehicles. You will be asked for your views on these vehicles in the questionnaire.

How to complete the questionnaire

Please use the at the bottom of each page to go forward. As soon as you do this your answer is saved.

If you need to go back, please use the button.

If you leave the survey idle for a while, you will be logged out automatically, but don't worry, your answers will be saved so long as you have completed a question by pressing the forward button

To restart the questionnaire at the same stage, simply click the original link that was sent to you.

What other questionnaires will I have to complete for this trial?

None; this is the final questionnaire.

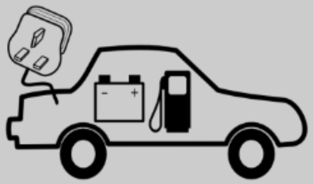
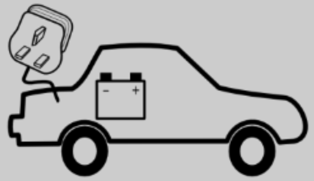
Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	**Completed**
Interim questionnaire 1	**Completed**
Interim questionnaire 2	**Completed**
Interim questionnaire 3	**Completed**
Time point 2 questionnaire	In progress (this questionnaire)

Thank you for taking part in this research. Your participation is extremely important.

Types of electric vehicles and definitions for this questionnaire

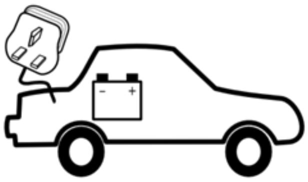
In this questionnaire we will ask you about your views of types of plug-in vehicles (PiVs). This table provides a summary of the differences between plug-in vehicles and non-plug-in (conventional) vehicles that you will be used to.

[table on following page – present on one page online]

Non-plug-in (conventional) vehicles		Plug-in Vehicles (PiVs)	
Conventional vehicle	**Hybrid Electric Vehicle (HEV)**	**Plug-in Hybrid Electric Vehicle (PHEV)**	**Battery Electric Vehicle (BEV)**
			
Typically powered by petrol / diesel only.	A non-plug-in Hybrid Electric Vehicle (HEV) has a petrol / diesel engine and an electric motor powered by a small battery. The battery gets charged when the engine is running. It does not need to (and cannot) be plugged in to an electrical socket to charge the battery. Battery power is mainly used at lower speeds, like when in traffic; this improves fuel consumption.	A Plug-in Hybrid Electric Vehicle (PHEV) is like a conventional HEV with both petrol / diesel engine and an electric motor. BUT, the battery can be charged by plugging it in to a normal electrical socket (like you have at home) or dedicated charging point, as needed. The battery also gets charged when the engine is running. If you run out of charge you can continue driving as long as there is petrol or diesel in the tank. The car will use the electric motor whenever possible to save fuel, but also uses power from the petrol / diesel engine when required.	A Battery Electric Vehicle (BEV) is powered only by a battery. The battery is charged by plugging it in to a normal electric socket (like you have at home) or dedicated charging point, as needed. No petrol or diesel is required; once you run out of electrical charge in the battery you will no longer be able to operate the vehicle.

Section 1: Battery Electric Vehicles (BEVs)

This section will ask you about Battery Electric Vehicles (BEVs) only. Please think specifically about BEVs when answering the questions.



1. **To what extent do you agree or disagree with the following statements?**
Please tick one box on each line to rate your agreement or disagreement with the statement
[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The chances of breaking down in a BEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to 'refuel' at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
BEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a BEV would give me a 'feel good factor' because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of BEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a BEV	☐	☐	☐	☐	☐
Having to remember to plug in a BEV would put me off buying one	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A BEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a BEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a BEV	☐	☐	☐	☐	☐
Adapting to charging a BEV would be difficult for me	☐	☐	☐	☐	☐
If I had a BEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a BEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a BEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a BEV	☐	☐	☐	☐	☐
When driving a BEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a BEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel would make me more likely to buy a BEV	☐	☐	☐	☐	☐

2. **The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.**
   These statements are not about you; instead please imagine the kind of person who would drive a BEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
   Please tick one box on each line
   [RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

3. **To what extent do you agree or disagree with the following statements about BEVs?**
Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs are a very exciting new technology	☐	☐	☐	☐	☐
BEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
BEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
BEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
BEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
BEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
BEVs are too new to be reliable	☐	☐	☐	☐	☐
BEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
BEVs perform better than a conventional car	☐	☐	☐	☐	☐
BEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
BEVs are good for the environment	☐	☐	☐	☐	☐
are pleasant to drive	☐	☐	☐	☐	☐
BEVs are impractical	☐	☐	☐	☐	☐
BEVs are a really good idea	☐	☐	☐	☐	☐
BEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
BEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
BEVs offer environmental benefits	☐	☐	☐	☐	☐
BEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐
BEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
BEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
BEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
BEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
BEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
BEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
BEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
BEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
BEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

4. **Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a <u>Battery Electric Vehicle (BEV)</u> …**

   Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

5. **Please indicate whether you would consider owning a *<u>Battery Electric Vehicle (BEV)</u>* as the MAIN car in your household if it had a range when fully charged of:**
   Please choose 'yes' or 'no' for each row

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

6. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *<u>Battery Electric Vehicle (BEV)</u>* as a SECOND car in your household if it had a range when fully charged of:**
   Please choose 'yes' or 'no' for each row,

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

7. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

8. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the SECOND car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row,

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

9. **How important or unimportant would the following factors be if you were considering a *__Battery Electric Vehicle (BEV)__* for your household?**

Please tick one box on each line

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Purchase price	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Size	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐
Appearance	☐	☐	☐	☐	☐
Time to fully charge vehicle	☐	☐	☐	☐	☐
Electric range	☐	☐	☐	☐	☐
Running costs	☐	☐	☐	☐	☐
Built-in satellite navigation system	☐	☐	☐	☐	☐
Hands-free Bluetooth phone connectivity	☐	☐	☐	☐	☐
Cruise control	☐	☐	☐	☐	☐
Automatic rain-sensing windscreen wipers	☐	☐	☐	☐	☐
Rate of depreciation of vehicle value	☐	☐	☐	☐	☐
Convenient access to public transport	☐	☐	☐	☐	☐
Access to an alternative vehicle in your household	☐	☐	☐	☐	☐
Please add any other factors that would be important to you that are not listed					

10. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a *Battery Electric Vehicle (BEV)* in my household if I got… : [RANDOMISE ORDER]

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…discounted access to hire cars (e.g. for longer journeys)”	☐	☐	☐	☐	☐
…discounted access to public transport”	☐	☐	☐	☐	☐
..permission to drive in bus lanes”	☐	☐	☐	☐	☐
…access to free parking”	☐	☐	☐	☐	☐
…free access to congestion charge zones”	☐	☐	☐	☐	☐
…a free chargepoint for my home”	☐	☐	☐	☐	☐
…a government grant towards purchase price”	☐	☐	☐	☐	☐
…free access to low emission zones / clean air zones	☐	☐	☐	☐	☐
…exemption from car tax (Vehicle Excise Duty)	☐	☐	☐	☐	☐

11. The average conventional car which does 10,000 miles per year will be worth around <u>40% of its original value</u> after 3 years.

Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) in my household if after 3 years it was worth…

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
...20% of its value" (faster depreciation than conventional car)	☐	☐	☐	☐	☐
…30% of its value"	☐	☐	☐	☐	☐
…40% of its value" (same rate of depreciation as conventional car)	☐	☐	☐	☐	☐
…50% of its value"	☐	☐	☐	☐	☐
…60% of its value" (slower depreciation than conventional car)	☐	☐	☐	☐	☐

12. Please indicate how likely or unlikely it is that:

Please tick one box on each line

"In the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) in my household if after three years it lost…					
	Very unlikely	**Fairly unlikely**	**Neither likely nor unlikely**	**Fairly likely**	**Very likely**
..none of its original electric range"	☐	☐	☐	☐	☐
…10% of its original electric range"	☐	☐	☐	☐	☐
…20% of its original electric range"	☐	☐	☐	☐	☐
…30% of its original electric range"	☐	☐	☐	☐	☐

13. How informed do you currently feel about Battery Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

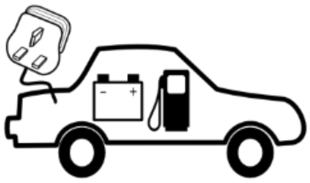
☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 2: Plug-in Hybrid Electric Vehicles (PHEVs)

This section will ask you about Plug-in Hybrid Electric Vehicles (PHEVs) only. Please think specifically about PHEVs when answering the questions.



14. To what extent do you agree or disagree with the following statements?
Please tick one box on each line to rate your agreement or disagreement with the statement
[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The chances of breaking down in a PHEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to 'refuel' at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
PHEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a PHEV would give me a 'feel good factor' because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of PHEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a PHEV	☐	☐	☐	☐	☐
Having to remember to plug in a PHEV would put me off buying one	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A PHEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a PHEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a PHEV	☐	☐	☐	☐	☐
Adapting to charging a PHEV would be difficult for me	☐	☐	☐	☐	☐
If I had a PHEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a PHEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a PHEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a PHEV	☐	☐	☐	☐	☐
When driving a PHEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a PHEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel would make me more likely to buy a PHEV	☐	☐	☐	☐	☐

15. The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.
These statements are not about you; instead please imagine the kind of person who would drive a PHEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
Please tick one box on each line
[RANDOMISE ORDER]

	Doesn't fit the driver	**Only fits the driver a little**	**Fits the driver moderately**	**Fits the driver well**	**Fits the driver very well**
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

16. To what extent do you agree or disagree with the following statements about PHEVs?

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
PHEVs are a very exciting new technology	☐	☐	☐	☐	☐
PHEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
PHEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
PHEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
PHEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
PHEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
PHEVs are too new to be reliable	☐	☐	☐	☐	☐
PHEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
PHEVs perform better than a conventional car	☐	☐	☐	☐	☐
PHEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
are good for the environment	☐	☐	☐	☐	☐
PHEVs are pleasant to drive	☐	☐	☐	☐	☐
PHEVs are impractical	☐	☐	☐	☐	☐
PHEVs are a really good idea	☐	☐	☐	☐	☐
PHEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
PHEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
PHEVs offer environmental benefits	☐	☐	☐	☐	☐
PHEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐
PHEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PHEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
PHEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
PHEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
PHEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
PHEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
PHEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
PHEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

17. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a <u>Plug-in Hybrid Electric Vehicle (PHEV) …</u>

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

18. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if it had an electric driving range when fully charged of:

Please choose 'yes' or 'no' for each row

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

19. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as a SECOND car in your household if it had an electric driving range when fully charged of:**

Please choose 'yes' or 'no' for each row, or

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

20. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if the charging time required to provide 100 miles of electric driving range was:

Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

21. Show if Q7a+Q7b >1. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the SECOND car in your household if the charging time required to provide 100 miles of electric driving range was:**

Please choose 'yes' or 'no' for each row,

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

22. How important or unimportant would the following factors be if you were considering a *Plug-in Hybrid Electric Vehicle (PHEV)* for your household?

Please tick one box on each line

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Purchase price	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Size	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐
Appearance	☐	☐	☐	☐	☐
Time to fully charge vehicle	☐	☐	☐	☐	☐
Electric range	☐	☐	☐	☐	☐
Running costs	☐	☐	☐	☐	☐
Built-in satellite navigation system	☐	☐	☐	☐	☐
Hands-free Bluetooth phone connectivity	☐	☐	☐	☐	☐
Cruise control	☐	☐	☐	☐	☐
Automatic rain-sensing windscreen wipers	☐	☐	☐	☐	☐
Rate of depreciation of vehicle value	☐	☐	☐	☐	☐
Convenient access to public transport	☐	☐	☐	☐	☐
Access to an alternative vehicle in your household	☐	☐	☐	☐	☐
Please add any other factors that would be important to you that are not listed	☐	☐	☐	☐	☐

23. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a *Plug-in Hybrid Electric Vehicle (PHEV)* in my household if I got… [RANDOMISE ORDER]

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…discounted access to hire cars"	☐	☐	☐	☐	☐
…discounted access to public transport"	☐	☐	☐	☐	☐
..permission to drive in bus lanes"	☐	☐	☐	☐	☐
…access to free parking"	☐	☐	☐	☐	☐
…free access to congestion charge zones"	☐	☐	☐	☐	☐
…a free chargepoint for my home"	☐	☐	☐	☐	☐
…a government grant towards purchase price"	☐	☐	☐	☐	☐
…free access to low emission zones / clean air zones	☐	☐	☐	☐	☐
…exemption from car tax (Vehicle Excise Duty)	☐	☐	☐	☐	☐

24. The average conventional car which does 10,000 miles per year will be worth around 40% of its original value after 3 years.

Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) in my household if after 3 years it was worth…

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
...20% of its value" (faster depreciation than conventional car)	☐	☐	☐	☐	☐
…30% of its value"	☐	☐	☐	☐	☐
…40% of its value" (same rate of depreciation as conventional car)	☐	☐	☐	☐	☐
…50% of its value"	☐	☐	☐	☐	☐
…60% of its value" (slower depreciation than conventional car)	☐	☐	☐	☐	☐

25. Please indicate how likely or unlikely it is that:

Please tick one box on each line

"In the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) in my household if after three years it lost…					
	Very unlikely	**Fairly unlikely**	**Neither likely nor unlikely**	**Fairly likely**	**Very likely**
..none of its original electric range"	☐	☐	☐	☐	☐
…10% of its original electric range"	☐	☐	☐	☐	☐
…20% of its original electric range"	☐	☐	☐	☐	☐
…30% of its original electric range"	☐	☐	☐	☐	☐

26. How informed do you currently feel about Plug-in Hybrid Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 3: Next vehicle purchase

27. When do you next intend to buy your next car?

☐ Within the next year

☐ Between 1 and 2 years from now

☐ Between 2 and 5 years from now

☐ More than 5 years from now

☐ Not sure/don't know

28. Do you expect to buy your car:

☐ Brand new (Less than 1 year old)

☐ Nearly new (1-2 years old)

☐ Used (More than 2 years old)

☐ Not sure / don't know

29. Have you sourced information about PHEVs or BEVs from any of the following since starting this study?

Select all that apply

☐ Car magazines (e.g. CAR, Auto Express)
☐ TV motoring shows (e.g. Top Gear)
☐ The news (e.g. television or newspaper)
☐ Information from car dealers
☐ Television commercials
☐ Family and friends
☐ Personal research (internet, books, movies, talks)
☐ Government (ads, brochures, etc.)
☐ Other sources, please specify:_____________________

☐ None of these

Section 4: Plug-in vehicle charging

30. If you owned a BEV, how often would you charge the vehicle in each of the following circumstances?
[DO NOT RANDOMISE, PRESENT AS SHOWN]
Please tick one box on each line

	Never	Rarely	Some of the time	Most of the time	Always
I would charge my BEV at **home**	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at **work**	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at a **petrol station**	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV in a **supermarket** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at a **town centre** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at **roadside parking** places	☐	☐	☐	☐	☐

31. If you owned a PHEV, how often would you charge the vehicle in each of the following circumstances?
[DO NOT RANDOMISE, PRESENT AS SHOWN]
Please tick one box on each line

	Never	Rarely	Some of the time	Most of the time	Always
I would charge my PHEV at **home**	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at **work**	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at a **petrol station**	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV in a **supermarket** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at a **town centre** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at **roadside parking** places	☐	☐	☐	☐	☐

32. Are you aware of Plug-in Vehicle (PiV) charging opportunities at any of the following locations that are local to you?
Please select all that apply

- ☐ My workplace
- ☐ A supermarket
- ☐ A retail store or retail estate
- ☐ A shopping mall
- ☐ A restaurant
- ☐ A gym/recreation facility or community centre
- ☐ An on-street parking bay
- ☐ A fee-charging car park (e.g. NCP)
- ☐ A government building
- ☐ A religious or spiritual building
- ☐ A motorway service area
- ☐ Other: ___________________

- ☐ I have not seen any charge points local to me

Section 5: About you

33. How accurately do each of the statements below describe you?

Please use the rating scale to describe how accurately each of the below statements describes *you.*

Please describe yourself as you generally are now, not as you wish to be in the future.

Please describe yourself as you honestly see yourself, in relation to other people you know of the same sex and age (approximately).

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Very little	Little	Moderate	Much	Very much
Have a low status job	☐	☐	☐	☐	☐
Like to tidy up	☐	☐	☐	☐	☐
Sympathise with the homeless	☐	☐	☐	☐	☐
Feel uncomfortable around people	☐	☐	☐	☐	☐
I worry about things	☐	☐	☐	☐	☐
Like philosophical discussions	☐	☐	☐	☐	☐
Have a lot of fun	☐	☐	☐	☐	☐
Make rash decisions	☐	☐	☐	☐	☐
Prefer to stick to things that I know	☐	☐	☐	☐	☐
I am physically unattractive	☐	☐	☐	☐	☐
Have a high income	☐	☐	☐	☐	☐
I am physically attractive	☐	☐	☐	☐	☐
Feel that I'm able to deal with things	☐	☐	☐	☐	☐
Get back at others	☐	☐	☐	☐	☐

34. To what extent would you say each of the following is typical or 'characteristic' of you?

Please use the rating scale to indicate the extent to which each of the statements below are characteristic or uncharacteristic of you.

Please describe yourself as you generally are now, not as you wish to be in the future.

Please describe yourself as you honestly see yourself, in relation to other people you know of the same sex and age (approximately).

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

	Very uncharacteristic of me	Moderately uncharacteristic of me	Neither characteristic nor uncharacteristic of me	Moderately characteristic of me	Very characteristic of me
Starting a conversation with a stranger	☐	☐	☐	☐	☐
Making sure others are comfortable and happy	☐	☐	☐	☐	☐
Creating an artwork, piece of writing or music	☐	☐	☐	☐	☐
Preparing for things well in advance	☐	☐	☐	☐	☐
Feeling blue or depressed	☐	☐	☐	☐	☐
Planning social events or parties	☐	☐	☐	☐	☐
Insulting people	☐	☐	☐	☐	☐
Thinking about philosophical or spiritual questions	☐	☐	☐	☐	☐
Letting things get into a mess	☐	☐	☐	☐	☐
Feeling stressed or worried	☐	☐	☐	☐	☐
Using difficult words	☐	☐	☐	☐	☐
Sympathising with others' feelings	☐	☐	☐	☐	☐

THANK YOU – THAT IS THE END OF THIS SURVEY AND THE TRIAL

If you have any comments about this questionnaire then please note them here.

If you have any comments about the trial then please note them here.

PROJECT REPORT

CVEI Stage 2

Deliverable D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Part 3 – Consumer Charging Trials Study Plan

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Disclaimer

This document is provided to the ETI under, and is subject to the terms of, the Energy Technologies Institute's Agreement for the Consumers, Vehicles and Energy Integration (CVEI) Project – Stage 2.

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Abbreviations

AC	Alternating Current
ACEA	European Automobile Manufacturers' Association
AER	All Electric Range
ALARP	As Low As Reasonably Practicable
ANOVA	Analysis Of Variance
API	Application Programming Interface
BEAMA	British Electrotechnical and Allied Manufacturers' Association
BEV	Battery Electric Vehicle
BIK	Benefit-in-Kind
BIT	Behavioural Insights Team
CAN	Controller Area Network
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CLASS	Customer Load Active System Services
CNG	Compressed Natural Gas
CPAT	Commercial Policy and Accounting Tool
CPMS	Chargepoint Management System
CSM	Charge Station Manager
CVEI	Consumers, Vehicles and Energy Integration project
DC	Direct Current
Defra	Department for Environment Food and Rural Affairs
DfT	Department for Transport
DM	Demand Management
DNO	Distribution Network Operator
DSR	Demand Side Response
DUoS	Distribution Use of System
DVLA	Driver and Vehicle Licensing Agency
ECCo	Electric Car Consumer
EE	Element Energy
EOBD	European On-Board Diagnostics
ESME	Energy System Modelling Environment
ESOS	Energy Savings Opportunity Scheme
EV	Electric Vehicle (including all plug-in vehicles)
EVSE	Electric Vehicle Supply Equipment
ETI	Energy Technologies Institute
FCV	Fuel Cell Vehicle
FIPS	Federal Information Processing Standard
FTP	File Transfer Protocol

GB	Great Britain
GEE	Generalised Estimating Equations
GPS	Global Positioning System
HAZID	Hazard Identification
HEV	Hybrid Electric Vehicle
IC-CPD	In-Cable Control and Protective Device
ICE	Internal Combustion Engine
ID	Identification
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers
IMS	Integrated Management System
IPIP	International Personality Item Pool
ISO	International Organization for Standardization
KPH	Kilometers per Hour
LD	Light Duty
LPG	Liquified Petroleum Gas
MC	Managed Charging
MCAR	Managed Charging Availability Ratio
MCB	Miniature Circuit Breaker
MDSI	Multi-Dimensional Driving Style Inventory
MCPT	Macro Charging Point Tool
MHDT	Macro Hydrogen Distribution Tool
NICEIC	National Inspection Council for Electrical Installation Contracting
NEDC	New European Driving Cycle
NTS	National Travel Survey
OBD	On-Board Diagnosis
OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
ONS	Office for National Statistics
OSGR	Ordnance Survey Grid Reference
PHEV	Plug-in Hybrid Electric Vehicle
PIA	Privacy Impact Assessment
PiV	Plug in Vehicle
PM	Project Manager
RCD	Residual Current Device
RCT	Randomised Controlled Trial
RFQ	Request for Quotation
RPM	Revolutions Per Minute
SMC	Supplier Managed Charging
SMMT	Society of Motor Manufacturers and Traders
SMS	Short Message Service

SOC	State of Charge
SOH	State of Health
SQL	Structured Query Language
SQS	Simple Queue Service
SToU	Static Time of Use
TCO	Total Cost of Ownership
TNUoS	Transmission Network Use of System
TOU	Time of Use
TRL	Transport Research Laboratory
UF	Utility Factors
UK	United Kingdom
ULEV	Ultra Low Emission Vehicle
UMC	User Managed Charging
VAT	Value Added Tax
VDC	Vehicle Data Collector
VGL	Volkswagen Group Leasing
VKT	Vehicle Kilometres Travelled
VW	Volkswagen
VWFS	Volkswagen Financial Services
WP	Work Package

Glossary

Item	Description
Affective attitudes	The emotions and feelings evoked by owning and using a vehicle.
Analytical tools	The quantitative part of the Analytical Framework, used to calculate values for the quantitative Success Metrics.
Analytical framework	Overarching Multi-Criteria Assessment (MCA) framework applied to each narrative to help understand what 'good looks like' for mass market deployment and use of ULEVs and the potential trade-offs, via the assessment of the Success Metrics. This framework comprises the analytical tools which are used to help inform the quantitative assessment as well as a set of supporting qualitative assessment metrics.
Battery Electric Vehicle	A vehicle powered solely by a battery, such battery being charged only by a source of electricity external to and not part of the vehicle itself.
Consumer	A private, domestic, individual driver who owns or leases his/her own vehicle.
Demand management	The modification of one or more energy consumers' demand for energy through various methods including financial incentives, time of use tariffs and/or education.
Descriptive (or behavioural) norms	Perceptions of what other group members you associate with actually do.
Early adopter	Those who adopt after Innovators, and only after awareness, knowledge, and positive attitudes have diffused to them from Innovator. Times to adoption are between one and two standard deviations before the mean time to adopt.
Injunctive norms	Perceptions of what other group members (e.g. family group, friendship group) approve or disapprove of.
Innovators	People high in innovativeness who are first to adopt new technology. They are sources of awareness, knowledge, and positive attitudes towards the innovation whose times to adoption are greater than two standard deviations before the mean time to adopt
Instrumental attitudes	Attitudes towards factors relating to general practical or functional attributes of driving a vehicle.
Mainstream consumer/adopter	All those whose adoption of technology has been influenced by diffusion of awareness, knowledge, and positive attitudes from people who have already adopted the innovation (i.e. everyone except innovators)

Managed charging	Means the management of vehicle charging in such a way as to control the timing and/or extent of energy transfer to provide Demand Management benefits to the energy system and the vehicle user.
Personal norms	Perceived obligations to act in a way consistent with personal views.
Plug-in Hybrid Electric Vehicle	A vehicle that is equipped so that it may be powered both by an external electricity source and by liquid fuel.
Provincial norms	The same as injunctive norms but more specifically referring to other people who live under similar conditions such as in the same locality.
S Range-extended Electric Vehicle	A vehicle that is equipped so that it may be powered both by an external electricity source and by liquid fuel; similar to a PHEV, except that a RE-EV generally uses the engine solely to charge the battery whereas a PHEV generally uses the engine for direct propulsion).
Self-identity	The perception of oneself including how you see yourself and how one perceives others see them.
Social norms	Similar to injunctive norms but mores specifically referring to the approval or disapproval by close friends/family/colleagues. Informal understandings that influence the behaviour of members of a group, or wider society.
Symbolic meaning/ attitudes	What the vehicle says about its owner/driver in terms of social status, social conscience and personal values

Preface

The purpose of the Consumers, Vehicles and Energy Integration (CVEI) project is to investigate challenges and opportunities involved in transitioning to a secure and sustainable low carbon vehicle fleet. The project explores how the integration of vehicles with the energy supply system can benefit vehicle users, vehicle manufacturers and those involved in the supply of energy.

The objective of the project is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. In addition to developing new knowledge and understanding, the project aims to develop an integrated set of analytical tools that can be used to model future market scenarios in order to test the impact of future policy, industry and societal choices.

This report details the design, materials and management arrangements for the consumer uptake and charging trials for Stage 2 of the CVEI project.

Stage 2 of the project aims to test, and as far as possible validate, the solutions identified in Stage 1. This will address gaps in knowledge, by conducting scientifically robust research, including real-world trials with private vehicle consumers, and in-depth research with business fleets. The results of the research activities conducted in Stage 2 will be used to update and improve the analytical framework developed in Stage 1. The updated framework will be used to further develop the system analysis and develop prominent policy and industry strategies to enhance energy integration between consumers, vehicles and energy systems in the future.

Stage 2 will consist of four Work Packages (WPs):

- WP5: Consumer Trials
- WP6: Fleet Study
- WP7: Modelling and System Analysis
- WP8: Project Management and Dissemination

This document provides details relating to the WP5 Consumer trials and supersedes the details relating to the Consumer trials in Deliverable D1.4. Deliverable D1.4 provides details related to WP6 and WP7.

There are four parts to this report:

- Part 1: Consumer Uptake Trial Study Plan
- Part 2: Appendices to Consumer Uptake Trial Study Plan
- Part 3: Consumer Charging Trials Study Plan (this document)
- Part 4: Appendices to Consumer Charging Trials Study Plan

This document covers Part 3, the study plan for the Consumer Charging Trials. The other parts of Deliverable D5.1 are provided in separate documents.

The contents of this document provide full details of the rationale, methodology, design and management arrangements that will be employed for the Consumer Charging Trials. Example copies of the materials which will be used throughout the trials (such as recruitment adverts, questionnaires, and Participant Information Packs) are provided in Part 4 of Deliverable D5.1: Appendices to Consumer Charging Trials Study Plan. For ease of cross-referencing, the appendices are also listed in Section 6 of this document.

1 Introduction

1.1 Summary of Task 5.2 – Consumer Charging Trials

The Consumer Charging Trials are Task 5.2 of the CVEI project. The aims, objectives and value of Task 5.2, along with the roles and responsibilities of the project team, are summarised in Table 1.

Table 1: Overview of Task 5.2

Task Lead: TRL	**Key Support: Cenex, EE, EV Connect, BIT**
	Task Aims, Objectives and Value
Aims	To investigate Mainstream Consumer charging behaviour with PHEVs and BEVs, and their responses and attitudes to alternative customer propositions which aim to manage energy demand associated with charging PHEVs and BEVs. This will provide robust inputs to the Analytical Framework to allow more accurate prediction of the likely charging behaviour and use of Demand Management schemes by the Mass-Market, and the resulting impact on UK aggregated EV charging demand.
Objectives	• To give samples of Mainstream Consumers sufficient experience of using either a BEV or PHEV vehicle, along with either a User-Managed Charging scheme or a Supplier-Managed Charging scheme, to reduce their psychological distance to use of such vehicles and charging schemes; • To measure their charging behaviour and attitudes towards such schemes following this experience, in order to inform modelling of likely Mass-Market engagement with Managed Charging schemes; • To test selected elements of the systems required to implement successful Demand Management; • To test Consumer responses to key elements of the market structures, customer propositions, energy supply management and technology options that are reflected in the Managed Charging conditions experienced by Trial Participants and in the choice options offered in the Choice Experiment; • To implement the Consumer Charging Trials designs (see Part 3) while ensuring the health and safety and privacy of Trial Participants (see sections 4.2 and 5); • To assess the impact of unavailability (or prohibitively high cost) of electricity on PHEV users and the potential for liquid fuel to act as a buffer; and • To provide data in the required format for input into WP7.

Value	The Consumer Charging Trials are unique in their application of a controlled scientific experimental design to measure Mainstream Consumers' charging behaviour and their acceptance of and behavioural response to propositions to control energy demand when charging a PiV. There will be two similar but separate Trials; one to test Mainstream Consumer charging behaviour and responses to Managed Charging schemes when using a PHEV, and the other to test the same when using a BEV. The Trial methods will be similar except that different sampling strategies will be used in the two Trials. Two distinct types of Managed Charging scheme, plus a control condition that enables measurement of charging behaviour in the absence of Managed Charging schemes, will be included in the design. No other study has used these participant samples and this study design. The data collected will advance understanding of Mainstream Consumers' charging behaviours and responses to Managed Charging schemes and ensure that representation of Mainstream Consumer behaviour in the Analytical Framework is as valid as possible. Additional analysis of PHEV Trial data by Shell will provide an understanding of utility factors (UF, the fraction of mileage covered under electric power) which will enable estimation of the impact of the unavailability (or prohibitively high cost) of electricity (due, for instance, to variability in the provision of renewable power) on the PHEV component of a future, de-carbonised, light-duty road transport vehicle parc in the UK.
Deliverables, Dependencies, Constraints and Assumptions	
Deliverables	• **D5.1** – Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials; (This Deliverable covers both Task 5.1 and Task 5.2); • **D5.3** – Consumer Charging Trials Report: Mainstream Consumers' Attitudes and Behaviours under Managed Charging Schemes for BEVs and PHEVs; and • **D5.4** – Potential Impact of PHEVs on the Ability of Liquid Fuels to Act as a Buffer in the Energy Supply System.
Dependencies	• Recruitment of required sample of Trial Participants. • Successful development and integration of technologies to simulate Managed Charging schemes and collect vehicle use and charging behaviour data. • Successful collection of required telematics data at suitable frequency.
Constraints	• The design provides maximum robustness and validity within the project's budget; and

	• In the event that a requirement is identified for analysis beyond that set out in the research questions section below, this may be subject to a Variation Request.
Assumptions	None
Roles and Responsibilities	
TRL	• Manage and implement Trial design, leading engagement with Subcontractors and the ETI; • Design and pilot questionnaire materials (except Choice Experiment items by EE below); • Pilot Trial procedures and vehicle telematics system; • Test and aid development of Charge Point Management System (CPMS) and User Interface smartphone application; • Obtain ethics approval; • Recruit Trial Participants and obtain informed consent; • Run Trial, managing Trial Participants in line with ethical, health and safety and privacy protection protocols; • Cross-reference data from EV Connect with questionnaire data and provide to Baringa and Element Energy; and • Analyse and report on attitudinal and behavioural responses.
CENEX	• Engage closely with TRL trials team during Trial procedure development and preparation phase; • Follow standardised Trial procedure developed by TRL; • Pilot Trial procedure and vehicle telematics system as required by TRL; and • Run Trial from CENEX headquarters, managing Trial Participants in line with ethical, health and safety and privacy protection protocols.
Element Energy	• Design and pilot Choice Experiment; and • Analyse and report the results of the Choice Experiment for input into Deliverable D5.3.
EV Connect	• Set-up data management system to collect telematics data from Trial vehicles; • Develop and test User Interface smartphone application, providing on-going support throughout the Trials; • Input into and support of piloting; • Data collection, processing and cleaning during Trial; and • Provide cleaned data in agreed format to TRL.
Shell	• Analyse in-trip telematics data, assess impact of electricity availability/cost, and report as per D5.4.

EDF	• Provide advice and assistance during development and testing from the consumer business team.
BIT	• Review of results and deliverables to ensure input into policy analysis and WP7.

1.2 Key principles of experimental design

1.2.1 Validity: a fundamental issue in experimental design

Validity refers to the ability of the research design to support causal inferences in relation to the research questions it is aimed at addressing. It has two major aspects: internal validity and external validity.

Internal validity is a property of experimental designs that reflects the extent to which a causal conclusion based on research using that design is warranted. That depends on the extent to which the study minimises systematic error, and the extent to which the study design excludes possible explanations for the findings, other than the one being hypothesised. Designing research to control for all possible confounding errors is the key to internal validity. Uncontrolled research designs have very low internal validity. Research with low internal validity cannot generate meaningful answers to research questions. Randomised Controlled Trials generally have the highest internal validity.

External validity refers to the validity of generalised causal inferences from the results of a study. In other words, it is the extent to which the results of a study can be generalised to other situations and to other people. One of the main threats to external validity is sample bias. For instance, it is not valid to infer that “mainstream consumers” will show particular attitudes to adoption of EVs, based only on results from a study with “Innovators” (see section 1.3). Research with low external validity can only generate answers to research questions that are applicable to a narrow set of circumstances, which might not apply to the real world.

1.2.2 Validity trade-offs in research design

In most scientific research designs involving human participants, there is an explicit trade-off to be made between internal validity and external validity. When control measures are implemented to increase the internal validity, these measures may also limit the generalisability of the findings (i.e. the external validity), and vice-versa. Budget and time constraints often play some part in the trade-offs that are eventually made.

1.2.3 The importance of causal attribution

In order to achieve the aims and objectives of the Consumer Charging Trials, charging behaviours and attitudes of mainstream consumers engaged with the two main forms of Managed Charging schemes (User-Managed Charging – UMC - and Supplier-Managed Charging - SMC) must be compared with the charging behaviours of mainstream consumers not engaged in such schemes. The research must be so designed that any differences in charging behaviours and attitudes between participants engaged in Managed Charging schemes and those who are not can be *causally attributed* to engagement in the schemes. Unless that cause-effect relation is established by the experiment, valid policy recommendations could not be made based on it. To illustrate this, suppose 120 people were given experience of engaging in a SMC scheme, and found that most of them began charging their vehicles at midnight. A valid conclusion could be drawn that "Supplier-Managed charging causes people to delay their charging until midnight", because of the possibility that those people might have begun charging their vehicles at midnight anyway, even if not engaged in supplier-managed charging. Regrettably such "uncontrolled" research designs are not uncommon in the PiV literature[1].

To ensure that valid inferences can be drawn, the Consumer Charging Trials are designed as *between-participant experiments.*

1.2.4 Between-participants experiments

In a between-participants experiment, participants are allocated to different groups, each of which receives an experimental treatment that differs in only one respect from that experienced by the other groups. All other potential sources of inter-group difference are controlled for, so it is possible to make a causal attribution: any difference in outcome can be attributed to the difference between experimental treatments. This is a powerful advantage over other research designs. Crucially in a field study, a between-participants design controls for "history" effects (the impacts of contextual variables outside the influence of the experimenters). Since participation in the different groups happens simultaneously, history effects impact equally on all groups. Equally crucially, this design also fully controls for "order" and "learning" effects that can occur in alternative designs where each participant experiences each treatment in turn.

If the effect of one or more specific interventions that are aimed at changing behaviours or attitudes were tested, to be able to make a causal attribution that the intervention(s) caused certain behaviours or attititudes, outcomes for treatment group(s) that receive the intervention with outcomes from a "Control" group that does not must be compared. Such experimental designs are known as "controlled" designs. The Consumer Charging Trials will be Between-Participants Controlled Experiments.

1.2.5 Controlling for individual differences in a between-participants experiment

The validity of conclusions drawn from a between-participants experiment depends on how well the design controls for non-treatment differences between the groups. People differ from each other in innumerable ways that may impact on their individual attitudes, behaviours, and responses in experiments. For instance, personality is often conceptualised in social psychology as being represented by five broad traits: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Each of these traits is independent and normally distributed within populations, so each individual has a unique combination of them; there are individual differences between members of any group. If two members of a population were selected, and compared to two other members, it is very likely that the average Conscientiousness in each pair will be different. Thus it can be expected that any behaviours and attitudes that are influenced by Conscientiousness will be different between the pairs. To minimise such inter-group differences, group sizes can be increased: since

[1] As found in the Stage 1 literature review (Deliverable D2.1).

personality traits are normally distributed, if members of the population were randomly allocated to the two groups, the mean values of Conscientiousness in the two groups will tend to converge. Thus the well-established way to control for individual differences in a between-participants design is to recruit sufficient participants to minimise inter-group differences in the mean values of salient characteristics, and to randomly allocate them to the treatment groups. Research designs must select an appropriate sample size to ensure that the distribution of behaviours is adequately sampled (and, pragmatically, not excessively sampled in relation to the required statistical power). Such designs are known as a Between-Participants Randomised Controlled Experiment, or, if the research involves a trial of the efficacy of an intervention (such as Managed Charging), a Randomised Controlled Trial.

Researchers can subsequently test whether the groups exhibit any statistically significant differences in respect of factors that can be measured, such as personality traits. This “sample characterisation” is standard best practice in the behavioural sciences and will be carried out in the Consumer Charging Trials. However people vary in innumerable ways: an individual’s present attitudes and behaviours depend on an individual’s history of lived experiences, and no two life experiences are the same. Whilst it might be possible to theoretically anticipate and measure some differences, it cannot be hoped to do this for all. Holt and Walker (2009) give the example of factors that might influence peoples’ responses to an apparently simple question, “what is your favourite colour?” It might be predicted that measureable factors like age, gender, personality, etc. might influence responses. The authors suggest a variety of others; responses might be influenced by colour blindness, what others have told them they should like (as when five-year old UK girls respond “pink”), the impression the person wants to make on the researcher, a colour whose name it amuses them to say (“mauve”). It is not credible to imagine a priori all such influences, and devise measures of them.

To relate this to the study of charging behaviour, consider one possible outcome measure: the time of day at which an individual plugs in their vehicle at home on a weekday. It might be anticipated theoretically that this could be influenced by the person’s daily mileage, which affects their vehicle’s state of charge, or the time the person normally finishes work, or a reminder message received from a smartphone vehicle-charging app – and ways of measuring all of these could be built into the study. However, there will always be other influences on individuals that cannot readily be anticipated and measured. A person might regularly engage in some other activity in the evenings that requires their vehicle; their attention is frequently captured by other things as they return home; they may prefer not to enter their garage or driveway after dark, and so on. It cannot be hoped to identify all the influences on specific behaviours by individuals.

Instead, research relies on controlling for individual differences by comparing outcomes for groups, not individuals. Causal attributions can only be made in respect of outcome differences between one group as a whole, and another group as a whole. Valid inferences cannot be drawn from differences in outcomes between any individual member of one group and any individual member of another group, because these individuals may differ from one another in many salient ways besides membership of their different treatment groups. Causal inferences can only be drawn about the effects of different treatments from ensemble data about outcomes for the groups as a whole.

Relating this general argument to the Consumer Charging Trials, the project seeks to know whether engaging mainstream consumers in Managed Charging (in either of its two main variants, User-Managed and Supplier-Managed Charging) can change their charging behaviours compared to those of mainstream consumers not engaged in such schemes. To do so, the project will recruit a large number of participants, and randomly allocate them to one of three "treatment" groups, each of which will receive a different experience: a User-Managed Charging group, a Supplier-Managed charging group, and Control group of participants not engaged in managed charging. Assuming the groups are large enough to control for individual differences, then any differences between the charging behaviours of the managed charging groups and the Control group can be causally attributed to the differences in treatment (i.e. engagement in managed charging). It could be concluded, therefore, "those who engage in Supplier-Managed charging begin to charge their PiVs an average of 4.6 hours later than those who do not", or, potentially, "neither form of managed charging causes any change in the time when charging starts" – but only because comparisons will be made between groups, not between individuals within them.

1.2.6 Controlling for Hawthorne effects

There is a further reason for adopting a controlled research design. All field research is vulnerable to "Hawthorne" effects which can bias findings due to participants changing their behaviours, attitudes or preferences because they are aware that they are being observed, rather than in response to the research stimuli. Observed effect sizes in uncontrolled studies are often substantially larger than those in studies using research designs that control for Hawthorne effects (Graham-Rowe, Skippon, Gardner & Abraham, 2012) because uncontrolled designs measure the sum of two effects (i.e. any effects due to the treatment variable plus the Hawthorne effect). To yield valid results, research must be designed so as to control for Hawthorne effects. In a Randomised Controlled Trial, Hawthorne effects impact the outcomes for all groups equally, whereas the treatment variable only affects the experimental group(s), not the Control group. Thus Hawthorne effects can be controlled for by making comparisons between the groups.

1.2.7 Controlling for random error

The discussion above outlined how research design controls for individual differences between participants that might lead to them responding differently within an experiment. This discussion has so far implicitly been about systematic differences – differences that are likely to be apparent most, or even every time that individual experiences the treatment condition. However, people do not exhibit exactly the same behaviour each time they encounter the same situation. Particular unanticipated influences on them may be present on one occasion but not on another: for example, a call from a friend or relative; preoccupation with an impending divorce hearing the next day; a spontaneous decision to go to the cinema with a friend; a frightening experience while driving that day; and so on. Thus each person exhibits natural variation from occasion to occasion. Research designs must therefore ensure sufficient repeats of the experimental situation to ensure that the distributions of within-participant behaviours are adequately sampled.

1.2.8 Sample bias

Sample bias arises when an aspect of the research design or sampling strategy leads to the sample being, in some relevant sense, not fully representative of the population from which it is drawn. Most behavioural science research suffers from at least one source of sample bias; participants are necessarily drawn from those members of the population under study who are willing to engage in research.

Analysis of data from biased samples can in principle be corrected for sample bias, but only if the relationship between the bias and the dependent variable is known *a priori*, e.g. from previous studies. It is relatively unusual for this to be the case in behavioural science research, and it is particularly difficult to assess the potential impact, if any, of bias associated with using participants willing to engage in research.

Where there is a known, quantifiable relationship between an identified bias and any of the dependent variables measured in the trial (if, for instance, such a relationship has been identified in prior research) then it will be possible to apply a specific correcting factor; results will then be reported in both corrected and uncorrected form. For the majority of potential biases it is unlikely that such a relationship will be known. In those cases, the conventional approach in behavioural science research shall be followed, which is to report the uncorrected results, whilst acknowledging the known biases and discussing their likely magnitude, direction and impacts on the validity and generalisability of the results; this is the approach that will be taken in the CVEI project.

Within the wider CVEI project, outputs from the Consumer Uptake Trial (outlined in Part 1 of Deliverable D5.1) and the Consumer Charging Trials (outlined in this document) will be used as inputs to the Analytical Framework. It will be possible to assess the impacts of any sample biases identified through sample characterisation of the outputs from the Analytical Framework; this will be achieved via sensitivity analyses. Sensitivity analyses will be used in this way to ensure that the Analytical Framework outputs and the resulting policy recommendations are robust; the results of these analyses will be reported in Deliverable D7.6.

1.2.8.1 Specific sources of bias

There are some known sample biases resulting from the design of the Consumer Charging Trials. The trials have been explicitly designed to capture data on mainstream consumer charging behaviour when using either a BEV or a PHEV. An ability to charge these plug-in vehicles is therefore integral to the success of the trial, and since there is no extant network of public charging points at sufficient density to ensure convenient charging close to participants' homes, it is necessary to recruit participants whose homes are compatible for charging a PiV off-road (on a driveway or in a garage) using a dedicated Mode 3 chargepoint installed for the project (see section 2.7). This introduces a sample bias since it excludes those mainstream consumers who are currently unable to have a chargepoint fitted at their home.

There is also an additional source of sample bias in the BEV Consumer Charging Trial. In order to ensure that participants are able to engage in their normal vehicle usage patterns and do not have to adapt their usage patterns to the limited range of the BEVs they are supplied with, participants will be filtered to ensure that the BEV is objectively suitable for their stated daily travel needs (see section 2.2.2.3). Thus the BEV Consumer Charging Trial sample will be biased in that it will exclude those who daily mileage exceeds the range of the BEV.

The results from the Consumer Charging Trials will be reported in Deliverable D5.3 without correction for these biases, because there is no a priori knowledge of the relationships between the biases and the dependent variables and so no basis on which to make a suitable statistical correction. However, in discussing the results, the existence of the bias shall be acknowledged along with the potential impacts on validity and generalisability.

Attrition of the sample through participants dropping out after recruitment may also lead to bias if the reason for some participants dropping out is systematically connected to the research topic – for instance, if participants who are predisposed against PiVs were to drop out more frequently than participants who are neutral or are predisposed in favour of PiVs. Since willingness to consider both BEVs and PHEVs is measured at Time Point 1, it will be possible to make an inter-group comparison of willingness to consider at this stage between those who subsequently withdraw versus those who complete the study (note however that for ethical reasons, participants who withdraw have the right to withdraw ALL their data, including data collected before their withdrawal, without explanation). Participants who withdraw before Time Point 1 will be replaced.

Another potential source of bias arises if one or more of the recruitment channels by which potential participants are contacted preferentially accesses people who are more or less predisposed to consider a PiV than the population as a whole. For instance, followers of TRL's and Cenex's social media outputs may have more interest in transport (TRL) and specifically PiVs (Cenex) than the general driving population. In this case, since the recruitment channel for each participant is recorded, inter-group comparisons can be made between participants recruited via different channels, to identify any significant differences between them in willingness to consider.

1.2.9 Correlational research design – the effects of multiple variables

A Randomised Controlled Trial design has the major advantage that it enables causal attributions. This is <u>the</u> essential research design feature required to establish whether Managed Charging has an effect on charging behaviour. However, there is a disadvantage to this type of design: every additional independent variable requires a doubling of the sample size, or a reduction in the statistical power of the design if the sample size is fixed by other pragmatic considerations such as budget. Thus it is very difficult to investigate the potential effects of many variables at once.

A *correlational* design offers a different trade-off. In such a design, researchers simultaneously measure many variables, and then investigate how far any of these are associated (or "correlated") with each other. Questionnaire research typically has such a design. For instance, a questionnaire might contain an item asking participants to rate their willingness to consider engaging with Supplier-Managed charging, plus other items measuring, say, personality traits, innovativeness, income, age, etc. If the questionnaire is administered to many participants, a correlation table (or "matrix") can be calculated showing the extent to which any pair of the variables are associated. This might identify that some of the other variables are strongly associated with willingness to consider Supplier-Managed charging. Regression analysis can be used to quantify the extent to which the variance in a "dependent" variable (such as willingness to consider) is associated with the variances in each of a number of other, "predictor" variables.

The benefit of being able to investigate associations between many variables comes at a cost: it is not possible to make causal attributions. If two variables are correlated, that may be because one caused the other, or vice-versa; or it may be that both were caused by some other factor that was not measured. Thus correlational designs cannot be used to measure the efficacy of interventions.

1.2.10 "Holistic" analysis in the Consumer Charging Trials

The Consumer Charging Trials will use a Randomised Controlled Trial design, as outlined above, to enable causal inferences to be made about the efficacy of Managed Charging in changing charging behaviours relative to those of people whose charging is not managed. However the design will also make use of the strengths of a correlational design to investigate a wider range of variables. A wide range of personal and personal-situational variables will be measured through questionnaires administered at various time points during participation, various telematics data will be recorded giving information on usage of the trial vehicles during participation, and data will be recorded on the ways that participants interact with the various versions of the smartphone app that will be used by each group.

An extensive Supplementary Analysis will be conducted that will enable identification of all associations between variables in the Trials. This will take the form of the correlational and regression analyses outlined above, augmented by additional statistical techniques (see Section 3 for details). In Section 3 a number of specific charging behaviour outcome measures were defined; all of these will be included in the correlation analysis, and a regression model will be developed for each. In principle, membership of treatment groups can be treated as a categorical variable in regression analyses, and so included. However it may be that, if the Managed Charging schemes are effective, variance in charging behaviours is dominated by differences between the Managed Charging groups and the Control group. In this case, it will be necessary to calculate separate regression models for each treatment group.

This Supplementary Analysis will provide a fully comprehensive, "holistic" view, based on the full dataset, of factors that influence charging behaviour.

1.2.11 Measuring Mainstream Consumer choices and preferences for Managed Charging schemes

The Consumer Charging Trials will also measure consumer choices between Managed Charging schemes that vary in respect of key attributes. The same approach to measuring consumer choices in the Charging trials will be adopted as will be used in the Consumer Uptake Trial; that is, choices will be measured using a Choice Experiment, administered after participants have experienced eight weeks of use and charging of either a BEV or a PHEV, and after two-thirds of participants have had their psychological distance[2] from the novel concept of Managed Charging reduced by direct experience of engaging in one or other of its two major variants.

When considering choice between alternatives that vary in respect of independent attributes, people may hold different and potentially conflicting attitudes towards those attributes, so must trade them off against each other. Desirable attributes may come at a cost. For instance,

[2] For an explanation of psychological distance and it's reduction, please see Section 1 of Part 1 of Deliverable 5.1, Consumer Uptake Trial Study Plan.

an increase in the level of expected annual charging cost savings may be associated with lower accuracy in the estimate that can be given of these savings.

The most appropriate method to characterise choice between alternatives that differ in respect of multiple attributes is the choice experiment (e.g. Anderson, de Palma, & Thisse, 1992; Louviere, Henscher, & Swait, 2000). A choice experiment presents participants with discrete choices to be made between alternatives that vary in respect of the attributes under study. In making their choices, participants must mentally trade off some attributes against others. Although each participant is only asked to make a limited number of such choices, across the whole set of participants choices are presented in such a way that the independent effects of each attribute can be identified. The results of many choices made by many participants are used to build a choice model that reflects the relative influence of each attribute on the choices that would be made by the population represented by the experimental sample.

A choice model constructed from a choice experiment is therefore the principal means of addressing research questions concerning the potential uptake of Managed Charging schemes, and will be used to update the Analytical Framework where the level of uptake is represented.

1.3 Mainstream consumers

The rationale behind the design of the Consumer Charging Trials makes reference to a clear distinction between “Innovators” and “mainstream consumers”. The distinction is based on Rogers’ (2003) ‘Diffusion Model’ for the adoption of innovations. The Diffusion Model suggests that, once an innovation has become available, individual differences in times to adopt are driven at least in part by differences in a specific trait (known as ‘Innovativeness’) which reflects a general behavioural tendency to engage with new experiences. It further suggests that adoption will proceed through a process of ‘diffusion’, in which awareness of, knowledge about, and positive attitudes towards the innovation diffuse through a population in a process of uni-directional influence. This starts with adoption by a few “Innovators” (i.e. people high in Innovativeness), progressing next to “Early adopters”, and then into the wider population, with the attitudes of low-Innovativeness “Laggards” being the last to shift. This process gives rise to an ogive (cumulative normal) S-curve distribution of adoption with time (Figure 1), and a normal distribution of times to adoption (Figure 2).

Innovators are distinctive in the Diffusion Model in that they are the sources of awareness, knowledge, and positive attitudes towards the innovation. All others in the population act first as receivers of this information, and then become sources for further diffusion themselves. The last few to adopt are receivers only. It is useful to define a category of ‘non-Innovators’, that is, all those individuals whose adoption has been solely influenced by diffusion of awareness, knowledge, and positive attitudes from people who have already adopted the innovation. In the Diffusion Model, non-Innovators encompass all those in the Early adopter, Early majority, Late majority, and Laggard segments (see Figure 1). For the purposes of the CVEI project, this report and the Consumer Charging Trials, they will be referred to as mainstream consumers .

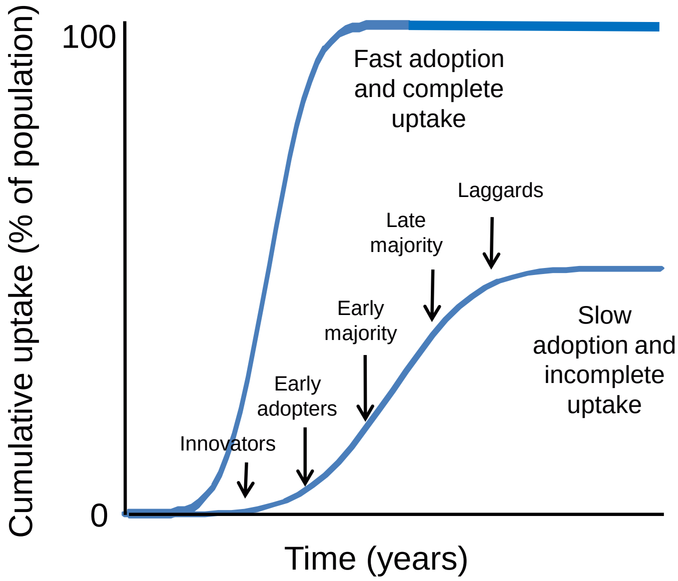

Figure 1: Rogers' (2003) Diffusion Model: cumulative uptake over time

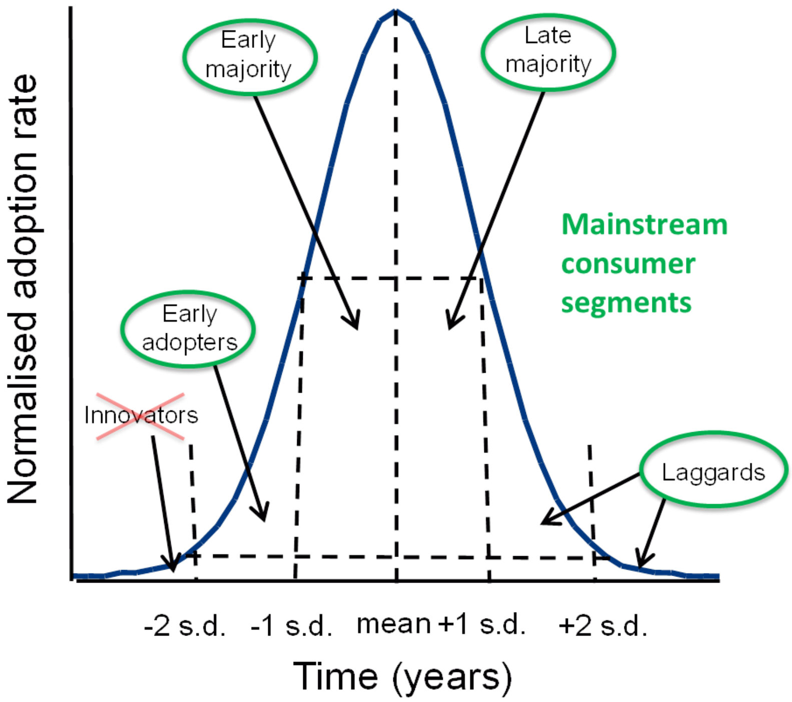

Figure 2: Rogers' (2003) Diffusion Model: normal distribution of times to adopt, relative position of adoption segments in that distribution, and illustration of the mainstream consumer segments

The various segments in the Diffusion Model are defined statistically in terms of their position in relation to the normal distribution curve (see Figure 2). Innovators are those whose times to adoption are earlier than two standard deviations before the population mean time to adoption (around 2.5% of the population); Early Adopters are those whose times to adoption lie between two and one standard deviation earlier than the mean time to adoption (a further 13.5% of the population), and so on. In this report, the term Innovator is used to refer to a consumer car user who is among the first 2.5% to adopt a PiV.

In the UK there are approximately 30 million cars (DfT, 2016). If all of these were replaced by EVs, “Innovators” would represent the first 750,000 to adopt. At present, there are around 310,000 “alternative fuel vehicles” (DfT, 2016), representing approximately 1% of the total car fleet. Therefore, according to Diffusion Theory, all present owners/users of EVs are Innovators, and this will remain the case for some time.

1.4 Charging behaviour of mainstream consumers

The diurnal time profile of aggregated charging demand is central to the CVEI Analytical Framework. The literature review performed in Stage 1 of the CVEI project (Deliverable D2.1: Kinnear, Anable, Delmonte, Tailor & Skippon, 2016) identified some research evidence regarding the charging behaviour of Innovators when using BEVs, but no research evidence about the charging behaviour of Innovators when using PHEVs. Furthermore, the literature review identified *no* research evidence regarding the charging behaviour of mainstream consumers, whether using BEVs or PHEVs. Beyond the earliest stages of PiV uptake, the diurnal time profile of aggregated PiV charging demand will increasingly be determined by the charging behaviours adopted by mainstream consumers.

The segmentation analysis performed for the ETI’s PiV project (Anable, Kinnear, Hutchins, Delmonte & Skippon, 2011) provides very clear evidence that Innovators’ attitudes towards PiVs differ markedly from those of each of the variety of mainstream consumer segments identified. Innovators’ attitudes towards PiVs, in general and particularly towards ownership of a BEV or PHEV, are much more positive than those of mainstream consumer segments. While this information does not directly bear on the question of whether their charging profiles might differ, it does suggest considerable caution is needed in making assumptions of similarity between different consumer segments.

Further, the qualitative interviews with Innovators, undertaken in WP2.1 of Stage 1 (Kinnear *et al.*, 2016), indicated that a majority exhibited pro-environmental motivations for their vehicle choice. It was also found that the main benefits Innovators could see in engaging with “supplier-managed charging” (i.e. a concept tariff in which the energy supplier would control PiV charging) were that it would “benefit society” or “benefit the environment”. A reasonable hypothesis might therefore be that Innovators would respond more positively than mainstream consumers to these kinds of Managed Charging schemes, and would therefore be more willing to modify their charging behaviour in ways that confer a system-level benefit (because of their greater pro-environmental motivations).

In summary, all previous UK trials have measured *only* the charging profiles of Innovators, and there is no *a priori* case to assume that their charging behaviour will accurately reflect that of mainstream consumers. This represents a major gap in knowledge. Evidence available to date casts serious doubt on the validity of assuming that mainstream consumer charging profiles will be the same as those of Innovators. Accordingly, it would be ill-advised to base their charging profiles on those already measured in previous trials: this would pose a substantial, unquantified risk to the validity of the modelling outputs. There is therefore a clear scientific need to provide the Analytical Framework with new empirical data from measurements of the actual charging behaviours of mainstream consumers.

1.5 Specific factors potentially influencing mainstream consumer charging profiles

1.5.1 Type of PiV

The ETI PiV study (Anable *et al*., 2011) indicated that mainstream consumers are more likely to adopt PHEVs than BEVs over the period to 2050. Because of their relatively later introduction to the vehicle market, there has been very little empirical research with PHEVs, and none which has quantitatively measured the PHEV charging behaviour of mainstream consumers.

PHEVs have smaller batteries than BEVs: at a fixed recharging rate, the time to recharge a fully depleted battery on a PHEV with an AER of 50km is expected to be around as little as a quarter of the time to recharge a fully depleted battery on a modern BEV with a claimed range [3] of 150-200km. Despite having smaller individual charging demands, a greater willingness of mainstream consumers to adopt PHEVs than BEVs (as suggested by Anable *et al*., 2011) may imply that, collectively, PHEVs could make a much bigger contribution to overall PiV charging demand than BEVs. It follows that there is a clear need for empirical data on mainstream consumer charging behaviours when using PHEVs.

Strength of motivation to recharge BEVs and PHEVs may differ. Users of BEVs are dependent on recharging their vehicles for mobility, since a BEV with a depleted battery cannot be used until recharged. Conversely, users of PHEVs are much less dependent on the SOC, since their vehicles can operate in ICE mode if the battery is fully depleted. Although PHEV users still have a motivation to recharge (i.e. lower energy cost), this is unlikely to be as strong as the mobility-related motivation for BEVs.

The optimum design for a study of this kind is an RCT in which participants are randomly allocated into an experimental group and given experience of either a BEV or a PHEV supplied by the researchers, as a substitute for an existing ICE vehicle in the household. This strategy would be unproblematic for PHEVs, as they have broadly similar utility to the ICE vehicles they would replace (particularly, range before needing to refuel). However the utility of BEVs is objectively lower than that of ICEs because of their restricted range. As a consequence, BEVs are only objectively suitable as substitute vehicles for a sub-set of the mainstream consumer segment; that is, those whose travel patterns are consistent with the restricted range offered by BEVs currently available in the market. The sub-set for whom BEVs are *subjectively* suitable (i.e. those mainstream consumers who themselves perceive that BEVs would meet their needs) may be even smaller.

Accordingly, two distinct trials with different samples are required:

[3] PiV range is closely coupled to driving conditions. The range quoted by manufacturers typically refers to the range achievable in controlled tests using repeated NEDC cycles. Users typically report real-world ranges somewhat shorter than this. Measurements have shown that at extra-urban cruising speeds range can be less than half that claimed by manufacturers. Here, where the term “range” is used without specific qualification, it refers to range measured in repeated NEDC cycles.

- a PHEV Consumer Charging Trial with a stratified sample of mainstream consumers, and;
- a BEV Consumer Charging Trial with an opportunistic sample of mainstream consumers, for whom BEVs are suitable for their travel needs (i.e. 'Compatible' mainstream consumers).

The BEV sample will be representative only of a more restricted sub-set of mainstream consumers, and is therefore unlikely to be representative of the mainstream consumer segment as a whole.

It should be noted that the difference between samples will confound any attempt to make meaningful between-groups comparisons of charging behaviour based on vehicle type, because any observed differences in charging behaviour could be causally attributed *either* to vehicle type *or* to the sample differences. Nevertheless, interpretation and discussion of the results between the PHEV Charging Trial and BEV Charging Trial will be made *where possible*, with appropriate caveats concerning the differences in method.

1.5.1.1 Other vehicles in the household

The extent to which participants in the study use (and therefore, charge) the trial vehicles may depend on the availability of other vehicles in the household. For maximum external validity, it is preferable to ensure that the total number of vehicles in the household does not change as a result of the trial.

This would involve substituting the trial BEVs and PHEVs for (one of) the participants' own vehicles, removing the latter for storage until completion of the trial. However, doing this adds substantial costs to the project, e.g. for secure parking for the removed vehicles, and staff time to transfer vehicles to/from secure parking. These costs must be met, either by increasing the budget allocated to the trial, or by reducing participant numbers. The latter course would compromise the validity of the trials, and so is not recommended.

The alternative approach would be to leave the participants' own vehicles with them, so that the trial vehicle is an addition to the household fleet. That option poses a threat to the external validity of the trial, as participants' vehicle use, and therefore EV charging behaviour, might be un-representative of 'real-world' vehicle use if those participants were to adopt an EV. This threat to validity would be particularly acute when there is one more driving licence holder in a household than the number of vehicles presently used by the household.

A pragmatic solution is therefore recommended for this study in which the vehicle is substituted in the following circumstances only:

- in households where there are more drivers than vehicles; or
- where (in the view of the participant) there is insufficient space to park an additional vehicle or a significant inconvenience or loss of utility would be experienced; or
- where the participant wishes their own vehicle to be removed.

If these criteria are not met, then the participant will be provided with the trial vehicle in addition to their own. In this circumstance, the risk of the participant not using the trial vehicle and engaging with the Managed Charging scheme will be mitigated by:

- Explicitly tasking participants with using the trial vehicle for their everyday travel needs, instead of their own vehicle.
- Making the requirements of the trial clear to participants upon recruitment, during the vehicle handover briefings, and in follow-up calls with participants during the trial period.
- Directly linking the trial incentives use of the trial vehicle (see section 2.8).
- Monitoring vehicle use periodically throughout the trial (via vehicle telematics data) to ensure that participants are using the vehicles.
- Asking participants to provide time-stamped photographic evidence of their personal vehicle's mileage at the start (upon arrival back at home following vehicle handover) and the end of the trial (before returning the trial vehicle) – this will provide a psychological deterrent for using their own vehicle during the trial.

1.5.2 Seasonal variation

Energy demand from PiV use is likely to be subject to some seasonal variation, and this may impact on charging behaviour. For example, the length of daylight hours could affect both the timing and number/length of trips undertaken during certain seasons. Adverse weather in winter may result in reduced private vehicle use. Likewise, the extended school holiday during the summer period may also impact on both the timing and number/length of trips undertaken. Further, battery efficiency is known to be lower in the colder temperatures of winter, and the energy load greater (due to the requirement for vehicle cabin heating), requiring more energy input to the battery for the same mileage capability (Zahabi *et al*., 2014).

Consideration of seasonal variation in charging behaviour must therefore be incorporated into the design of the trials. Ideally, the trials would be conducted over one complete 12-month period; but where this is impracticable, data from a 6-month 'half-cycle' from summer to winter (or vice versa) are required so as to provide coverage of the broadest range in daylight lengths, temperatures, and precipitation likely to occur over a full year (i.e. compared with a half-cycle covering spring to autumn, or vice versa).

1.5.3 Within-participants variations in charging behaviour

As discussed, people exhibit natural variation from occasion to occasion, and research designs must ensure sufficient repeats of the experimental situation to ensure that the distributions of within-participant behaviours are adequately sampled. Since charging behaviour is expected to be mainly a daily activity, the experiment must extend over multiple days to ensure enough repeats. In addition, since daily vehicle use behaviour is likely to differ between weekends and weekdays, charging behaviour may also differ substantially by day of the week.

Trial durations of four weeks, for example, would allow for measurement of a maximum of only eight repeats of charging behaviour on weekend days (i.e. two possible repeats per weekend). However, it may not be guaranteed that charging will take place on both the Saturday and the Sunday of every weekend – or indeed on either. Thus extended participation times are preferred to enable appropriate characterisation of within-participant variability in charging behaviour.

Further, it may take time for people to habituate to a new behaviour, and it may take many repeats before a stable distribution of behaviours has emerged. Experience in previous trials (see Deliverable D2.1) suggests that a majority of participants habituated to charging a BEV within one week, and practically all participants habituated within two weeks[4]. This suggests that participation durations should extend substantially beyond two weeks (and also that it would be useful to measure the way the charging behaviour of mainstream consumers habituates).

Ultimately in any trial design participation time must be traded off against limitations in budget, total time available for the field research, and the number of participants who can practicably be included in the trials over the entire duration of the field research. It is recommended that each participant's vehicle use and charging behaviours are measured for a minimum period of 8 weeks, to allow for habituation and sufficient measurement of multiple repeats of charging behaviours and vehicle use. Successive staggering of participants over a 6-month period would allow charging behaviour data to be captured for at least half of an annual cycle.

1.5.4 Managed Charging schemes

Measuring the charging behaviour of mainstream consumers will enable an accurate picture of charging demand to be incorporated into the Analytical Framework. That is not enough on its own, however, to enable the framework to be used to investigate how far charging demand can be optimally integrated within the wider energy system to provide systemic benefits[5].

Supply-demand balance becomes an increasingly complex issue as electricity generation is decarbonised. Demand varies diurnally, weekly, seasonally, in response to changes in weather, and as a consequence of social factors. Supply from renewable sources also varies diurnally, seasonally, and in response to changes in weather. When supply from low-cost sources is low, additional supply capacity must be activated to meet demand as required. Such additional capacity may have to be maintained in order to meet peak demands but will often be under-utilised, so its costs are high. It is generally also the case that the carbon intensity of supply increases as it becomes necessary to bring additional capacity on stream. Thus supply-demand balance is reflected in variable electricity wholesale costs, ranging from cheap when the balance is favourable to very expensive when it is unfavourable.

To illustrate this, Figure 3 shows a model of how retail electricity prices (calculated hourly) might vary throughout the year 2030 (calculated using the CVEI Analytic Framework: see Deliverable 7.1 for full details).

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[4] With the caveat that participants in these trials were Innovators, whose habituation times may not necessarily generalise to mainstream consumers.

[5] Systemic benefits can be expressed in terms of economic value, to be shared between parties in the value chain, and with the user. There may also be benefits in terms of CO_2 emissions reductions, etc. that are important for policy goals, for instance.

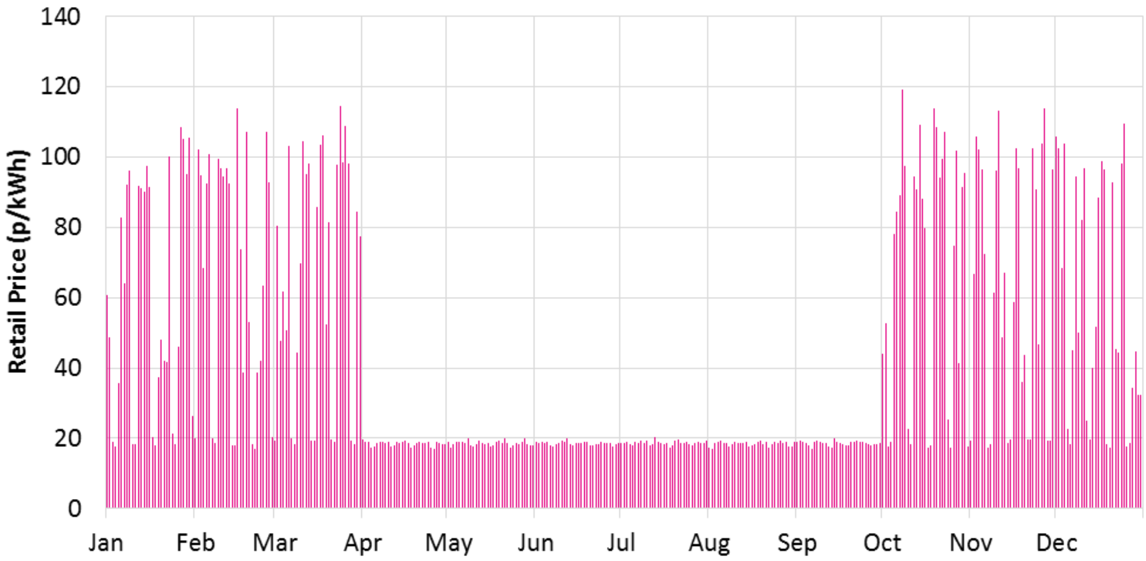

Figure 3: Modelled variation in hourly retail price of electricity in 2030 (adapted from Deliverable D7.1)

Figure 3 above shows diurnal, weekly, and seasonal variations. Figure 4 below shows how these prices are constituted from various supply-side cost elements, and shows diurnal and weekly variations in more detail.

One approach to addressing these issues is “demand management” – measures that time-shift demand from periods of unfavourable supply-demand balance, when supply cost and carbon intensity are high, to periods of favourable supply-demand balance, when supply cost and carbon intensity are lower. ‘Managed Charging’ schemes are proposed ways of managing the contribution of charging demand to the overall supply-demand balance[6].

[6] Demand management may also be used to help manage constraints on the network, both at transmission and distribution level, as well as to provide services to the system operator (such as frequency response and reserve) that are required to manage short term fluctuations in supply and demand).

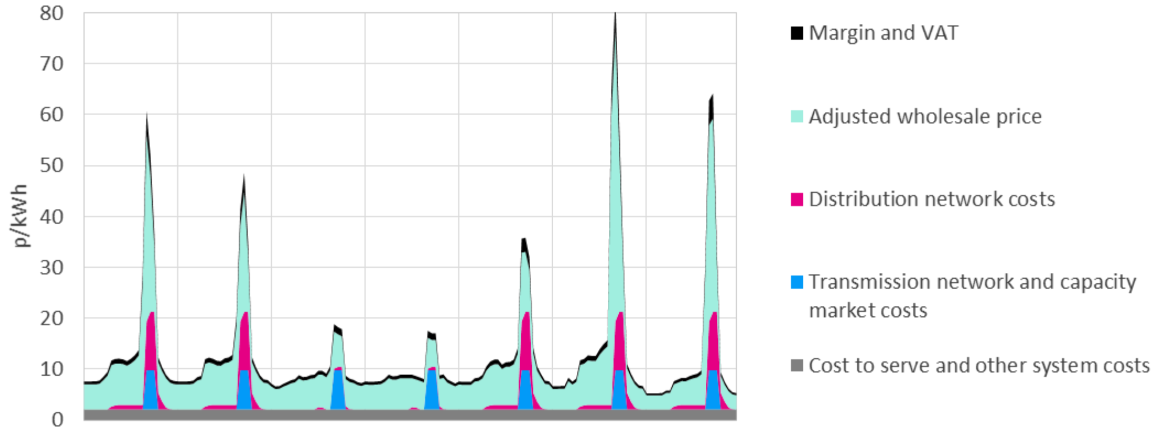

Figure 4: Modelled variation in hourly retail price in 2030 at higher resolution, showing diurnal and weekly variations (see Deliverable D7.1)[7]

To be able to model the systemic effects of Managed Charging schemes, there is a need for robust data relating to mainstream consumers' charging behaviours under particular sets of conditions that represent the major types of possible Managed Charging schemes. Likewise, to be able to make valid causal inferences about the effect of engagement with various Managed Charging schemes on charging behaviour, the charging behaviour of mainstream consumers using a Managed Charging scheme must be experimentally compared with the charging behaviours of mainstream consumers who are not using a Managed Charging scheme.

1.5.4.1 Supplier-Managed Charging (SMC) schemes

The greatest potential for systemic optimisation is offered in principle by a Managed Charging scheme in which the 'Charging Supplier'[8] manages when the PiV is charged, and thus can time-shift that energy demand to periods of favourable supply-demand balance and so lower wholesale cost, within constraints set by the user. In principle the user benefits from engagement with a SMC scheme by having their charging needs met at the lowest cost compatible with those needs, without the need to manage the charging themselves.

To provide the Charging Supplier with flexibility in time-shifting PiV charging demand, the user must minimally ensure that their vehicle is plugged in (i.e. available to be charged) for longer than the total time it will take to recharge it to the desired level. To maximise the benefit, the user should make the vehicle available for charging whenever possible (maximising the length

[7] Peaks tend to occur in the late afternoon/early evening and troughs in the overnight period. Peak-time demand is generally higher on weekdays; this influences wholesale and retail prices, but other effects, particularly capacity effects on supply, are also influential

[8] Here, the term 'Charging Supplier' is used to describe a business entity that manages charging on behalf of the user, by controlling the timing of charging to time-shift energy demand to favourable periods of supply-demand balance and obtain the lowest costs for the user. It is assumed that the Charging Supplier buys electricity from a market in which prices vary according to the supply-demand balance, as discussed above. The Charging Supplier may or may not be a Demand Management Aggregator.

of the time window available for the Charging Supplier to use), and as far as possible ensure that that time window includes times of day when the supply-demand balance is favourable and wholesale costs are low.

For example, suppose a BEV has a state of charge (SOC) of 60% that the user requires it to be fully charged by 07:00 the following weekday morning, and that it will take four hours to fully recharge it. If the user were to plug the vehicle in at 18:00 on returning home the day before the journey, and begin charging immediately, charging would take place in the early evening when demand is high and wholesale costs are generally high too. In the (unlikely) event that the user were to plug the vehicle in four hours before the stated departure time (i.e. at 03:00), the whole period between plugging in and the departure time will be required for charging; this would provide no opportunity for the Charging Supplier to time-shift the demand and so minimising costs would be reliant on the vehicle being plugged in at a period of favourable supply-demand balance. If, however, the user were to plug the vehicle in at 18:00 and specify that it needed to be fully charged by 07:00 the following morning, the Charging Supplier would have a 13-hour window in which to deliver the required 4 hours of charge. Thus the Charging Supplier would have the opportunity to directly time-shift the demand from the high-cost early evening to the lower-cost (more favourable supply-demand balance) overnight period, thereby contributing to systemic optimisation, and potentially delivering a lower cost of charging to the user.

Anticipatory charging

Potentially, greater systemic benefits and greater user benefits (in terms of lower average cost of charging) can accrue if the Charging Supplier is able to add additional charge to the vehicle at times when the cost is particularly low, *in anticipation of future need* rather than in response to a specific user requirement. In other words, even if the user had requested a 70% SOC, it may be optimal for the system and for the user for the Charging Supplier to deliver 100% SOC if the cost of energy is particularly low at the time of charging. Hence, the Charging Supplier could take advantage of that lower rate (to the benefit of the user and the system) and charge the vehicle to a higher SOC, in anticipation of a future need for charge.

It is not proposed to represent an anticipatory charging element in the Supplier-Managed Charging experience in the Consumer Charging Trials, as it would not be possible to uncouple its behavioural effects from those of engaging with a Supplier-Managed Charging scheme *without* anticipatory charging[9]. However the post-trial choice experiment will test how far anticipatory charging, as an attribute of Supplier-Managed Charging schemes (at different levels of additional benefit), impacts on willingness to consider uptake of such schemes.

User behaviour to maximise benefits

It follows that, to maximise both user benefits (lower costs) and systemic benefits, users should be encouraged to adopt the following behaviours:

[9] To do so would require a third experimental condition (in addition to the control condition) in the trials, so that SMC was represented with and without anticipatory charging. That is not possible within the budget and time constraints of the project.

- Ensure that the PiV is plugged in whenever not in use, when in a suitable charging location (in the trial, at home) and when a significant additional charge is possible (i.e not a high initial SOC), to enable the Charging Supplier to charge it whenever electricity can be obtained at a favourably low cost.
- Ensure that the vehicle is plugged in and available to charge at times when supply-demand balance is generally favourable and wholesale costs are generally low, particularly overnight
- Specify only the minimum SOC actually required, rather than routinely specifying 100% SOC (which might lead to the excess electricity being obtained at a higher than necessary price, because of the constraint that it needs to be obtained within a particular time window).

Feedback on user behaviour

Behavioural science indicates that users are more likely to adopt the most effective behaviours if they receive feedback on how effective their previous behaviours have been, in terms of the reward gained (Fishbach & Finkelstein, 2012; Shafir, 2013). Therefore, the Charging Supplier should provide feedback on the actual cost of charging (or savings made against some baseline), so that the user can relate that cost of charging to their behaviour.

The more closely coupled the feedback is to the behaviour, the more effectively it reinforces the behaviour. Thus for a Managed Charging scheme, feedback should optimally be given after each charging event, so that the information on actual costs (or savings) can be associated directly in the user's mind with the charging behaviour they undertook in their last charging event. Feedback on a weekly, monthly, or annual basis would be less effective.

However feedback after each charging event is potentially problematic in the sense that, from charging event to charging event, it is likely to be inconsistent. The inconsistency has two sources: *intrinsic* variations in the user's usage and charging behaviours such that their charging requirements and the time window they specify differ from event to event, and *extrinsic* variations due to the variations in retail prices discussed above. Even if the charging behaviour was exactly the same between two charging events (the same plug-in time, the same starting SOC at plug-in, the same stated departure time, and the same required SOC), the actual cost of charging (and so any saving made against a baseline cost) could be different between the events. That weakens the effectiveness of the feedback. Accordingly, a Charging Supplier may wish to attenuate the event-to-event variations in charging costs experienced by the user.

A Charging Supplier could do this to different extents:

- <u>No attenuation</u>: The user would pay for a charging event and receive post-hoc feedback on its cost based directly on the actual cost of charging during that charging event. This feedback would fully reflect the hour-by-hour variations in cost experienced by the Charging Supplier, but it would be relatively loosely coupled to the users' charging behaviour, and so offer only a relatively weak signal to the user as to the relationship between their charging behaviour and its cost to them.
- <u>Full attenuation</u>: The user would pay for a charging event based on some invariant set of hourly prices – for instance, a set based on the Option Value of each hour (the value

to the Charging Supplier of having the vehicle available for charging in that hour). The cost to the user of a particular charging event, and the feedback received, would not be subject to the extrinsic component of the event-to-event variation that originates in retail price variation. If the user has the same Charging Requirement and makes the vehicle available for the same Time Window in two different events, they will pay the same cost and receive the same feedback. This would provide closer coupling between charging behaviour and feedback, and therefore stronger reinforcement learning.

- Partial attenuation: In practice, full damping requires the Charging Supplier to accurately assign option values to each hour of the day, and the risk of systematic errors of assignment could potentially lead to extra costs that would be passed on to users. The Charging Supplier must balance this possibility against the considerations around strength of feedback outlined above. This trade-off might lead a Charging Supplier to offer some combination of the above approaches, partly but not fully attenuating the extrinsic contribution to event-to-event variation in cost of charging events and the feedback received on it.

A partial attenuation approach is recommended for the Consumer Charging Trials since this will allow user feedback to incorporate both a ‘predictable’ element (where consistent behaviours result in consistent feedback) and a variable element (where the feedback is directly dependent on the event-to-event variation in retail prices that the Supplier faces). As such, this balanced approach allows the Supplier to manage the risk associated with the unpredictability of hourly electricity costs, whilst also including a predictable element of consumer feedback to facilitate stronger reinforcement learning through experience in the trial.

Consumer disutility associated with a Supplier-Managed Charging scheme

Engagement with a SMC scheme also has some disutility or “cost” from a consumer’s perspective. First, there is potential for some inconvenience associated with perceived loss of use of the PiV while it is plugged in for a period longer than actually required to charge it. Second, there is a risk that, if the user unexpectedly requires the PiV before the planned departure time, it may not be charged to a sufficient level.

Engagement with a SMC scheme also places a requirement on the user to provide two pieces of information for each charging event. These are the minimum SOC required, and the planned departure time by which that SOC is required. The requirement to input information may also be associated with some degree of inconvenience. Since there are likely to be regularities in users’ patterns of use, this can largely be addressed through a simple system of user-entered defaults. That is, the user would enter default values for required SOC and departure time when first making use of the system; the system would then use these values for all subsequent charging events unless the user overrides them.

Defining an experimental condition to study Supplier-Managed Charging

The essential attributes of a SMC scheme[10], from the user's perspective, are:

- The user specifies their goal for each charging event[11] (the required minimum SOC and the required departure time)
- The Charging Supplier manages the time of charging to obtain the required SOC, by the required time, at the lowest cost to the user
- The user determines the plug-in and plug-out times, and is encouraged to plug the vehicle in for as long as possible, and to have the vehicle plugged in at favourable times (e.g. overnight) in order to maximise user (and systemic) benefit
- The user receives a financial benefit, experienced as a lower cost of charging compared to a benchmark
- The user receives feedback on the cost of charging, and is rewarded (through a lower average cost of charging) for maximising the opportunity for the Charging Supplier to time-shift charging to periods of favourable supply-demand balance
- The cost of charging (and the feedback received) is experienced as variable between charging events. In part this is due to variations in the user's own charging behaviour between charging events; in part it reflects extrinsic variations in retail price. The extent to which the user experiences the latter depends on the extent of the attenuation of extrinsic variability that the Charging supplier selects
- The user does not have direct control of the risk that the vehicle will not be adequately charged if he/she chooses to use it before the planned departure time

These attributes must all be present in an experimental condition for the experiment to have adequate external validity.

However it is NOT necessary for participants to experience these by virtue of engagement in an operational Managed Charging scheme; that is, with an operational supply side. It is only necessary for the above attributes to be present in the participant experience, and for them to be consistent with what the modelling analysis suggests is likely from a supply-side perspective. In other words, the trials must accurately emulate the participant experience so that it is representative of a real-world operational SMC scheme.

Experimental representation of Supplier-Managed Charging

To achieve the above attributes, the user experience of a SMC scheme with partial attenuation of retail price variations can be represented with the following elements:

1. **Retail Price Model**

[10] Excluding anticipatory charging, as discussed above.

[11] "Charging Event" defined as the continuous period between plug-in and plug-out, during which at least some charge is provided to the vehicle.

A model to represent hour-by-hour variations in the retail price of electricity. The model should provide retail price data which is representative of a likely scenario from a chosen part of the study period, to feed into the Chargepoint Management System (see below). The Retail Price Model has been developed in the preparation phase of Stage 2 and is reported in Deliverable D7.1 (see also the supporting slides in Appendix Q).

2. **Hourly Option Value Model**

   A model to represent hourly Option Values (the value to the Charging Supplier of having the PiV plugged in and available to charge in any given hour of the day[12]). Option Values will differ seasonally and between weekend days and weekdays, so such a model should minimally consist of four 24-hour time series, representing all four combinations of (weekend day vs. weekday) × (summer vs. winter).

3. **Chargepoint Management System**

   A system to handle the user's inputs of charging requirements (SOC and departure time) via a User Interface (e.g. smartphone app), and control the timing of charging to ensure delivery of the SOC by the stated departure time. It should compare the user requirements with data from the Retail Price Model to calculate a cost (or a saving against some benchmark cost) for the charging event and similarly use data to calculate a further saving based on the Option Value of the Time Window the user has made available for meeting the Charging Requirement. Finally, the system should output the total cost (or total saving against a benchmark) of the charging event via the User Interface.

4. **User Interface**

   A user interface to a) enable the user to input required SOC, and required departure time, and b) feed information to the user, such as present SOC, cost of charging (or saving against a benchmark) for previous charging event, average cost of charging per charging event (or average saving against a benchmark per charging event), etc.

   The interface should allow for user-supplied default values to be set, in order to minimise user effort and mitigate for the event of no user input. Users should be able to override the default values whenever their requirements are different.

5. **Home Chargepoint**

   A domestic Mode 3 chargepoint that receives commands from the Chargepoint Management System to switch charging on and off, and feeds data on energy consumption and SOC to the Chargepoint Management System.

[12] In reality, the value would vary more often than hourly, but hourly option values are an adequate representation for the purposes of this trial.

1.5.4.2 User-Managed Charging (UMC) schemes

While SMC schemes potentially offer the greatest systemic benefits and user cost savings, Stage 1 qualitative research with users of PiVs found that a majority of those users were not comfortable with the risks associated with SMC. Instead, they tended to prefer to have full personal control[13] over when their vehicle was being charged. This finding suggests that SMC schemes may not have widespread appeal among mainstream consumers (although see section 1.5.5 for justification that both types of Managed Charging scheme need to be studied). It should be noted, however, that these findings are based on a small sample that had no direct experience of Supplier-Managed Charging; their views were therefore reflective of a brief presentation of the concept only.

Participants in the Stage 1 research were more positive towards the alternative of User-Managed Charging (UMC) schemes[14], in which the user determines the time of charging, and cost of electricity varies diurnally in a banded tariff structure that represents, approximately, the average supply-side costs. Users in such a scheme can choose to maximise their benefit by charging at the cheaper times, whilst retaining full control of precisely when the charging occurs, so as to minimise (perceived) risk. Compared with SMC Schemes, these schemes more loosely couple the cost to the user with the cost of supply, so the expectation is that systemic and user benefits per consumer will be lower than with UMC than SMC. However, if UMC schemes have higher appeal to consumers, and succeed in shifting charging behaviour to times that are favourable from a systemic perspective, the aggregate systemic benefit may be higher.

In a UMC scheme, the user would control the timing of charging. This could be done simply through plug-in and plug-out times, via a controller attached to the home chargepoint that enables the user to specify times when the vehicle is to be charged, or via a User Interface (e.g. smartphone app) that connects with the home charging station. In the latter two cases, defaults for the timing of charging could also be established, to be used automatically for each charging event unless the user overrides them.

In a UMC Scheme, the costs to the user should be reflective of the times of day when the PiV is charged; the user benefits from choosing to charge at times of day when the cost is low, which is reflected in a banded tariff structure. Tariff bands will reflect supply-side costs. As the energy system develops over coming years, the present diurnal pattern of supply-demand balance is expected to change and is likely to become far more variable from day to day and also within a day, much more spiky and less predictable, and consequently that the ability of a ToU tariff to reflect the real supply-demand balance is reduced. (The simplicity of the present Economy 7 type tariff for example, or even of multi-band tariffs, may not remain viable or effective reflections of real supply-demand balance or cost, and dynamic ToU tariffs may become necessary.

[13] “Control” can refer to a range of different constructs in psychology. Here, and throughout this report, it is used not in relation to any specific theoretical construct, but rather to reflect the language used by participants themselves in the Stage 1 qualitative study.

[14] Often referred to as “Time of Use” (ToU) tariff schemes

Defining an experimental condition to study User-Managed Charging

The essential attributes of a UMC scheme, from the user's perspective, are:

- The user does not specify the goal of each charging event.
- The user directly manages the time of charging.
- The user is provided with information about the cost (or level of saving against a benchmark) of charging at different times within a 24-hour period. Such costs (savings) are structured into several bands within the 24-hour period, with constant values within each band.
- There may be distinct tariff structures for weekdays vs. weekend days, and different structures to reflect seasonal variations in supply-side costs (minimally, distinct winter vs. summer tariff structures).
- On specifying the start and finish times of charging, the user receives feedback on the predicted cost (or savings relative to a benchmark) of the planned charging event.
- On completion of the charging event the user receives feedback on the actual cost (or savings relative to a benchmark) of the completed charging event. This will match the predicted cost unless the user has intervened during the event, for instance by unplugging the vehicle early.
- The user has control of the risk that the vehicle will not be adequately charged if the user chooses to use it before the planned departure time.

These attributes must all be present in an experimental condition for the experiment to have adequate external validity. However it is NOT necessary for participants to experience these by virtue of engagement in an operational User-Managed Charging scheme; that is, with an operational supply side. It is only necessary for the above attributes to be present in the participant experience, and for them to be consistent with what the modelling analysis suggests is likely from a supply-side perspective. In other words, the trials must accurately emulate the participant experience so that it is representative of a real-world operational UMC scheme.

Experimental representation of User-Managed Charging scheme

To achieve the above attributes, the user experience of a UMC scheme can be represented with the following elements:

1. **Banded Tariff Structure**

   The user is provided with information on the banded tariff structure that applies during their participation period and will be used to calculate the cost (or savings relative to a benchmark) of the user's charging events

2. **Chargepoint Management System**

   A system to handle user requirement inputs via the User Interface (charge start and finish times) and control charging accordingly. The system should calculate (based on the banded tariff structure), the predicted cost of charging (or savings relative to a benchmark) prior to each planned charging event and the actual cost of charging (or savings relative to a benchmark) after each completed charging event. It should output these to the User Interface, and to the Research Database.

3. **User Interface**

   A user interface to a) enable the user to specify charging start and completion times, with defaults that can be overridden, and b) feed information to the user, including the banded tariff structure, present SOC, predicted cost (or savings relative to a benchmark) for planned charging event, actual cost (or savings relative to a benchmark) for previous charging event

   The interface should allow for user-supplied default values to be set, in order to minimise user effort and mitigate for the event of no user input. Users should be able to override the default values whenever their requirements are different.

4. **Home Chargepoint**

   A domestic Mode 3 chargepoint that receives commands from the Chargepoint Management System to switch charging on and off, and feeds data on energy consumption and SOC to the Chargepoint Management System.

1.5.5 Mainstream consumer choice between Managed Charging schemes

The systemic benefit from Managed Charging schemes depends not just on the size of the effects on charging behaviour that they generate, but also on how many mainstream consumers choose to engage with them.

The Stage 1 qualitative research found that, among its 60 participants, around two-thirds preferred a UMC scheme, and around one-third preferred SMC. However, it is not possible to generalise findings from that qualitative research to the future mainstream consumer population, because the participants were largely Innovators (and thus were likely to have had different motivations for engagement with Managed Charging schemes generally). In addition, participants in Stage 1 were given only limited information and *no* direct experience of engagement with a Managed Charging scheme, meaning they were psychologically distant from them. It therefore follows that data are needed on mainstream consumer choice between Managed Charging schemes in order to maximise the validity of the Analytical Framework.

In theory it would be possible to include behavioural measures of choice between UMC and SMC in the BEV and PHEV Charging Trials. For example, one option would be to provide participants in both experimental groups with the option to opt-out of engagement with User- or SMC for any particular charging event, or the option to opt-out of one Managed Charging scheme in favour of the other. However, this type of design would pose substantial threats to the validity of the charging behaviour measurements. For example, allowing participants to opt-out of either scheme would in essence create four experimental groups, not two:

a) SMC default: Participant accepts
b) SMC default: Participant rejects
c) UMC default: Participant accepts
d) UMC default: Participant rejects

Allowing participants to opt-out in this way could therefore reduce, to an unacceptably low level, the total number of charging behaviour repeats experienced by those participants who did opt-out. Likewise, enabling users to switch between Managed Charging schemes could reduce the effective size of the experimental groups to an unacceptably low level.

Accordingly, it would not be valid to measure choice through behavioural measures in the Consumer Charging Trials. A more robust way of measuring consumer choice is to use a *choice experiment*. This methodology presents participants with a series of choices between options that enable exploration of the way that choice is influenced by a range of attributes. This allows robust study of consumer choice to be conducted without compromising the validity of other data collected during the course of the trial.

For this project therefore, consumer choice in relation to Managed Charging schemes will be measured using a choice experiment (see section 2.14). In principle the choice experiment could be conducted independently from the trials, with separate participants. However, given that Managed Charging is a new, unfamiliar product category, consumers are generally psychologically distant from it (as were participants in the Stage 1 qualitative research, mentioned above). The psychological distance reduction that will be achieved through the Consumer Charging Trials will be ideal for providing a pool of participants who are psychologically close with Managed Charging to engage with a choice experiment of this kind. The choice experiment will therefore be administered to participants in the Consumer Charging Trials at the end of the trial period (i.e. after they have had direct experience with a PiV and a Managed Charging scheme).

1.6 Research questions

The CVEI project aims to model the potential integration of UK aggregated charging demand into the wider UK energy system to 2050. The validity of that modelling depends on having a clear picture of the charging behaviours of mass market consumers who drive BEVs and PHEVs.

In other words, to update the analytical framework, empirical data are required regarding the actual charging behaviours of mainstream consumers using BEVs or PHEVs. The Consumer Charging Trials will therefore address (for users of both BEVs and PHEVs) a fundamental initial research question:

> **What is the charging behaviour of mainstream consumers when not participating in a Managed Charging scheme?**

To meet the overall aims of the CVEI project, it is also necessary to measure mainstream consumers' charging behaviour under conditions that are designed to represent the user experience of engaging with Managed Charging schemes. The potential systemic and user benefits of such schemes depend on how far mainstream consumer users *change* their charging behaviour, compared with their charging behaviour if not engaged in such a scheme. The between-participants experimental design is explicitly aimed at measuring these differences.

To understand these impacts fully it is appropriate also to measure various aspects of variability in charging behaviour, including within-user habituation behaviour on beginning their engagement with a Managed Charging Scheme, within-user diurnal, weekly and seasonal variability, and between-user variability.

To some extent it may be that charging behaviour depends on how users interact with particular features of the Managed Charging scheme they engage with. To maximise the generalisability of findings, Trial conditions and therefore features of Managed Charging schemes should in principle be as generic as possible. However in practice some features (such as functionality of the User Interface Smartphone App) need to be defined rather specifically. It is therefore appropriate, as far as possible, to measure how users interact with such specific features.

As observed in section 2.4, the systemic benefits from Managed Charging schemes depend not just on the size of the effects on charging behaviour that they generate, but also on how many mainstream consumers choose to engage with them and how this depends on their various attributes. The choice experiment element of the Consumer Charging Trials will address research questions relevant to this topic.

To the extent that engagement with Managed Charging schemes generates user benefits in the form of reduced running costs, this may impact on the potential uptake of both BEVs and PHEVs by mainstream consumers. Thus it is appropriate to investigate how far experience of engagement with such schemes impacts on mainstream consumers’ willingness to consider adopting BEVs or PHEVs.

Finally, while all BEV mileage must be, by definition, driven under electric power, that is not the case for PHEVs, which may also be driven under ICE power. The potential impact of PHEV charging on total electricity demand (and the potential systemic and user benefits of PHEV users’ engagement with Managed Charging will depend on the utility factors (the fraction of total mileage carried out under electric power) for PHEVs used by mainstream consumers. Thus to fully understand the potential systemic and user benefits of Managed Charging schemes it is necessary to measure mainstream consumers’ real-world PHEV utility factors.

This discussion leads to the set of specific research questions listed in Table 2, which also indicates how the data required to address these questions will be gathered in the trials.

Specific analyses will be carried out in respect of each of these questions. In addition, a set of Supplementary analyses will provide a comprehensive, “holistic” exploration of factors that influence mainstream consumer charging behaviour in addition to engagement or not in Managed Charging schemes. Full details of analyses are given in Section 3.

Table 2: Research questions

Consumer Charging Trials research questions	How will the research questions be addressed?			
	Questionnaires	Choice Experiment	Telematics/ chargepoint data	App data
1. What is the charging behaviour of mainstream consumers when not participating in a Managed Charging scheme?			✓	
2. How does the charging behaviour of mainstream consumers when participating in a Managed Charging scheme compare with their behaviour when they are not?			✓	
3. How does the charging behaviour of mainstream consumers when participating in a Supplier-Managed Charging scheme compare with their behaviour when participating in a User-Managed Charging scheme?			✓	
4. What are the diurnal, weekly and seasonal time profiles of charging when participating (or not) in a given Managed Charging scheme?			✓	
5. What are the between-participant variabilities in Mainstream Consumer charging behaviour when participating (or not) in a given Managed Charging scheme?			✓	
6. How does charging behaviour vary with time over the first eight weeks of using and charging a PiV, whether participating in a Managed Charging scheme or not?			✓	
7. How do mainstream consumers interact with specific features of User- and Supplier-Managed Charging?				✓
8. What preferences do mainstream consumers have between Supplier-Managed Charging, User-Managed Charging, and no Managed Charging?	✓	✓		
9. What factors influence preferences between Supplier-Managed Charging, User-Managed Charging, and no Managed Charging?	✓	✓		
10. What are the impacts of different User-Managed Charging tariffs and Supplier-Managed Charging schemes on a Consumer's likelihood to participate in these arrangements?		✓		
11. What are the impacts of different User-Managed Charging tariffs and Supplier-Managed Charging schemes on the likelihood of car buyers choosing a PHEV / BEV over other powertrains?	✓			
12. What are the utility factors (fraction of total mileage carried out under electric power) for PHEVs used by mainstream consumers, and how do these vary between mainstream consumers?			✓	

1.7 Comprehensive database for potential future research

ETI and the project team recognise the potential value of the data collected from the Stage 2 trials to address further research questions in the future, after completion of the CVEI project itself. Such questions might use the dataset to explore, for instance, differences in the ways

BEVs and PHEVs are used in practice, given their different characteristics. The existence of this dataset could simplify some future research by removing the need to run time-consuming and costly further field trials. Accordingly, the project team will take the opportunity (within time and budget constraints) to record certain additional data (e.g. telematics data) that is not needed for the Consumer Charging Trials, but may add value to the dataset.

2 Method

2.1 Overview of experimental design

Two separate trials will be conducted:

- a PHEV Consumer Charging Trial to investigate the charging behaviours, attitudes and responses of mainstream consumers who drive a PHEV, and;
- a BEV Consumer Charging Trial to investigate the charging behaviours, attitudes and responses of mainstream consumers who drive a BEV.

Each trial will use a between-participants Randomised Controlled Trial (RCT) design, in which participants are randomly allocated to one of three groups;

1. a Control Group, in which participants are free to charge their vehicles as they wish, in the absence of a specific Managed Charging scheme.
2. a User-Managed Charging (UMC) group, in which participants are incentivised to actively shift their charging to periods of generally favourable supply-demand balance, through a banded tariff structure.
3. a Supplier-Managed Charging (SMC) group, in which participants are encouraged to relinquish control of their charging to a simulated energy supplier in exchange for consequent savings on overall charging cost

In order to test the effect of different reward levels in UMC and SMC, the UMC and SMC groups will be further divided into two sub-groups. The reward levels experienced by the sub-groups will be based on Summer and Winter tariffs (UMC) and price differentials (SMC) respectively, as modelled in D7.1. The allocation of participants across these sub-groups is shown in Table 3.

Table 3: Allocation of participants across experimental groups and sub-groups

Experimental group	BEV Consumer Charging Trial		PHEV Consumer Charging Trial		Total
Control	40		40		**80**
	Summer	**Winter**	**Summer**	**Winter**	
UMC	20	20	20	20	**80**
SMC	20	20	20	20	**80**
Total	**120**		**120**		**240**

The sub-group labels “Summer” and “Winter” here refer only to the reward levels that members of the UMC or SMC sub-group will experience. The control group will not be split into “Summer” and “Winter” sub-groups like the UMC and SMC groups, because all participants in the control group will experience the same reward levels.

Participation for all three groups (Control, UMC, SMC) will be spread across approximately six months (in three blocks of eight weeks) to control as far as practicable for seasonal variations in temperature and vehicle usage and consequent effects on charging behaviour. The ideal trial dates for this purpose would encompass a full half-cycle of daylight lengths, temperatures, and precipitation: i.e. approximately from July to December. For operational reasons this is not possible for the Consumer Charging Trials: they are expected to run from late September to late February, so that there will be a systemastic bias towards Autumn/Winter external conditions. It is known that vehicle usage is lower in Winter months than in Summer, partly due to adverse weather preventing some trips, partly due to reduced leisure trips, and partly due to some drivers preferring to drive in daylight conditions (there are less daylight hours in Winter). This is a “known” bias in the sense discussed in section 1.2.8, i.e. its direction is known, and it may be possible to estimate its magnitude from available seasonal road use statistics. However, it is not possible to be certain that magnitude estimates based on use of ICEs will read across to PiV utilisation. Accordingly the conventional approach in behavioural science research shall be followed: the uncorrected results will be reported, with acknowledgement of the known bias and discussion of its likely magnitude, direction and impacts on the validity and generalisability of the results. It will also be possible to assess the impacts of this bias on the outputs from the Analytical Framework via sensitivity analyses to ensure that the Analytical Framework outputs and the resulting policy recommendations are robust; the results of these analyses will be reported in Deliverable D7.6.

Two-thirds of participants in the “Summer” UMC and SMC reward level sub-groups will participate in the first block (in the Autumn months), the remainder in the second block. Two-thirds of participants in the “Winter” UMC and SMC reward level sub-groups will participate in the third block (in the Winter months), the remainder in the second block. Participants in the Control group will be spread evenly between the blocks.

Participants in the UMC and SMC group will be given a User App for their smartphone which they will use to engage with the Managed Charging scheme. In the case of UMC participants, the User App will allow them to choose the time at which their vehicle starts (and stops) charging. In the case of the SMC participants, the User App will allow them to choose whether or not they are willing for the supplier to control their charging, and to set specific parameters related to their charging needs, such as desired SOC and the time at which they need the vehicle next. Further details about the User App are provided in section 2.9.

Participants in both trials will be given a plug-in vehicle for a period of 8 weeks to use for their normal day-to-day journeys. Participants in the PHEV Consumer Charging Trial will be given a VW Golf GTE hatchback 1.4 TSI 5dr (either 2016 or 2017 model); participants in the BEV Consumer Charging Trial will be given a VW e-Golf hatchback (5dr, 2017 model) (see section 2.6.1 and Appendix C for full details of the vehicles).

The trial vehicles (either a BEV or PHEV) will be provided to participants for use in place of the vehicle the participant normally drives. Participants’ own personal vehicles will be retained by the participants for the duration of the trial, except in two circumstances where they will be asked to leave their personal vehicles with the research team at TRL or Cenex for the duration of the trial:

1. Where the number of drivers exceeds the number of vehicles in the household (in which case an additional car might have a material impact on household vehicle use patterns).
2. Where there is insufficient off-street parking to accommodate an additional vehicle.

Physically replacing their personal vehicles with the trial vehicles in these circumstances will ensure that the trial does not alter household vehicle use dynamics and inadvertently result in collection of unrepresentative data. All participants will be encouraged, in the participant briefing and Participant Information Pack, to use the vehicle for their everyday travel needs. Participants who do not store their own vehicles with the research team for the duration of the trial will be asked to send photographic evidence of their own vehicle's mileage at the start and the end of the trial, to serve as an additional check that they used the trial vehicle and not their own vehicle.

Further, participants in all three experimental groups will receive incentives for taking part in the trial and engaging with vehicle charging. Incentives will be given in the form of compensation for their time (via Amazon vouchers) and reward points for engaging in particular charging behaviours (depending on which experimental group they are in) – the total value of the reward package will be £250 per participant (see section 2.3). Reward points will be converted to a combination of cash payments and vouchers on completion of participation. In the control group, the reward points will be called 'Participation Points', and in the SMC and UMC groups they will be called 'Savings Points'. Full details about the process for earning reward points in each of the three groups are provided in section 2.8. In addition to the fixed compensation and incentives, participants will be entered into a prize draw for a chance to win £2,500.

Participants will be asked to complete a series of questionnaires during the trial:

- **Recruitment Filter Surveys**: screening questionnaires will be administered during the recruitment process (see section 2.2.2)
- **Pre-trial questionnaire:** administered following receipt of consent to participate
- **Time Point 1 questionnaire**: administered approximately 7-10 days before vehicle handover
- **Time Point 2 questionnaire**: administered approximately seven days after the return of the vehicle

Data from a vehicle telematics dongle connected to the OBD-II port and data from the chargepoint in participants' homes will be collected during trial. These data will be used to understand how participants used and charged the vehicles. In addition, usage and preference data will be obtained from the smartphone app.

An overview of the methodology for the two Consumer Charging Trials is illustrated below.

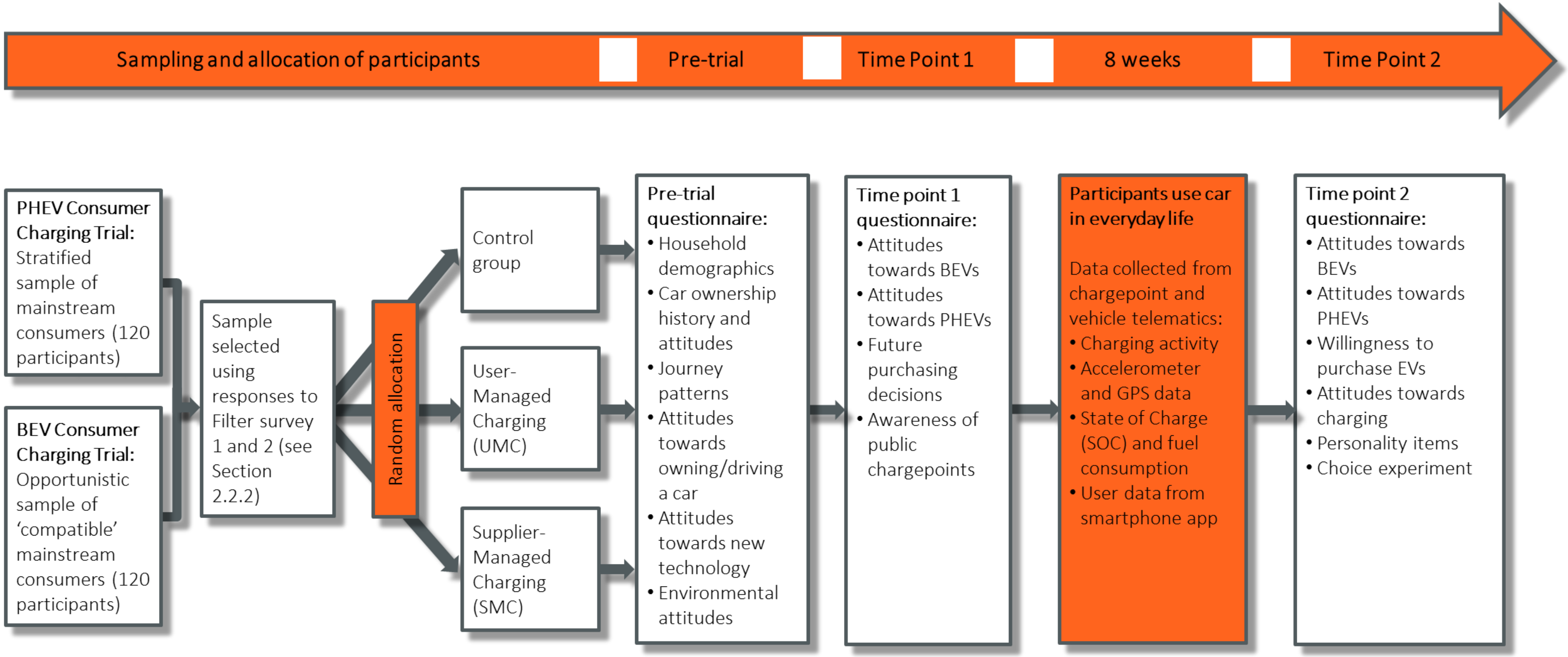

Figure 5: Overview of methodology for Consumer Charging Trials

2.2 Participants

2.2.1 Sampling

A total of 240 participants will be recruited across the two trials (120 participants for the PHEV Consumer Charging Trial and 120 for the BEV Consumer Charging Trial). This allows for 40 participants per condition (control, SMC, UMC) in each trial. TRL experience indicates that this is a sufficient group size to control for individual differences in transportation research with people. As explained in section 3.4.2.1, the sample size is sufficient to enable detection of differences in measures of behaviour between groups with standardized effect sizes[15] of around 0.16-0.26.

All participants will be recruited from within a 50-mile radius of TRL (RG40 3GA) and Cenex (LE11 3QF), with a 50/50 split between the two trial locations (i.e. 60 PHEV and 60 BEV participants recruited from around TRL and the same recruited from around Cenex).

Due to the differences in the utility of PHEVs and BEVs, the two trials will utilise different sampling techniques (see section 1.5.1). This is discussed further in the following sections.

2.2.1.1 PHEV Consumer Charging Trial

The target sample for the PHEV Consumer Charging Trial is 120 mainstream consumers. As discussed in section 1.3, mainstream consumers are defined as all whose adoption of technology has been influenced by diffusion of awareness, knowledge, and positive attitudes from people who have already adopted the innovation (i.e. everyone except Innovators). This includes all consumers in Rogers' (2003) Diffusion Model except for Innovators; that is the Early Adopter, Early Majority, Late Majority, and Laggard segments (see Figure 2).

Innovators represent the first 2.5% (approximately) of the eventual adopter population, assuming a normal distribution. "Alternative fuel vehicles" currently represent around 1% of the total car fleet in the UK (DfT, 2016a), and so according to Diffusion Theory, all present owners/users of PiVs are Innovators, and the next set of future PiV owners who make up the remaining 1.5% of the fleet are also likely to be Innovators. In order to ensure the sample is representative of mainstream consumers, it is necessary to exclude Innovators. Individuals who currently have, have had, or have had regular driving experience with a plug-in vehicle in the last 5 years, and those who are currently considering acquiring a plug-in vehicle in the next six months will therefore be excluded from the study.

It is also important to ensure that the sample is representative of the driving population in Great Britain. As a minimum, a sample that is intended to be representative should have the same male/female ratio and the same age distribution as the parent population. In transport research, ensuring a representative distribution between urban and extra-urban residency is

[15] Standardized effect size = ratio of difference between means/pooled standard deviation (the size of the effect, measured in units of its standard deviation)

also important, as this impacts on vehicle usage[16]. A stratified sampling approach based on driving licence data from the Driver and Vehicle Standards Agency (DVSA), and population and travel data from the National Travel Survey (NTS) and the Office of National Statistics (ONS) will be applied for this purpose (see Table 4).

Table 4: Target sample matrix for the PHEV Consumer Charging Trial, stratified using DVSA, NTS and ONS data

Resident area[17]	Age group[18]	Gender		Total
		Male	Female	
Rural	19-29	1	1	**2**
	30-49	4	4	**8**
	50+	7	6	**13**
Urban	19-29	9	7	**16**
	30-49	20	18	**38**
	50+	23	19	**42**
Total		**64**	**56**	**120**

2.2.1.2 BEV Consumer Charging Trial

The current model VW e-Golf hatchback is claimed by the manufacturer to have an electric range of 118 miles[19]. With realistic everyday use, this stated range is likely to equate to an actual electric range of between 80 and 90 miles. Due to this limited range, the e-Golf (BEV) (and other comparable BEVs available in the market) are only objectively suitable as substitute vehicles for a sub-set of the mainstream consumer segment; that is, those whose travel patterns are consistent with the e-Golf's restricted range of approximately 80 miles. The sub-set of mainstream consumers for whom the e-Golf is *subjectively* suitable (i.e. those who themselves perceive that it would meet their needs) may be even smaller.

For these reasons the travel needs of many individuals in the mainstream consumer population will not be met by the VW e-Golf, nor will it be met by other comparable affordable C-segment BEVs currently available on the market. The target sample for the BEV Consumer

[16] It might be that EV users who have domestic gas as well as electricity (so proportionally less electricity usage) may haqve different responses to the savings available from Managed Charging than those who have domestic electricity only. The sample is not stratified using this distinction; it is assumed however that given its size, it will be reasonably representative of the UK population in this respect.

[17] The 2011 rural-urban classification (RUC2011) from the Office for National Statistics (ONS) will be used to define the rural/urban classification:

https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications/2011ruralurbanclassification

[18] 17-18 year olds will be excluded to mitigate known increased crash risk associated with young and novice drivers.

[19] Maximum range of 2016 model, as stated by OEM. Specifications of 2017 model will be released by OEM once vehicles are delivered; any updates to range or battery capacity will be fed into the final trial design documentation, as required.

Charging Trial will therefore be 120 mainstream consumers whose vehicle needs are met by the current capabilities of BEVs available in today's market (this group will be called "compatible mainstream consumers" - that is, mainstream consumers for whom the vast majority of return journeys are shorter than 80 miles).

Recruitment of 120 compatible mainstream consumers will require an opportunistic sampling approach. This technique involves recruiting interested individuals from the target population who meet the travel pattern (and other) eligibility criteria. With an opportunistic sampling approach, there is limited opportunity to stratify the sample by other factors such as age, gender and location (as is being done in the PHEV Consumer Charging Trial). As a result it will not be possible to ensure that the sample is fully representative of the mainstream consumer segment as a whole.

For these reasons, the risk of recruiting a biased sample of Innovators is particularly high in the BEV Consumer Charging Trial. This risk will be mitigated in the same way as described for the PHEV Consumer Charging Trial; that is, individuals who currently have, have had, or have had regular driving experience with a plug-in vehicle in the last 5 years, and those who are currently considering acquiring a plug-in vehicle in the next six months will be excluded.

2.2.2 Recruitment process

In order to recruit participants who are suitable for the project it is necessary to employ a filtering process to select eligible participants and exclude ineligible participants. This process is described below and illustrated in Figure 6:

- **Advertise**: A variety of advertisements will be published to reach a wide demographic of prospective participants.
- **Step 1**: Interested prospective participants will complete Filter Survey 1 to register their interest, using the URL provided in the advertisements.
- **Step 2**: Prospective participants who are eligible (based on responses to Filter Survey 1) will be invited to complete Filter Survey 2. This is a short but more detailed questionnaire in order to further filter prospective participants and assess suitability specifically for each trial.
- **Step 3**: Prospective participants who are eligible (based on responses to Filter Survey 2) will be invited to participate in the Consumer Uptake Trial, the BEV Consumer Charging Trial or the PHEV Consumer Trial. In some cases an eligible respondent may fit a stratified category that is already full. Where this is the case the prospective participants will be sent an email thanking them for their time and asking them if they would be happy to be kept on a reserve list. Those who agree will be kept on the participant management database and will either be invited to participate later, where another participant drops out, or be informed that the trial is full once all data have been collected for that group.

The above steps represent a standardised recruitment process which will be used for both the Consumer Charging Trials and the Consumer Uptake Trial (see Parts 1 and 2). The responses to Filter Survey 1 and Filter Survey 2 will be used to determine which trial participants are eligible for. Where prospective participants are eligible for more than one trial, their assignment to a particular trial will be based on the current sampling requirements.

The recruitment process is described in more detail in this section, and is repeated for clarity in Part 1, which contains the study plan for the Consumer Uptake Trial.

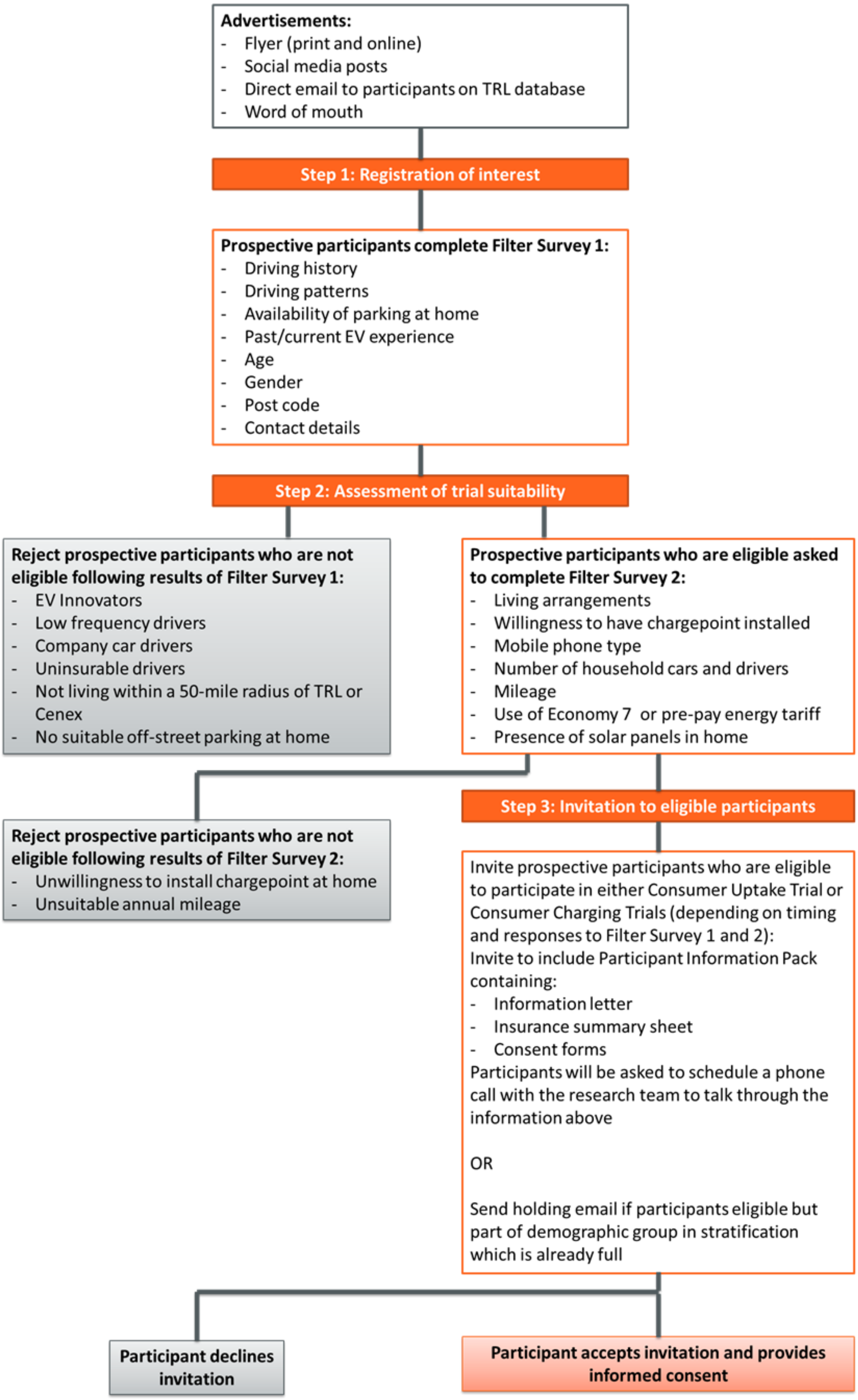

Figure 6: Overview of recruitment strategy up to the point of trial invitation

2.2.2.1 Advertisements

In previous experience recruiting for research trials, using a variety of advertising methods has proven effective for recruiting participants from a wide range of demographic backgrounds and social groups.

For example, use of social media (especially Twitter) has worked well for recruiting younger participants. The vast majority of TRL's Twitter followers are between the ages of 25 and 44 years with a 70:30 male to female ratio. LinkedIn has also been used for recruitment and tends to draw a more professional audience. TRL's LinkedIn followers are from a range of backgrounds and interests, but most relate to engineering and transport research.

Recruitment via social media carries the potential risk of bias towards PiV Innovators. While it is possible that TRL and Cenex may attract a larger-than-normal proportion through social media compared with other organisations, not all social media followers of these companies will be PiV Innovators. TRL conducts research in a broad range of topics and has followers interested in wider and unrelated domains. Nevertheless, it would clearly be undesirable to recruit solely from TRL social media followers; hence diversity is necessary through the use of other approaches to engage the wider public. In any case, Innovators who express interest in participation will be excluded from the sample by identifying individuals who currently have or have had regular experience of a plug-in vehicle, or who are considering adopting a plug-in vehicle in the next six months; these questions are contained in Filter survey 1. In addition, diversity is supported through the process of stratification (section 2.2).

Word of mouth is also an extremely valuable resource. Interested prospective participants can be invited to share information about the trial and the registration links to others[20], thus providing a 'snowball' effect. This will also occur naturally via social media which allows users to share. In addition to snowballing via interested prospective participants, members of the project team (and members of staff in the wider TRL Group in which the project is managed), can also share adverts on their own social media accounts (e.g. Facebook, Twitter, Instagram, Linkedin) and in doing so, request that their followers also repost the adverts. This enables adverts to rapidly reach a large number of individuals from a broad range of backgrounds. From previous trials, such word of mouth recruitment has proven to be a very powerful recruitment tool.

The use of flyers and newspaper/magazine adverts can help to avoid biasing the sample towards people who use social media, in particular only those who follow certain accounts on social media (such as TRL or Cenex). Flyers can be used to target a range of different socio-economic backgrounds by being circulated through businesses to employees and around local educational and medical facilities. This will attract people from professional and non-professional environments and a wide range of ages. Newspaper and magazine adverts will also reach audiences from different socio-economic backgrounds and are expected to attract an older audience. They will also cover broader geographical areas and may reassure people of the credibility of the advert compared to paper flyers.

[20] Due to the limited amount of information that will be on the adverts and recruitment surveys, the information shared via word of mouth should be in line with the research needs.

For the reasons discussed above, a variety of advertising methods will be used to attract prospective participants from the varied demographics needed for the sample. An overview of the types of advertising methods that will be used, and the expected level of effectiveness for reaching each target age group is summarised in Table 5.

Table 5: Advertisement methods and expected level of effectiveness by age group (darker shading represents greater anticipated effectiveness)

Age group	Existing TRL database	Newspaper/ magazine adverts	Local employers	Public places	Twitter	LinkedIn	Facebook	Word of mouth	Local forums (e.g. Gumtree)
19 - 29									
30 - 49									
50+									

Adverts will be used to promote the study within the targeted geographical locations (i.e. within a 50-mile radius of the TRL and Cenex headquarters in Crowthorne and Loughborough, respectively). An advertising database has been produced which includes a list of organisations and places within the target areas that will be used to advertise through. The advertising database currently contains contact details from various members of relevant local authorities, universities, hospitals/health centres, newspapers, and private-sector businesses (see Table 6).

Table 6: Breakdown of organisations contained within the advertising database

	TRL	CENEX
Local authorities[21]	203 contacts	222 contacts
Hospitals	44 hospitals	28 hospitals
Private sector industries[22]	568 contacts	161 contacts
Universities[23]	65 contacts	84 contacts
Local newspapers	22 newspapers	24 newspapers

The primary aim of the adverts will be to direct prospective participants to the first step of the recruitment process so that they can register their interest in taking part. Each method of

[21] Local authorities are broken down into seven different levels; County, Borough, District, Unitary, City, Town and Parish.

[22] Private sector industries include organisations from automotive, aviation, consultancy, engineering, legal, insurance, media, rail, electronics and retail.

[23] Universities include, where possible, contacts within internal communication teams and student unions.

advertising will have its own unique web address / QR[24] code which will link interested prospective participants to Filter Survey 1; this will enable identification of where the prospective participant saw the trial advertised. If it is determined that particular methods of advertising are not effective for recruiting the desired sample then alternative approaches will be considered. For example, in the case of social media adverts, it may be deemed appropriate to consider a targeted Facebook advert if generic adverts prove to be ineffective. Additional escalation options, such as local radio advertisement, will also be considered where the pace of recruitment does not match the requirements of the trial.

Adverts do not mention “electric” or “low emission” vehicles specifically; this avoids undesirable interest from PiV enthusiasts (who are unlikely to represent mainstream consumers) and instead simply advertises the opportunity to participate in ‘vehicle trials research’. Further details about the trials will be provided to the prospective participant in Steps 2 and 3.

Four advertisements have been produced in collaboration with TRL’s marketing department. These are shown in Appendix A and described in more detail below:

[24] A Quick Response (QR) code is a type of matrix barcode (or two-dimensional barcode) that can be linked to online material, such as a survey, via readable devices such as smartphones.

Flyer (see Appendix A)

The flyer is a highly visual A5 document which can either be posted online (e.g. on a business's intranet) or printed and displayed on a notice board. Very high level information about the trial is included on the flyer, along with a hyperlink and QR code for Filter Survey 1. A pdf version of the flyer will be emailed to local councils, large businesses, supermarkets, hospitals, health centres, large educational facilities etc. requesting them to circulate the flyer as well as print and display it on their notice boards. This method relies on external companies posting or circulating the advert within the business. Typically, organisations will post the advert on their internal intranet or circulate it via email; however TRL will also offer printed copies if they would prefer. Previous experience working with many of the contacts in the database has shown a good level of cooperation.

In the Loughborough area, Cenex will support TRL in identifying further contacts to add to the advertising database. A member of the TRL recruitment team, who is based in TRL's Nottingham office, will lead recruitment for the Cenex area and will be responsible for engaging with local businesses to ensure responsiveness to these requests.

In addition, TRL will print 1,000 flyers (500 for the TRL area and 500 Cenex area) to pass onto organisations who agree to help with advertising. These flyers will also be distributed by members of the Cenex and TRL teams (who live within 50-miles of Cenex or TRL, respectively) in their local areas in order to supplement the advertising database (e.g. cafés, shops and other community locations). Each member of the team will be asked to obtain consent before distributing any flyers and to record the date and location they have been distributed.

In order to maximise reach, the research team will also be tasked with distributing paper copies of the flyer to businesses and noticeboards within the local area. Previous experience has shown that a good response level can be achieved through this approach.

Social media advert (see Appendix A)

TRL has around 8,000 social media followers on Twitter, LinkedIn, and Facebook combined. A social media advert that consists of a project strapline (an eye catching sentence that describes the trial at a high level) and a link to the Step 1 registration of interest survey will be posted by TRL's Twitter and LinkedIn accounts and Cenex's Facebook, Twitter, and LinkedIn in accounts.

This advert will also be shared on active local forums and groups (with the aim of attracting a more diverse and non-professional demographic as well as samples unlikely to include PiV Innovators). The adverts will also be reposted by the research team via personal social media accounts.

Newspaper/magazine/online advert (see Appendix A)

The advert will contain the same level of information as the social media post but it will have a more structured graphical design in order to be newspaper- and magazine- friendly. The research team will contact local newspapers and magazines (such as local Round and About magazines) to organise having an advert posted (newspapers and magazines are also included in the advertising database). The advert will also be posted on online local forums, such as Gumtree.

Email invitation (see Appendix A)

TRL has a participant database of over 2,000 volunteers who have agreed to be contacted about participating in future research projects. An email containing a copy of the flyer and a link to the Filter Survey 1 registration of interest questionnaire will be emailed to all prospective participants on the database.

2.2.2.2 Step 1: Registration of interest

Step 1 is for prospective participants to register their interest for the trials; this will be achieved by asking prospective participants to complete Filter Survey 1 (see section 2.13 and Appendix B). This provides a way for the research team to determine the suitability of individuals for each of the trials.

At this step of the process the survey contains minimal information about the design and aims of the research to avoid attracting interest from PiV enthusiasts, in particular Innovators. The survey will provide information about the incentives and the trials' contact email address; an email address dedicated to the trials which will be monitored daily.

The questionnaire covers essential information only and the questions only require quick response yes/no or short multiple choice answers only.

The choice of questions is designed to filter out prospective participants who can be rejected outright, including: Innovators, low frequency drivers, company car drivers and uninsurable drivers. Filter Survey 1 also includes a question to ascertain whether prospective participants currently work for TRL, Cenex or the ETI; if anyone indicates they are an employee of one of these organisations then this will be flagged with the research team and the ETI Project Manager so that an assessment of their suitability for the trial can be made. Eligible prospective participants will be contacted by email informing them that they may be suitable and inviting them to progress to Step 2; this is described in the section 2.2.2.3. Two reminder emails will be sent to prospective participants who have not completed Step 2 in the two weeks after the initial invite email.

2.2.2.3 Step 2: Assessment of trial suitability

Step 2 of the process is to further assess trial suitability using Filter Survey 2 (see section 2.13 and Appendix B), which contains a more detailed questionnaire to obtain data on living arrangements, chargepoint installation, smartphone type, the number of cars and drivers within the household, annual mileage, and household energy information. The questions require quick response yes/no or short multiple-choice answers only.

The Filter Survey 2 questionnaire includes an outline of both trials on the cover page. This is to provide prospective participants with additional information so that they can provide informed interest at this stage in the process. The survey will allow prospective participants to indicate if they have a preference for participating in either trial. Matching prospective participants to the trial they have a preference for is desirable for increasing the participant retention rate, although not essential. If a respondent is not suitable for the trial they expressed a preference for, the research team may still contact them (by email or telephone) regarding participating in the other trial. This will be done on an individual basis and will be determined by the success of recruiting in line with the stratified target sample.

Completion of the Filter Survey 2 questionnaire will provide the research team with sufficient information for assessing participants' suitability for the Consumer Charging Trials:

- **General suitability criteria:**
    - Must live within 50 miles of the TRL or Cenex headquarters
    - Must not currently own, have previously owned or had previous regular experience driving a PiV in the last five years
    - Must not be considering acquiring a PiV in the next six months
    - Must have held a valid UK driving licence for a minimum of two years
    - Must have received no penalty points if under 25 OR no more than 3 penalty points if aged 25 and over[25]
    - Must have not had an 'at fault' insurance claim in the last three years
    - Must be a current car owner
    - Must drive regularly (at least once every two or three days)
    - Must not have a company car as their main vehicle
    - Must not require Class 2 or 3 business insurance for their vehicle (i.e. does not require business travel beyond regular commute to work and occasional trips to external locations, such as for meetings)
    - Must have access to off-street parking at a location where a chargepoint could be installed safely
    - Must be willing to have a chargepoint installed in a suitable location

[25] According to data from the DVLA, the proportion of drivers with more than 3 points on their licence is 1.7%. New drivers (of whom approximately 70% are aged 17-25 years) are impacted by the New Drivers Act which restricts them to a maximum of 6 points within the first two years of gaining a full driving licence. Introduction of the Act has been associated with a reduction in the proportion of young drivers with penalty points. Approximately 10% of new drivers commit a violation within the first two years of licenced driving; implying that around 90% of drivers under 25 will have no points on their licence. As such, the effect of these insurance conditions on the representativeness of the sample is minimal.

- **Criteria specific to Consumer Charging Trials:**
  - Owns a smart phone (Android or iOS)
  - The household electricity is not on an economy 7 tariff or pre-pay energy meter
  - The household does not have photovoltaic solar panels feeding into the energy supply
- **Criteria specific to BEV Consumer Charging Trial:**
  - Participant mileage needs can be met using a BEV (with its restricted range); objectively assessed based on their stated annual and daily mileages..
- **Other information required:**
  - Age group
  - Gender
  - Urban/rural classification
  - Living arrangements (home owner[26], living with parents etc.)
  - Number of drivers in the household
  - Number of cars registered at the household address
  - Contact details (name, email address, and contact number)

The Filter Survey 1 and Filter Survey 2 questionnaires will be hosted online using 'SmartSurvey'[27]. TRL has a corporate SmartSurvey account. Data can be downloaded at any point whilst the survey is live. The URL is fully customisable, and it is possible to set-up access to the survey via a Quick Response (QR) code. As described above, SmartSurvey also provides the ability to monitor which advertising methods are most effective; unique QR codes and URLs will be provided on the various forms of adverts in order to link survey responses to the location at which prospective participants learned about the trial. This will provide information to the research team about which recruitment methods are most successful and which may need additional consideration. SmartSurvey is an effective research tool which has been successfully utilised on numerous previous projects run by TRL.

2.2.2.4 Step 3: Invitation to participate

Step 3 in the recruitment process is to invite eligible prospective participants to participate in the Consumer Uptake Trial, BEV Consumer Charging Trial or PHEV Consumer Charging trial, depending on their responses to Filter Survey 1 and 2 and the spaces within the target samples for each trial.

[26] Home owners will be preferred over tenants where multiple potential participants are available within sampling categories.

[27] https://www.smartsurvey.co.uk/

Once a prospective participant has been allocated to the Consumer Uptake Trial, they will be sent an invitation to participate by email. As part of this email, prospective participants will be sent the Participant Information Pack (see Appendix C). This pack will contain:

- An information letter
- A description of the key terms and conditions of the vehicle insurance policy
- The consent form and a link to a webpage where the consent form can be completed online

The information letter will include a description of the trial, information about what participation in the trial will involve and how the trial will run. It will also include information on health and safety and contact details for the research team should the prospective participant have additional questions.

In the invitation email, prospective participants will be asked to schedule a phone call with a member of the research team to talk through all the information in the Participant Information Pack, should the participants have any questions on any aspects of participating in the trial. Possible start dates for the prospective participant will also be discussed in the phone call (e.g. noting planned holidays or business trips).

Reminder emails will be sent out a week after the initial invitation if there has been no reply.

2.2.2.5 Exclusion points

In line with ethical practice, participants will be free to withdraw from the trial at any time without giving a reason. This will be made clear to prospective participants in the information sheet and consent form. There may also be circumstances where TRL or Cenex may deem a participant (who has been invited to take part in the trial) as unsuitable. These include:

- **Uninsurable drivers**
  - All drivers will be requested to provide permission for TRL to electronically access their DVLA records to ensure that their licence is valid and meets trial insurance requirements in terms of penalty points, violations and time held. Participants who do not meet the insurance criteria will be unable to continue in the trial.
- **Household unsuitable for installation of chargepoint**
  - Prior to installation of the chargepoint by Rolec (or Rolec's partner ChargedEV), they will check the property is suitable for safe installation of the chargepoint. Where no safe or suitable installation is possible the participant will be unable to continue in the trial. Further detail of where an installation may be deemed unsuitable is provided in the Health and Safety Plan.
- **Unsafe or illegal driving**
  - Vehicle familiarisation drives with a TRL or Cenex staff member will be completed at vehicle handover. The purpose of these drives is to allow the participant to become familiar with the vehicle. If the participant exhibits behaviours which are unsafe or illegal then this will result in the researcher terminating the trial for that participant.

All of these interactions and the outcomes will be logged in the participant management database.

2.2.3 Participant management

Participant recruitment will be managed through a secure participant management database[28]. The database will contain data from the Filter Surveys as well as a log to track participants' progress through the trial and details of any communication between the research team and the participant. The database will be in Microsoft Access and will have associated forms for any tables that require input from the recruitment team.

The recruitment process will be managed on a rolling basis; as responses to Filter Survey 1 are received, data will be transferred into the participant management database. A member of the recruitment team will then assess the responses and categorise them as either 'reject' or 'progress'. This will involve, for example, checking the prospective participants post code is within the recruitment region assigning them to either TRL, Cenex or 'out of area'. The allocation will be stored in the database along with any notes.

A unique participant identification number will be generated and stored in the database for all prospective participants who progress to Step 2. An email will be sent to all those who progress to Step 2 asking them to complete the Filter Survey 2 questionnaire and providing them with their participant ID. Recruitment correspondence will be completed by TRL using mail merge to ensure the contact details and unique reference number is included in each email.

Responses to Filter Survey 2 will also be transferred into the participant management database. A member of the recruitment team will then assess the responses and indicate which trials the prospective participant is suitable for:

- Consumer Uptake Trial
- BEV Consumer Charging Trial
- PHEV Consumer Charging Trial
- Not suitable

In the case that a participant is not suitable for any of the trials they will be sent an email to thank them for their interest and inform them that they are not suitable.

Following this, the current sampling requirements will be assessed on the basis of the stratified sampling matrix (see Table 4). Where the required sample has not been met, a researcher will filter the newly added responses by those who are suitable for the trial and have the required characteristics (e.g. aged 19-29, male, rural location). The researcher will then add the prospective participant to the invite list.

If the number of eligible prospective participants within a given stratum in the matrix is bigger than the target size of that stratum, participants will be selected using a random number

[28] Data privacy and protection is discussed in section 4.5 and in the CVEI 'Managing Data Protection' document.

generator[29] until the specific target sample has been reached. Prospective participants who are eligible but not required (i.e. because their stratum is full) will be sent an email thanking them for their time and asking them if they would be happy to be kept on a reserve list. Those who agree will be kept on the participant management database and will either be invited to participate later, where another participant drops out, or be informed that the trial is full once all data have been collected for that group.

Assessment of the recruited sample against the target stratified sample will be monitored throughout the trials. Where there is a discrepancy or difficult to reach group, this will be specifically targeted within the boundaries of the project timeline. If it is unlikely that a target sample group, in line with the stratified sampling, can be obtained, a pragmatic approach will be taken in order to achieve the total sample and the sampling criteria may be relaxed. In the event that this approach is required, it will be discussed and agreed with the ETI before proceeding[30].

2.3 Participant incentives and compensation

As part of Stage 1, a literature review was conducted by the Behavioural Insights Team (BIT) to understand the validity of using different forms of incentives in behavioural research. The key findings from this literature review have been used to inform the design of the trial incentives.

It is first important to distinguish between two types of incentive:

1. an incentive to participate in a research trial, and;
2. an incentive designed to influence a particular behaviour during a research trial.

The first of these will be referred to here as ‘compensation’ (for participating), and the latter as an ‘incentive’ (to encourage engagement with particular Managed Charging schemes).

Fundamentally, it is important to ensure that compensation and incentives are psychologically separated so that one does not distort the effect of the other. This will be achieved via two approaches:

- Taken together, the compensation and incentives will be equivalent to a total offering of £250, but will take two distinct forms:
    - Compensation will be provided in the form of Amazon vouchers, so as to remove the likelihood that the value of the compensation will be psychologically offset against expenditure on electricity bills during the trial.
    - Incentives will be provided in the form of a points-based reward system, where desired charging behaviours are rewarded with points. Points will be accumulated and redeemable against a cash lump-sum at the end of the trial (see section 2.8).
- The compensation and the incentives will be provided at different points in time:

[29] This will be subject to certain preferences, for example, home owners will be preferable to tenants.

[30] Relaxations to the sampling criteria will only be permitted with the express prior written consent of the ETI.

- Compensation will be provided both at the start of the trial, before participants collect the trial vehicle (once the Pre-trial questionnaire has been completed and again once the Time point 1 questionnaire has been completed), and at the end of the trial (once the final 'Time point 2' questionnaire has been completed, and as a final debrief payment).
- Participants will be provided with the status of their points in real-time throughout the trial, and alerted when actions result in points. Total accumulated points will be converted to cash at the end of the trial (upon return of the vehicle).

An important aspect of the design of the Consumer Charging Trials is the consideration of seasonal variation in charging behaviour, PiV use and energy prices (see section 1.5.2 and 2.8). Of particular importance are the distinct differences in energy prices between 'summer' and 'winter' periods. In the winter, there are much higher daily price differentials than in the summer period, and there are sharp transitions in prices between the summer and winter periods. Because of this, the UMC and SMC experimental groups will be further divided into two sub-groups:

- A Summer group, in which the reward points participants can earn are based on low daily energy price differentials, and;
- A Winter group, in which the reward points participants can earn are based on high daily energy price differentials.

As such, the maximum value of reward points that participants will be able to earn will differ across the four sub-groups[31] (UMC-Summer, UMC-Winter, SMC-Summer and SMC-Winter). The relative sizes of these maxima reflect the relative differences in cost savings that would occur seasonally in future UMC and SMC charging offerings, as modelled in Deliverable D7.1 (see Deliverable D7.1 for a full explanation of the seasonal variation in energy prices for the UMC and SMC conditions, supporting documentation for D7.1 can be found in Appendix Q).

The compensation and incentives will be administered at different points during the trial; the breakdown of this is shown in

[31] In order to avoid participant bias, the participants will not be made aware of the different sub-groups in the trial, nor will they told the name of the sub-group to which they belong.

Table 7 below:

Table 7: Breakdown of compensation and incentives for Consumer Charging Trials

Group	Sub-group	Time at which participant receives compensation				
		Pre-trial questionnaire	Time point 1 questionnaire	Conversion of reward points to cash	Time point 2 questionnaire	Final debrief "top-up" payment
Control group	N/A	£25 voucher	£25 voucher	Up to £150 cash	£50 voucher	£0-150 voucher
User-Managed Charging (UMC) group	Summer	£25 voucher	£25 voucher	Up to £20 cash	£180 voucher	£0-20 voucher
	Winter	£25 voucher	£25 voucher	Up to £125 cash	£75 voucher	£0-125 voucher
Supplier-Managed Charging (SMC) group	Summer	£25 voucher	£25 voucher	Up to £30 cash	£170 voucher	£0-30 voucher
	Winter	£25 voucher	£25 voucher	Up to £150 cash	£50 voucher	£0-150 voucher

There are undesirable ethical implications associated with the maximum achievable value of reward points differing between sub-groups, in that it would be unethical to limit the opportunity to receive the full reward value of £250 for some participants but not others. As such, a final "top-up" payment will be made at the point of participant debrief whereby participants will be given Amazon vouchers worth whatever value is required to bring their total reward package up to the value of £250.

For example, if a participant in the UMC Winter group receives:

- £25 Amazon voucher upon completion of the Pre-trial questionnaire
- £25 Amazon voucher upon completion of the Time Point 1 questionnaire
- Conversion of reward points to £100 cash upon return of the vehicle, and;
- £75 Amazon voucher upon completion of the Time Point 2 questionnaire

Then the total value of their reward package will be £25 + £25 + £100 + £75 = £225. A final debrief top-up payment of £25 (given as an Amazon voucher) would therefore be made to bring the total value of reward up to £250.

The method by which participants will accumulate reward points during the trial is explained in section 2.8. At the end of each trial block (see section 2.5.1), reward points will be converted to cash using a conversion rate (C). The conversion rate will be calculated by dividing the maximum cash value of points (detailed in column 5 of

Table 7 above) by the maximum number of points earned by a participant in a given experimental group. The conversion rate will then be applied to all other participants, giving them a proportionate value.

For example, if, at the end of Block 1, the maximum number of points earn by a BEV participant in the UMC Winter group is 1000, then the conversion rate (C) will be calculated as:

- C = £150/1000 = 0.15 (or 1 point = £0.15)

Separate conversion rates will be calculated the BEV Consumer Charging Trial and the PHEV Consumer Charging, for each sub-group, and at the end of each trial block. The final top-up payment will not be disclosed to participants until the end of their trial block.

In addition to the above rewards, all participants will be entered into a prize draw for a chance to win £2,500. The winning name will be drawn at random once all participants have completed the trial.

2.4 Piloting

Piloting will take place following approval of the trial method and materials by the ETI and readiness of all software elements (such as integration with chargepoint communications and mobile app development). This will ensure that the method and materials can be fully tested prior to going 'live' with real participants. There will be four distinct phases to piloting:

- **Pilot phase 1: Cognitive testing**
    - All questionnaires and the choice experiment will undergo 'cognitive testing' to ensure that the wording of questions is understandable for participants, that the questions can be answered in a reasonable timeframe, and that the delivery methods are suitable. The principle aim of 'cognitive testing' is to sense check the questions to ensure that wording is clear and free from errors, that comprehension of questions is correct, and that scale and multiple-choice items are logical and appropriate.
    - All questionnaires (Filter Survey 1, Filter Survey 2, Pre-trial, Time Point 1, and Time Point 2, including the choice experiment) will be tested as hosted online to ensure evaluation of the online functionality of the questionnaires.
    - Cognitive testing will be undertaken with five TRL staff who are not involved with the CVEI project. Pilot participants will be asked to time how long it takes for them to complete each questionnaire, and make a note of any typographical or formatting errors, and any functionality issues with the online portal.
    - Pilot participants will be interviewed upon completion of the survey to gauge their general response (e.g. how long it felt to complete, appropriateness, etc.) and discuss any specific questions that stood out (e.g. that may have caused some confusion or didn't represent their answer). Feedback from the cognitive interviews will be used to refine and update the questionnaires as necessary.
    - This will enable any issues with questionnaire wording and functionality to be identified prior to commencing the trial.

- **Pilot phase 2: Equipment testing**
    - This phase of piloting will involve doing a full test of the vehicles, the OBD-II telematics dongle, the Mode 3 chargepoints and the 'User App' smartphone application.
    - TRL staff will do at least five practice drives with each vehicle type (BEV and PHEV) once the telematics dongle is installed. Each drive will be a minimum of 30 minutes.
    - At the end of each drive, the vehicles will be plugged into a chargepoint at TRL's Crowthorne House site; this chargepoint will be identical in specification to the chargepoints which will be installed in participants' homes for the purposes of the trials.
    - On one of the occasions staff will test the 'control group' use case whereby the driver simply plugs the vehicle in and it begins charging. On the other occasions, Staff will be asked to test the User App for the UMC and SMC experimental groups. This test will ensure that the User App functions correctly, is simple to use, and controls vehicle charging as expected.
    - Following each drive and charge event, TRL will work with EV Connect and FleetCarma to check that the telematics and chargepoint data are being recorded, are sensible and appropriately labelled, and that they can be extracted.
- **Pilot phase 3: Incident rehearsals**
    - Health and safety is critical to the success of the project. TRL has developed an Incident Reporting Escalation Procedure which conforms with the ETI's Project Incident Protocol.
    - In order to ensure that this procedure is robust and fully understood by the research team, up to four 'Incident rehearsals' will be conducted during phase 3 of the piloting process.
    - Up to two rehearsals will be conducted where the mock incident originates at TRL, and up to two will be conducted where it originates at Cenex.
    - Key staff within TRL, Cenex and the ETI will be made aware that the rehearsal is taking place in order to avoid unnecessary escalation beyond that required for the purposes of testing procedural robustness. It is noted that all incident reporting should be made to the nominated call handling system and not directly to the ETI staff members.
    - Following piloting, the protocol and/or staff training will be updated, as required, if any issues with the reporting process are identified.
- **Pilot phase 4: Practice trials**
    - The final phase of piloting will involve completing a practice run of the trial with up to six participants; three from the area surrounding TRL and three from the area surrounding Cenex.

- The six pilot participants will be split evenly between the PHEV and BEV Consumer Charging Trials and the control, UMC and SMC experimental groups. The pilots will run for seven days.
- Apart from the reduced trial length (seven days instead of eight weeks), pilot participants will undergo exactly the same procedure as 'real' participants. This is important because it will ensure that all aspects of the trial procedure are fully tested before commencing with the trials for real.

2.5 Trial procedure

Following the delivery of the Participant Information Pack, receipt of returned and completed consent forms will signal that the participant is fully signed up for the trial. Completed consent forms will be stored in the participant management database. The next stages of the trial procedure will then commence; these are illustrated in Figure 7.

The trial procedure will be standardised to minimise any potential bias resulting from the use of two locations (TRL and Cenex). TRL will run a training workshop with all vehicle handover staff (including those from TRL and Cenex) prior to commencing the pilot (and again following the pilot if necessary), which will include specific training on the vehicles from VW representatives, a full safety briefing, and training on how to brief participants and manage vehicle handovers (some of the materials which will be used for this purpose can be found in Appendix E). This will ensure that all staff involved in the trial procedure are fully briefed and informed. As a further check, a TRL researcher will attend the first few trial days at Cenex to ensure consistency across the two trial locations.

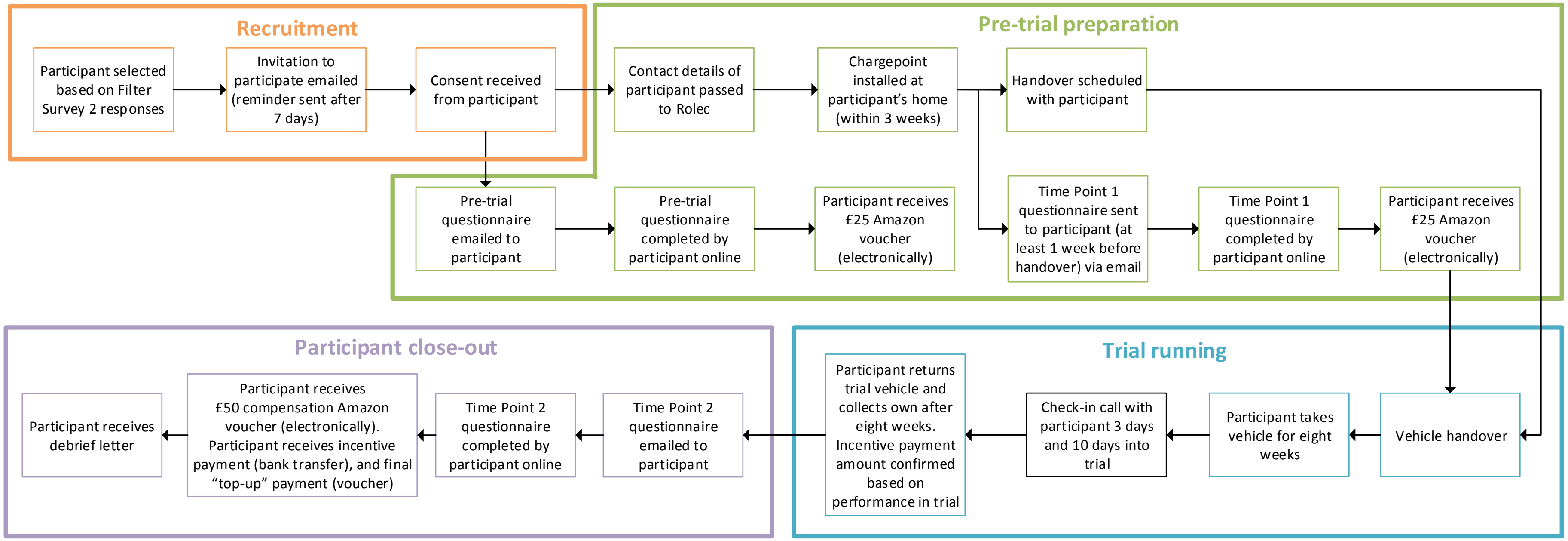

Figure 7: Trial procedure flow diagram

The following sections provide a more detailed description of each stage of the trial procedure.

2.5.1 *Pre-trial preparation phase*

2.5.1.1 *Installation of chargepoints*

Mode 3 chargepoints will be supplied and installed by Rolec Ltd and their installation partner ChargedEV (a trading name of Hybrid Energy Solutions Ltd, company registration no. 09666725).

Installation work will be undertaken by professional experienced contractors and only after a participant survey and/or site inspection has taken place with the participant to make sure their property is suitable. All installations will be preceded by a dynamic risk assessment to document anything on site which might result in hazards which are not within, or different from that within, the standard Risk Assessment. An "abort" arrangement will be setup with criteria to determine when it is not safe to undertake installation. A flow diagram outlining the installation process can be found in Appendix F.

At the end of the trial, participants will be given the option of keeping the chargepoint, or having it removed, and any rectification work required undertaken, at no cost to them.

2.5.1.2 *Scheduling vehicle handovers*

Once confirmation has been received from Rolec that the chargepoint has been safely installed at a participant's home, the participant will be contacted by the research team in order to schedule vehicle handovers.

The trial will be run in three 'blocks' of 58 days each; with 90 participants in each block (44 at TRL and 46 at Cenex) given an 8 week experience with the vehicles. If a block runs over the Christmas period, the block will be extended by one week as data collected during the Christmas week (25th – 31st December 2018) are likely to be atypical; but participants will be given a total of 9 weeks with the vehicles to compensate for this.

An illustration of the structure of 'Block 1' is shown in Figure 8; this shows the schedule for running the first 44 participants from TRL using approximately half of the vehicle fleet (22 BEVs and 22 PHEVs – see section 2.6 an equivalent schedule will be run simultaneously at Cenex where there will be 23 BEVs and 23 PHEVs).

The scheduling process will be as follows:

- The first 11 BEV participants (BEV Group 1) and the first 11 PHEV participants (PHEV Group 1) receive a car on Day 1 of the trial, at the start of the block.
- The next set of 11 BEV participants (BEV Group 2) and 11 PHEV participants (PHEV Group 2) receive a car on Day 2 of the trial.
- On Day 57, BEV Group 1 and PHEV Group 1 return their vehicles. On Day 58, BEV Group 2 and PHEV Group 2 return their vehicles, thus marking the end of Block 1.

Blocks 2 and 3 will be identical in structure and will be run consecutively after Block 1 (following a 5 day break for maintenance and valeting), and identical block structures will be employed simultaneously at Cenex, thus allowing 90 participants per block to be completed using the full fleet of trial vehicles across the two trial locations. There is a contingency of 10 participants built into each block; the target sample of 240 participants will be met as long as at least 40 participants per block are completed at each location (TRL and Cenex). In the event that fewer than 40 participants take part in a given block, additional contingency will be sought by running subsequent blocks using the additional 12 BEVs and 12 PHEVs from the consumer Uptake Trial vehicle fleet (see section 2.6).

		BLOCK 1 - 58 DAYS																																																													
		M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S	M	T	W	Th	F	S	S
Vehicle ID	Trial day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
	Vehicle type																																																															
B1	BEV	1																																																													
B2	BEV	2																																																													
B3	BEV	3																																																													
B4	BEV	4																																																													
B5	BEV	5																																																													
B6	BEV	6																																																													
B7	BEV	7																																																													
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B21	BEV		21																																																											
B22	BEV		22																																																											
P1	PHEV	1																																																													
P2	PHEV	2																																																													
P3	PHEV	3																																																													
P4	PHEV	4																																																													
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P22	PHEV		22																																																											
P23	PHEV		23																																																										

Figure 8: Illustration of Block 1 structure for running Consumer Charging Trials at TRL (comparative block will also simultaneously take place at Cenex)

2.5.2 Trial running phase

2.5.2.1 Vehicle handovers

This section describes the standardised vehicle handover process which will be used for the Consumer Charging Trials.

Vehicle handover

1. Participants will arrive at local trial headquarters (TRL or Cenex) at the date and time specified. On arrival participants will be met by the researcher.
2. If participants are storing their personal vehicles with the research team for the duration of the trial, they will be directed to the secure parking area. A researcher will accompany the participant on a walk-around of their personal vehicle to ensure that the existing condition of the vehicle, including any damage, is noted. If necessary, photos of the vehicle will be taken and saved in the secure project area. The mileage of the vehicle will also be recorded. The participant will be asked to sign a form confirming the current condition of their vehicle. One copy of this form will stay with TRL and one copy of this form will be given to the participant. The researcher will take the keys to the participant's vehicle and add a key tag with the vehicle details. The keys will then be stored in a secure location.
3. Participants will be met by a member of the research team. As requested in the letter in the Participant Information Pack (see Appendix C), participants will be asked to provide their driving licence and DVLA authorisation "check code". A member of the research team will then verify the licence details online. To do this they will need the last eight characters from the driving licence and the "check code". This will confirm the vehicles that the participant can drive, and any penalty points or disqualifications. Participants will also be asked to provide another form of ID to confirm their identity and address (e.g. utility bill or bank statement). If the participant wishes to add an additional driver in the household to the insurance they will be asked to provide the additional driver's licence and DVLA authorisation "check code" also.
4. Participants who do not store their own vehicles with the research team for the duration of the trial will be asked to send photographic evidence of their own vehicle's mileage – this will also be requested at the end of the trial to serve as an additional check that they used the trial vehicle and not their own vehicle.
5. Participants may arrive either in their own car, in a friend or partner's car, or by public transport. In the event that they are dropped off on site by a partner or friend (for example), if the partner or friend wishes to wait, then they will be asked to park in the visitor parking area and wait in reception.
6. Participants will be asked to undertake an eyesight test, to the standard required in the current driving test. If they are unable to successfully pass this test they will not be allowed to drive the vehicle. They will be given the option of either not participating in the trial or returning at a later time and trying again with their corrective eyewear.
7. Assuming the licence and eyesight checks are passed, participants will then be given a PowerPoint presentation by the researcher. The presentation will cover background information about the trial, what is expected of the participant and a comprehensive

health and safety briefing. On completion of the presentation, participants will be assigned to a researcher. The researcher will be responsible for providing the participant with further information about the vehicle they will take away.

8. Participants will complete a walk-around inspection of the trial vehicle condition, including an interior inspection, with the researcher. The condition of the vehicle and any existing damage will be noted on the vehicle condition form. In addition, the vehicle mileage, fuel level (if applicable), and battery charge level will be noted, and the presence of key equipment will be checked. The participant will be asked to sign that they agree with the description of the vehicle condition and will be given a duplicate copy of the vehicle condition form.
9. Researchers will then provide participants with an explanation of the vehicle controls and key features. Researchers will follow a set protocol in order to ensure that information given to participants is standardised and accurate (see Appendix E).
10. Participants will be familiarised with the features and controls unique to the BEV and PHEV vehicles. They will also be given a demonstration of how to access the charging port on the vehicle, locate the charging cable, how to safely plug in the charging cable at both the vehicle and chargepoint ends, and how to remove the charging cable on completion of charging. Researchers will make sure that BEV and PHEV participants are familiar with the in-vehicle displays of battery SOC and range. This will also include providing them with information on the AER of the vehicle and the likely impact when operating it under various driving conditions (e.g. urban driving vs. motorway driving).
11. Participants will be briefed on the reward points system (see section 2.8); for participants in the UMC and SMC experimental groups this will also include a full demonstration and explanation of the User App.
12. On completion of the vehicle briefing, participants will be asked to take the vehicle for a short familiarisation drive, accompanied by a researcher, to ensure that they have understood how the vehicle operates and are comfortable with driving the vehicle. The familiarisation drive will also give the researcher the opportunity to appraise the driving of the participant and assess whether it could be considered unsafe, or if any illegal manoeuvres are performed. If the driving of the participant is unsafe or illegal, on return to the trial headquarters the researcher will alert the researcher and the participant will be notified that they will not be able to take part in the trial.
13. On completion of a successful familiarisation drive the participant will be issued with the In-vehicle Information Pack (see Appendix I). The pack will include key information about how the vehicle operates, how to charge it (if applicable), health and safety information, and a list of key contacts, including what to do in the event of a breakdown or incident.
14. The PHEV trial vehicles will be given to participants with a full tank of fuel. Both the BEV and PHEV vehicles will have a SOC of at least 80%. Participants will be asked to return the vehicles with the same amount of fuel, and as much charge as possible.
15. On completion of all briefing and handover activities, the participant will be given the opportunity to ask any questions and will then sign a consent form (see Appendix I). The researcher will check-out the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix M).

16. Participants will take the vehicle away for use during their normal day-to-day activities for a period of 8 weeks.

Follow-up

17. At 3 days and 10 days into the trial, the research team will telephone each participant to check how they are getting on with the vehicle, the chargepoint and the User App (in the case of UMC and SMC participants).

Return of vehicle

1. Participants will return the vehicle to TRL/Cenex at a pre-arranged time at the end of the 8-week period. Participants will be met by a researcher who will accompany them on a walk-around of the vehicle, and interior inspection, to check the returned condition against the condition of the vehicle when it was taken away. If there is any new damage to the vehicle this will be recorded and the participant will be encouraged to provide an explanation. If the damage requires repair, the participant will be notified that they may be liable for any costs up to the agreed maximum excess (see Appendix C for insurance summary sheet).
2. Researchers will record the mileage, fuel level and charge level of the vehicle (as applicable), and will check all original equipment (owner's manual, first aid kit, locking wheel nut, and charge cables) is still with the vehicle.
3. The researcher will check-in the vehicle on the Admin Portal noting the Participant ID and the Vehicle ID (see Appendix M.
4. The reward points which participants accumulated over the course of the trial (see section 2.8) will be converted to cash.
5. Where applicable, participants will be shown to their personal vehicle by a researcher who will accompany them on a walk-around of the vehicle, and interior inspection, to check the current condition against the condition of the vehicle when it was first brought in by the participant. If there is any new damage to the vehicle this will be recorded and the participant will be notified that an investigation will be undertaken. The participant will be notified that TRL will organise and cover the costs of repairing any damage.
6. The researcher will log the date and time of collection of the participant's personal vehicle along with the Participant ID.
7. Participants will be notified that the final questionnaire (Time point 2) will be sent to them by email within one week and that upon completion they will receive a £50 Amazon voucher.

2.5.2.2 Vehicle safety checks and cleaning

There will be five days between each block of participants (see section 2.5.1.2). During these transitionary periods, safety checks will be performed on all the vehicles. This will cover items such as tyre wear and condition, seatbelt functioning, lights, and oil, coolant and washer fluid level, as well as valeting. A copy of the vehicle checklist can be found in Appendix L. More extensive maintenance and servicing will also be arranged where necessary.

All vehicles will also be given an interior and exterior valet by a third-party valet company.

2.5.3 Participant close-out phase

2.5.3.1 Participant debrief

Upon receipt of the completed Time point 2 questionnaires, participants will be given a £50 Amazon voucher as compensation for their time. Participants will be sent a debrief letter to thank them for their time and confirm what will happen to their data and when the findings of the research will be published. A copy of this letter is provided in Appendix P.

2.6 Vehicle management

2.6.1 Trial vehicle fleet

During Stage 1 of the CVEI project, a market analysis of BEVs and PHEVs available in the UK was performed to identify possible vehicles for the trials. Since B- and C-segment vehicles account for approximately 35% and 25% of the UK vehicle fleet, respectively (Society of Motor Manufacturers and Traders, 2015), a shortlist was developed using B and C-segment vehicles only (see Table 8)[32].

Table 8: B- and C-segment BEVs and PHEVs in the UK market (April 2016)

Make	Model	Base variant	Segment	Electric range (miles)	List price (£)
Plug-in Hybrid Electric Vehicles (PHEVs)					
Audi	A3	Sportback e-tron 1.4 TFSI 150PS S Tronic	C	31	35,690
Volkswagen	Golf	1.4 TSI GTE DSG	C	31	33,995
Battery Electric Vehicles (BEVs)					
BMW	i3	127kW Auto	B	118	30,980
Ford	Focus	107kW Auto	C	100	31,145
Kia	Soul	EV 81.4kW Auto	B	132	29,995
Mercedes-Benz	B-Class	Electric Drive B250 eSport Auto	C	124	32,275
Nissan	Leaf	Visia 80kW Auto	C	124	25,790
Renault	Zoe	Expression Nav 65kW Auto	B	149	18,445
Volkswagen	Golf	e-Golf 85kW Auto	C	118	31,650

This market analysis identified 7 models of BEV and 2 models of PHEV (with an official stated electric range of at least 50km) available in the UK and classified as either B- or C-segment

[32] PHEVs were limited to those with at least 50km of electric range.

vehicles. The VW Golf GTE is one of the only C-segment PHEVs with an official stated electric range greater than 30 miles. The only other C-segment PHEV is the Audi A3 Sportback, which is a premium version of the VW Golf GTE.

The VW Golf is also the only vehicle to offer comparable models of BEV and gasoline PHEV. Use of the BEV equivalent to the PHEV Golf GTE (i.e. the e-Golf) is the optimal choice since it allows identical data collection methodologies to be employed between the two Consumer Charging Trials, and between the Consumer Charging Trials and the Consumer Uptake Trial (where similarities between vehicle models are more important – see Part 1 of Deliverable D5.1).

As such, the Consumer Charging Trials will use two variants of the Volkswagen Golf; the 'e-Golf' BEV and 'Golf GTE' PHEV. The two models are identical in functional capability (other than the drivetrain differences) and are (as closely as possible) matched in trim (see Appendix C). The battery specifications of the PHEV and BEV models are shown in Table 9.

Table 9: Vehicle manufacturer reported battery specifications for PHEV and BEV

Manufacturer reported specification	VW Golf GTE (PHEV) – 2016 model	VW Golf GTE (PHEV) – 2017 model	VW e-Golf (BEV)
Nominal Capacity, i.e. units to full charge (kWh)	8.7	8.7	35.8
Maximum AER (miles)	31	31	186
Expected AER (miles)	25	25	175
Time to full charge (AC - 2.3kW) (hours)	3.75	3.75	17
Time to full charge (AC - 3.6kW) (hours)	2.25	2.25	10.5
Time to 80% charge (DC) (hours)	n/a	n/a	0.75

The vehicle fleet will consist of a total of 90 new Volkswagen Golf vehicles; 45 PHEV GTE models, and 45 BEV e-Golf models, split between TRL and Cenex - see Table 10. The vehicles will be leased directly from Volkswagen Group Financial Services (VGFS) for a period of 12 months commencing between February and April 2017. The manufacturer's warranty will cover all vehicles for the duration of the trial. Vehicle maintenance and servicing will be covered under the terms of the lease agreement; Volkswagen dealerships local to TRL and Cenex have been assigned and will be used for this purpose. Servicing or maintenance will, wherever possible, be scheduled in-between participant experiences or blocks so as to minimise disruption to the trial. The lease agreement will also provide comprehensive breakdown cover and tyre replacement; participants will be provided with full details of this cover (and what to do in the event of an incident) as part of the In-vehicle Information Pack (see Appendix I).

Table 10. Consumer Charging Trials vehicle fleet

Model		Total number	Number at TRL	Number at Cenex
VW e-Golf	BEV	45	22	23
VW Golf GTE	PHEV	45	22	23

The Consumer Charging Trials will be run from the end of September 2017 to March 2018. Once the full sample of 200 participants has been achieved in the Consumer Uptake Trial, the BEVs and the PHEVs in that trial fleet will be made available to the Consumer Charging Trials. This will provide an additional 12 BEVs and 12 PHEVs as contingency should any delays arise, or additional sampling of participants in particular categories or charging conditions be needed.

2.6.2 Vehicle storage

Trial vehicles will be stored at TRL's head office in Crowthorne, Berkshire and at Cenex's offices on the campus of the University of Loughborough in Leicestershire. Where necessary (see section 1.5.1.1), participants' personal vehicles will also be stored at either the Crowthorne House site or the University of Loughborough campus for the duration of the trial, or at a secure location in close proximity. As part of the vehicle handover process, participants' vehicles will be inspected on arrival to record any damage and log the mileage. Keys will be tagged with participant and vehicle details and locked in secure storage. For some participants, vehicle storage will not be necessary as their own vehicle will remain at their household.

2.6.2.1 TRL

At TRL, both trial vehicles and participants' vehicles will be kept in allocated spaces in the main Crowthorne House car park and a secure storage yard in close proximity to TRL. Crowthorne House is a secure site; the reception is manned 24 hours a day by security personnel, there is full CCTV coverage across the site, including the car park, and there are regular foot patrols undertaken by the security team. The site also has access control outside of working hours. Trial vehicles will be given priority access to four Mode 3 chargepoints located in the Crowthorne House car park to ensure they can be fully charged before handing over to participants. There are a further four chargepoints at TRL's premises which can be used if required. At the off-site secure storage location, high security fencing and CCTV will be provided at all times and the site manned during working hours. Chargepoints will also be installed for trial purposes.

2.6.2.2 Cenex

At Cenex, trial vehicles and participants' vehicles will be kept on the second floor of Car Park One at the west end of Loughborough University campus. Loughborough University is a secure site with a strict traffic enforcement policy that includes gated access for vehicles and a dedicated automatic number plate recognition (ANPR) security and parking permit system. Loughborough campus is manned and patrolled 24 hours a day by security personnel, there is full CCTV coverage across the site, including Car Park One, and there are regular drive-by patrols of the multi-storey car park undertaken by the security team. The site also has access control outside of working hours. Trial vehicles will be given priority access to two Mode 3 chargepoints located on the second floor of Car Park One to ensure they can be fully charged before handing over to participants. There are a further 17 chargepoints on university campus property that can be accessed if required.

2.7 Vehicle charging

The e-Golf (BEV) and the Golf GTE (PHEV) will be supplied with both Mode 2 and Mode 3 charging cables. Participants will be able to charge the vehicle at home (via the dedicated Mode 3 chargepoint), at public chargepoints or at other locations with suitable charging facilities (such as their work place). At vehicle handover, the research team will provide participants with a demonstration of how to charge the vehicles; hard-copy instructions will also be provided to participants as part of the In-vehicle Information Pack.

2.7.1 Charging at home

For long-term use of plug-in vehicles, Mode 3 charging (involving the use of a dedicated PiV charging station with its own circuit) is the recommended method for domestic charging. For the purposes of the Consumer Charging Trials, a dedicated Mode 3 chargepoint will be installed in participants’ homes to enable them to safely charge the BEV/PHEV during the 8-week trial. Domestic chargepoints currently available in the EVSE market are typically rated for 3.6kW or 7.2kW power transfer. It is predicted that 7.2kW installations will become more common in UK homes over the next few decades. But, at present, many households in the UK, particularly those older than 20 years, will not have the capacity to accommodate 7.2kW charging since they are likely fused for a maximum current draw of 60A. A 7.2kW chargepoint brings a current draw of approximately 30A on its own; therefore the maximum of 60A will likely be exceeded if a 7.2kW chargepoint is used in combination with other electrical appliances in the household.

As such a 3.6kW chargepoint is the most appropriate option since the domestic wiring circuits of most UK households should be able to cope with this level of charging without any overall strain being put on household power consumption, or any increase in safety risk. This means a broader pool of participants will be available to take part in the study, even if they live in older houses or houses without a high capacity wiring system; thus maximising the ability to recruit a representative sample of Mainstream consumers. Using a 7.2kW chargepoint would either have ruled out a number of potential participants, or would have incurred time and cost penalties associated with upgrading domestic wiring.

Mode 3 chargepoints will be supplied and installed by Rolec Ltd and their installation partner ChargedEV (a trading name of Hybrid Energy Solutions Ltd, company registration no. 09666725). Further information about the installation process is provided in section 2.5.1.

The domestic chargepoints in participants’ homes will be controlled by a bespoke Chargepoint Management System (CPMS) developed for the purposes of the Consumer Charging Trials by EV Connect. This is described in more detail below.

2.7.2 Chargepoint Management System (CPMS)

The Chargepoint Management System (CPMS) is a cloud-based system which will be used to manage individual charging operations, process information from and feed information to the User Interface (smartphone app), collect and process data from the vehicles and chargepoints, and save data to the research database. An overview of the interactions between the CPMS and other components of the wider system is shown in Figure 9.

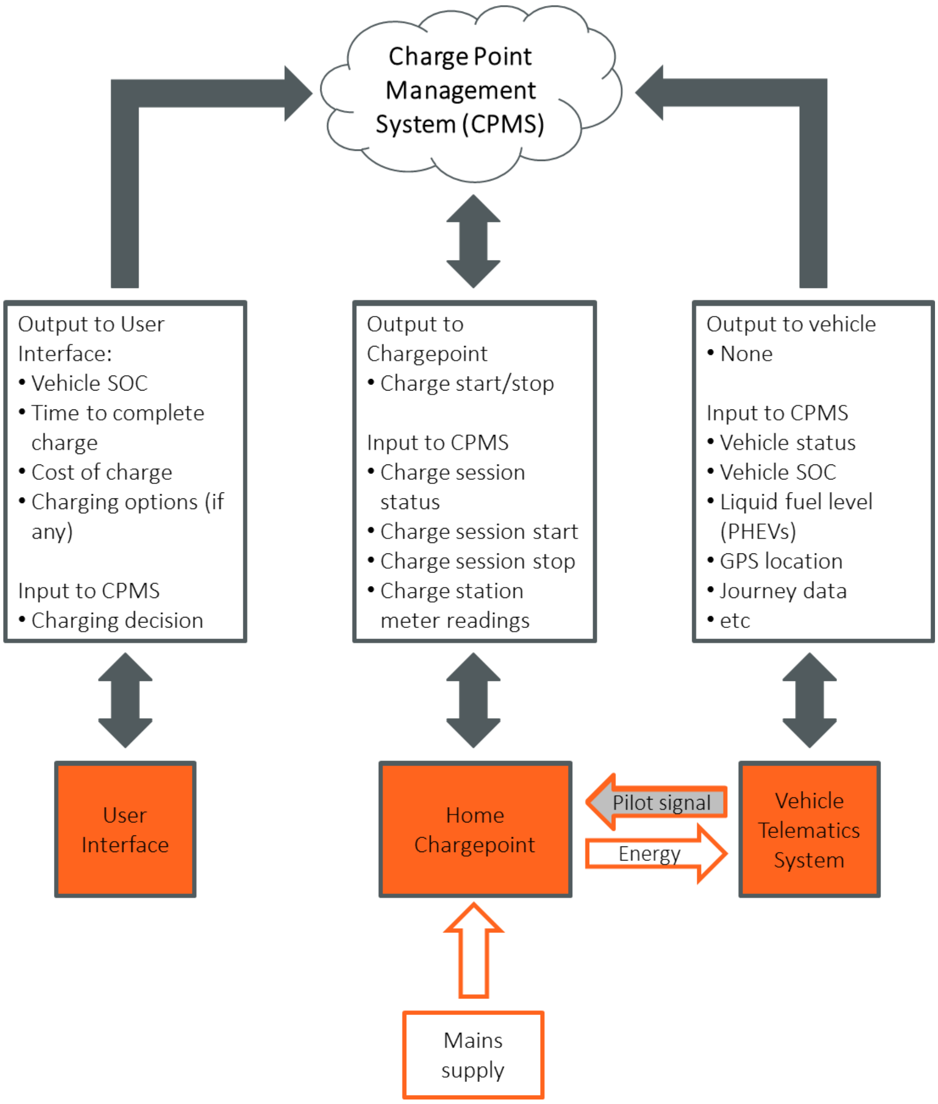

Figure 9: **Overview of interactions between CPMS and other components**

The CPMS will interact with the vehicles, the drivers who operate the vehicles, the chargepoints, and the smartphone 'User App' interface. Specifically, it will act as intermediary between all of the components and will log all interactions:

- The vehicle will communicate location, status and other relevant information to the CPMS.
- Vehicle information will be processed and served to the driver from the CPMS through a mobile application on their smartphone enabling the driver to make decisions about charging their vehicle.
- Decisions from the driver will be processed by the CPMS which controls the chargepoint.
- Regularly updated status from the vehicle will be received by the CPMS and used to control chargepoint behaviour.
- Charge session status is used to inform the driver of charging progress.

The participants' charging decision inputs (UMC and SMC groups only) will be sent to the CPMS via the User App. The CPMS will send notifications to the user upon each plug-in at home, requesting the user's charging preferences for that particular session. If no user inputs are recorded by the CPMS within 15-minutes after plug-in, then the default values will be selected. Further information about the User App is provided in section 2.9.

In the Control group, charging will begin immediately upon plug-in; the CPMS will log the start and end of the charge session, and will feed SOC data (received every 5 minutes from the vehicle telematics dongle) to the User App when the user presses 'Refresh' on the SOC page (see section 2.9.2).

In the UMC group, charging will either begin immediately (if participants choose to 'Charge Now') or it will be scheduled on the basis of 'Start Time' and 'Stop Time' inputs (either default inputs or new inputs from the user) (see section 2.9.3). This information will be fed into the CPMS so that the system knows when to start (and stop) charging the vehicle. If no stop time is requested by the user, then the system will charge the vehicle until it reaches 100% or until the user ends the charge session (e.g. by plugging out).

In the SMC group, charging will either begin immediately (if participants choose to 'Charge Now' or it will be scheduled on the basis of 'Desired SOC' and 'Departure Time' inputs (either default inputs or new inputs from the user) (see section 2.9.4). Using these inputs, the CPMS will define:

- a 'Charging Requirement'; the number of hours of charge needed to charge the battery from the current SOC (obtained via the Vehicle Telematics System – see right-hand side of Figure 9 to the Desired SOC (input from User App), and:
- a 'Time Window'; the amount of time available for charging from the current time to the required departure time.

Using these parameters, the CPMS will then generate appropriate commands to the chargepoint. The Charging Requirement will be delivered at the end of the Time Window, minus a one-hour buffer. For example, if the Charging Requirement is 5 hours, and the Time Window is 10 hours (2000 to 0600), the CPMS will deliver the 5 hours of required charge between 0000 and 0500, allowing a one-hour buffer before the Time Window ends at 0600.

The delivery of charge in the SMC group (as described above) differs from the way in which the Savings Points will be calculated for SMC participants (see section 2.8.3). From the user experience perspective, it is important for the SMC condition to simulate the inconvenience to the user of not having full control of precisely when the charge is administered. This is achieved with the proposed charge delivery system since it ensures that charging in the SMC group is delayed from the time of plug-in for most use cases. The one-hour buffer is provided so that users are not inconvenienced (by having lower SOC than requested) if they make a minor variation in departure time, but are inconvenienced if they choose to end the charging event and start using the vehicle more than an hour before the time they specified. Critically, the solution ensures the system is simple to implement for the purposes of the trial, and minimises the risk of system faults.

2.7.3 Public charging

Participants will be given free access to the 'POLAR plus' public charging network via a membership card or key fob which will be provided with each vehicle. POLAR is the UK's largest public charging network and contains thousands of charge points across the UK, ranging from 3-pin and Type 2 sockets, to their rapid charger, The Ultracharger. POLAR plus customers can also access the Charge Your Car (CYC) network of charge points.

The POLAR network gives access to over 5,000 chargepoints across the country. Maps showing the location of POLAR network chargepoints in the areas surrounding TRL and Cenex are shown in Figure 10 and Figure 11, respectively.

TRL will register an account for each vehicle on a monthly subscription, which is free for the first six months. Around 80% of the network's charge points are free to use. Charge points requiring payment cost 9p per kWh and will be charged directly to the TRL account; participants will not be directly charged for the use of public charge points in this trial. Participants will be directed to the POLAR plus map web page (https://polar-network.com/map) during vehicle handover so that they are aware of how to find a local public charge point.

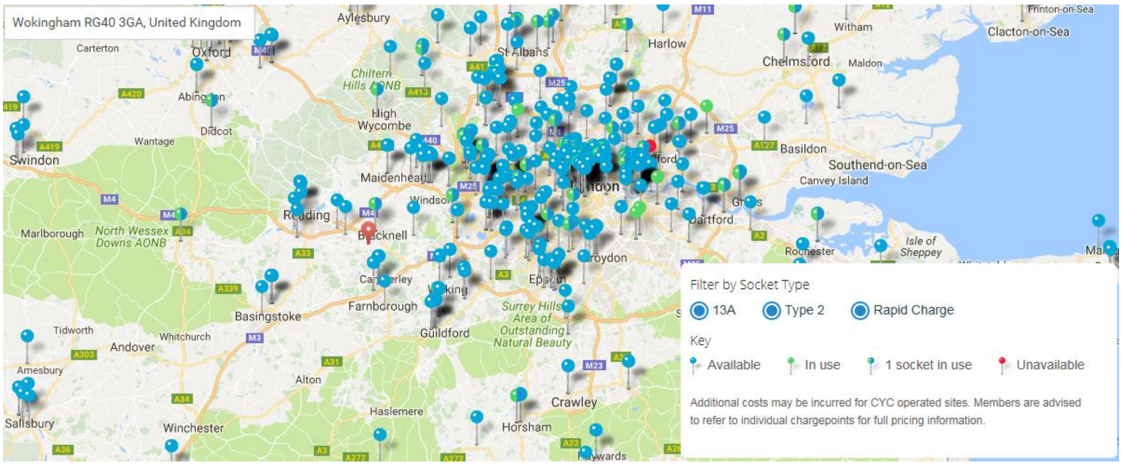

Figure 10: Location of public chargepoints on POLAR network in area surrounding TRL

Figure 11: Location of public chargepoints on POLAR network in area surrounding Cenex

2.8 Experimental conditions and reward points logic

2.8.1 Overview of experimental conditions

Both the PHEV Consumer Charging Trial and the BEV Consumer Charging Trial will employ identical experimental conditions. The detail provided in this section therefore applies to both trials. Trial participants will be randomly allocated to one of three groups; the group into which participants are allocated will determine the Managed Charging schemes (experimental conditions) which they will experience during the trial (see Table 11).

Table 11: Experimental conditions

Group	Description
Control group	Participants will be free to charge when they want, with no financial or other incentives for charging in a particular way (although they will be incentivised to meet minimum weekly usage requirements). This will establish a baseline for energy use and charging behaviour when there are no constraints placed on the consumer, so that comparisons can be made with each of the experimental groups.
User-Managed Charging (UMC) group	Participants will be encouraged to actively manage their charging, through the provision of a banded tariff that gives them financial incentives to charge at particular times of day. This will be used to understand energy use and charging behaviour when consumers are encouraged to engage with a User-Managed Charging scheme[33].
Supplier-Managed Charging (SMC) group	Participants will be encouraged to delegate management of their charging to the (simulated) energy supplier. Participants will be provided with financial incentives for relinquishing control[34] over when their vehicle is charged, and plugging in at the most appropriate times of day This will be used to understand energy use and charging behaviour when consumers are encouraged to engage with a Supplier-Managed Charging scheme.

As discussed in section 1.5.2, the design of the Consumer Charging Trials must consider the seasonal variation in charging behaviour, PiV use and energy prices (see Deliverable D7.1 for detailed discussion on the seasonal variation in energy prices). Of particular importance are the distinct differences in energy prices between 'summer' and 'winter' periods. In the winter, there are much higher daily price differentials than in the summer period, and there are sharp transitions in prices between the summer and winter periods.

It is therefore necessary to ensure that these periods are equally represented in the trial, and so the control, UMC and SMC groups will be further divided into two sub-groups. The distribution of participants across these sub-groups is shown in Table 3. The allocation of participants to the control, UMC and SMC groups will be evenly split across all three blocks.

[33] Savings available in the UMC and SMC conditions will be based on PiV charging behaviour; it will not be possible for participants to make additional savings by shifting other elements of their total household electricity demand. This may well be reflected in real-world MC offers, since it is perhaps easier to time-shift PiV charging demand than other elements of household electricity demand.

[34] As discussed earlier, "control" here, and throughout this document, is used not in relation to any specific theoretical construct, but rather to reflect the language used by participants in the Stage 1 qualitative study.

All participants in Block 1 and half the participants in Block 2 (see section 2.5) will be assigned to the 'summer' sub-groups. The other half of participants in Block 2, plus all participants in Block 3 will be assigned to the 'winter sub-groups. This means that the seasonal variations in energy prices throughout a year (reflected in the differences between the summer and winter periods) will be captured in the trial and approximately aligned to the actual summer and winter seasons in the UK.

Participants in all groups will receive incentives for taking part in the trial; incentives will be given in the form of compensation for taking part in the trial (via Amazon vouchers) and reward points for engaging in particular charging behaviours (depending on which experimental group they are in) (see section 2.3). This section describes the process for earning reward points in the control, UMC and SMC groups. In the control group, they will be called 'Participation Points', and in the SMC and UMC groups they will be called 'Savings Points'.

2.8.2 Control group

In the control condition, participants will be free to charge their vehicle as they wish, with no incentive for charging in a particular way.

The incentive scheme in the Control group will be linked to a minimum vehicle usage requirement as opposed to a minimum charging requirement. This is particularly important for the PHEV Charging Trial; in this trial, it is possible that some participants will choose not to charge the PHEV by plugging it in, and instead operate the vehicle like a HEV or pure petrol vehicle. Instigating a minimum charging reguirement in the PHEV control group could therefore bias the findings by deterring this behaviour. In the case of the BEV Charging Trial, driving the BEV directly links with a requirement to charge and so this bias is not an issue, however for simplicity it is beneficial to employ the same incentive structure across the two trials.

Hence, participants in both the PHEV and BEV control groups will be asked to use the vehicle for their normal day-to-day journeys, driving at least 50 miles per calendar week (Monday-Sunday). For each week during the trial in which they meet the minimum usage requirement Control group participants in the BEV and PHEV Charging Trials will accumulate 'Participation Points'. Each week they will be able to accumulate 20 Participation Points worth £18.75 (£150 split evenly over the 8 week period). Participation Points will accumulate over each week in the trial period and will be administered upon return of the vehicle at the end of the trial. Therefore, participants who meet the usage requirement in every week of the trial will earn a total of 8 x 20 = 160 Participant Points, worth £150 cash.

2.8.3 Supplier-Managed Charging (SMC)

In the SMC condition, participants will be able to reduce the cost of their energy bill by relinquishing control of their charging to the simulated energy supplier; the system will then optimise the participants' charging so as to deliver the maximum savings available (via Savings Points).

Savings points awarded will be the weighted sum of two elements, X and Y. "X" Savings Points represent the actual savings that the supplier has been able to make during the charging event by manipulating the timing of charging. Recognising that these savings may vary considerably from charging event to charging event (so making it difficult for the consumer to link savings achieved to their behaviour – their required SOC and the length and timing of the charging window they provide) an additional element "Y" is added that makes the savings more closely coupled to these behaviours. It is anticipated that different suppliers may seek different balances between these ways of offering savings; for the purpose of the trial, the weightings of the X and Y contributions will be equal.

Savings Points (SP) will be calculated retrospectively for each charging event in the SMC condition using the following formula:

$$\mathbf{SP = w_1k_1X + w_2k_2Y}$$

Thus, Savings Points (SP) will consist of four elements:

1. The actual savings to the supplier (relative to an assumed counterfactual) associated with the actual charging for that day (X)
2. The Option Value to the supplier associated with the available window for charging, taking into account the time of day and length of the window for which the vehicle is available for charging (Y)
3. Pass through factors set by the supplier (k_1 and k_2)
4. Weightings that reflect the balance of the (unpredictable) actual savings and the (predictable) expected savings (where $w_1 + w_2 = 1$).

Participants will be provided with information on the Savings Points earned in the previous charging event and the cumulative Savings Points earned to date, via the App.

2.8.3.1 Variable savings based on actual charging costs incurred (X)

Hourly energy prices (p/kwh) for the trial year (2030) are represented in the Price Series Model (the Model is Deliverable 7.1; the basis of the model is explained in the associated supporting slides which are included as Appendix Q). This model indicates the price of energy in hourly time intervals for each hour of each day for a full year. The structure of the Price Series Model is shown in Table 12.

Table 12: Structure of 12-month SMC Price Series Model for trial year 2030 (full set of prices can be found in Deliverable D7.1)

Time	Energy prices (p/kwh) for each day in trial year 2030			
	01/01/30	**02/01/30**	**…**	**31/12/30**
00:00	7.18	7.58		7.15
01:00	7.18	7.58		7.14
02:00	7.18	7.57		7.13
03:00	7.16	7.60		7.16
04:00	7.34	7.84		7.82
05:00	8.45	8.46		7.91
06:00	14.81	8.69		9.86
07:00	11.72	12.46		12.20
08:00	13.68	12.71		12.46
09:00	13.64	12.04		12.57

10:00	11.57	11.61		12.57
11:00	11.45	11.54		12.57
12:00	13.64	12.10		12.57
13:00	13.64	12.26		12.57
14:00	15.75	12.82		12.57
15:00	27.26	19.98		13.13
16:00	57.26	41.02		31.92
17:00	49.53	48.19		32.16
18:00	35.23	34.59		29.34
19:00	12.22	12.31		13.97
20:00	10.28	11.55		9.69
21:00	8.81	8.83		10.81
22:00	8.49	7.96		7.27
23:00	7.25	7.84		7.11

Appendix Q provides full explanation of how the Price Series Model was developed for the purposes of the trial.. The Price Series Model contains distinct but equally proportioned ‘summer’ and ‘winter’ periods. Thus, for half of the participants (20 in the BEV Consumer Charging Trial and 20 in the PHEV Consumer Charging Trial), energy prices from the summer period of the Price Series Model will be used. For the other half, the energy prices from the winter period of Price Series Model will be used[35] (thus defining two sub-groups within SMC – see section 2.8.1). Two composite 9-week[36] price series will be used for this purpose; one reflecting the energy prices in the summer period and one reflecting energy prices in the winter period. Due to the differences in energy prices between the summer and winter periods, this will also enable investigation of consumer behaviours in SMC conditions with both high and low levels of total potential reward; for participants in the summer sub-group, Savings Points will be based on low energy price differentials, and for participants in the winter sub-group, Savings Points will be based on high energy price differentials.

Since this will have an impact on the total level of incentive available to participants in the ‘summer’ period compared to those in the ‘winter’ period, the level of the ‘top-up’ payment made on debrief will be adjusted between these two sub-groups to ensure that each participant has overall a similar size of incentive (see section 2.3).

For each plug-in event, the users will specify when they next need the vehicle (the departure time) and the state of charge (SOC) they need by that time[37]. This will define a:

[35] A configuration selector in the Admin Portal (see Appendix M) will be set at vehicle check-out to determine which series will be used for each participant – this will also be used for the same purpose in the UMC condition.

[36] The day of the week in which participants start the trial will vary, so a 9-week series was chosen to ensure that prices are available for a full 8-week period, irrespective of the day on which participants start the trial in week 1.

[37] Evidence from previous trials suggests that BEV users find SOC easier the work with than “range”, since the available range reported by vehicles is heavily dependent on type of driving, and thus less reliable a measure

- **Time Window;** in which the vehicle is available for charging, and a;
- **Charging Requirement**; the number of hours of charge which the system must deliver within the Time Window (dependent on the initial SOC when the vehicle is plugged in at the start of the Time Window, and the required SOC).

The system will look at the energy prices within the Price Series Model and identify the cheapest hours within the Time Window in which to deliver the Charging Requirement.

For example, if the Time Window is 12 hours, and the Charging Requirement is 5 hours, then the system will select the 5 lowest prices from the Price Series Model which fall within the 12-hour Time Window.

The Actual Charging Cost (A) will be determined by the sum of the lowest prices identified from the Price Series Model. For each given charge event, the Actual Charging Cost will then be compared to the Baseline Cost (B_{SMC}). The Baseline Cost will be determined by the cost of charging if the Charging Requirement was delivered as soon as possible within the Time Window.

For example, if the Time Window is 12 hours, and the Charging Requirement is 5 hours, then the Baseline Cost will be calculated by summing the first 5 hours of energy prices from the Price Series Model which fall at the start of the 12-hour Time Window.

Thus the value of X, will be calculated using the following formula:

$$\mathbf{X = B_{SMC} - A}$$

Participants who provide greater flexibility to the system (i.e. longer Time Windows relative to the Charging Requirements), will have a better chance of maximising the value of X, since there will be more opportunity to charge across lower price periods. The level of reward for a given availability window will vary day-to-day throughout the 8-week trial, based on the underlying price series.

X Savings Points reflect the users' share of the actual savings made in a particular charging event: they vary depending on:

(a) The user's charging behaviour – how much charge they require (the Charging Requirement), and the Time Window for which they make the vehicle available for charging; and;
(b) The actual, variable costs incurred by the supplier to provide that amount of charge during that Time Window.

By passing through this variation to the user, the supplier manages its risk associated with the unpredictability of hourly electricity costs.

This however has the disadvantage that participants will be less easily able to associate the value of X with their behaviours, and so the extent of implicit learning about how to maximise benefits will be limited unless a more predictable element is included within the calculation of Savings Points.

than SOC. Evidence also suggests that users develop an internal working model for the relationship of vehicle range to SOC, mediated by the type of driving, within two weeks of beginning regular use of a BEV.

2.8.3.2 *Fixed savings for making vehicle available to charge at optimum times of day (Y)*

For the reasons above, Savings Points will also incorporate an element, Y, which represents Estimated Option Values to the supplier associated with the available window for charging, taking into account the time of day and length of the window. The value of Y will not be subject to day-to-day uncertainty: if the participant has the same Charging Requirement and makes the vehicle available for the same Time Window on two different days, they will receive the same Y Savings Points. This will provide stronger reinforcement learning through experience in the trial.

Y Savings Points will also act as a reward for charging at times that have high Option Value (generally low electricity price).

A real-world CVP including a mechanism similar to the Y Savings Points would restrict the degree to which the Supplier passes on price risk to the consumer. Thus it seems reasonable to expect Suppliers to aim for some appropriate balance between X and Y mechanisms. Identifying an appropriate balance is beyond the scope of the present trial; the choice of a 50/50 ratio is subjective.

Estimated Option Values will be represented in an Hourly Value Model (Deliverable D7.1). Generally, times where the wholesale costs of electricity purchased by the supplier are low result in higher Option Values (which also need to account for variations in wholesale costs - an explanation of how these values will be calculated will be included in Deliverable D7.1). The Hourly Value Model will indicate the Estimated Option Value of charging in each hourly time interval for a typical weekday and a typical weekend day during the trial.

To account for seasonal variation of Option Values during the year, it is proposed that two sets of values are generated, thus giving two versions of the Hourly Value Model:

1. Hourly Value Model 1 (‘summer’)
2. Hourly Value Model 2 (‘winter’)

These Hourly Value Models are shown in Table 13. Participants in the summer sub-group will accumulate Y Savings Points based on Hourly Value Model 1, and participants in the winter sub-group will accumulate them based on Hourly Value Model 2[38].

The system will sum the Option Values from the Hourly Value Model within the Time Window for which the Charging Requirement could be delivered. Charging Event Option Value (Y) will then be given by:

> Y = sum of highest hourly option values in Time Window as needed to deliver Charging Requirement

Thus, the greater flexibility a participant provides to the system (i.e. the bigger the Time Window relative to the Charging Requirement) at times when the Option Value is high, the bigger the value of Y, and the more Savings Points participants will earn. Participants who

[38] A configuration selector in the Admin Portal (see Appendix M) will be set at vehicle check-out to determine which Hourly Value Model will be used for each participant – this will also be used for the same purpose in the UMC condition.

perform identical charging behaviours throughout their participation will receive consistent values of Y.

The Y points awarded depend on the Charging Requirement, so that there is no perverse incentive to plug in for extended times when no substantial charge is needed.

Table 13: SMC Hourly Option Value Model (see Deliverable D7.1)

	Hourly Value Model 1 ('summer')		Hourly Value Model 2 ('winter')	
Time	**Summer Weekday Option Value (p/kwh)**	**Summer Weekend Estimated Option Value (p/kwh)**	**Winter Weekday Option Value (p/kwh)**	**Winter Weekend Estimated Option Value (p/kwh)**
00:00	2.65	2.65	9.58	9.74
01:00	2.67	2.66	9.61	9.80
02:00	2.68	2.74	9.63	9.81
03:00	2.67	2.71	9.61	9.76
04:00	2.38	2.48	9.12	9.59
05:00	1.63	1.83	8.40	9.05
06:00	1.17	1.14	6.61	8.00
07:00	0.62	1.35	3.23	8.11
08:00	-0.01	1.37	3.13	7.94
09:00	-0.33	1.28	3.09	8.02
10:00	-0.33	1.25	3.30	8.08
11:00	-0.37	1.20	2.78	8.20
12:00	-0.47	0.82	1.96	7.76
13:00	-0.54	0.57	1.03	7.92
14:00	-0.59	1.21	-0.03	8.20
15:00	-0.77	1.23	-33.87	8.05
16:00	-8.32	-6.78	-57.96	-0.85
17:00	-8.34	-7.31	-58.59	-0.74
18:00	-8.04	-7.23	-39.03	-0.20
19:00	-0.05	0.70	3.10	8.11
20:00	0.11	1.26	6.08	8.76
21:00	1.18	1.87	8.10	8.97
22:00	2.21	2.33	9.06	9.55
23:00	2.58	2.70	9.51	9.78

2.8.3.3 Pass through factors set by the supplier (k_1 and k_2)

These factors represent the level of savings that the supplier will pass through to the customer, taking into account target margin and risk premiums. In the Consumer Charging Trials $k_1 = k_2 = 1$ will be set (in the trials the pass-through is not directly to cash savings, but to Savings Points).

2.8.3.4 Weighting factors (w_1 and w_2)

The weighting factors w_1 and w_2 will be used to create the required balance between the "variable" X and the "static" Y. There is no ex-ante way to define the optimum split, so it is proposed that these be set as $w_1 = w_2 = 0.5$.

2.8.3.5 Feedback

Calculation of actual savings (expressed in Savings Points) will be retrospective. Participants will be provided with retrospective feedback on the Savings Points earned during the last charging event (see section 2.9).

2.8.4 User-Managed Charging (UMC)

In the User-Managed Charging (UMC) condition, participants will be able to reduce the cost of their energy bill by actively managing the charging of their vehicle so that their energy use is highest at times when the cost of energy is lowest. Savings will be delivered to the participants via the accumulation of Savings Points.

Savings Points (SP) will be calculated for each participant for each 24 hour period in the UMC condition using the following formula:

$$\mathbf{SP = k_3 Z = k_3(B_{UMC} - A)}$$

Thus, Savings Points (SP) for UMC will consist of one element made up of:

1. A function of the savings to the supplier (relative to an assumed baseline) associated with the actual charging for that day (Z)
2. A pass through factor set by the supplier (k_3)

Participants will be provided with information on the Savings Points earned in the previous charging event and the cumulative Savings Points earned to date, via the App.

2.8.4.1 A function of the savings to the supplier associated with the actual charging for that day (Z)

Hourly energy prices (p/kwh) for the trial year (2030) from the Price Series Model will be used to produce a Tariff Model (an explanation of how these values are calculated is included in Deliverable D7.1). This will indicate the price of charging in hourly time intervals for each hour of the day, organised into "bands", and split by weekdays and weekend days. The Tariff Model is shown in Table 14.

A real-world UMC Tariff Model would likely include summer and winter tariffs to reflect the seasonal structure in prices and daily price differentials seen in the Price Series Model. To reflect this in the trials, half of the participants will receive a "summer" tariff with low price differentials between bands, and the other half will receive a "winter" tariff with high price differentials between the bands.

Since this will have an impact on the total level of incentive available to participants in the 'summer' period compared to those in the 'winter' period, the level of fixed compensation for participation will be adjusted between these two sub-groups to ensure that each participant has overall a similar size of incentive.

For each plug-in event, the users will specify when they wish the charge to start (i.e. by choosing to charge immediately, or to delay charging to a specified time) and, if desired, when they wish charging to stop (i.e. by selecting a charge finish time, or selecting 'not required').

Table 14: UMC Tariff Model block prices with the winter tariff price differentials higher than the summer differentials (see Deliverable D7.1)

Time increment (hour)	Summer weekday charging cost (p/kwh)	Summer weekend charging cost (p/kwh)	Winter weekday charging cost (p/kwh)	Winter weekend charging cost (p/kwh)	Tariff band
00:00	8.27	7.90	9.27	7.93	Low
01:00	8.27	7.90	9.27	7.93	
02:00	8.27	7.90	9.27	7.93	
03:00	8.27	7.90	9.27	7.93	
04:00	8.27	7.90	9.27	7.93	
05:00	9.56	8.64	12.45	9.09	Standard
06:00	9.56	8.64	12.45	9.09	
07:00	9.56	8.64	12.45	9.09	
08:00	9.56	8.64	12.45	9.09	
09:00	9.56	8.64	12.45	9.09	
10:00	10.65	8.99	15.44	9.39	Medium
11:00	10.65	8.99	15.44	9.39	
12:00	10.65	8.99	15.44	9.39	
13:00	10.65	8.99	15.44	9.39	
14:00	10.65	8.99	15.44	9.39	
15:00	16.54	15.05	65.47	15.91	High
16:00	16.54	15.05	65.47	15.91	
17:00	16.54	15.05	65.47	15.91	
18:00	16.54	15.05	65.47	15.91	
19:00	8.27	7.90	9.27	7.93	Low
20:00	8.27	7.90	9.27	7.93	
21:00	8.27	7.90	9.27	7.93	
22:00	8.27	7.90	9.27	7.93	
23:00	8.27	7.90	9.27	7.93	

This will allow users to define a window within which they wish the vehicle to be charged, thus giving them the ability to limit their charging to, for example, one Tariff band whilst preventing charging in another Tariff band. This information, coupled with the current SOC of the vehicle (obtained via the telematics system), will define a:

- **Charge Start Time;** the time at which charging will begin;
- **Charge Stop Time;** the time at which charging will stop (irrespective of SOC), if applicable, and a;
- **Charging Requirement**; the number of hours of charge required to reach 100% SOC, or the number of hours between the Charge Start Time and Charge Stop Time (whichever is smaller).

The system will look at the energy prices within the Tariff Model, starting from the Charge Start Time and ending either at a time when 100% SOC will be reached, or at the Charge Stop Time, if the user specified one.

For example, if the user plugs in at 19:00, sets the Charge Start Time to 22:00, does not set a Charge Stop Time, and the Charging Requirement is 5 hours, then the system will look up the energy prices between 22:00 and 03:00.

Alternatively, if the user plugs in at 19:00, chooses to start the charge immediately, sets a Charge Stop Time of 23:00, then the system will look up the energy prices between 19:00 and 23:00.

The **Actual Charging Cost (A)** will therefore be determined by the sum of those prices identified from the Tariff Model. To estimate the value of savings achieved by the system for each given charge event, the Actual Charging Cost will be compared to the **Baseline Cost (B_{UMC})**. The Baseline Cost will be determined by the cost of charging at the High tariff in the Tariff model (the Baseline Tariff) which may be different for weekdays and weekend days[39].

> For example, if the Charging Requirement is 5 hours, then the Baseline Cost will be calculated by summing 5 hours at the Baseline Tariff.

Thus the value of Z, will be calculated using the following formula:

$$\mathbf{Z = B_{UMC} - A}$$

Participants who delay their charging to times when the energy prices are low (e.g. during the Low time band in the Tariff Model) will receive greater savings.

2.8.4.2 A pass through factor set by the supplier (k_3)

This factor represents the level of savings that the supplier passes through to the customer, taking into account target margin and risk premiums. In the Consumer Charging Trials $k_3 = 1$ will be set (in the trials the pass-through is not directly to cash savings, but to Savings Points).

2.8.4.3 Feedback

Users will be informed of the available Savings Points upon entering their required charging start time (and stop time, if applicable), based on the Charging Requirement calculated by the system. On completion of the charging event, the actual Savings Points acquired will be fed back to the participant via the User App (see section 2.9). Since UMC Savings Points are based on fixed tariff bands, actual Savings Points acquired will be the same as available Savings Points unless the vehicle is disconnected early, before the Charging Requirement has been met.

2.9 User App: Smartphone application

Participants in the UMC and SMC groups will interact with vehicle charging via a dedicated smartphone-friendly web application. The application will primarily be accessed on participants' mobile phones, however, access will also be possible via any computer, tablet or

[39] Savings versus. an average tariff would better represent reality. However, in the Charging Trials the intention is to determine the extent of the savings needed to shift consumers' charging times, so it is important to test the bounds of this by ensuring that savings are large enough to have a behavioural impact.

other web-browsing device. This will ensure participants can maintain control of their vehicle charging in the event that their mobile phone is damaged or lost during the trial.

The key purpose of the 'User App' is to allow participants in the SMC and UMC groups to adjust their charging preferences and engage with the managed charging scheme. A passive version of the app will also be provided for participants in the Control group; this will simply display the current vehicle status and SOC, allowing participants to monitor battery charge levels remotely.

VW operate a smartphone app called 'CarNet' which allows users of some VW vehicles (including the e-Golf and Golf GTE) to monitor vehicle status and control vehicle charging remotely. As such, to avoid conflict between the User App designed for the trials and this manufacturer-developed app, access to CarNet will be blocked for all participants.

Participants will access the User App through a URL provided by the research team. Full training on how to use the app will be provided at vehicle handover (see section 2.5.2.1), and participants will be given a User App Guide to take away with them (see Appendix I). The User App has been designed to be simple and easy to use. The following sections provide a full description of the interface which participants in each of the experimental groups will be given.

2.9.1 Login page

The home page will present participants with a request to login using their Participant ID and password (see Figure 12).

Login credentials will be provided to participants at vehicle handover and pre-programmed into the EV Connect platform using the Admin Portal (see Appendix M). Upon plug-in at the home chargepoint, users in the UMC and SMC groups will be sent an email notification containing a link to the User App URL. This link will have their Login ID embedded, so users will be required to enter their password only. Control group participants will not be sent an email notification, since they are not required to make any inputs at plug-in. The Login page includes a 'Remember me' function, so that users can save their login credentials if they wish to do so, meaning that they do not have to re-enter the password each time they access the app.

The subsequent pages which are accessible to the participant following login will depend on the experimental group to which they are assigned. The pages and features available to participants in each group are described in the following sections.

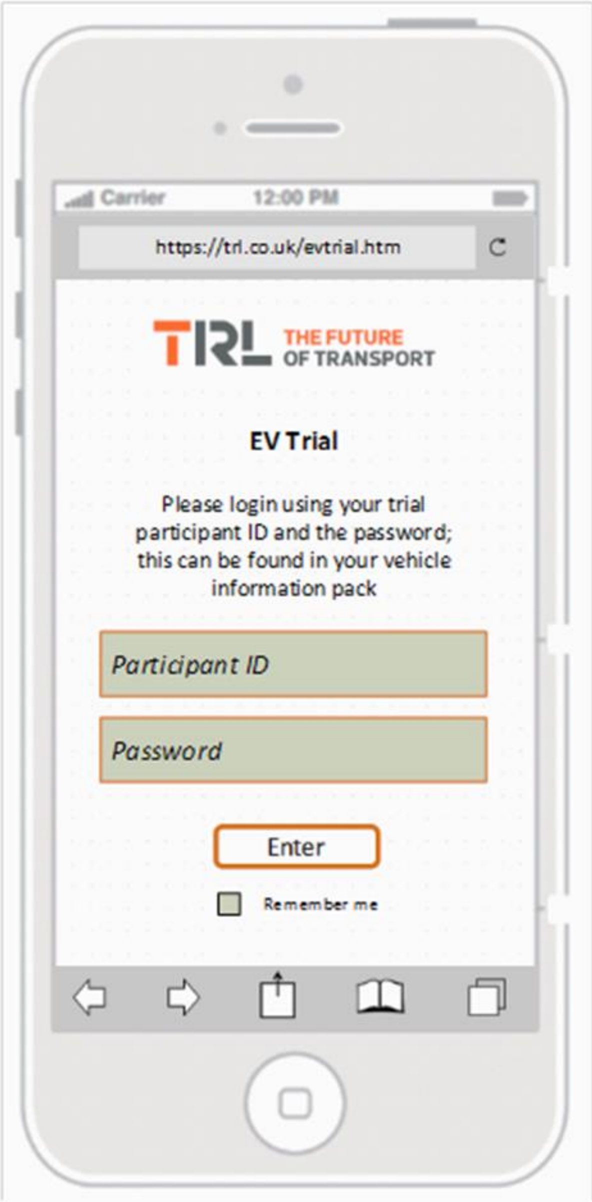

Figure 12: User App login page

2.9.2 App design for Control group

Upon login, Control group participants will be presented with a static State of Charge screen showing their vehicles' current SOC and the current status of the vehicle – charging, charge scheduled, no charge scheduled, charge finished (see Figure 13). This page will display the SOC from the last data packet received from the FleetCarma telematics system (see section 2.11) and the date and time at which this data packet was received. The refresh button will query the system for the most recently logged value of the SOC enabling participants to view the most up-to-date values.

The purpose of the User App for the Control group is to provide participants with a facility for viewing their vehicle SOC and status remotely; they will not have access to the other pages or features which participants in the UMC and SMC groups will be given.

Participants can choose to sign out of the User App, or remain logged in for future usage. Participants will be able to save their login credentials using the 'Remember me' function, if they wish.

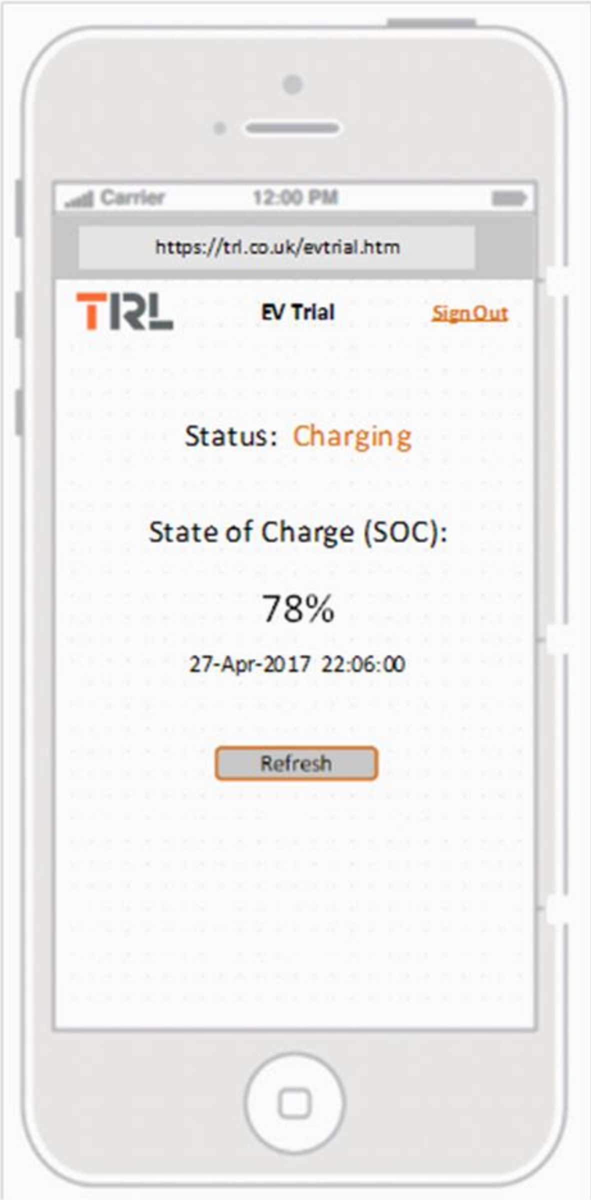

Figure 13: Control group SOC page

2.9.2.1 Example use case

An example use case for a participant in the control group is described below:

1. Participant arrives home and plugs vehicle into home chargepoint at 17:00
2. Chargepoint sends plug-in signal to the CPMS, which then initiates the charge and records the start of the charge event
3. Vehicle begins charging immediately
4. CPMS reads last known SOC from the vehicle
5. User checks their vehicle SOC at 18:00 by logging into the app

6. User checks SOC again at 21:00, pressing the refresh button to update the value
7. User unplugs the vehicle at 22:00
8. Chargepoint sends plug-out signal to the CPMS, which then records the end of the charge event

2.9.3 App design for UMC group

Participants in the UMC group will have access to four pages:

- **'SOC' page**: View latest vehicle SOC data and current status
- **'Charge' page**: Set charging preferences for next charge event
- **'Defaults' page**: Set default charging preferences for future charge events
- **'Points' page**: View Savings Points earned to date

Participants will be able to navigate between the pages by clicking the relevant buttons on the horizontal bar at the top of the screen. These pages are described further in the following sections.

2.9.3.1 SOC page

On the SOC page, participants will be presented with a static State of Charge (SOC) screen showing their vehicles' current SOC and status – charging, charge scheduled, no charge scheduled, charge finished (see Figure 14).

This page will display the SOC from the last data packet received from the FleetCarma telematics system (see section 2.11) and the date and time at which this data packet was received. The refresh button will query the system for the most recently logged value of the SOC enabling participants to view the most up-to-date values.

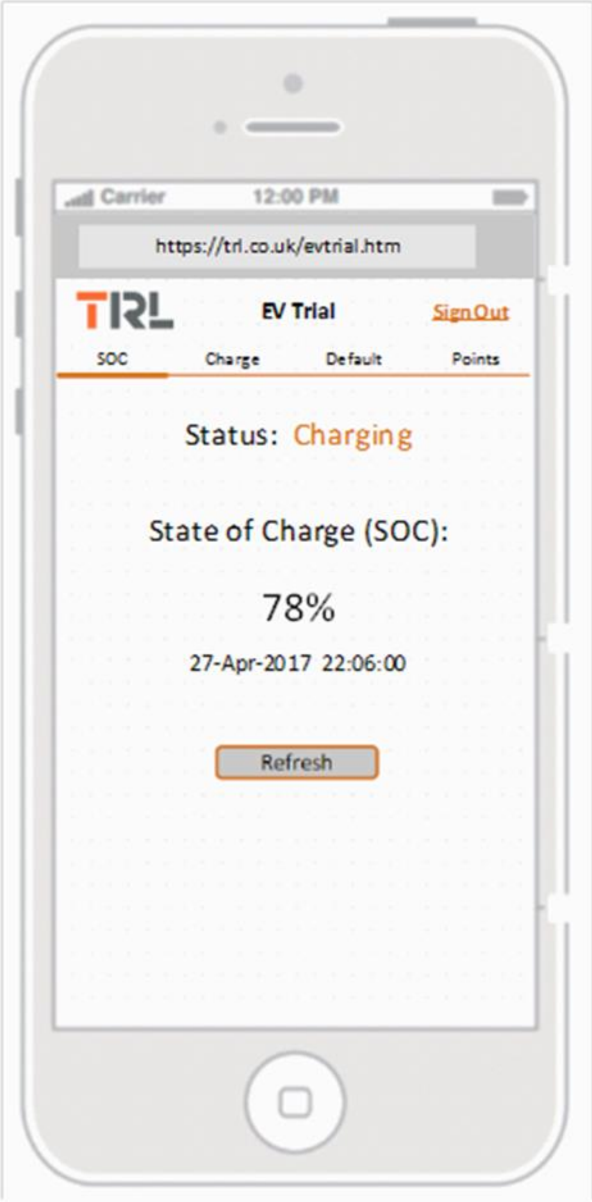

Figure 14: UMC SOC page

2.9.3.2 Charge page

Participants will be able to set their charging preferences for the next charge event on the Charge page. On this page, participants will be presented with two options:

1. Choose the Start Time and Stop Time (optional) for the charge
2. Charge immediately

To choose the Start Time and Stop Time for the charge, the user simply clicks on the window and a drop-down menu appears which will present them with a list of times in half-hourly increments (see Figure 15 – right). In the Stop Time drop-down menu, an option to set ‘ No Stop Time’ is included, in case they wish to allow the vehicle to continue charging into the SOC is 100% (or until they manually stop the charge by unplugging the vehicle, whichever is sooner).

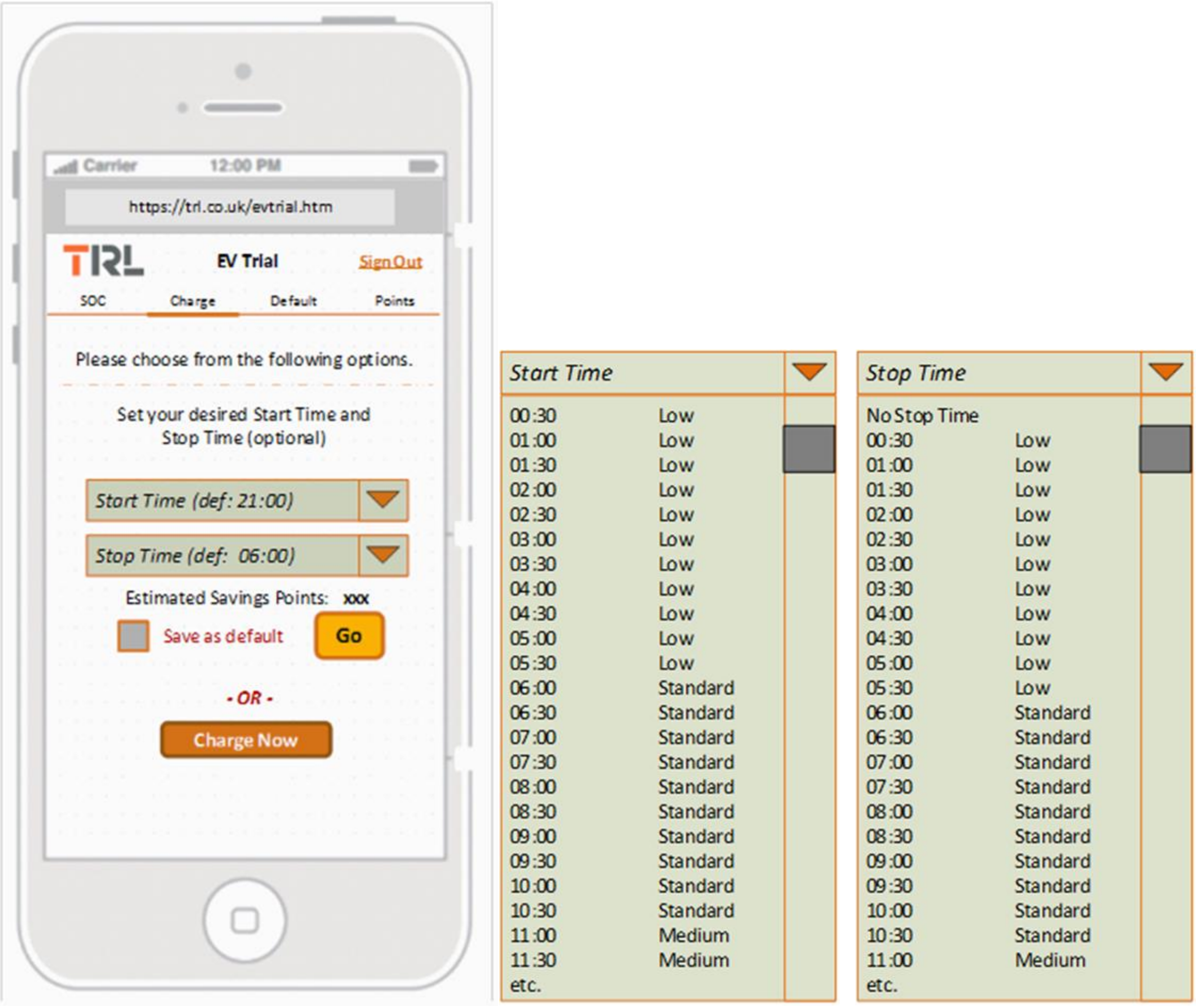

Figure 15: UMC Charge page (left) and drop-down menus for Start Time and Stop Time (right)

The drop-down menus also display the UMC tariff bands (Low, Standard, Medium, High) so that users know which band they will be charging in, depending on the Start Times and Stop Times they select.

Once the user has selected their desired Start Time and Stop Time, pressing ‘Go’ will schedule the charge session and a pop-up notification will appear (see Figure 16 - left). This pop-up will remain on screen until users press the ‘OK’ button to close it. When scheduling a charge session, users can also choose to save the values they entered as defaults, if they wish, by ticking the ‘Save as default’ tick box before pressing ‘Go’.

Alternatively, the user can choose to start the charge session immediately by pressing the ‘Charge Now’ button at the bottom of the page. Using the “Charge Now” button may result in a loss of potential to gain Savings Points, depending on the time of day at which the action is taken. This action will bring up a notification window to signal that the charging has begun (see Figure 16 - right). As above, this pop-up will remain on screen until users press the ‘OK’ button to close it.

In the event that users change their mind after scheduling a charge session, they will be able to override the existing charging preferences by unplugging the vehicle; this will send a charge stop command to the CPMS and the Savings Points will be calculated and transmitted to the App. Users can initiate a new charge session by plugging the vehicle in again.

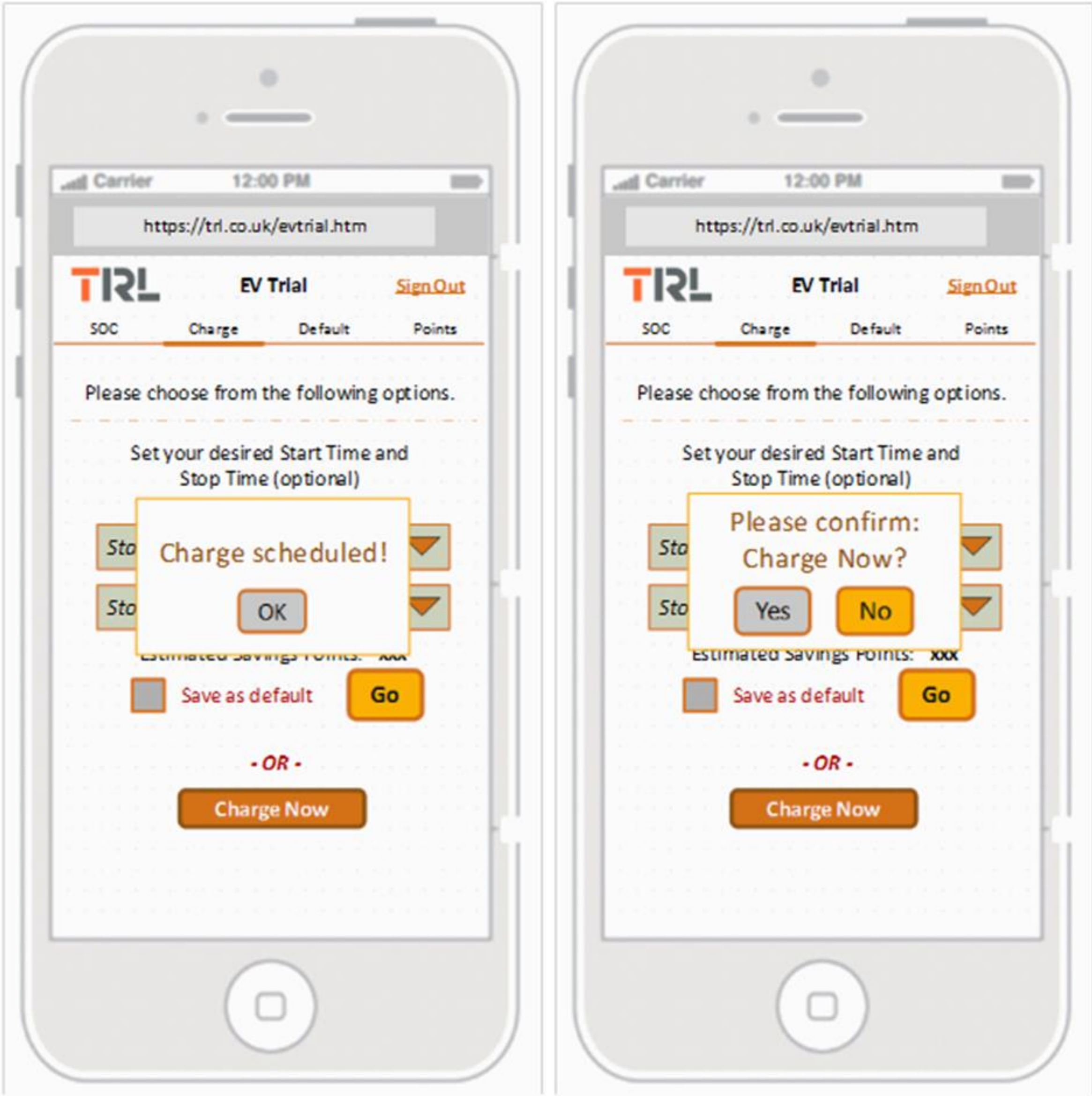

Figure 16: UMC Charge page notifications shown after pressing 'Go' when scheduling a charge session (left) and after pressing 'Charge Now' (right)

2.9.3.3 Defaults page

On the Defaults page, users can set default values for the Start Time and Stop Time (see Figure 17). Default values will be selected in the event that no user inputs are received within 15-minutes following a new plug-in. This function allows users to set recurring charging preferences and negates the need for them to physically interact with the User App at the start of every charge session.

Default values will be selected using drop-down menus, identical in design to the Charge page. The values can be saved by clicking the 'Save Defaults' button. Alternatively, if the user decides not to change the defaults they can either navigate to a different page (using the horizontal bar at the top of the page) or click 'Reset' which will reset the values to what they were previously.

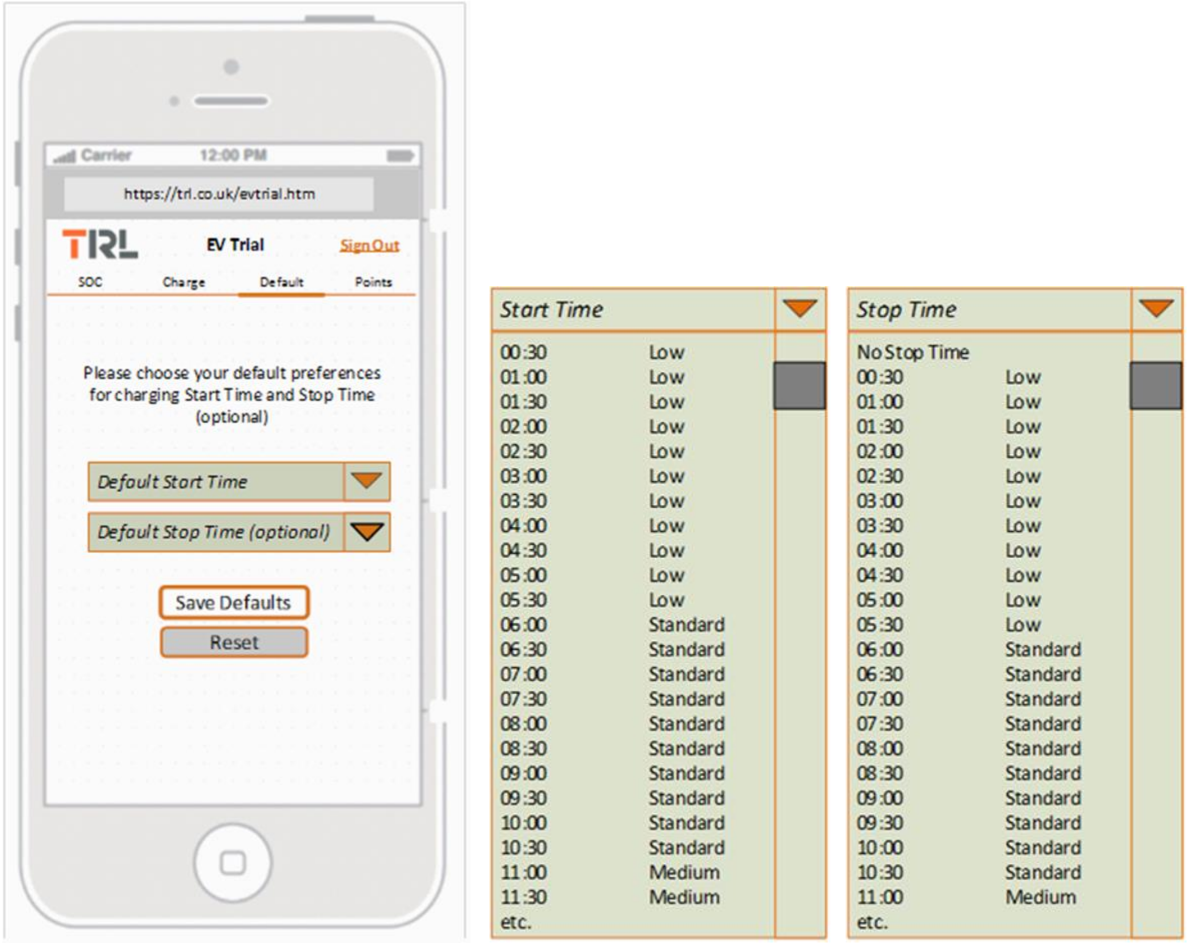

Figure 17: UMC Defaults page (left) and drop-down menus for Start Time and Stop Time (right)

2.9.3.4 Points page

For each charge event, participants in the UMC group will accumulate Savings Points, depending on when they choose to charge their vehicle (see section 2.8.4). Participants will be able to view the Savings Points they have earned to date on the Points page (see Figure 18). The page will display data for all home charging events completed for the duration of the trial, and will include:

- The start date and time of the charge
- The stop date and time of the charge
- The amount of SOC added to the battery (expressed as a percentage)
- The Savings Points earned for each charge event

The total number of Savings Points earned to date will be displayed at the bottom of the page.

Figure 18: UMC Points page

2.9.3.5 Example use case 1

An example use case for a participant in the UMC group is described below:

1. Participant arrives home and plugs vehicle into home chargepoint at 17:00
2. Chargepoint sends plug-in signal to the CPMS, which then records the plug-in
3. CPMS sends email notification to user informing them of the plug-in
4. CPMS reads last known SOC from the vehicle
5. User logs into the User App at 17:05 by clicking on the link contained in the email notification
6. User enters a new Start Time (22:00) and Stop Time (07:00) and presses ‘Go’
7. Charge parameters sent to CPMS and user receives notification that charge session is scheduled via the User App

8. Charging begins at 22:00
9. User opens App at 23:00 to check vehicle SOC
10. Vehicle reaches 100% charge at 06:00 and charge session stops
11. Chargepoint sends signal to CPMS which records the charge stop time
12. User unplugs the vehicle at 07:30 which ends the session; the CPMS calculates the number of Savings Points earned and transmits to the App.

2.9.3.6 Example use case 2

An additional example use case for a participant in the UMC group is described below:

1. Participant arrives home and plugs vehicle into home chargepoint at 17:00
2. Chargepoint sends plug-in signal to the CPMS, which then records the plug-in
3. CPMS sends email notification to user informing them of the plug-in
4. CPMS reads last known SOC from the vehicle
5. User logs into the User App at 17:05 by clicking on the link contained in the email notification
6. User enters a new Start Time (22:00) and Stop Time (07:00) and presses 'Go'
7. Charge parameters sent to CPMS and user receives notification that charge session is scheduled via the User App
8. At 18:00, user decides vehicle required again that evening
9. User overrides scheduled charge session by unplugging vehicle; this triggers a signal to CPMS which records end of the charge event and Savings Points are calculated (they would be zero in this case)
10. User plugs vehicle in again, opens User App and presses 'Charge now'
11. Charging begins immediately
12. User opens App at 20:00 to check vehicle SOC
13. User unplugs the vehicle at 20:30
14. Chargepoint sends signal to CPMS which records end of the charge event and calculates the user's Savings Points

2.9.4 App design for SMC group

Participants in the SMC group will also have access to four pages:

- **'SOC' page**: View latest vehicle SOC data and current status
- **'Charge' page**: Set charging preferences for next charge event
- **'Defaults' page**: Set default charging preferences for future charge events
- **'Points' page**: View Savings Points earned to date

As with the UMC group, participants will be able to navigate between the pages by clicking the relevant buttons on the horizontal bar at the top of the screen. These pages are described further in the following sections.

2.9.4.1 SOC page

On the SOC page, participants will be presented with a static State of Charge screen showing their vehicles' current SOC and status - charging, charge scheduled, no charge scheduled, charge finished (see Figure 19). This page will display the SOC from the last data packet received from the FleetCarma telematics system (see section 2.11) and the date and time at which this data packet was received. The refresh button will query the system for the most recently logged value of the SOC enabling participants to view the most up-to-date values.

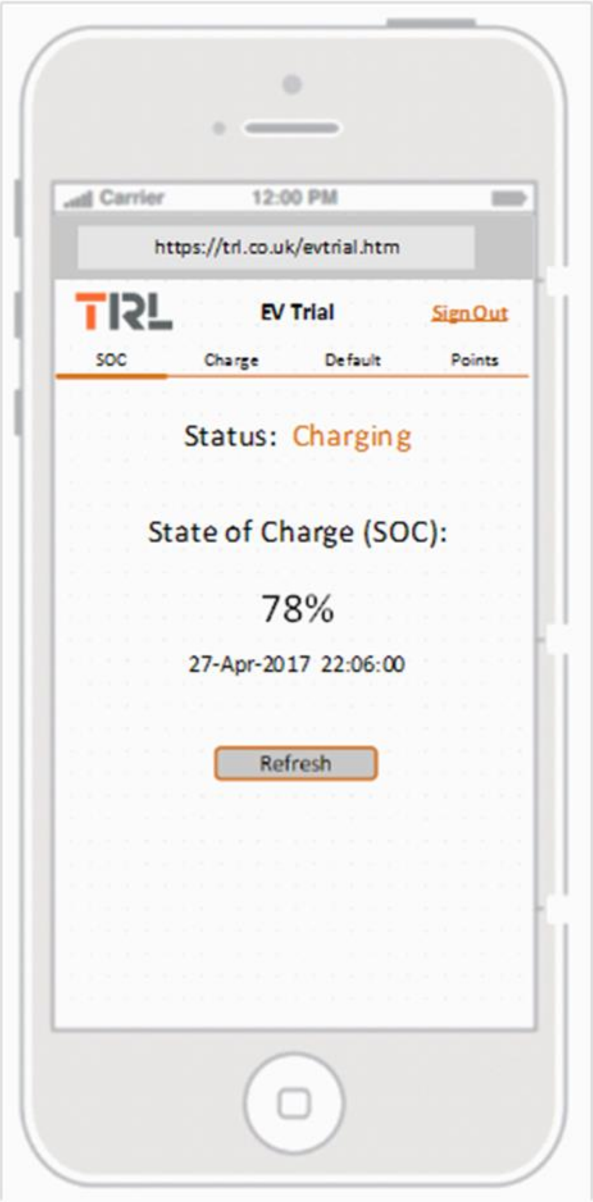

Figure 19: SMC SOC page

2.9.4.2 Charge page

Participants will be able to set their charging preferences for the next charge event on the Charge page. On this page, participants will be presented with two options:

1. Choose their Desired SOC and Departure Time
2. Charge immediately

To choose the Desired SOC and Departure Time, the user clicks on the relevant window and a drop-down menu appears presenting them with a list of values (see Figure 20 - right). The parameters must be entered sequentially; Desired SOC must be selected first and then Departure Time. The Desired SOC drop-down menus will display SOC in 5% increments between 10% and 100%. When a value is selected by the user it will be highlighted as an affirmative indication. The Departure Time drop-down menu will display times in half hourly increments.

Values which are not achievable will be greyed out and will be non-selectable. For example, only SOC values greater than the vehicles' current SOC will be selectable from the Desired SOC drop-down menu. Likewise, the Departure Time drop-down menu will preclude drivers from selecting a Departure Time and a Desired SOC which is not possible (e.g. 80% within 1 hour).

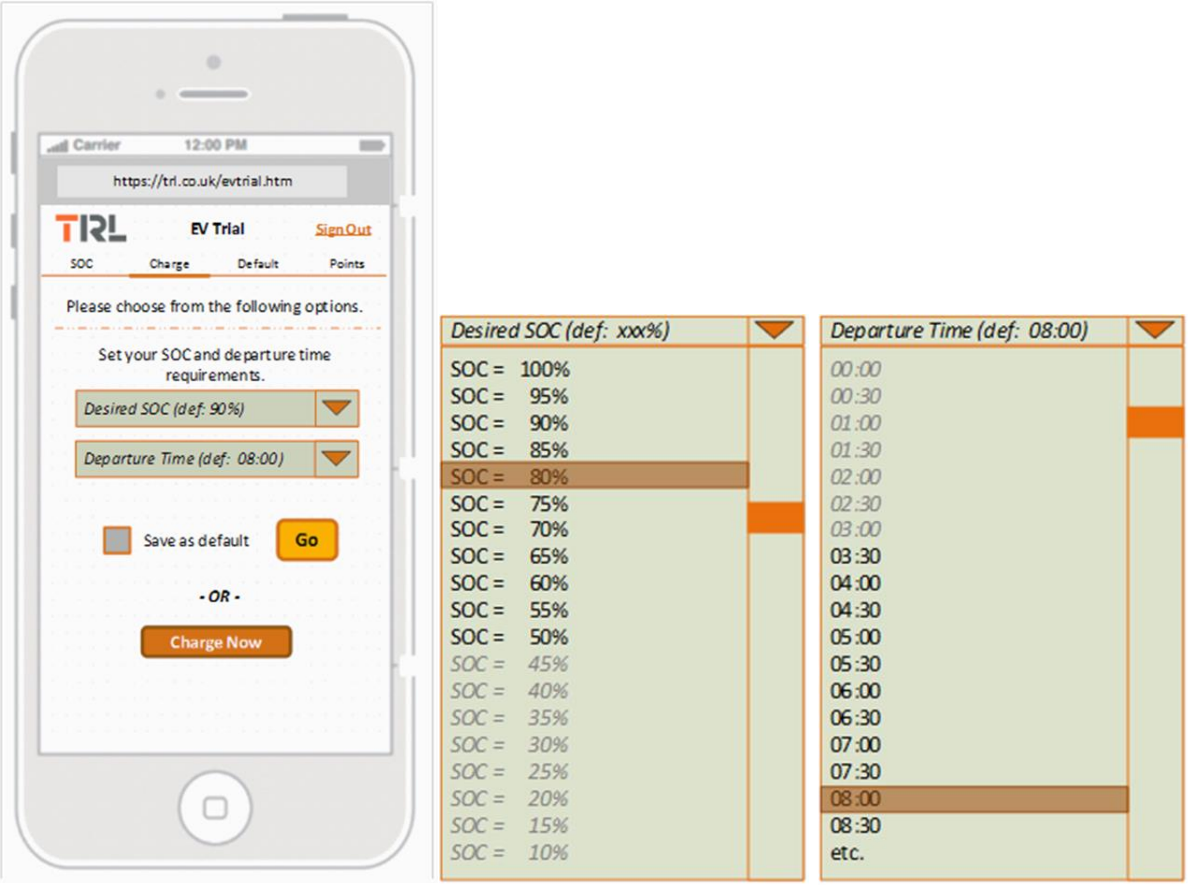

Figure 20: SMC Charge page (left) and drop-down menus for Desired SOC and Departure Time (right)

Once the user has selected their Desired SOC and Departure Time, pressing 'Go' will schedule the charge session and a pop-up notification will appear (see Figure 21 - left). This pop-up will remain on screen until users press the 'OK' button to close it. Users can also choose to save the values they entered as defaults, if they wish, by ticking the 'Save as default' tick box before pressing 'Go'.

Alternatively, the user can choose to start the charge session immediately by pressing the 'Charge Now' button at the bottom of the page. Using the "Charge Now" button will result in a loss of potential to gain Savings Points because the system will be unable to optimise the charge session so for the user. This action will bring up a notification window to signal that the charging has begun (see Figure 21 - right).

In the event that users change their mind after scheduling a charge session, they will be able to override the existing charging preferences by unplugging the vehicle; this will send a charge stop command to the CPMS and the Savings Points will be calculated and transmitted to the App. Users can initiate a new charge session by plugging the vehicle in again.

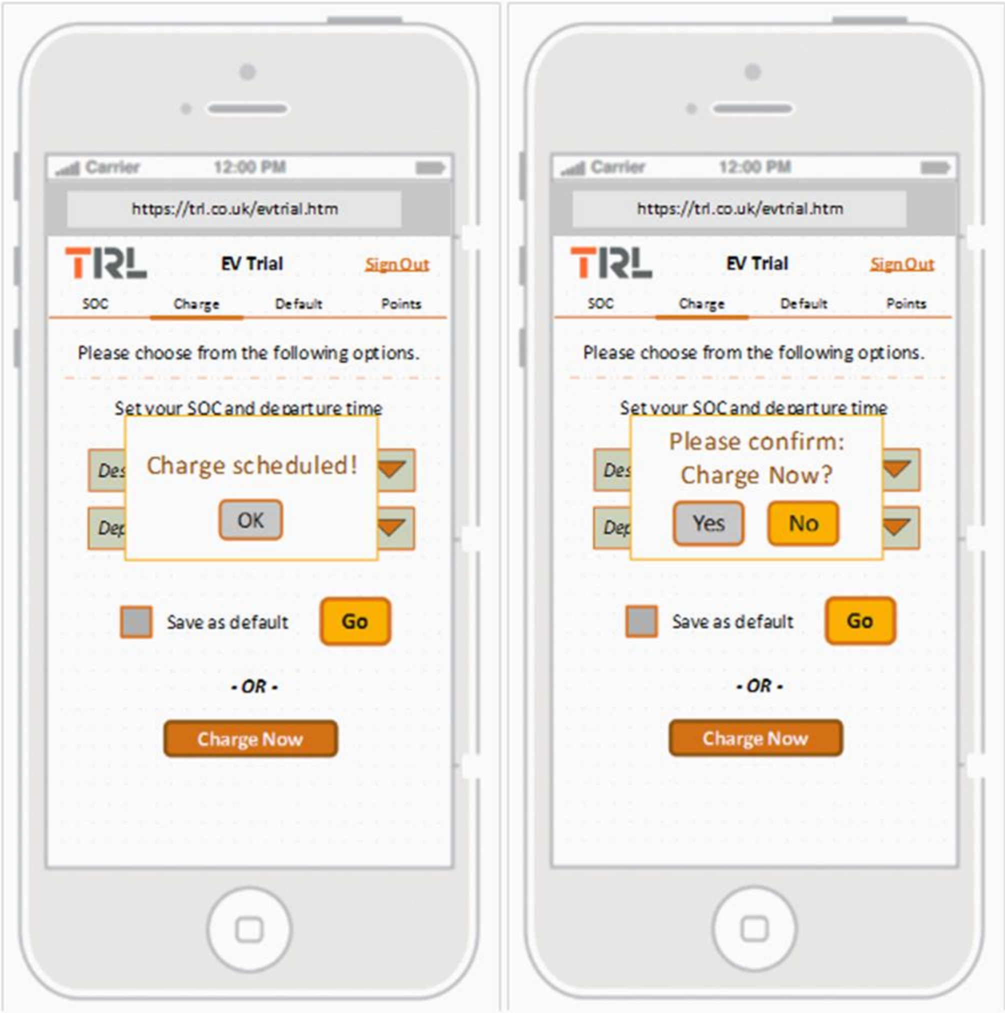

Figure 21: SMC Charge page notifications shown after pressing 'Go' when setting charge preferences (left) and after pressing 'Charge Now' (right)

2.9.4.3 Defaults page

On the Defaults page, users can set default values for the Desired SOC and Departure Time (see Figure 22). Default values will be selected in the event that no user inputs are received within 15-minutes following a new plug-in. This function allows users to set recurring charging preferences and negates the need for them to physically interact with the User App at the start of every charge session. In the event that the default values are selected but are unachievable at the time of charging (for example, if default values of 100% SOC by 0700 were selected following a plug-in with 10% SOC at 05:00), the charge session will initiate immediately.

Default values will be selected using drop-down menus, identical in design to the Charge page. The values can be saved by clicking the ‘Save Defaults’ button. Alternatively, if the user decides not to change the defaults they can either navigate to a different page (using the horizontal bar at the top of the page) or click ‘Reset’ which will reset the values to what they were previously.

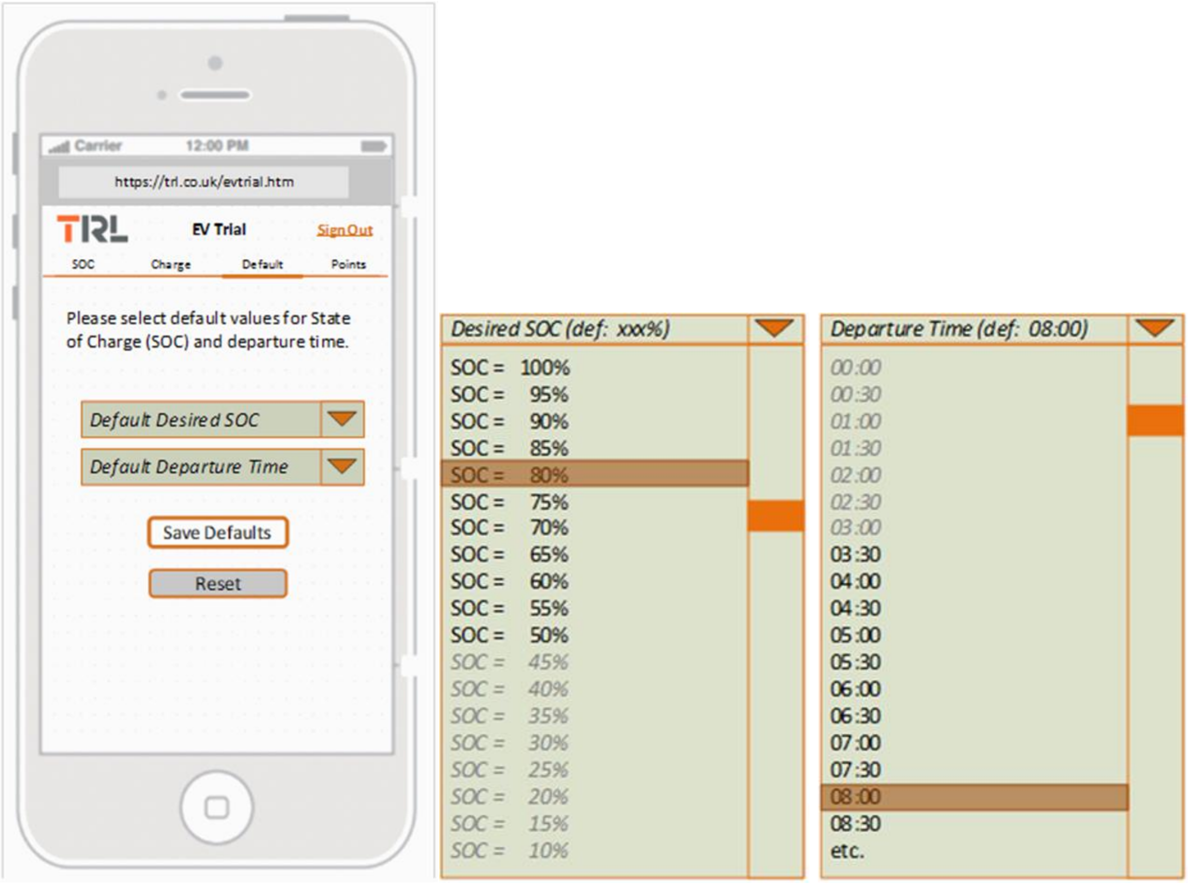

Figure 22: SMC Defaults page (left) and drop-down menus for Desired SOC and Departure Time (right)

2.9.4.4 Points page

For each charge event, participants in the SMC group will accumulate Savings Points, depending on the charging parameters they set (see section 2.8.3). Participants will be able to view the Savings Points they have earned to date on the Points page (see Figure 23). The page will display data for all valid charging events completed for the duration of the trial, and will include:

- The plug-in date and time
- The departure date and time
- The amount of SOC added to the battery (expressed as a percentage)

- The Savings Points earned for each charge event

The total number of Savings Points earned to date will be displayed at the bottom of the page.

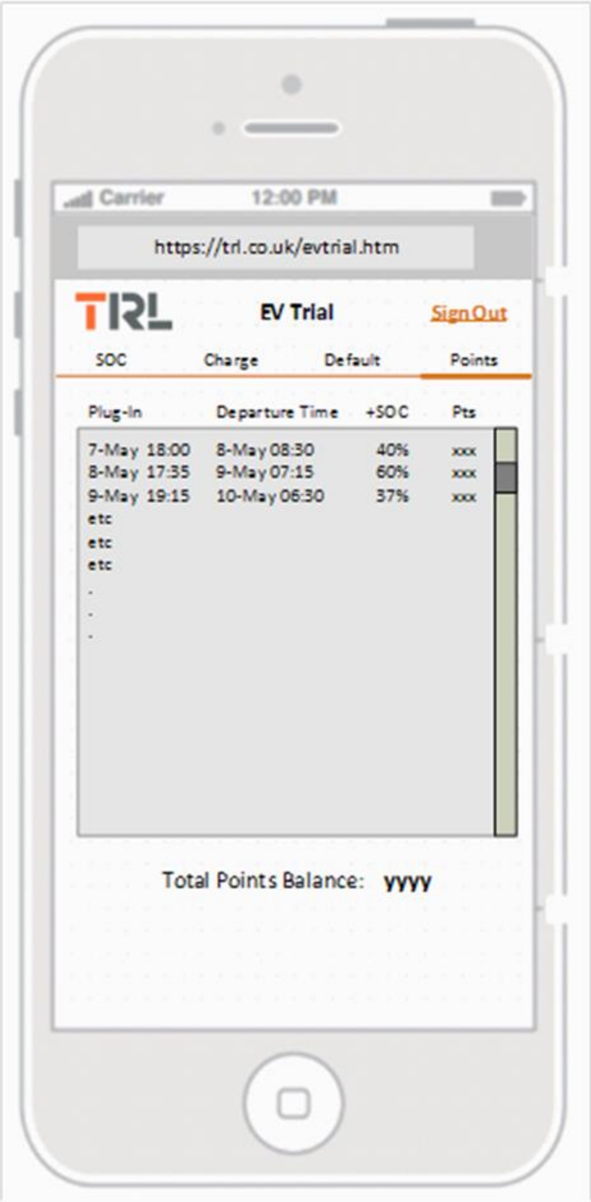

Figure 23: SMC Points page

2.9.4.5 Example use case 1

An example use case for a participant in the SMC group is described below:

1. Participant arrives home and plugs vehicle into home chargepoint at 17:00
2. Chargepoint sends plug-in signal to the CPMS, which then records the plug-in
3. CPMS sends email notification to user informing them of the plug-in
4. CPMS reads last known SOC (50%) from the vehicle
5. User logs into the User App at 17:05 by clicking on the link contained in the email notification

6. User enters a new Desired SOC (100%) and Departure Time (07:00) and presses 'Go'
7. Charge parameters sent to CPMS and user receives notification that charge session is scheduled via the User App
8. User opens App at 23:00 to check vehicle SOC
9. Charging begins at 01:00, vehicle reaches Desired SOC (100%) at 06:00 and then charging stops
10. User unplugs the vehicle at 07:30, chargepoint sends signal to CPMS which records end of the charge event and calculates the user's Savings Points

2.9.4.6 Example use case 2

An additional example use case for a participant in the SMC group is described below:

1. Participant arrives home and plugs vehicle into home chargepoint at 17:00
2. Chargepoint sends plug-in signal to the CPMS, which then records the plug-in
3. CPMS sends email notification to user informing them of the plug-in
4. CPMS reads last known SOC (50%) from the vehicle
5. No user inputs received by CPMS; at 17:15 user's default values are selected (Desired SOC - 100% and Departure Time - 07:00)
6. Charge parameters sent to CPMS and notification sent to User App
7. User opens App at 19:00 and sees notification that charge session is scheduled
8. Charging begins at 01:00, vehicle reaches Desired SOC (100%) at 06:00 and then charging stops
9. User unplugs the vehicle at 07:30, chargepoint sends signal to CPMS which records end of the charge event and calculates the user's Savings Points

2.10 Charging data

Charging data will be obtained from the vehicle telematics dongle (see section 2.11 and Appendix O) and the home charging station installed at each participant's house. Data will be collected at plug-in and plug-out and at various frequencies when the vehicle is charging.

Details of the contents of this dataset, and how it will be processed and analysed, can be found in section 3.2.4.

2.11 Telematics data

The trial vehicles will be equipped with telematics dongle in the form of a lightweight cellular data logger fitted to the OBD-II port. The dongles will be supplied and maintained by FleetCarma; a Cleantech Information and Communications Technology company based in Ontario, Canada Ltd.with experience working with more than 150 clients across 23 countries[40].

[40] https://www.fleetcarma.com/about/

The hardware consists of a self-contained unit which clips simply into a vehicle's OBD-II port (see Figure 24).

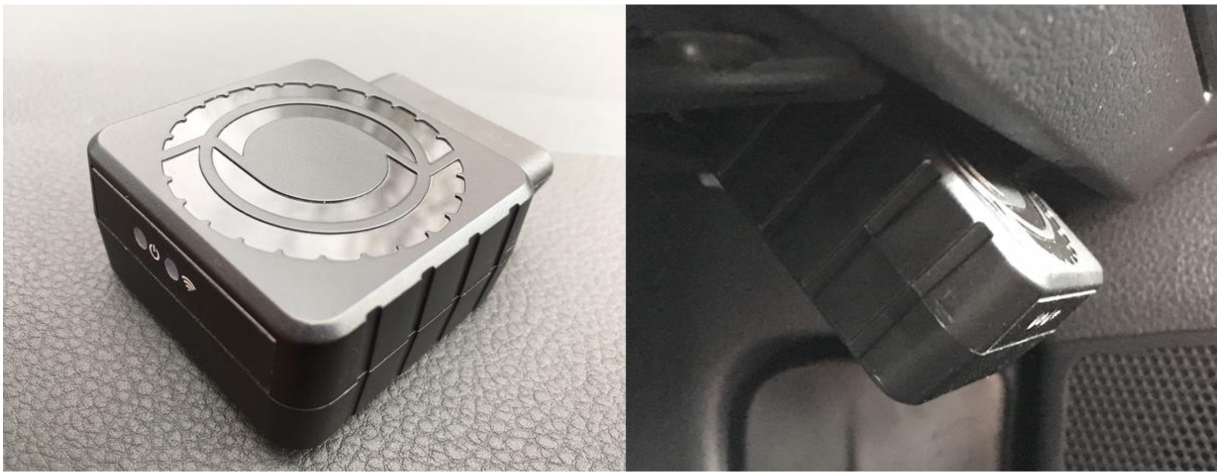

Figure 24: FleetCarma telematics dongle (left) and in situ in vehicle (right)

The devices:

- integrate with the FleetCarma web portal to allow real-time capture of vehicle status and location
- are compatible with all CAN and Legacy protocols dating back to 1996, and interface with J1979 OBD-II data
- are powered by the vehicle battery, with low power consumption
- automatically transmit encoded and encrypted data via the cellular SIM card[41]
- have an on-board backup capacity to store data locally in the event that there is poor cellular signal or a fault with the network; stored data are transmitted automatically once network connection is restored
- fit quickly and easily within the vehicle without obstructing the driver or the operation of the vehicle

A full specification of the 'C2' telematics device can be found in Appendix N.

The device will collect event-based data (e.g. at ignition on/off), journey data every 10 seconds whilst the vehicle is in operation and charging data every 5 minutes whilst the vehicle is being charged (see section 2.10). The full list of data fields which will be collected is provided in Appendix O.

In addition to collecting raw telematics data during driving and charging, FleetCarma will integrate their back-office with EV Connect's CPMS via an API. This will allow periodic polling of key vehicle data (e.g. charge start date and time, SOC at charge start/end and during charging, and charge end date and time) to the CPMS which will be fed into the User App and used to calculate charging parameters and reward points (see section 2.8).

Telematics data will be transmitted wirelessly to FleetCarma's back-office servers; this will be pushed to EV Connect via a secure API and to TRL's secure FTP site at regular intervals for

[41] Data will be pushed periodically via a secure FTP. All data will be verified.

backup purposes. Summary datasets will also be extracted from FleetCarma's online portal to facilitate data checks during the trial and to facilitate analysis.

TRL will clean and process the telematics data into the format required for data analysis (see section 3). The processed data will then be sent to other partners for analysis (as required) via a secure FTP.

2.12 User App data

Data relating to UMC and SMC participants' charging preferences and their interactions with the User App will also be recorded by the CPMS, including:

- Date and timestamps of user inputs:
    - New charging inputs
    - Requests to charge immediately (overriding UMC/SMC)
    - Use of default values (i.e. no new values entered)
- Details of user inputs:
    - Desired SOC and Departure Time (SMC only)
    - Start Time and Stop Time (UMC only)
- Savings Points for each charge event
- Total Savings Points for each user

TRL will clean and process the data into the format required for data analysis (see section 0). The processed data will then be sent to other partners for analysis (as required) via a secure FTP.

2.13 Questionnaires

Throughout the duration of the trial, participants will complete a number of questionnaires including a two-stage filter survey process to inform recruitment, a pre-trial questionnaire, and an attitudinal questionnaire which is repeated before and after the trial.

The questionnaires are based on those developed for previous ETI PiV research (Anable, *et al.*, 2011). These were further developed for a Shell-TRL PiV trial (Skippon *et al.*, 2016) and variants were used in a segmentation survey study by Element Energy (DfT, 2016b).

The **filter survey questionnaires (Filter Survey 1 and Filter Survey 2)** will be used to determine the eligibility of participants to take part in the trial.

The **Pre-trial questionnaire** will collect data to be used for the segmentation and descriptive analysis to understand how participants fit into the different consumer segments based on their willingness to adopt. It contains questions relating to the participant's household, vehicle ownership history, travel patterns, attitudes about owning and driving a car, driving style, mobility-as-a-service, attitudes about new technology, personal travel and the environment.

The **Time Point 1 questionnaire** will be used to understand participants' attitudes towards BEVs and PHEVs before experience of the vehicles. The questionnaire contains BEV and PHEV specific questions comparing them with conventional cars, affective, symbolic and instrumental attitudes towards BEVs and PHEVs, and propensity to adopt a BEV or PHEV as a main or second car.

The **Time Point 2 questionnaire** is an extended version of the Time Point 1 questionnaire aimed at understanding how attitudes change with experience of the vehicles. In addition to all the questions in the Time Point 1 questionnaire, this contains additional questions on preferred charging locations, a personality inventory and the **choice experiment**.

A summary of the content and data collected by the questionnaires can be seen in Table 15. The recruitment screening questionnaires (Filter Survey 1 and 2) can be seen in Appendix B and the Pre-trial, Time Point 1, Interim and Time Point 2 questionnaires can be seen in Appendix J.

Table 15: Breakdown of data being collected by each questionnaire in the Consumer Charging Trials

Questionnaire	Data being collected
Filter Survey 1	**Section 1: Driving history** • Time holding a UK driving licence • Penalty points on driving licence • At fault insurance claims **Section 2: Vehicles and driving information** • Driving regularity • Car owner • Company car driver • Off-street parking • PiV ownership • Intention to adopt a PiV **Section 3: Information about you** • Age group • Gender • Contact details
Filter Survey 2	**Section 1: Trial interest** • Trial interest • Living arrangement • Willingness to install a chargepoint **Section 2: Your car(s)** • Number of cars in the household

Questionnaire	Data being collected
	• Number of licensed driver in the household • Car type • Number of car drivers • Annual mileage • Long journey (i.e. >typical BEV range) regularity • BEV acceptability **Section 3: Domestic energy information** • Smartphone suitability • Economy 7 and pre-pay tariffs • Solar panels
Pre-trial	**Section 1: General background** • Educational attainment • Employment status • Household income • Relationship status • Living status **Section 2: Your household and cars** • Household membership • Cars in the household • Car types • Car purchase method • Car mileage • Main car year of purchase • Main car purchase type (e.g. new or old) • Main car purchase price • Main car purchase choice factors • Main car fuel economy • Main car purchase decision influence **Section 3: Your journeys** • Commuting • Weekday and weekend typical mileage

Questionnaire	Data being collected
	• Journey distance • Urban/rural driving • Mode use and regularity • Current car club membership • Current mobility services user • Journey app planning user **Section 4: Owning and driving a car** • Attitudes to car ownership (car-authority identity) • Driving style (Multidimensional Driving Style Inventory) **Section 5: New technology** • Attitudes to new technology **Section 6: The environment** • Attitudes to Driving and the Environment Inventory
Time Point 1	**Section 1: Battery Electric Vehicles** • Instrumental, Symbolic and Affective attitudes towards BEVs • Self-congruity to BEVs • Willingness to adopt a BEV • Willingness to adopt a BEV by range • Willingness to adopt a BEV by time to charge • Important factors in decision to adopt a BEV • Influence of access to long-range vehicle options on willingness to adopt • Influence of depreciation on willingness to adopt **Section 2: Plug-in Hybrid Vehicles** • [Repeat Section 1 for PHEVs] **Section 3: Next vehicle purchase** • Future car purchase intentions **Section 4: Home electricity use** • Household energy use patterns • Attitudes towards energy use **Section 5: Plug-in Vehicle charging**

Questionnaire	Data being collected
	• Awareness of PiV public charging points
Time Point 2	**Section 1: Battery Electric Vehicles** • Instrumental, Symbolic and Affective attitudes towards BEVs • Self-congruity to BEVs • Willingness to adopt a BEV • Willingness to adopt a BEV by range • Willingness to adopt a BEV by time to charge • Important factors in decision to adopt a BEV • Influence of access to long-range vehicle options on willingness to adopt • Influence of depreciation on willingness to adopt **Section 2: Plug-in Hybrid Vehicles** • [Repeat Section 1 for PHEVs] **Section 3: Next vehicle purchase** • Future car purchase intentions • Information on PHEVs or BEVs sourced **Section 4: Experience with the Plug-in Vehicle** • Evaluation of vehicle performance • Feedback on charging experience • Future charge location predictions • Awareness of PiV public charging points **Section 5: Charging tariff** • Feedback on charging tariffs **Section 6: About you** • Self-identity to PiVs • Newcastle Personality Assessor **Section 7: Choice experiment**

2.13.1.1 Filter Survey questionnaires

The primary purpose of the Filter Survey questionnaires is to establish potential participants who are suitable for taking part in the trial. The questionnaires are designed to obtain information relating to factors that would rule respondents out of taking part (e.g. they currently have a PiV in their household); the remaining respondents can then be entered into the trial recruitment process (see section 2.2.2). Where a respondent is taken forward into the trial and becomes a participant, the demographic information recorded will be utilised in subsequent analyses.

2.13.1.2 Pre-trial questionnaire

The questions in the Pre-Trial Questionnaire do not need to be repeated before and after participants have completed their trial experience with the vehicles. They are, therefore, distinct from the items in the Time point 1 and Time point 2 questionnaires.

The purpose of the Pre-trial questionnaire is to capture further details about participant demographics which were not obtained via the Filter Surveys. In addition, the questionnaire is designed to collect data regarding a participant's household (including members and cars within the household) and regular travel behaviour. The questionnaire also contains standardised scale-items to capture information on driving style, and attitudes towards the environment, technology, personal travel and journey purpose, and owning and driving a car. Further detail regarding data captured within this questionnaire is described below.

This questionnaire will be administered after participants have provided consent to take part in the trial.

The questionnaire also contains items relating to engagement with mobility-as-a-service exploring whether participants are current members of a car club such as City Car or Zipcar, currently use mobility services such as Uber, or regularly use apps to plan their travel (a proxy measure for future use of mobility-as-a service alternatives).

Car ownership

Car-authority identity will be measured with statements from measures of consumer novelty seeking (Manning, Bearden & Madden, 1995) and opinion leadership (Flynn, Goldsmith & Eastman, 1996). Statements, such as "My car says something about who I am" will be answered on a five-point Likert-type scale ranging from "strongly disagree" to "strongly agree". This can be seen in Section 4 of the questionnaire.

Multidimensional Driving Inventory (MDSI)

The MDSI (see Section 4 of the questionnaire) was constructed to conceptualise an individual's habitual driving style as a driving-specific factor. It is traditionally used as a measure to explain involvement in car crashes and traffic violations both directly and in terms of more general sociodemographic and personality factors (Taubman-Ben-Ari, Mikulincer & Gillath, 2004). It was developed from a previous differentiation between driving skill and driving style (Elander, West & French, 1993). "Skill" refers to a driver's performance, that is their ability to maintain control of the vehicle and respond adaptively to complex traffic situations. "Style" is defined as the way the driver chooses to drive, or habitually drives. Driving style is thought to be influenced by attitudes and beliefs regarding driving, as well as by more general needs and values. The MDSI was designed to assess driving style, rather than driving skill. The MDSI is based on the basic principle that the complex nature of driving can only be measured using a multidimensional conceptualisation of driving style.

Statements, such as “I like to take risks while driving”, will be answered on a six-point scale ranging from “not at all” to “very much”.

The MDSI data will be used to segment participants by self-reported driving styles, and the scores may be entered as factors in regression models.

Attitudes to new technology

Attitudes to new technology (see Section 5 of the questionnaire) are measured via a 16-item scale that was developed for the previous ETI PiV project. The statements were developed on the basis of a literature review conducted at the time and qualitative data from interviews with mainstream consumers who had experienced a PiV (Graham-Rowe *et al.*, 2012).

Statements, such as “I generally know more than other people about new technology”, will be answered on a five-point Likert-type scale ranging from “strongly disagree” to “strongly agree”.

Attitudes to Driving and the Environment Inventory

Section 6 in the questionnaire contains the Attitudes to Driving and the Environment Inventory. It is designed to measure attitudes to driving, travel and the environment by exploring the dynamic between car use, perceptions of travel choices and environmental impact.

Attitudes are measured by participants responding to multiple statements to indicate their degree of agreement. Participants will be asked to rate items (e.g. “I am actively trying to use my car less”) on five-point Likert-type scale ranging from “strongly disagree” to “strongly agree”. It is based on items used by Anable (2005) in segmentation studies of UK adults’ travel choices and statements to measure pro-environmental identity, which are an expansion of those used by Whitmarsh and O’Neill (2010).

2.13.1.3 Time Point 1 questionnaire

The purpose of the Time Point 1 questionnaire is to capture data on attitudes towards, and willingness to purchase BEVs and PHEVs. These items are repeated in the Time Point 2 questionnaire to allow comparison of how attitudes and willingness to purchase are impacted by direct experience with BEVs and PHEVs.

This questionnaire will be administered approximately one week before participants attend the vehicle handover session.

The Time Point 1 questionnaire begins by providing participants with an information sheet of a basic comparison of the vehicle types of interest (i.e. conventional vehicles and plug-in vehicles). This information has been developed from that used previously in the ETI PiV study (Anable *et al.*, 2011). The purpose is to ensure that participants are aware of the key differences between the vehicle types and therefore have a clear understanding of the vehicle types being asked about in the questions.

Section 1 of the questionnaire asks questions relating to BEVs only and Section 2 repeats these questions for PHEVs only. The content of these sections is described in more detail below. Section 3 of the questionnaire asks basic questions relating to participants’ next vehicle purchase intentions. Section 4 asks about household electricity usage, and Section 5 asks about awareness of PiV charging facilities in participants’ local area.

Perceived instrumental, affective, and symbolic attitudes to PiVs

Three main motivational dimensions of consumer attitudes towards products have been distinguished: instrumental, affective (or hedonic), and symbolic (Vandecasteele & Geuens, 2010). Traditionally consumers focus most strongly on instrumental attributes when they have instrumental motives to adopt a product. Instrumental attributes refer to the functionality or utility that can be derived from functions performed by a product or new technology (Dittmar, 1992; Voss, Spangenberg & Grohmann, 2003). Affective attitudes refer to the emotional experience derived from using (i.e. driving) a new technology, such as joy or pleasure (Dittmar, 1992; Roehrich, 2004; Voss, *et al.*, 2003). Symbolic attitudes meanwhile refer to a sense of self or social identity that is afforded by being seen in, or associated with, a vehicle type and new technology (Dittmar, 1992; Roehrich, 2004).

In general, car use and car ownership are typically associated with elements of instrumental, affective, and symbolic attributes (e.g. Anable & Gatersleben, 2005; Bergstad *et al.*, 2011; Steg, Vlek & Slotegraaf, 2001; Steg, 2005; Turrentine & Kurani, 2007). The adoption and use of PiVs is also likely to involve elements of instrumental, affective, and symbolic motivations although the dynamic is likely to be different (Heffner, Turrentine & Kurani, 2006; Kurani, Turrentine & Heffner, 2007; Skippon & Garwood, 2011; Skippon *et al.*, 2016).

Schuitema, Anable, Skippon and Kinnear's (2013) study of mainstream consumers' intention to adopt PiVs noted that affective and symbolic attributes mediate the effect of instrumental attributes on PiV adoption. Further, people with a pro-environmental identity have more positive perceptions of PiV attributes. The results, utilising data collected for the earlier ETI PiV study, also found that PHEVs were perceived more positively than BEVs and there was a greater intention to adopt PHEVs than BEVs.

Sections 1 and 2 of the questionnaire therefore contain questions to measure instrumental, affective, and symbolic attributes to PiVs based on items previously developed and tested. The sections are repeated for BEVs (Section 1) and PHEVs (Section 2) separately noting the importance of the distinction between the vehicle types found previously. The statements were developed, and based on input, from a qualitative PiV interview study for the ETI (Graham-Rowe *et al.*, 2012) and a literature review completed for that project (Anable *et al.*, 2011).

Symbolic meaning

Sections 1 and 2 of the questionnaire also measure participants' attributions of symbolic meaning to BEVs and PHEVs respectively. Symbolic meaning will be measured using the attribution-vignette method (Skippon, 2014; Skippon & Garwood, 2011). For example, participants are asked to indicate on a five-point scale ranging from "doesn't fit the driver" to "fits the driver very well" how well a description (e.g. "Has a lot of fun") can be attributed to the driver of a BEV (Section 1) or a PHEV (Section 2). Eighteen items like this measure participants' attributions of personal characteristics to an imagined typical user of a BEV or PHEV. Responses can be compared to norms recorded in Skippon's (2014) study of the symbolic meanings of the major types of European light duty cars.

Ten of the items were used to measure participants' attributions of the five-factor personality traits openness, conscientiousness, extraversion, agreeableness and neuroticism to an imagined typical user of a BEV or a PHEV. The remaining eight items measure participants' attributions of other mating-salient characteristics of an imagined typical user: status, gender, age, relationship investment (focus on long-term vs. casual relationships), and physical attractiveness.

Relative attractiveness of PiVs

Sections 1 and 2 also include a question set to measure the relative attractiveness of a BEV (Section 1) or PHEV (Section 2) in comparison to a conventional vehicle. The importance of asking about relative attractiveness outside of the choice experiment is that it provides a direct measure for each participant that can be used in regression analyses with personality traits, driving style, (see Time Point 2 questionnaire) as well as other demographic & attitudinal variables. Responses to these questions will also be used in the segmentation analysis.

Intention to adopt

Intention to adopt PHEVs and BEVs as main and second car will be measured on a five-point scale ranging from “very unlikely” to “very likely” with the single statement: “In the next 5 years, I would choose to have a BEV (Section 1) or a PHEV (Section 2) as a main car; repeated for a second car.

Participants are also asked to indicate (by selecting ‘yes’ or ‘no’) whether they would consider owning a BEV (Section 1) as a main car in their household, if it had a range when fully charged of 50, 100, 150, 200 or 250 miles. These questions are repeated for ownership of a second car in the household. The same questions are repeated in Section 2 for PHEVs but with appropriate ranges for the vehicle type: 10, 25, 50, 75, 100 miles.

In the same way, participants are asked to indicate if they would consider owning a BEV (Section 1) or PHEV (Section 2) if the charge time to provide 100 miles of range was 1, 2, 4, 6, 8 hours. In both sections this question is repeated for the main and second car in the household.

Home electricity use

Section 4 of the questionnaire has been developed for the study to collect background data on and attitudes towards household electricity use. Questions have been developed from materials obtained from the authors of a large-scale PiV survey (Axsen *et al.*, 2015). The questions capture some basic details regarding the household electricity bill, who in the household has responsibility for the energy bill, knowledge of the amount spent on electricity, and consideration of whether the participant would be willing to shift habits to save money. In addition, the questionnaire also asks for participants’ perceptions of their household impact on the environment due to their electricity use.

This section also includes an 18-item question set to measure the frequency of typical household energy saving behaviours. Participants are asked to rate, on a four-point scale from ‘never’ to ‘always’ how often they are likely to engage in actions such as “Turn off lights in areas of the house you’re not using”. These items aim to measure what is known as ‘behavioural spillover’ (Whitmarsh *et al.*, 2017). Behavioural spillover occurs when engagement in a particular behaviour (e.g. recycling) leads to engagement in other related behaviours (e.g. deliberately buying products with less packaging). The literature review in Stage 1 (See D2.1) identified that there is a significant gap in knowledge with regard to the relationship between PiV use and charging and other related behaviours and the Consumer Charging Trials provide an opportunity to explore this relationship.

The data collected from this section may be useful for segmentation and will aid the understanding of background participant profiles to tariff preference.

2.13.1.4 Time Point 2 questionnaire

The purpose of the Time Point 2 Questionnaire is to capture feedback on participants' experience of using and charging the vehicle over the 8-week trial period, including their preferences and opinions on different types of charging tariffs.

The questionnaire will also be used to capture data on attitudes towards and willingness to purchase BEVs and PHEVs using items repeated from the Time point 1 questionnaire, to allow comparison of how attitudes and willingness to purchase are impacted by direct experience with BEVs and PHEVs. Sections 1 and 2 of this questionnaire are therefore identical to those in the Time Point 1 questionnaire.

This questionnaire also contains additional items to obtain information on personality characteristics (described in more detail below), self-congruity with PiV owners (based on the symbolic meaning questions in Sections 1 and 2), participants' evaluation of the performance of the vehicle they experienced in the trial, and bespoke questions to collect data on perceptions of preferred PiV charging locations, charging preferences and feedback on different types of charging tariffs.

This questionnaire will be administered approximately one week after participants have returned the vehicle.

The Time Point 2 questionnaire begins by providing participants with a reminder of the information sheet showing a basic comparison of the vehicle types of interest (i.e. conventional vehicles and plug-in vehicles). This is to ensure that participants are aware of the key differences between the main vehicle types and therefore have a clear understanding of the vehicle types being asked about in the questions.

Section 1 of the questionnaire asks questions relating to BEVs only and Section 2 repeats these questions for PHEVs only.

Charging tariffs

Section 5 of the questionnaire asks participants to consider the charging tariffs being tested in the trials. As participants in each group will only have experienced one charging condition, it is necessary to provide information at the start of this section. The information explains the key differences between a standard tariff, a user-managed charging tariff and a supplier-managed charging tariff. The information provided is the same as that provided for the choice experiment to ensure consistency.

Participants are asked directly, which tariff they would choose should they own a BEV. Responses to this question can be used when segmenting and profiling participants and for comparing between groups. The question is repeated for PHEVs. Participants are further asked to rate a number of items for importance, on a five-point scale from 'not at all important' to 'extremely important', with regard to choosing an energy tariff if they owned a BEV. Again, the question is repeated for PHEVs.

Additional questions explore the impact on adoption of a BEV or PHEV as a main or second car were a user-managed or supplier managed charging tariff available.

Evaluation of vehicle performance

The evaluation of vehicle performance contains eleven items measuring participant ratings of performance of the vehicle experienced, plus other aspects of the driving experience. The items cover those aspects of performance identified by Skippon (2014) as the ways in which drivers construe vehicle performance: acceleration from 0-20mph, acceleration from 30-50mph, responsiveness, power, smoothness and noise when cruising. Top speed is not included because the top speed of all vehicles in the trial substantially exceeds the UK national speed limit, so asking drivers to evaluate it would not be ethical. Smoothness of gear changes is not included as it is not relevant for the trial PiVs. In addition, participants will be asked to rate overall performance, and three other aspects of the driving experience: comfort, safety and enjoyment.

The questionnaire uses the Borg CR-10 Category-Ratio scale. This scale is claimed (Borg, 1998, p39) “to be able to describe a psychophysical stimulus-response function over a wide range of stimulus intensities with a mathematical function that as accurately as possible reflects the genuine growth of the sensory perception”, i.e. it is intended to reflect the form of mental “scales” of perceived stimulus intensity better than, say, Likert-type ordinal scales. The scale has a non-linear, positively accelerating growth function for perceived intensity, with verbal anchors ranging from “no (stimulus) at all” up to “extremely high” (the maximum the participant has ever experienced). There is also a final category, “maximal (stimulus)”, defined as the highest value of the stimulus that the participant could imagine experiencing. The scale was developed to measure perceived exertion and perceived pain, but has also been used previously for perception of vehicle performance attributes (perceived loudness of engine idle noise and perceived intensity of steering wheel vibration; Ajovalasit & Giacomin, 2007) and in the BEV study of Skippon *et al.* (2016).

Newcastle Personality Assessor (NPA)

The NPA is a brief measure of personality. Five dimensions of personality (extraversion, neuroticism, conscientiousness, agreeableness and openness) are assessed by a total of 12 items rated on five-point scales, with 1 being “very uncharacteristic”, 3 being “moderately characteristic” and 5 being “very characteristic”. Example items include: “planning parties and social events” (extraversion), “feeling stressed or worried” (neuroticism), “preparing for things well in advance” (conscientiousness), “making sure others are comfortable and happy” (agreeableness), and “thinking about philosophical or spiritual questions” (openness). Scores for each personality dimension are formed by summing the scores from the relevant two or three items.

Higher scores indicate a higher level of the personality trait. The NPA dimension scores correlate with coefficients of .7 or higher with those from the more extensive the International Personality Item Pool inventory (Goldberg *et al.*, 2006); the NPA has the advantage of being much shorter.

By measuring participants’ own personality profiles it is possible to calculate a measure of self-congruity, the extent to which the symbolic meaning of a product (in this case, a BEV or PHEV) is congruent with personal identity. Skippon *et al.* (2016) found evidence that self-congruity was a factor in willingness to consider having a BEV, particularly one with a shorter AER.

2.14 Choice experiment

2.14.1 Discrete Choice Analysis

The purpose of Discrete Choice Analysis is to simulate the decision-making process followed by consumers in the real world. When choosing between various alternatives, consumers are assumed to trade-off between the attributes of each in order to come to a decision. For a car, these attributes could include purchase price, fuel consumption and range etc. Discrete Choice Analysis is used to quantify the different weighting consumers apply to each attribute, and thus the overall 'utility' that each alternative would provide. A consumer will choose the alternative that offers the greatest 'utility', and so the results of Discrete Choice Analysis can be used to predict the likely uptake of each member of a choice set. This can be used to estimate how the market shares of vehicles will evolve over time as their attributes change. Critically, the technique simulates a choice between discrete alternatives which represents the real-world choice facing buyers of a product who face a choice between several different options and choose only one (and cannot mix and match the attributes of each).

2.14.2 Choice experiment design for this trial

This section outlines the design of the choice experiment to quantify consumer attitude towards different managed charging schemes.

Consumer appetite for managed charging is a relatively new field of study, since work to date has mainly focussed on the purchase of electric vehicles and user driving behaviour, rather than different customer offers regarding domestic charging. The Consumer Charging Trials will explore this in detail, investigating consumer charging behaviour in response to main managed charging options, and reducing consumers' psychological distance from the choices that they could face in the future. The choice experiment is a valuable opportunity to test in more detail the trade-offs users make between different charging 'offers', since it allows testing of a larger set of conditions to be tested than is possible in the trial itself.

The key outputs from the choice experiment will be a set of choice coefficients that allow calculation of the number of participants selecting a given managed charging scheme. The impact of demographic and attitudinal factors will be used to map the results to the existing consumer segments.

The sub-set of the trial's research questions that can be addressed through a choice experiment are as follows:

- Q8. What preferences do mainstream consumers have between Supplier-Managed Charging, User-Managed Charging, and no Managed Charging?
- Q9. What factors influence preferences between Supplier-Managed Charging, User-Managed Charging, and no Managed Charging?
- Q10. What are the impacts of Supplier-Managed Charging, User-Managed Charging, and no Managed Charging on the likelihood of car buyers choosing a PHEV / BEV over other powertrains?

The choice experiment will be used to gather choice parameters that provide quantitative answers to Research Questions 7 and 8. These results will inform how consumers value the running cost savings for each managed charging scheme. This must include the disutility of the disadvantages that the managed charging scheme imposes:

$$managed\ charging\ utility = predicted\ running\ cost\ saving + benefits - disadvantages$$

The net value of these savings will be incorporated into the running cost attribute in ECCo's vehicle choice model, thus providing insight into how managed charging will affect uptake of plug-in vehicles (Research Question 9).

2.14.3 Discussion of attributes

The attributes used in the choice experiment are intended to encompass the benefits and inconveniences of each of the managed charging schemes. However, they also need to be relevant to ECCo, such that their values can be adjusted to test the impact on uptake. Some characteristics identified during the literature review are implicit in the managed charging schemes and since they cannot be varied, need not be included in the attribute list. For example, SMC, by definition, requires a level of external monitoring and control, whereas UMC does not. The perceived inconvenience for these inherent characteristics will be quantified in the alternative specific constants. However, to capture these, a detailed description of UMC and SMC must be provided to participants before they answer the choice questionnaire.

Only the attributes of the managed charging schemes that could realistically be varied, and which alter the consumer proposition should be included in the choice sets. Based on the research questions, the structure of the managed charging schemes in the trial, and the findings of the literature review, the following attributes are proposed:

<u>Expected value of the annual savings/revenue</u>: Like purchase price in the consumer uptake choice sets, this is a key attribute in this choice experiment since it allows the willingness to pay for the other aspects of managed charging to be expressed in monetary terms. This can be expressed in terms of a cash payment or net savings on the electricity bill (the former approach will be used in the Consumer Charging Trials). In the real world, consumers may prefer one of these methods of compensation over the other; however, it is assumed that under choice experiment conditions where only hypothetical money is at stake consumers will behave agnostically. This avoids having to explore two attributes relating to cost savings. Presenting this attribute as the "net annual savings in charging cost" provides the necessary ambiguity.

In both the UMC and SMC conditions, the tariff/reward structures are seasonal (see section 2.8). During the tariff design process it was estimated that, in 2030, the benefit of managed charging to the grid is six times larger in winter than in summer. If managed charging structures in future choose to also reflect this seasonality, and if savings are realised periodically (e.g. quarterly or monthly) then these will be higher in winter than in summer. However, quoting the savings as annual avoids participants having to consider the seasonal variation in plug-in car running costs. This is similar to how different utility tariffs are shown on price comparison websites, or how savings from residential solar PV panels are quoted, both of which show a very strong seasonal variation. However, if managed charging is provided as part of the household electricity supply then it is plausible that users will be able to pay a fixed monthly amount (e.g. through standing order) and then settle their account at the end of the year, as is often employed today. Consequently, the potential for season variation in the savings will be explained in the information before the choice experiment, but will not be tested directly as an attribute. In reality, suppliers may offer options to smooth these seasonal variations such as fixed monthly direct debit payments already familiar to bill payers.

<u>Accuracy in the estimate of annual savings:</u> Uncertainty associated with the actual value of the net savings arises from two main sources:

- User side: variability in the charging behaviour of participants
- Supplier side: the tariff/rewards structure set by the electricity/charging supplier

Quantifying user side uncertainty is challenging and is not something that users could know when choosing between managed charging schemes. To avoid including this in the choice experiment, the net savings are defined as what would be expected if their trip patterns remain consistent. However, even if this is the case, changes on the supplier-side would result in the annual savings differing from the expected value.

In the user-managed charging trial, there are four different time-of-use tariffs: Summer Weekday, Summer Weekend, Winter Weekday and Winter Weekend. User-managed charging itself is not limited to these tariffs and could in theory involve daily tariffs throughout the entire year. However, the limitation is that these tariffs must be set in advance, and so savings can be predicted with a high degree of precision (assuming trip patterns remain consistent). UMC therefore does not show supplier-side variability. The risk that the grid savings do not materialise to the extent predicted when setting the time-of-use tariff is borne by the supplier.

A major difference with SMC is that the tariff and therefore the savings are unknown until after the charging event. The risk that grid benefits do not materialise is therefore transferred to the user. An estimate can be made for the annual cost savings based on expected demand and supply over the course of the year, but with far less precision than for UMC. Willingness-to-accept this risk must therefore be quantified. For the SMC choice sets, participants will be presented with not only the expected annual savings, but also a possible variability range, from 0% to ±50%. The “no variability” level (0%) represents a situation where the rewards tariff is set in advance and the electricity supplier takes on the risk that the grid savings are less than expected.

The remaining attributes look to summarise the perceived disadvantages of managed charging that consumers must be compensated for:

<u>Override function:</u> A key risk associated with managed charging is that the car is unexpectedly required before the specified departure time. In unmanaged charging (the control group), the car will have at least charged to some extent from the point of plugging in and is more likely to have the necessary SOC to meet the needs of the unexpected trip. However, for managed charging, there is a risk that if participants need their car earlier than expected then no or very little charging will have taken place. The ability to immediately start charging at this point would reduce the impact of this risk. For UMC, this can be achieved by simply changing the charge start time to the present. However, for SMC, charging control is ceded to the (simulated) supplier and so an override function would necessary to return control back to the user. Financial reward is allocated against the level of flexibility that electricity suppliers

are provided with to charge the car, but this flexibility is lost if users suddenly remove their vehicle from the stock of cars under the supplier's control. A financial penalty or loss-of-benefit may be put in place to discourage this action. If an override feature is in place, an example penalty could entail the user losing the entire reward available for that charging event. A softer approach could be to allow the user to adjust their charging configuration mid-charge to force immediate charging, but this will still result in a financial penalty since they will receive only the reward accrued up to that point. This forms the basis for two of the levels for this attribute in the SMC choice set. A base level of no override function at all should also be included, to enable the value of an override function to be assessed. In practice, this would be the inability to change the charging configuration once it has been defined for that charging event. This is of particular relevance for PHEV drivers, who are not reliant on charging to make a journey and so may forgo an override function in return for higher savings. This could also be acceptable for BEV drivers who regularly charge and so rarely allow the vehicles to enter a low state of charge.

<u>Access to rapid/slow public charging</u>: For BEVs, the risk of making unexpected trips can also be mitigated through the provision of a dense rapid charging network. If necessary, a driver can quickly top up their car with additional energy without too much delay to their journey. This applies to both forms of managed charging. It is proposed that charging density be presented in the choice sets as travel time from home to reach the nearest rapid charge point. This can then be translated to a charge point density factor in ECCo. For PHEVs, which are unlikely to have rapid charging capability, this attribute will test the benefit gained from the availability of nearby 7kW public charging instead. As for the choice experiment in the Consumer Uptake Trial (see Part 1 of Deliverable D5.1), a base level of no charge point access must be included to measure the inconvenience of, for example, not having a rapid charge enabled BEV.

<u>Additional cost of charging during peak hours relative to unmanaged</u>: It was found by Kaufmann *et al*. (2013) that consumers are less willing to accept time-of-use tariffs with large differences between peak and off-peak prices. Ideally, participants in UMC will only charge during off-peak hours. However, there may be some occasions where charging during peak hours is unavoidable, for example, during days with lots of trips or where a trip is unexpected. The higher the peak price, the greater the impact this will have on the user and the more they will perceive the risk. This risk should be considered relative to the cost of unmanaged charging, and so for UMC participants will be shown the average peak price relative to the unmanaged fixed rate price. This isolates the additional expense of charging during peak hours compared with not participating in managed charging at all.

For SMC, savings are awarded based on actual retail prices during each charging event. These are variable, but tend to be higher and lower at certain times of day. User that provide very little flexibility and do most of their charging during peak hours would therefore end up paying more than for unmanaged charging. This is equivalent to a high peak price in the UMC time-of-use tariff, and will be similarly perceived as a risk by users that may be required to occasionally charge during peak hours. SMC choice sets will therefore also include the average additional cost of charging during peak hours relative to unmanaged charging.

<u>Anticipatory charging function:</u> In SMC, participants are required to define the SOC that they require at the end of the charging event. Some may choose not to charge to 100% in order to increase the financial reward by offering more charging flexibility. However, if wholesale electricity prices are low (or are anticipated to be high during the next charge event) and the

requested SOC is met before the specified end of the charge event, there is an opportunity to further charge the car at lower cost to the electricity supplier and therefore consumer. An *anticipatory charging function* would determine when this is possible, thus providing additional savings to the vehicle owner. The true benefit of this function is strongly dependent on the extent to which participants select a required SOC below 100% and how often both cheaper electricity is available and the SOC has been met early. This latter is challenging to predict without the actual algorithm for the SMC scheme, and the function may be entirely redundant should users always select 100% SOC. Consequently, the attribute will be presented as the maximum value of the additional saving, but participants will be told that they should expect to receive less than this and nothing at all if they always demand 100% SOC. Maximum additional savings will take two levels, either 10% or 20% above the quoted annual savings.

Since this will not feature experimentally in the Consumer Charging Trials there is a risk that its utility will be poorly understood by the participants when answering the choice questions, particularly for the control group who have had no experience of managed charging. Consequently, the significance of this attribute must be revisited after pilot testing to ensure that it shows a noticeable willingness to pay. If there is evidence that it has negligible impact on choice, then it should be removed to avoid contaminating the results.

2.14.4 Final list of attributes

Table 16 summarises the attributes to be explored in the Consumer Charging Trials choice experiment. Like the Consumer Uptake Trial choice experiment, this experiment consists of six attributes which is appropriate for the similar sample size.

Table 16: Description of each attribute to be explored in the Consumer Charging Trials choice experiment and how it will be represented

Attribute	Description	Levels
Expected annual charging cost savings	Expected net annual financial benefit for participating in each managed charging scheme (assuming consistent trip patterns)	*5 levels* £50 / £100 / £150 / £200 / £250 per year
Accuracy in the estimate of net annual savings	Maximum deviation between the expected and actual annual savings, for SMC	*4 levels* ±10% / ±25% / ±50% / no variability Expressed in £s, dependent on the annual cost saving level
Access to rapid charging close to home (BEVs only) or 7kW public charge points (PHEV only)	Ease at which user can top up car if not charged to required SOC (when unplugged earlier than user has specified), related to density of the charge point network	*4 levels* For BEVs: Rapid charge point within 5 / 15 / 30 minutes of home / no rapid charging available For PHEVs: 7kW charge point within 5 / 15 / 30 minutes of home / no nearby public charging available

Existence of an override function	Ability for user to override charging configuration if circumstances change, and associated penalty	*3 levels* (SMC only) • Yes, complete flexibility to change configuration • Yes, but changing configuration results in loss of all financial reward for that charge event • No, configuration cannot be changed once set
Anticipatory charging	System will charge above set end SOC if prices are low and time available	*3 levels* (SMC only) • Available with extra savings of 10% / 20% • No, unavailable
Additional cost of charging during peak hours relative to unmanaged charging	Extent to which costs of charging at peak times in either scheme are higher than unmanaged fixed electricity costs	*4 levels* None, 40% higher, 100% higher, or 400% times as high relative to unmanaged fixed electricity price

2.14.5 Choice experiment sets

The managed charging proposition will differ between drivers of BEVs and PHEVs. Since PHEVs use less electricity, the savings from managed charging are likely to be lower. However, the perceived risks will also be lower as their operation is not reliant on a charged battery. Consumer attitudes towards the attributes of managed charging must therefore be measured separately for PHEV and BEV users. The choice experiment questionnaires should therefore be answered from the perspective of charging the type of vehicle participants were allocated in the charging trial.

The choice sets were generated with Ngene using a D-efficient design analogously to the choice sets for the Consumer Uptake Trial (see Part 1 of Deliverable D5.1). Since the access to rapid charging and 7kW public charging attributes apply only to BEVs and PHEVs respectively, separate BEV and PHEV choice sets must be generated. Removal of this redundant attribute optimises the design efficiency. Due to the lack of similar studies in the literature, defining prior choice parameters is challenging. However, any information on the size and approximate magnitude of these values will improve the efficiency of the choice sets over a simple orthogonal design.

An example choice question from each of the resulting designs is shown in Appendix K. In addition to both a UMC and SMC option, participants can also select an unmanaged charging alternative. However, if they choose this, they are then asked to choose between the managed charging options so that at least some information can be extracted.

3 Data processing and analysis

This section describes how data from the questionnaires, the choice experiment, the vehicle telematics dongle, the charging point and the user app will be processed and analysed in order to address the research questions.

3.1 Data management

All data storage and handling will be performed in accordance with the International Standard for Information Security Management System (ISO 27001:2013). Full details about data privacy and protection are provided in section 4.5.

An overview of the key types of data which will be collected, along with the roles and responsibilities for cleaning, processing and analysis, is provided in Figure 25.

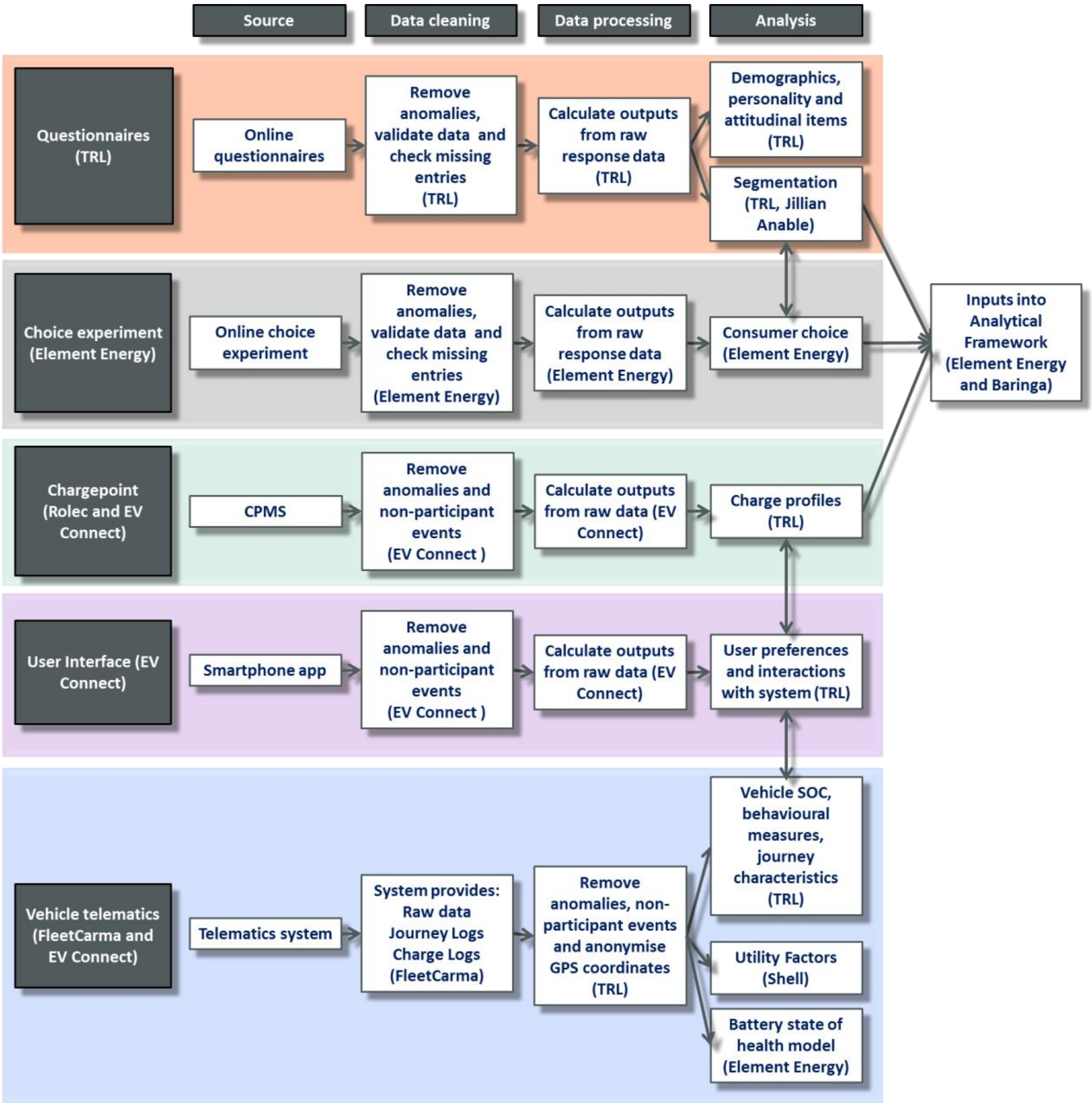

Figure 25: Overview of data management roles and responsibilities

On completion of the first recruitment survey, all participants will be assigned a Participant ID. All subsequent data collected will be linked to the Participant ID, rather than a participant's name or other personal details, in order to anonymise data. This will include questionnaire data, telematics data, GPS data, and charge point data.

3.2 Data processing

Data will be excluded for any participants who drop-out during the trial and fail to complete the full eight weeks with each vehicle and all questionnaires (including the choice experiment). Data will also be excluded for participants who experience technical faults with the vehicle(s) and/or home chargepoint which are not resolved and result in loss of use of the vehicle for more than 2 weeks; in these cases, replacement participants will be recruited to avoid loss of statistical power.

The various data sources will be linked together using Participant ID numbers in order to provide a holistic dataset.

Figure 26 shows a flow diagram illustrating the data collection and processing requirements for the Consumer Charging Trial, including who is responsible at each stage of the process. Further details about this process are described in the following sections.

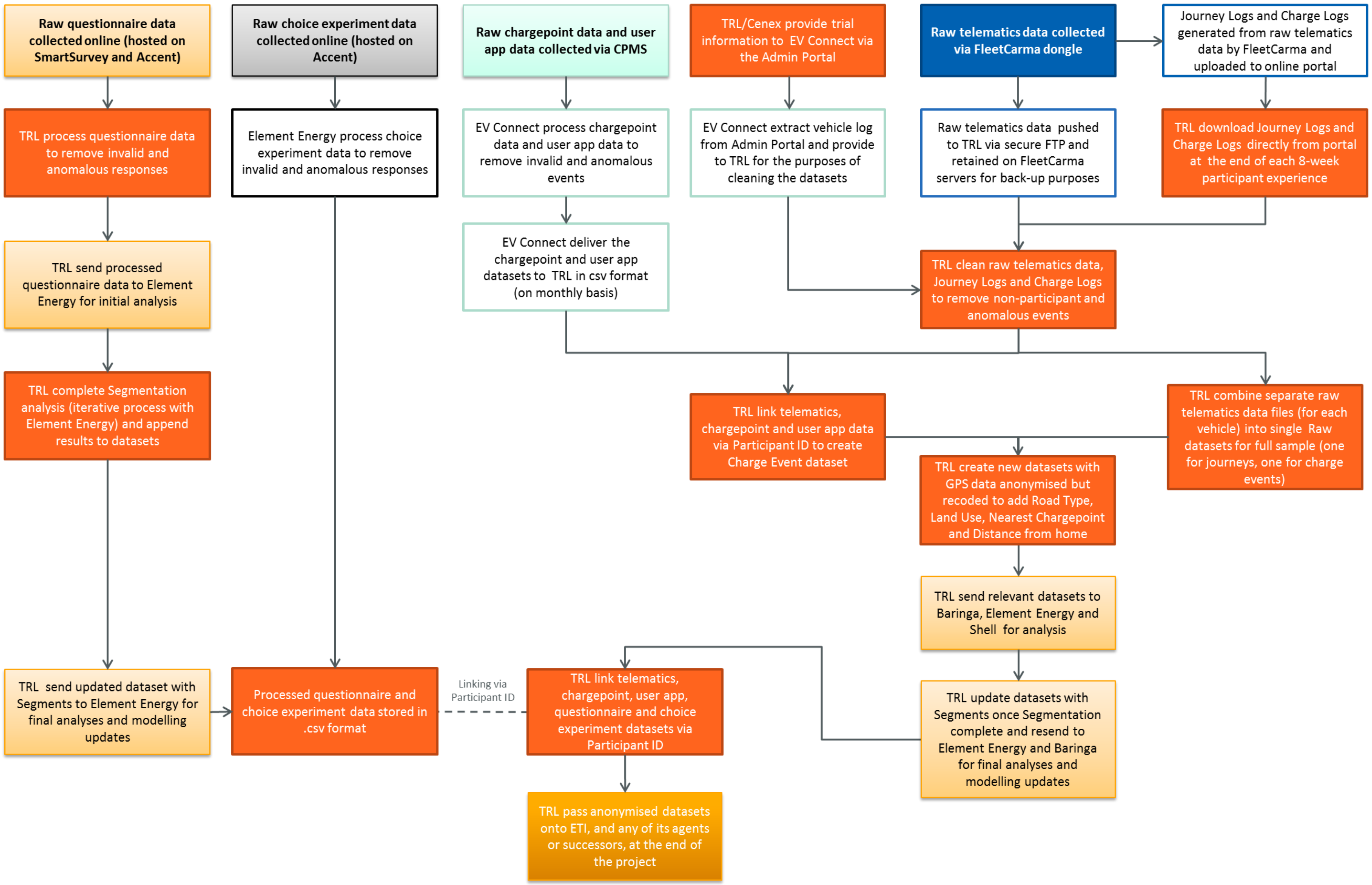

Figure 26: Flow chart showing data collection and processing for the Consumer Charging Trials

3.2.1 Questionnaire data

The questionnaires will be hosted online by Accent. Questionnaire data will be provided to TRL in electronic format. Each questionnaire will be recorded with the Participant ID to enable linking between questionnaires (e.g. Time point 1 and Time point 2) and to enable linking with other sources of data including the telematics, charging and app data.

All questionnaire data will be cleaned by TRL; this will include checking for missing or invalid values and unusual patterns in the data. For example, if participants always answer the first option for each question in a particular set then it suggests they may not be answering honestly and openly; data will be excluded for such cases. The completion time for all questionnaires will be logged by Accent. Average response times will then be assessed for each questionnaire, and extreme outliers will be identified. Any outliers which are deemed to represent invalid responses will be removed (such as those which are completed unusually fast or unusually slowly[42]).

3.2.2 Choice experiment data

Element Energy will clean and process the raw data from the choice experiment before undertaking the required consumer choice analyses. These analyses are described in more detail in section 2.14 and in response to the research questions as outlined in section 3.3.

3.2.3 Telematics data

Telematics data will be provided by FleetCarma in three forms (see Appendix O):

- A raw dataset containing all data fields at the original sampling frequency
- A ‘Journey Logs’ dataset containing aggregated data for each journey
- A ‘Charge Logs’ dataset containing aggregated data for each charge event

All datasets will be cleaned by TRL in order to remove data which do not represent valid participant use cases (see Figure 26). The cleaned datasets will be used by Element Energy for the battery state of health modelling and by Shell in its analysis of PHEV fuel utility factors (the fraction of total mileage carried out under electric vs ICE power). The cleaning process will involve:

- Removing journeys less than 0.1km (100m) in distance or one minute in time (whichever is lesser) – this will remove instances where the driver turns the vehicle on and off in order to check the charge, or moves the car in the driveway to enable recharging.

[42] Completion times will be captured for all questionnaires completed during piloting and during the trial. Using these data, an acceptable range of completion times will be defined based on the average completion time +/- three standard deviations – this range is expected to contain over 99% of completion times. The data from questionnaires which are completed in times outside this range will be interrogated further to assess their validity.

- Removing journeys carried out by TRL or Cenex staff as part of the vehicle handover process, or when the vehicle requires maintenance (i.e. non-participant events).

GPS coordinates during charge events will be anonymised by recoding the location data as either 'Home' or 'Away from home'. Repeated charge events which occur away from home will be identified using appropriate labels, e.g. Away from home 1, Away from home 2, etc., to enable analysis of journey patterns. For example, if a participant charged at work on multiple occasions, all charge events at this location would be given a single location label (e.g. Away from home 1).

GPS coordinates captured within journeys (i.e. in the raw journey data files) will also be anonymised and recoded (a full description of how this will be achieved is provided in the sections below.

3.2.3.1 Anonymisation of journey GPS data

Since it will be possible to identify a participant's home location from their GPS journey data, it is necessary that GPS data are anonymised prior to delivery to partners and the ETI. There is no prescribed method for handling spatial information, such as GPS data, under the Data Protection Act 1998. There are several options for anonymising GPS data; these are outlined in Table 17.

Table 17: Approaches for anonymising GPS data

		Description	Pros	Cons
1	Privacy zone anonymisation	This approach hides the section of a user's activity that starts or ends in the defined 'privacy zone' (i.e. their home) based on structured parameters (e.g. 500 metres around the home coordinates).	Completely removes the coordinates of a participant's home and the surrounding area.	Results in the removal of data. With enough journey data, the data points can be plotted and simple geometry can determine the radius and the centre of the privacy zone, potentially identifying the participant's home. More data will need to be removed in rural areas, as it will be tougher to create ambiguity when houses are sparse.
2	Normalisation of coordinates to zero	This approach resets the coordinates so that the participant's home is zero and all	Completely anonymises the participants' home coordinates.	Patterns of journey could theoretically be overlaid against road maps and once

		journey co-ordinates are in relation to this point.		a fit is found this would identify the participant's start and end point (i.e. their home) and regular journey patterns.
3	Rotation Method with Normalisation	Employs option 2, and then rotates the coordinates by a set quantity (e.g 90 degrees).	Significantly strengthens the protection of participants' GPS data. Addresses the weakness of normalisation as it becomes more challenging to simply overlay to existing maps. It is relatively quick to implement and process, and allows links between journeys.	It would be possible to reverse the process if someone identified a major route, e.g. if a journey is sufficiently long, and then deduced the amount of rotation that had been applied. This could then be applied to the whole dataset, since all data are rotated by the same amount.
4	Randomised Rotation Method with Normalisation	Employs option 2, and then rotates the coordinates by a randomised quantity.	This makes linking common journeys on a single participant far more difficult than before, addressing a limitation of option 3.	Additional processing required.

In order to ensure protection of the participants' journey data it is recommended that Option 4 is used (Randomised Rotation Method with Normalisation), as it provides the most secure approach and requires no removal of data points.

It should be noted that there are limitations in the future use of these spatial data which result from the anonymisation process. These are limitations that are not unique to this project (see Aad & Niemi, 2010[43]). For example, transforming a set of participant journey data coordinates (e.g. normalisation of co-ordinates to zero) removes all information of points of interest, which may be a useful information component for future research areas. Future use of the

[43] Aad, I., & Niemi, V. (2010). NRC data collection and the privacy by design principles. Proc. of PhoneSense, 41-45.

data will be limited to journey patterns (e.g. A, to B, to C, to A) rather than identifying any appreciation of purpose based on coding with points of interest.

Because of these limitations associated with the anonymisation of GPS, there is greater importance placed on pre-processing of GPS data to extract and code spatial information in the journey dataset prior to anonymisation.

3.2.3.2 Pre-processing of journey GPS data

GPS coordinates in the raw journey data files will be processed to add value and provide potential for future analysis. The following information will be coded into the dataset:

- Road type
- Distance from nearest chargepoint
- Distance from home
- Land use

Further information regarding these fields is provided in the following sections.

Road Type

Ordnance Survey offer a free shape file product called "Open Roads" which classifies each road link by type.

https://www.ordnancesurvey.co.uk/opendatadownload/products.html

The shape file contains the centre line of each road in the country labelled with fields including "Class", "Formofway" and "Function". The available values for each field are shown below.

Class	**Formofway**	**Function**
A Road	Collapsed Dual Carriageway	A Road
B Road	Dual Carriageway	B Road
Classified Unnumbered	Roundabout	Local Access Road
Motorway	Shared Use Carriageway	Local Road
Not Classified	Single Carriageway	Minor Road
Unclassified	Slip Road	Motorway
		Restricted Local Access Road
		Secondary Access Road

The process will identify the nearest link for each recorded vehicle location, then copy the values associated with this link to the vehicle data file. The shape file is supplied as a set of 100km squares so that file sizes are manageable. As the process works through each journey file it will automatically load the relevant shape file then identify the nearest link. The distance from the vehicle position to the centre line of this link will also be stored. Journey files can be downloaded and batch processed periodically as data is collected. The data can also be combined into a database table if required.

Nearest Charging Point

Ordnance Survey has a free shape file product called "Local" which has a layer containing all of the charge point locations. The processing power required to locate the nearest charging point is negligible compared to identifying the nearest link in the road type file, and can be done as part of the same process. Ultimately values may only be needed for the start and end location of each journey. The straight line distance to the nearest charging point will be stored.

Distance travelled from home location

It is a simple task to calculate the straight line distance between the initial journey position and every other recorded position, and can be added as part of the above processing. The maximum value for each journey can then easily be extracted if required. If the home location of a participant is known then journeys can be filtered to ones which start at their home.

Land Use

The land use classification for each journey origin and destination can be established using a map from the data.gov.uk website.

https://data.gov.uk/dataset/oa-ew-bgc-with-rucoa11/resource/5da60e17-5d16-4b8a-9536-0e8c5313a407

The shape file download defines regions, and classifies them as shown below.

Land Use Classification (Field Name=Rucoa11nm)
Rural hamlets and isolated dwellings
Rural hamlets and isolated dwellings in a sparse setting
Rural town and fringe
Rural town and fringe in a sparse setting
Rural village
Rural village in a sparse setting
Urban city and town
Urban city and town in a sparse setting
Urban major conurbation
Urban minor conurbation

This process involves identifying the region to which each origin/destination point belongs - this can be done using MapInfo software. A separate table just containing journey start and end points will be created for this extra column.

3.2.4 Home charging and User App data

Data from the chargepoint will be pushed to the CPMS every five minutes during charging. Vehicle SOC will also be pushed to the CPMS from the FleetCarma telematics dongle at two-minute intervals. These data will be processed by EV Connect to:

- Remove plug-in events less than 5 minutes in duration.
- Remove non-participant plug-in events (i.e. when the vehicle is with TRL/Cenex staff)

- Remove plug-in events from non-participant vehicles (e.g. if a non-trial EV plugs into the home chargepoint)

The chargepoint, telematics and User App data will be collated in order to provide a holistic ‘Charge Event’ dataset for home charging events. This will include:

- Date and timestamps of plug-ins
- SOC at plug-in
- User entered charging preferences, including whether or not defaults were used (for UMC and SMC groups only)
- Date and timestamps of charge start
- User interactions during charging, including whether or not original UMC/SMC parameters overridden for UMC and SMC groups only)
- Date and timestamps of charge end
- SOC at plug-out
- Savings Points earned for charge event

Data on charging ‘away from home’ (see section 3.2.3) will also be captured and will include:

- Date and timestamps of charge start
- SOC at charge start
- Date and timestamps of charge end
- SOC at charge stop

This processed Charge Event dataset will generated directly from the EV Connect portal using the ‘Charging Report’ function. The Charge Event dataset will be used by Baringa for their analyses and updates to the Analytical Framework.

A raw charge dataset will also be provided. This will contain more detailed interval data for each charge event, displaying state of charge, battery current, battery voltage, battery temperature and GPS coordinates (see Appendix O).

Data will be stored in redundant databases in the EV Connect Cloud and backed up daily. Monthly data transfers to TRL will be scheduled as a further means of back up.

3.3 Data analysis plan

Analysis will proceed in three phases: initial analyses, primary analyses, and supplementary analyses. These are described in turn in the following sections.

3.3.1 Initial analyses

Prior to conducting any other analyses, extensive sample characterisation and tests for certain potential sample biases will be conducted.

3.3.1.1 Sample characterisation

Prior to commencing any statistical analysis, the questionnaire and telematics data will be summarised. This will include, but is not limited to:

- A summary of the sample characteristics, including an assessment of how representative this is of the general driving population.
- A summary of the sample's vehicle ownership history and general travel patterns.
- A summary of the attitudes to BEVs/PHEVs, vehicle charging and likelihood of vehicle purchase.
- A between-groups comparision to test how well random allocation of participants to groups has resulted in groups that are matched in respect of salient characteristics, including personality traits, driving style, age, gender, income, and existing travel patterns.

A extensive analysis of the 2012 TRL-Shell BEV trial that used a similar stratified sample and similar recruitment channels identified no significant inter-group differences in respect of salient sample characteristics, giving some confidence that appropriate matching will again be achieved. This analysis will test how far that is true; statistically significant mismatches will however be flagged and this information will be used in the interpretation of findings.

This analysis will generate a considerable volume of information; this will be reported in various ways as appropriate, including visualisation using charts and graphs. The key data will be included in a list of the results of statistical tests for inter-group differences in salient characteristics.

3.3.1.2 Analyses for potential sample biases

An inter-group comparison will be made of the Time Point 1 willingness to consider of participants who complete the study versus those who drop out after Time Point 1 (those who drop out prior to Time Point 1 will be replaced). This will identify whether those dropping out were systematically biased in favour of or against adoption of PiVs compared with those who completed the study (note however that for ethical reasons, participants who withdraw have the right to withdraw ALL their data, including data collected before their withdrawal, without explanation).

Inter-group comparisons of willingness to consider will be made between participants recruited via the different recruitment channels. This will identify any systematic biases arising if one or more of the recruitment channels preferentially accesses people who are more or less predisposed to consider a PiV than the population as a whole.

3.3.2 Primary analyses: addressing the research questions

The primary analyses of data from the Consumer Charging Trials will address the research questions set out in section 1.6. As described in section 1, because of different sampling strategies required for BEVs and PHEVs, there will be two Charging Trials, one using BEVs and the other using PHEVs. The designs of the two trials will be identical except for the differences in vehicles used, and the consequent difference in sampling strategies. These differences mean that it will not be possible to make meaningful between-trials comparisons of charging behaviour based on vehicle type; data from the BEV and PHEV Consumer Charging Trials will be analysed separately.

Key research questions concerning differences in charging behaviour between the Control, UMC, and SMC groups will be addressed in these analyses. The trial design ensures that it will be possible to make causal attributions of the kind "engagement in SMC caused change X in charging behaviour compared to the control (no MC) condition". This is a key benefit of this approach. However, as outlined in section 1, such analyses rely on analysis of whole-group aggregated data. Since the trial will also generate a great deal of data at the level of individual participants, a more exploratory analysis will also be carried out of the whole dataset based on correlation, factor, and regression analyses that will provide a comprehensive, "holistic" view, drawn from the whole dataset, of the factors that influence charging behaviour in addition to engagement or not in Managed Charging schemes. This, along with certain other supplementary analyses, will be described in section 3.3.3.

A description of what data are required for each of the primary analyses, how they will be used, and what kinds of outputs will be produced is provided in the following sub-sections.

3.3.2.1 What is the charging behaviour of mainstream consumers when not participating in a Managed Charging scheme?

To answer this research question, data are required on the real-world charging behaviour of mainstream consumers in the Control group (i.e. those who are not engaged in a Managed Charging scheme, and are free to charge their plug-in vehicle as they wish) in each trial (BEV and PHEV). Charge point data will be used to calculate a daily charging profile for each home charge point (effectively a home charging profile for each participant, since each charge point is fitted in the home of a particular participant), as shown illustratively in Figure 27 (black line), showing when, during that day, the charge point was delivering charge. These individual daily profiles will be aggregated into a characteristic profile for that participant (Figure 27, orange line) using data captured over the last 6 weeks of the 8-week trial experience (data from the first two weeks will not be included, as charging profiles might be different before the participant's charging behaviour has habituated, which in previous trials this has taken up to two weeks – but see section 3.3.2.4, where habituation in this trial will be analysed – if it is found to take a longer or shorter interval the aggregation time for characteristic profiles will be adjusted accordingly); separate profiles will be calculated for weekday and weekend day charging.

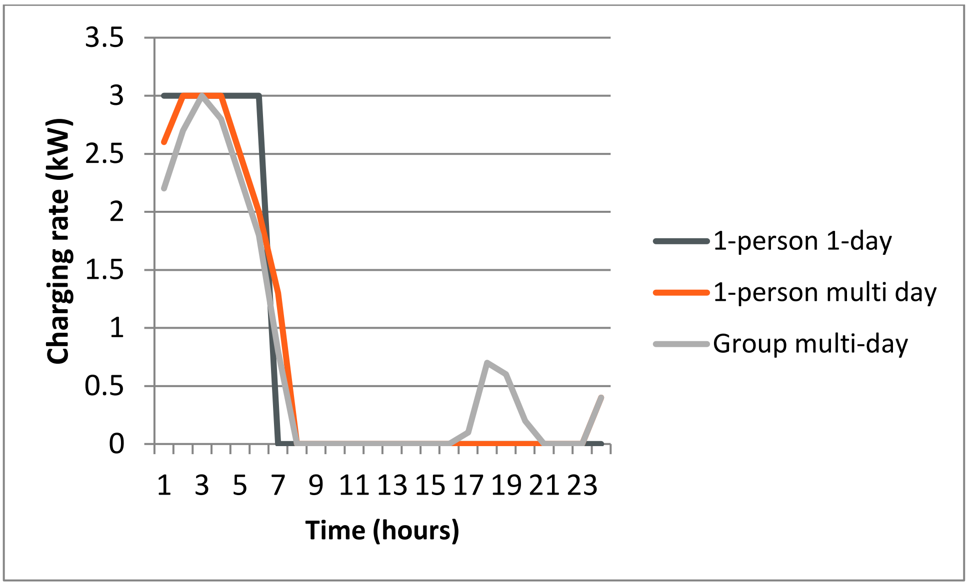

Figure 27: Individual daily charging profile for a single participant, characteristic charging profiles for that individual participant (averaged over many days when charging occurred), and characteristic charging profile for the whole Control group (example output using fictitious data generated for illustrative purposes only)

Individual characteristic profiles will then be aggregated into a characteristic profile for the whole Control group (Figure 27, grey line). Again, separate whole-group characteristic profiles will be calculated for weekday and weekend day charging.

These profiles will be incorporated into the Analytical Framework. They also provide an immediate visualisation of the charging data showing the charging behaviour of the Control group as a whole.

In additionfor each participant and for the Control group as a whole, the following metrics of *home* charging behaviour will be calculated:

- Mean and Standard Deviation (S.D.) of plug-in time
- Mean and S.D. of charge start time
- Mean and S.D. of SOC at charge start
- Mean and S.D. of charge end time
- Mean and S.D. of SOC at charge end (and thus total SOC delivered)
- Mean and S.D. of plug-out time

Separate metrics will be calculated for weekdays and weekend days. Data will be captured in the 'Charging Log' dataset incorporating data from the FleetCarma telematics dongle and the home chargepoint (see section 3.2.4).

For each participant and for the whole Control group, the following metrics of *away-from-home* charging behaviour ('home' and 'away-from-home' charge events shall be classified according to the GPS coordinates of the charge event) will also be calculated:

- Mean and S.D. of charge start time
- Mean and S.D. of SOC at charge start

- Mean and S.D. of charge end time
- Mean and S.D. of SOC at charge end (and thus total SOC delivered)

Separate metrics will be calculated for weekdays and weekend days. Data will be captured in the 'Charging Log' dataset incorporating data from the FleetCarma telematics, but not, in these cases, from the home chargepoint (plug-in and plug-out times for away-from-home charging cannot be recorded, as this data is supplied by the home chargepoint; it is a reasonable assumption, however, that in most away-from-home cases plug-in time and charge start time will be similar, as will charge end time and plug-out time) (see section 3.2.4).

These metrics will be used to make statistical inter-group comparisions between charging behaviour in the Control group and in the two Managed Charging groups (see next section). They will also be used in the Supplementary Analysis as the dependent variables in regression analyses. Further discussion about the analysis of charging profiles is provided in section 3.4.2.

3.3.2.2 How does the charging behaviour of mainstream consumers when participating in a Managed Charging scheme compare with their behaviour when they are not?

To answer this research question, equivalent data to that set out for the Control group in section 3.3.1.2 will also be captured for both the User-Managed Charging (UMC) and Supplier-Managed Charging (SMC) groups. Characteristic home charging profiles for the three groups will be presented visually, as shown illustratively in Figure 28, and these profiles will form inputs to the Analytic Framework. Separate profiles will be calculated for each group for weekdays and weekend days.

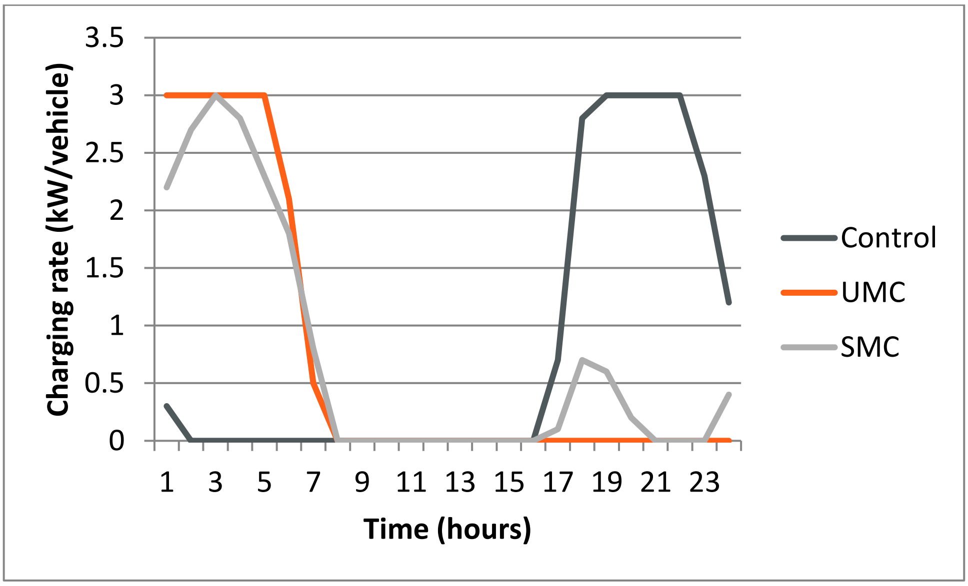

Figure 28: Data visualisation: Whole-group characteristic charging profiles for Control group, UMC group, and SMC group compared (example output using fictitious data generated for illustrative purposes only)

To make specific statistical inter-group comparisons, the set of metrics defined in section 3.3.2.1 will also be calculated for the UMC and SMC groups:

For home charging:

- Mean and Standard Deviation (S.D.) of plug-in time
- Mean and S.D. of charge start time
- Mean and S.D. of SOC at charge start
- Mean and S.D. of charge end time
- Mean and S.D. of SOC at charge end (and thus total SOC delivered)
- Mean and S.D. of plug-out time

Separate metrics will be calculated for weekdays and weekend days. Data will be captured in the 'Charging Log' dataset incorporating data from the FleetCarma telematics dongle and the home chargepoint (see section 3.2.4).

For away-from-home charging:

- Mean and S.D. of charge start time
- Mean and S.D. of SOC at charge start
- Mean and S.D. of charge end time
- Mean and S.D. of SOC at charge end (and thus total SOC delivered)

Separate metrics will be calculated for weekdays and weekend days. Data will be captured in the 'Charging Log' dataset incorporating data from the FleetCarma telematics, but not, in these cases, from the home chargepoint.

The size and statistical significance of inter-group differences (i.e. differences between SMC group and Control group; and differences between UMC group and Control group) on each metric will be calculated using Analysis of Variance (ANOVA) and/or other statistical tests appropriate for inter-group comparison. For example, if Control group behaviour is similar to that reported from previous charging trials, mean charge start time for the Control group might be some time in the early evening (e.g. 18:05); while if engagement with SMC has the effect of causing deferral of charging until overnight, mean charge start time might be substantially later, e.g. 23:47. Clearly there is likely to be substantial distribution around both of these mean values, so a statistical test is needed to establish whether the difference between means is in fact significant, i.e. unlikely to have occurred by chance.

It may be that there are significant inter-group differences in respect of some metrics but not others. For example, mean weekday plug-out times may be similar (say, 07.33 for Control group, 07.42 for UMC group) irrespective of different charge start and stop times. The use of multiple metrics will enable such patterns to be characterised.

The metrics will also be used in the Supplementary Analysis as the dependent variables in regression analyses. Further detail about data analysis techniques is provided in section 3.4.

To enable visualisation of the data used to make inter-group comparisons for each metric, frequency plots such as that shown in Figure 29 will be used.

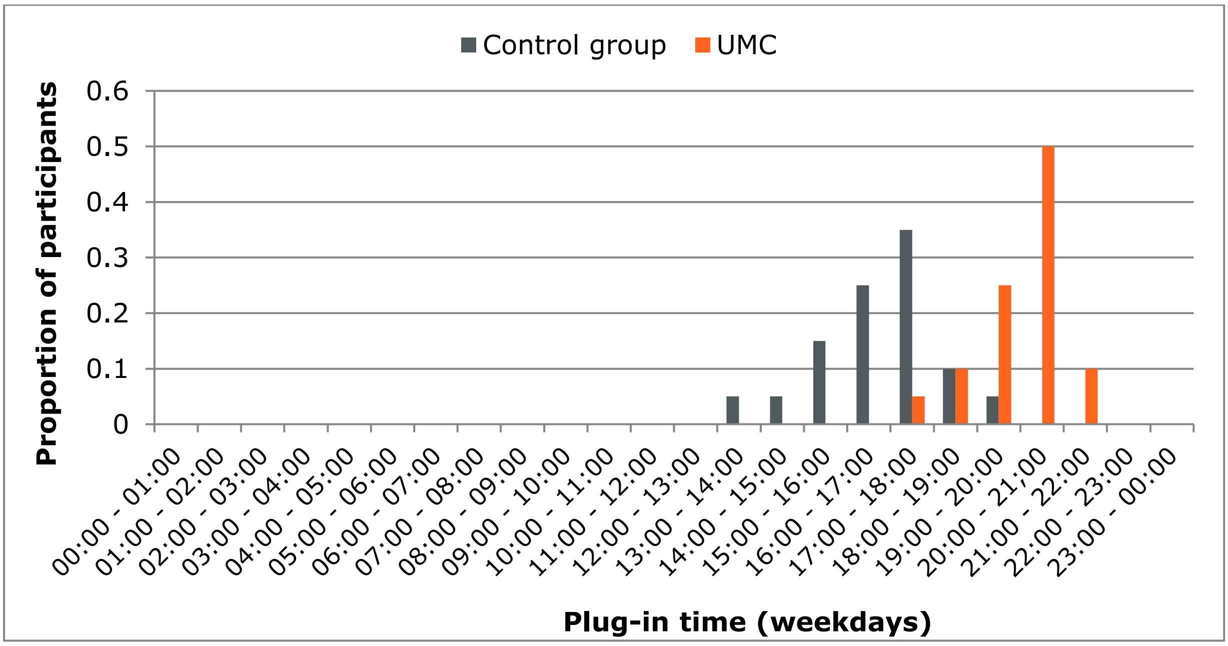

Figure 29: Data visualisation: Distribution of weekday Plug-in times for Control group and UMC group (this is an example output, using fictitious data generated for illustrative purposes only - similar plots will be produced for weekend-day data, and for Control group – SMC group Plug-in times)

In this illustrative example, weekday Plug-in times for the UMC group tend to be later than for the Control group, though there is some overlap; and the width of the distribution (i.e. its Standard Deviation) for the Control group appears larger. The chart shows the proportion of participants plugging in at particular times plotted against time of day; in this example, hypothetical data from both the Control group and the User Managed Charging group are shown together. In this illustrative example using fictional data, there is a clear difference in plug-in times between the groups, with the User Managed Charging group generally plugging in later than the Control group (this is illustrative only, this is not a formulation of a hypothesis that such a difference will be found in the trials).

Whenever inter-group comparisons are made (in respect of this research question and those that follow), these will include comparisons between the ‘Summer’ and ‘Winter’ pricing sub-groups of UMC and SMC and the Control group; however, due to the small sample sizes of these sub-groups (N = 20 participants) the statistical power of such comparisons will be lower, so only relatively larger effect sizes will be statistically significant[44].

[44] The Control group is not divided into sub-groups according to pricing levels experienced, as the UMC and SMC groups are; accordingly comparisions will preferentially be made between the UMC “summer” and “winter” pricing sub-groups and the whole Control group, and likewise for the SMC pricing sub-groups, to give greater statistical rigour. However since there may be some systematic bias in the utilisation of Control group vehicles month-by-month (see section 2.1), so the Control group will also be divided into two sub-groups, those participating at the same dates as the “summer” pricing UMC/SMC sub-groups, and those participating at the same dates as the “winter” pricing UMC/SMC sub-groups. Comparisons will then also be made against the appropriate Control sub-group.

3.3.2.3 How does the charging behaviour of mainstream consumers when participating in a Supplier-Managed Charging scheme compare with their behaviour when participating in a User-Managed Charging scheme?

This research question, like that above, requires inter-group comparison of charging behaviour, and the same analysis approaches will be used. Comparisons will also be made between the UMC and SMC pricing sub-groups.

3.3.2.4 What are the diurnal, weekly and seasonal time profiles of charging when participating (or not) in a given Managed Charging scheme?

This research question requires longitudinal comparisons of the real-world charging behaviour of mainstream consumers in each of the Control, UMC and SMC groups.

The approach will be similar to that adopted for the Research Questions above, using the same data and metrics to characterise charging behaviour. In this analysis, however, rather than between-groups comparisons of time-averaged charging profiles, profiles and metrics will be calculated separately for data aggregated over various time intervals (e.g. separate profiles and metrics for each week of participation). Data will be visualised in frequency plots (similar to Figure 29) and within-group statistical comparisons will be made using the metrics set out in section 3.3.2.1.

Within each Group, characteristic diurnal charging profiles and metrics will be compared for weekdays and weekend days to investigate how far these are similar or different. Data will be visualised in frequency plots such as Figure 30.

Weekly charging profiles will be compared to explore the rate at which participants' charging behaviour habituates. Experience in other trials (which have tended to have EV Innovators rather than Mainstream Consumers as participants) suggests that habituation typically takes no more than two weeks, after which charging behaviour stabilises. This analysis will characterise habituation of charging behaviour by Mainstream Consumers. If it indicates that habituation takes a longer or shorter period than the anticipated two weeks, the aggregation period for charging profiles and charging metrics used in other analyses will be adjusted accordingly.

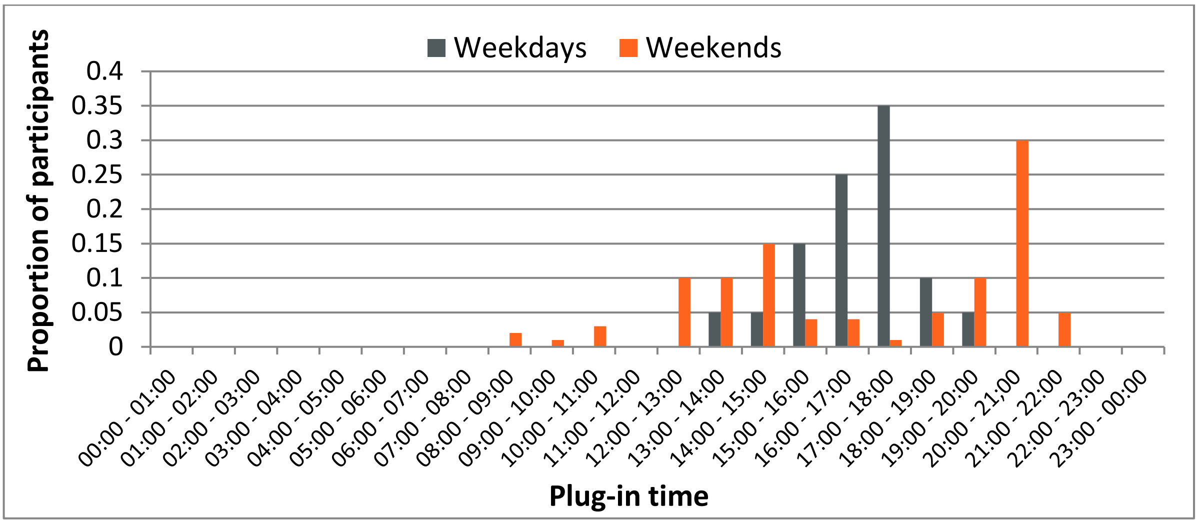

Figure 30: Plug-in times for weekdays and weekends compared (within one Group) (example output using fictitious data generated for illustrative purposes only)

Seasonal variations in charging behaviour will be characterised by calculating and comparing aggregated charging profiles and metrics for each group/sub-group separated into the three successive participation-time blocks described in Section 2.

3.3.2.5 What are the between-participant variabilities in Mainstream Consumer charging behaviour when participating (or not) in a given Managed Charging scheme?

It is important to understand not just the mean charging behaviour of each group, but also the distribution of charging behaviour within it. This will be characterised using the Standard Deviation of each of the metrics set out in section 3.3.2.1., which measures the width of the distributions. It will also be visualised using plots such as Figure 30, which shows the distribution of plug-in times for weekdays and weekend days for one participating group (using illustrative, fictional data). Standard deviations will be calculated and distributions visualised in this way, for all charging behaviour metrics calculated in all analyses.

Statistical comparisons of charging behaviour metrics between-Groups or within-Group will be made using appropriate statistical tests such as ANOVA (Analysis of Variance). Such tests make use of all the data, rather than simply comparing means. Between-participants ANOVA, for instance, compares the magnitude of the difference in the means for the groups to their variances in order to establish whether the differences are sufficiently large in relation to the variances to be considered significant according to conventional criteria.

3.3.2.6 How does charging behaviour vary with time over the first eight weeks of using and charging a PiV, whether participating in a Managed Charging scheme or not?

This research question will be answered by the comparison of weekly charging profiles and metrics within each group, described in Section 3.3.2.4.

3.3.2.7 How do mainstream consumers interact with specific features of User- and Supplier-Managed Charging?

This research question will be answered by capturing data on participants' interactions with UMC and SMC via the User App. The following data will be collected from the User App by the CPMS:

- Date and timestamps of participant logins
- Date and timestamps of user inputs:
  - New charging preferences
  - Requests to charge immediately (overriding UMC/SMC)
  - Change of default values
  - Use of default values (i.e. no new values entered)
- Savings Points for each charge event
- Total Savings Points earned

These data will be recorded in the Charging Log dataset, supplementing the data points captured from the FleetCarma telematics dongles and from the home chargepoint (see section 3.2.4). The data will be captured over the full 8-week trial experience from 40 UMC participants and 40 SMC participants (in both the BEV Charging Trial and the PHEV Charging Trial) and aggregated across each of the participant groups. Statistical comparisons using appropriate techniques for the data will be made to ascertain whether there are statistically significant differences in the charging preferences and interactions of participants in the UMC and SMC groups.

For example, one hypothesis might be that interactions with the User App in the SMC scheme are less frequent than that for the UMC scheme; an example output which could be used to test this hypothesis is shown in Figure 31.

The metrics calculated with respect to interactions with the User App will also be used as variables in the holistic correlation/regression analyses described in section 3.3.3.

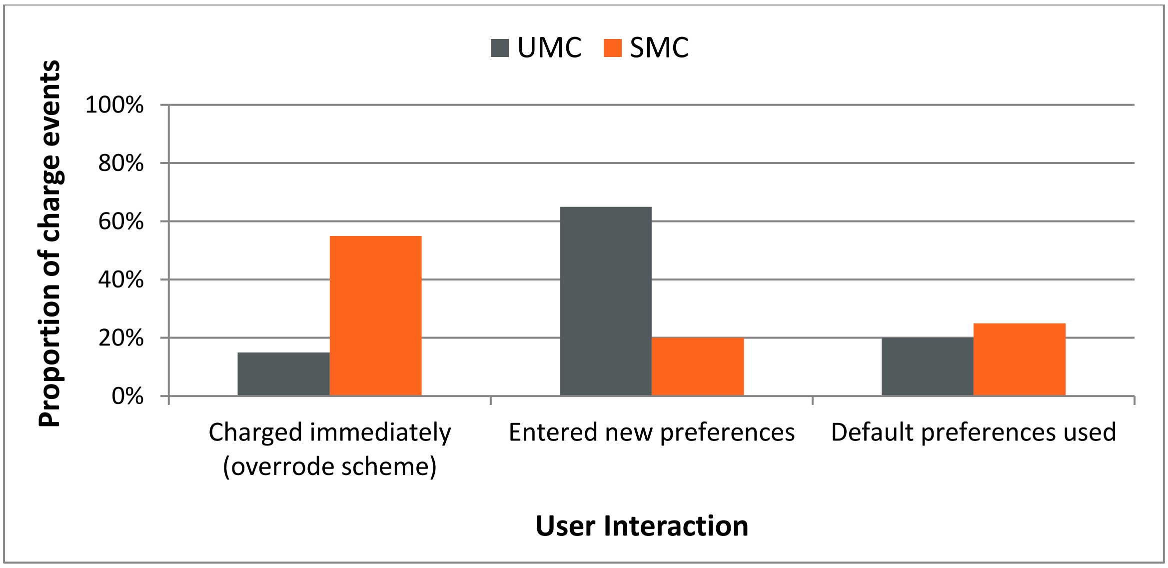

Figure 31: User interactions with UMC and SMC (example output using fictitious data generated for illustrative purposes only)

3.3.2.8 What preferences do mainstream consumers have between Supplier-Managed Charging, User-Managed Charging, and no Managed Charging?

This research question will be addressed using the choice experiment (see section 2.14). Participants will complete the choice experiment after their psychological distance from EV charging has been reduced through their participation in the Trial; for one-third of participants, their psychological distance from SMC specifically will have been reduced, and for another third, their psychological distance from UMC specifically will have been reduced. Accordingly, if possible with the data collected, separate choice coefficients will be calculated for each group within the BEV and PHEV Trials.

Further information about the choice experiment attributes and how they will be analysed to answer the research questions is provided in section 2.14 and section 3.4.7.

This analysis will be supplemented by statistical analyses of data that will be obtained from the Time Point 2 questionnaires (see section 2.13). Statistical comparisons will be made to ascertain whether there are significant inter-group differences between responses to these items, in order to assess the extent to which mainstream consumers perceptions of UMC and SMC were different.

3.3.2.9 What factors influence preferences between Supplier-Managed Charging, User-Managed Charging, and no Managed Charging?

This research question requires understanding of the factors which are important in mainstream consumer decision making with regards to choosing charging tariffs. These data will principally be obtained from the choice experiment, by exploring the relative impact of different attributes on participants' preferences for different types of managed charging scheme. This analysis will be supplemented by the Time Point 2 questionnaire, which will ask participants to rate the relative importance of the following factors when choosing an energy tariff:

- Cost of charging
- Convenience
- Simplicity
- Predictability of energy bill
- Compatibility with vehicle use and charging needs
- Ability to make savings
- Control over when your vehicle will charge
- Predictability of having a full charge when car is needed
- Control of charging via an app or website

One hypothesis might be, for example, that individuals who prefer UMC might rate the importance of the above factors differently to individuals who prefer SMC (or no managed charging). An example output which could be used to visualise the data in respect of this hypothesis is shown in Figure 32.

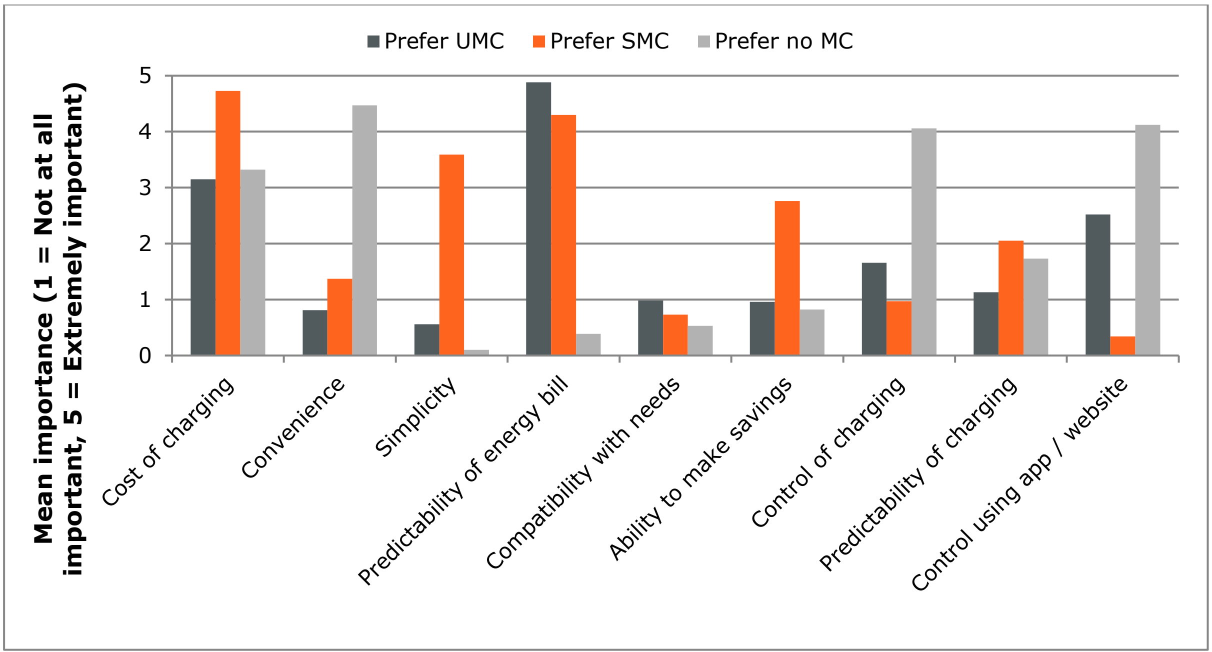

Figure 32: Mean importance of charging tariff factors (example output using fictitious data generated for illustrative purposes only)

Statistical comparisons will be made to ascertain whether there are significant differences in the importance of the various factors for participants who would prefer UMC, SMC or no managed charging. Further detail about the data analysis techniques which will be used is provided in section 3.4.

Supplementary analysis will also be performed to understand the extent to which preferences for UMC, SMC or no MC (and the associated factors important for those schemes) differ between sub-sets of the population. However, the ability to make robust statistical comparisons between these different groups will depend on the size of the groups.

3.3.2.10 What are the impacts of different User-Managed Charging tariffs and Supplier-Managed Charging schemes on a Consumer's likelihood to participate in these arrangements?

This analysis will principally be carried out using the choice experiment, by exploring willingness to consider UMC and SMC and the impact of different attributes on that decision (further information about the choice experiment can be found in section 2.14 and 3.4.7).

This analysis will again be supplemented by findings from the Time Point 2 questionnaire which also explores participants' willingness to consider UMC, SMC and no MC (see section 2.13) by asking participants 'If you owned a PHEV/BEV [different vehicle types covered in separate questions], which type of energy tariff would you choose?'. Inter-group comparisons of aggregated responses will be made between the "Summer" and "Winter" UMC and SMC sub-groups, since these sub-groups will have experienced different levels of reward for enagement in their Managed Charging scheme and this may influence their willingness to consider.

One hypothesis might be, for example, that UMC will be more popular than SMC, particularly if owning a BEV. An example output which could be produced to visualise the data in relation to this hypothesis is shown in Figure 33.

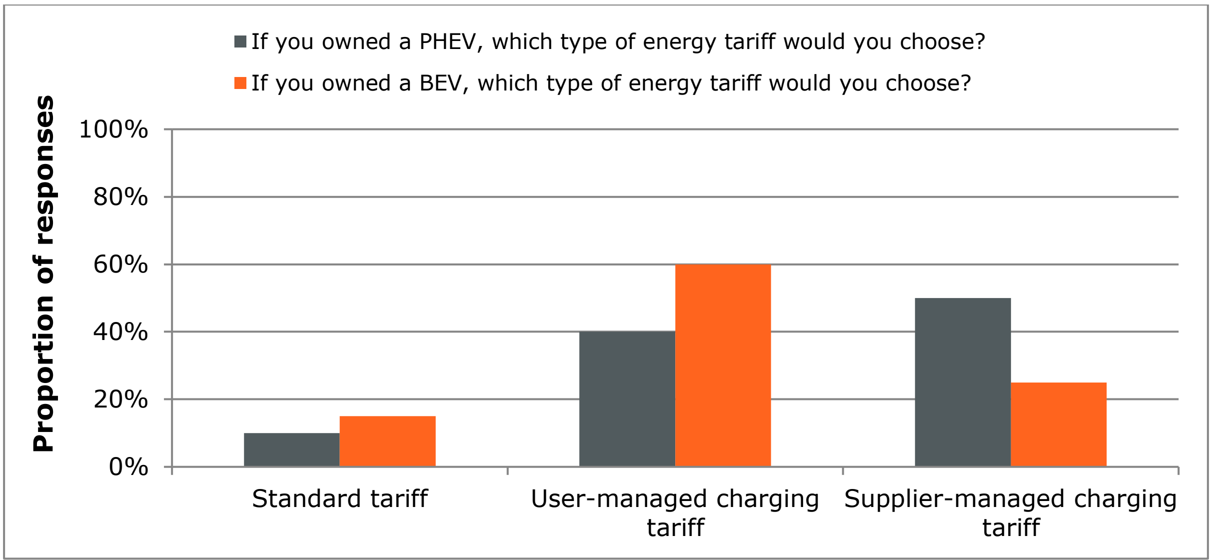

Figure 33: Preferred charging tariffs if owning a BEV or PHEV (example output using fictitious data generated for illustrative purposes only)

3.3.2.11 What are the impacts of different User-Managed Charging tariffs and Supplier-Managed Charging schemes on the likelihood of car buyers choosing a PHEV / BEV over other powertrains?

This research question will be answered using data captured in the Time Point 2 questionnaire on the impact of UMC and SMC on participants' willingness to adopt a BEV or PHEV, as both a main car and a second car. Statistical comparisons will be made to ascertain whether there are significant differences in responses for BEVs and PHEVs; that is, to understand the relative importance of managed charging schemes when considering adoption of a BEV versus a PHEV[45]. This will help to inform policy recommendations about the kinds of schemes which are most likely to have significant impacts on the uptake of PiVs in the future.

Further analysis will also be performed to understand the extent to which perceptions about UMC and SMC (and the influence on uptake of PiVs) differ between sub-sets of the population. However, the ability to make robust statistical comparisons between these different groups will depend on the size of the groups.

3.3.2.12 What are the utility factors (fraction of total mileage carried out under electric power) for PHEVs used by mainstream consumers, and how do these vary between mainstream consumers?

Analysis of PHEV trial data by Shell will provide an understanding of utility factors (UF, the fraction of mileage covered under electric power) which will enable estimation of the impact

[45] This analysis, like the others, will be carried out separately for participants in the BEV and PHEV Trials. However willingness to consider both BEVs and PHEVs will be asked at Time Point 2 in both Trials.

of the unavailability (or prohibitively high cost) of electricity (due, for instance, to variability in the provision of renewable power) on the PHEV component of a future, de-carbonised, light-duty road transport vehicle parc in the UK. This analysis requires data on real-world journeys undertaken in PHEVs by mainstream consumers. Aggregated journey data will be obtained directly from the Journey Log dataset provided by the FleetCarma telematics dongles (see section 3.2.3), which includes:

- Ignition on date & time (to mark start of journey)
- Total journey duration (to mark end of journey)
- Total journey distance (km) (measured from the odometer)
- Fuel consumed during journey (gal)
- Fuel consumption (mpg)
- Absolute engine load (%)
- SOC at ignition on and off
- Energy consumed during journey (kWh)
- Energy consumption (MPG_{eq})
- Average speed (mph)
- Maximum speed (mph)
- Average engine speed (RPM)
- Mean engine speed (RPM)
- Auxiliary Load (kW)
- Proportion idle time (%)
- EV Fraction (proportion of journey under electric power)

Data will be collected for all 120 participants in the PHEV Charging Trial for all journeys (greater than 0.1 miles – see section 3.2.3) undertaken during the 8-week trial period. Shell will use the data on journey length, liquid fuel consumption, and electrical energy consumption to calculate utility factors per journey. The data will be aggregated for each experimental group (Control, UMC and SMC) in order to understand inter-group differences in utility factors and enable statistical comparisons between the groups. The distribution of the data will also be assessed through calculation of standard deviations in order to understand variability between mainstream consumers, and how this variability differed between experimental groups.

3.3.3 Supplementary analyses

In addition to the core analyses described in section 3.3.2, supplementary analyses will also be performed to enhance interpretation of the findings.

These will help to explore, understand and interpret the primary results from the trials, and the factors underlying those results, in respect of the research questions and in some cases to supplement the findings from the Consumer Uptake Trial (see Part 1 of Deliverable D5.1).

1) Identification of factors influencing charging behaviour

The primary form of supplementary analysis will be a comprehensive, holistic analysis using the full dataset. The Trials will measure a wide range of personal and personal-situational variables through questionnaires administered at various time points during participant; record various telematics data giving information on usage of the trial vehicles during participation, and record data on the ways that participants interact with the various versions of the smartphone app that will be used by each group. All of these variables will be included in this analysis, as will the various charging behaviour metrics set out in the previous section.

The analysis will proceed through a series of steps:

- **Compute a correlation matrix**: a tabulated correlation matrix that will identify the degree of association (correlation) between all pairs of variables in the Trial. In particular it will identify the degree of correlation of all potential predictive variables (e.g. age, gender, personality, driving style, income, proportion of time spent on different road types, maximum and mean distance from home, etc.) with the charging behaviour metrics, to inform the approach for regression modelling (see section 3.4.6).
- **Where appropriate, perform factor analyses:** to reduce data by combining variables that are correlated with one another into independent factors. This will reduce collinearity between variables entered into regression analyses, increasing their robustness.
- **Undertake multiple regression analyses**: to assess the extent to which the most important factors (which are not highly correlated with each other) are predictive of charging behaviour (see section 3.4.6)

The output will be a regression model for each metric; the magnitudes of the regression coefficients will indicate the extent to which each predictor variable appears to influence the metric. Specifically, it will indicate the extent to which variance in the charging behaviour metric is associated with variance in each predictor variable. In principle, many of the wide range of variables recorded in the Trials could be included in any of the regression analyses, either directly or via its contribution to a factor identified in the preceding factor analysis. In practice, variables that show no significant correlation with an outcome metric will be excluded from the regression analysis, again to maximise robustness of the analysis. Further detail of the data analysis techniques is provided in section 3.4.

For inclusion in the regression analyses variables are required to be expressed in the form of a single scalar value per participant. Thus time-resolved data (e.g. telematics data) and spatially-resolved data (GPS) will be aggregated accordingly[46]. In the case of GPS data two metrics will be calculated to be used in the correlation/regression analyses: (a) mean distance from home (the perception of which may influence the charging behaviour of some

[46] Where appropriate, all three measures of central tendency (mean, mode, and median) will be calculated for variables such as trip length, and two measures of distribution spread (standard deviation and max-min difference); all will be used in the initial correlation analysis. This will enable more nuanced influences to be identified – for instance, participants whose mean trip length appears suitable for BEV use may be unwilling to adopt because they make some much longer trips. This pattern would be reflected in a low modal trip length but a higher mean.

participants, e.g. those high in trait neuroticism); (b) mean fraction of driving on motorways/dual carriageways, where speeds are higher, braking is less frequent, and energy use is considerably higher than on urban and other classes of inter-urban roads.

During the course of this holistic analysis, various decisions will need to made about inclusion/exclusion of variables in regression analyses, based on their degrees of correlation with charging behaviour metrics and with each other. The project team will liaise with ETI in the making of these decisions.

2) Comparisons between travel behaviour and vehicle usage for each of the three experimental groups

This will utilise vehicle telematics data to understand differences in the characteristics of journeys made by participants in each of the experimental groups, for example, average and maximum speeds, average fuel consumption, average SOC, average journey distance, driving style (proportions of hard acceleration and braking), proportion of time spent on different road types, and maximum and mean distance from home.

This supplementary analysis will provide detail about how participants in each of the experimental groups used the vehicles during the trial. The results may therefore aid interpretation of any differences in charging behaviours between UMC, SMC and the Control.

An example output which could be produced as part of this analysis is shown in Table 18.

Table 18: Comparison of BEV journey characteristics for each experimental group (example output using fictitious data generated for illustrative purposes only)

	Control	UMC	SMC
Average journey distance (km)	12.5	9.5	12.0
Average distance from home (km)	5.7	6.3	6.1
Average journey time (mins)	16.9	17.7	17.0
Average speed (kph)	44.5	32.3	40.5

This supplementary analysis will help to answer a number of secondary research questions including;

- Were there differences in travel behaviour (e.g. the number of journeys, average journey distance, types of road used, etc) between the three experimental groups?
- Were there differences in the longitudinal control aspects of driving style (e.g. average speed travelled or proportions of hard acceleration) between the three experimental groups?
- Were there differences in travel behaviour over the eight week trial period?

3) Comparisons between attitudes to different charging tariffs (after experience with one of the three)

This will utilise data from the Time Point 2 questionnaire in order to understand differences in the perceptions of different types of energy tariffs between participants in the Control, UMC and SMC groups. It might be expected, for example, that attitudes towards SMC might be different between individuals who have direct experience of an SMC scheme (through the trial) and individuals who have had direct experience with a UMC scheme.

This supplementary analysis will inform acceptability of user managed or supplier managed charging schemes in the future and will help to answer the following secondary research question:

- When given the choice, did participants choose the charging tariff they were familiar with having experienced it as part of the trial, or were other charging methods preferred?

4) Assessment of the extent to which attitudes towards electric vehicles differed before and after experience of the vehicles

This analysis relates to the potential uptake of PiVs and will supplement the findings from the Consumer Uptake Trial, utilising data captured from the attitudinal items in the Time Point 1 and Time Point 2 questionnaires. In doing so advantage will be taken of the fact that in the Consumer Charging Trials, the psychological distance of participants from either BEVs or PHEVs will have been reduced further than was possible in the Consumer Uptake Trial itself, because participants will have experienced their vehicle (either a BEV or a PHEV) for eight weeks. The findings will be used to inform conclusions about the likely future uptake once BEVs and PHEVs are mainstream (i.e. once mainstream consumers are no longer psychologically distant from them). This supplementary analysis will help to answer a number of secondary research questions including; "How did drivers' perceptions change with experience of a BEV (or PHEV)?", "Did the extent to which perceptions change differ between the three experimental groups (UMC, SMC, Control)?" and "Has experience of BEVs (or PHEVs) made drivers more or less likely to purchase these vehicles?"

An example output which could be produced from this analysis is shown in Table 19.

Table 19: Before/after comparison of likelihood to adopt a BEV as main car (example output using fictitious data shown for illustrative purposes only)

		After					Absolute difference
		Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely	
Before	Very unlikely	24	7	3	2	1	+13
	Fairly unlikely	26	28	10	3	0	-13
	Neither likely nor unlikely	15	27	19	8	0	-34
	Fairly likely	2	4	6	6	2	-10
	Very likely	0	1	1	1	3	-3

3.4 Data analysis techniques

3.4.1 Summary analysis

Prior to commencing any statistical analysis, the data will be summarised. This will include, but is not limited to:

- A summary of the sample characteristics, including an assessment of how representative this is of the general driving population.
- A summary of the attitudes to EVs and vehicle charging (from the questionnaire dataset).
- A summary of travel patterns of participants in each of the experimental groups (from the journey dataset).
- A summary of the charging behaviour of participants in each of the experimental groups (from the charge event dataset).

The most appropriate way to present this information, using charts and graphs where appropriate, will be determined after the data has been inspected. For attitudinal items, diverging stacked bar charts will be used to visually present what proportion of the sample agree or disagree with specific questions. The chart below shows an example of this type of chart for the two questions: "how likely are you to purchase a BEV (PHEV) in the future?"[47]

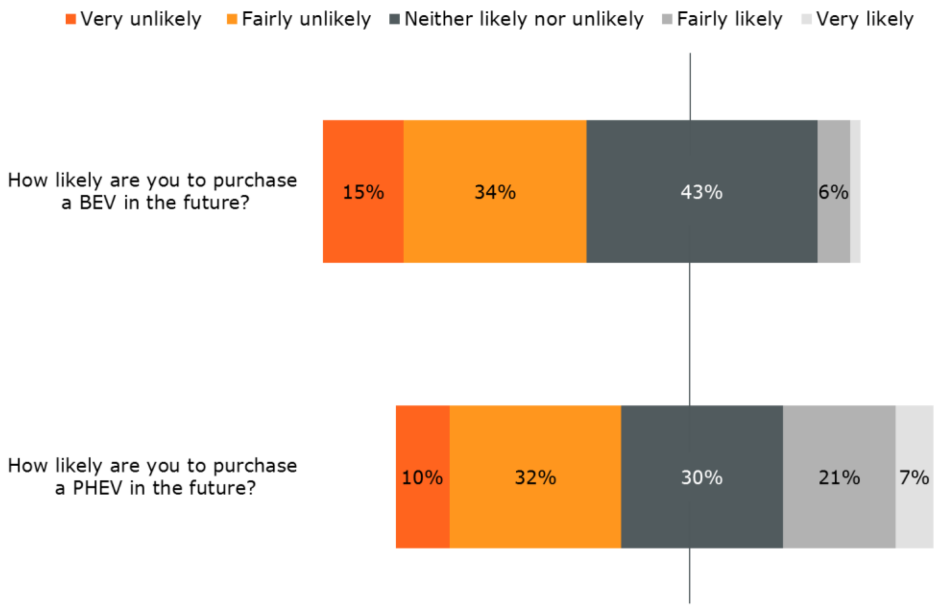

Figure 34: Example diverging stacked bar charts which can be used to present results from attitudinal questionnaire items (data generated for illustrative purposes only)

[47] Note that these data have been created for illustration purposes only.

3.4.2 Measurement of charging profiles

Charging profiles will vary between participants (see section 1.2.5) and from day to day for each participant (see section 1.5.3). As such, charging data will be aggregated across both sources of variation (as illustrated schematically in Figure 28).

The principal analysis in these trials will be the comparison of ensemble charging profiles between a control condition and two experimental conditions involving different Managed Charging schemes. This analysis will be performed to identify how far involvement in either experimental conditions causes changes in charging behaviour compared to the control.

3.4.2.1 Statistical power and effect size

Statistical power refers to the ability of an experiment using a sample of participants drawn from a parent population to detect an effect of a given size, if that effect is actually present in the parent population. Formally, it is the probability that the experimental design enables rejection of the null hypothesis when the alternative hypothesis is true. It is conventional in experimental research with people to aim for a statistical power of 0.8, and adjust the sample size to achieve this.

Statistical power depends on the statistical test being used, the sample size, the criterion probability for statistical significance α (conventionally set at $\alpha = 0.05$), and the standardized effect size, d. Effect size is defined in different ways depending on the statistical test used. For a simple comparison between means of data acquired from different groups (e.g. SMC and Control groups), the standardized effect size is given by:

$$d = (m_1 - m_2)/\sigma$$

where m_1 and m_2 are the means of the different groups and σ is the pooled standard deviation.

It is possible to fix the minimum effect size that is wished to be detected, and calculate the statistical power that can be achieved with different sample sizes. However in the Consumer Charging Trials there is limited a priori knowledge of potential effect sizes, since there has been no prior research on mainstream consumer engagement with Managed Charging. Hence it is preferable to consider the minimum effect sizes that can be detected with a given Power (and given criterion significance level) for different sample sizes.

To illustrate this for the Consumer Charging Trial, Figure 35 shows this comparison for a simple t test that compares means between an experimental group and a Control group.

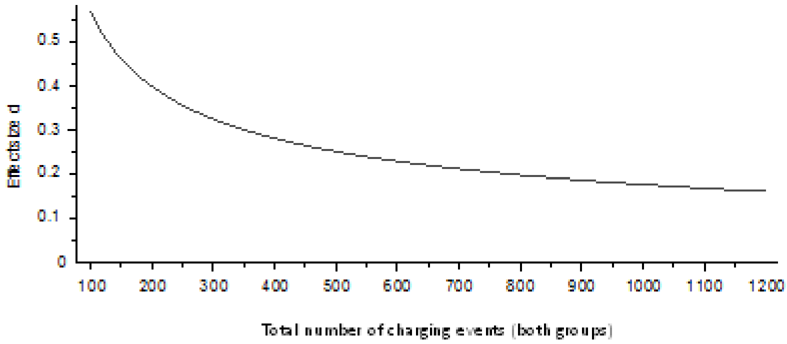

Figure 35: How smallest detectable effect size varies with number of charging events available for analysis (Power = 0.8, α = 0.05)

A test like this can be used in the Consumer Charging Trials to compare means of simple measures derived from the charging profile, such as the mean start time of charging events. Since two of the variables (Power and α) are fixed, the remaining two, effect size and sample size, can be plotted against each other on a single curve[48]. The figure shows d plotted against sample size (expressed as the total number of charging events recorded in the experiment, including both groups). The minimum detectable effect size with α = 0.05, Power = 0.8 initially falls rapidly as the number of charging events per group increases, but for larger numbers of charging events it decreases slowly.

In practice, a range of statistical tests will be used to address the Research Questions (as outlined in section 3.3), each with its own curve, but Figure 35 is representative of the relative impacts of total number of recorded charging events on minimum detectable effect size for a given Power and α.

The number of recorded charging events depends on the sample size (number of participants) the duration of individual participation, and how frequently participants charge their vehicles during their participation period. In the Consumer Charging Trials weekday and weekend day charging profiles will be separately recorded; it is anticipated that substantially more charging event data will be collected over the chosen participation period for weekday charging than for weekend day charging.

Ignoring data acquired during the 2 weeks habituation period, there will be 6 (weeks) x 2 (weekend days) x 40 (participants per condition) = 480 potential weekend charging events in the trial. Participants may not, of course, charge their vehicles daily: it is assumed that only 50% of these opportunities are taken up, yielding approximately 240 weekend charging events recorded. Referring to Figure 35, for a comparison between two groups (e.g. UMC vs. Control) there will be approximately 240+240 = 480 total charging events. It follows there that the minimum effect size that can be detected is approximately d = 0.26.

Ignoring data acquired during the 2 weeks habituation period, there will be 6 (weeks) x 5 (weekdays) x 40 (participants per condition) = 1200 potential weekday charging events in the trial. Participants may not, of course, charge their vehicles daily: it is assumed that only 50% of these opportunities are taken up, yielding approximately 600 weekday charging events recorded per group. Referring to Figure 35, for a comparison between two groups (e.g. SMC vs. Control) there will be approximately 600+600 = 1200 total charging events and the minimum effect size that can be detected is approximately d = 0.16. This means that smaller effects (differences in mean start time of charging) can be detected than for weekend days.

3.4.3 Segmentation

The aim of the segmentation analysis is to understand the characteristics of the sample population, including how they fit into consumer segments investigated in previous research e.g. Anable *et. al.* (2011) and Element Energy (2016). The previous segmentation analysis performed for the ETI's PiV project (Anable, Kinnear, Hutchins, Delmonte & Skippon, 2011) identified eight segments (proportion of sample categorised into each segment shown in parentheses):

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[48] There will be a family of such curves for different combinations of Power and α

1. Plug-in pioneers (2%)
2. Zealous optimists (13%)
3. Willing pragmatists (11%)
4. Anxious inspirers (16%)
5. Uninspired followers (19%),
6. Conventional sceptics (13%)
7. Image conscious rejectors (18%)
8. Company car drivers (8%).

A similar analysis carried out by Element Energy for the Department for Transport (2016) produced six segments:

1. Innovators (2%)
2. Cost-conscious greens (20%)
3. Pragmatists (21%)
4. Unmet needs (19%)
5. Uninterested rejectors (20%)
6. Car-loving rejectors (17%).

There is significant overlap between these two segmentations, but only the latter will be used since this replicates the segments used in the Electric Car Consumer (ECCo) Model.

Thus, this analysis represents a ‘confirmatory’ cluster analysis methodology which aims to confirm (or reject) that the segments found in previous studies apply to the sample of mainstream consumers included in this study. This analysis will use data from the Pre-trial and Time Point 1 questionnaires. The analysis will assume that the number of clusters is fixed (at six to match with the EE segmentation) and that some characteristics of the clusters are partially known (the cluster centres will be estimated from the previous study). The solution will be tested for robustness (i.e. cluster integrity and stability) to ensure that the segments are applicable to this sample. If the solution is not robust, then it will not be possible to classify the Consumer Charging Trial sample participants into the previously identified segments; although this is a highly unlikely outcome.

Previous analysis has provided clear evidence that Innovators’ attitudes towards EVs, in general and particularly towards ownership of a BEV or PHEV, are more positive than those of mainstream consumer segments. The intention of these trials is to exclude Innovators by filtering out anyone who has previously had, currently has, or has had regular experience with a PiV (see section 2.2). The confirmatory cluster analysis will check the success of this approach by testing whether five or six segments are required; i.e. whether or not inclusion of the Innovator segment is required. If the Innovators segment is identified and assessed as being robust, then this will indicate that a subset of the sample is made up of Innovators.

The previous segments identified by Element Energy do not disaggregate between attitudes towards BEVs and PHEVs. The degree to which these differ will be explored as part of the analysis of the questionnaire data and statistical comparisons will be carried out to determine whether differences are significant (see section 3.4.5). If differences are identified then the impact these have on the segmentation will be discussed in the report.

The final solution resulting from the cluster analysis will be compared to the results of the previous study to determine if the size and composition of segments has shifted. In addition, some exploratory analysis of the data from the Time Point 2 questionnaire will be carried out to understand whether participants remain in the same segment before and after experience with the vehicles. This analysis will be used to inform whether an additional segment may have been created following experience of the vehicles. Due to the relatively small size of the sample, any new segments will not be derived statistically but will be created based on comparisons of the stability of participants within segments before and after experience of the vehicles, and some qualitative judgement.

The final solution will then be profiled to understand the characteristics of each segment including demographic information, environmental behaviours, likelihood to adopt EVs, current travel behaviour, usage and attitudes to the trial vehicles, and response to the tariff structures.

The creation of the segments and subsequent profiling within the original study did not include any information on attitudes towards charging or charging tariffs. As a result, it is possible that there will be a wide range of responses to these questions within each segment, suggesting little correlation between participants' general attitudes to EVs and charging profiles/response to the tariff structures. Due to the size of the sample (n = 120), it will not be possible to carry out a new segmentation on the charging style and tariff choice questions. As a result, the segments will be used in the summary analysis, but not in the analysis of the choice experiment (see section 3.4.7).

3.4.4 Factor analysis and reliability measures

The questionnaires are made up of many attitudinal items which measure participant's attitudes and personality traits. For example, the driving style questions are made up of 44 items, each on a six point scale from 'not at all' to 'very much', which provide information on self-reported driving style.

In order to reduce the number of variables to a more manageable number for statistical analysis, a data reduction technique called factor analysis will be applied to these items. This combines the information from a large number of similar items into a smaller set of factors. It does this by looking at the inter-correlations between items and identifying common groups. The resulting factors represent coherent subscales and can be used in subsequent analysis.

The reliability of these subscales will be confirmed using reliability measures such as Cronbach's alpha. A highly reliable scale implies that all the items collectively describe the same personality or behaviour. A scale is considered to have good internal consistency if the output from the reliability of the scale gives a Cronbach's alpha coefficient of 0.7 or higher.

To ensure that results are comparable between each of the questionnaires, the same factoring will be used for both the Time point 1 and Time point 2 questionnaires.

3.4.5 Statistical comparisons

Comparison of the factors will be conducted using repeated-measures[49] statistical methods. This will enable identification of differences in attitudes before and after involvement in the trial. These repeated-measures techniques will include (but may not be limited to):

- Analysis of Variance (ANOVA) or Generalised Estimating Equations (GEE)
- Paired t-tests or Wilcoxon matched-pairs tests
- Cochran's Q or the McNemar dichotomous variables test

In addition, comparisons will be made between the three experimental groups. This will enable identification of differences in attitudes between the three experimental groups. Similar analyses will also be performed to identify differences in travel behaviour (e.g. average journey distance, or average speed) and charging behaviour (e.g. average time spent charging) between the three groups. Since each group contains different participants, a between-subjects analysis is required. These techniques will include (but may not be limited to):

- Analysis of Variance (ANOVA)
- Independent samples t-tests
- Chi-squared tests

This analysis will be used to identify differences in attitudes (e.g. attitudes to the different charging tariffs), travel behaviour (e.g. average journey distance, or average speed) and vehicle charging (e.g. average length of vehicle charge, average energy provided during charge, reward provided to the customer) between the three experimental groups.

Experienced statisticians will select the most appropriate statistical techniques for analysis of the various datasets collected during this trial. The techniques selected will depend on the characteristics of the data obtained. For example, parametric statistical tests such as ANOVA or t-tests rely on underlying assumptions about the distribution of the data; tests will be performed to check these assumptions before analysis is carried out.

3.4.6 Regression

Responses to questions on energy tariff choice will be used to supplement the findings from the stated choice experiment to understand whether personal characteristics (e.g. personality, self-congruity, driving style, demographic variables) or personal-situational variables (e.g. income) are predictive of mainstream consumers' preferences between SMC, UMC, and no Managed Charging.

Logistic regression, which is used when the dependent variable is categorical, will be used to determine which variables predict energy tariff choice. The analysis will use responses to the question: "If you owned a BEV (PHEV), which type of energy tariff would you choose?" as the dependent variable and use a stepwise approach to assess which variables best predict the answer to this question.

[49] 'Repeated measures' or 'within-participants' analysis is required since participants' attitudes and behaviours are measured multiple times at different time points.

3.4.7 Choice experiment

The results of the choice experiment will be analysed by Element Energy using the statistical package NLogit to derive choice parameters for each of the attributes. Unlike the choice experiment in the Consumer Uptake Trial, an existing consumer segmentation does not exist. Use of the consumer uptake segmentation is unsuitable since attitudes towards car purchasing and appetite for managed charging are not necessarily closely correlated. Given that half the sample will answer the choice experiment questionnaire from the perspective of owning a PHEV, and the other half a BEV, the sample size of each (n = 120) is not big enough to carry out a new segmentation. However, separate choice parameters can be derived for the sets of participants that were assigned to UMC and SMC, and the control group. This can be used to infer whether participants show a cognitive bias, either positive of negative, towards the managed charging system they have experience of, and therefore how psychological distance affects attitude.

Since participants are evenly distributed across the three charging options, overall these biases should cancel out. Choice parameters averaged across the whole sample, stratified if necessary to more closely resemble the general driving population, will be derived for both BEV and PHEV drivers for each attribute. These parameters will then be incorporated into ECCo to model the likely share of managed charging amongst plug-in vehicle drivers, and how this might impact plug-in vehicle uptake. The effect of this on the wider energy system can then be estimated in the overall Analytical Framework.

A detailed discussion of the analysis of the choice experiment results will form part of Deliverable D5.3.

4 Project Management

4.1 Team structure

The project team for Stage 2 draws upon a wealth of experience and expertise in research, policy, regulation, economics, energy supply, distribution, low carbon energy and vehicles, charging infrastructure, fuels, consumer usage, behaviour and adoption.

As lead partner, TRL is the Prime Contractor to ETI. The organisations brought together have the capacity and competence to fulfil Stage 2 of this project. The overall structure of the Stage 2 team and the roles of key individuals are outlined in Figure 36.

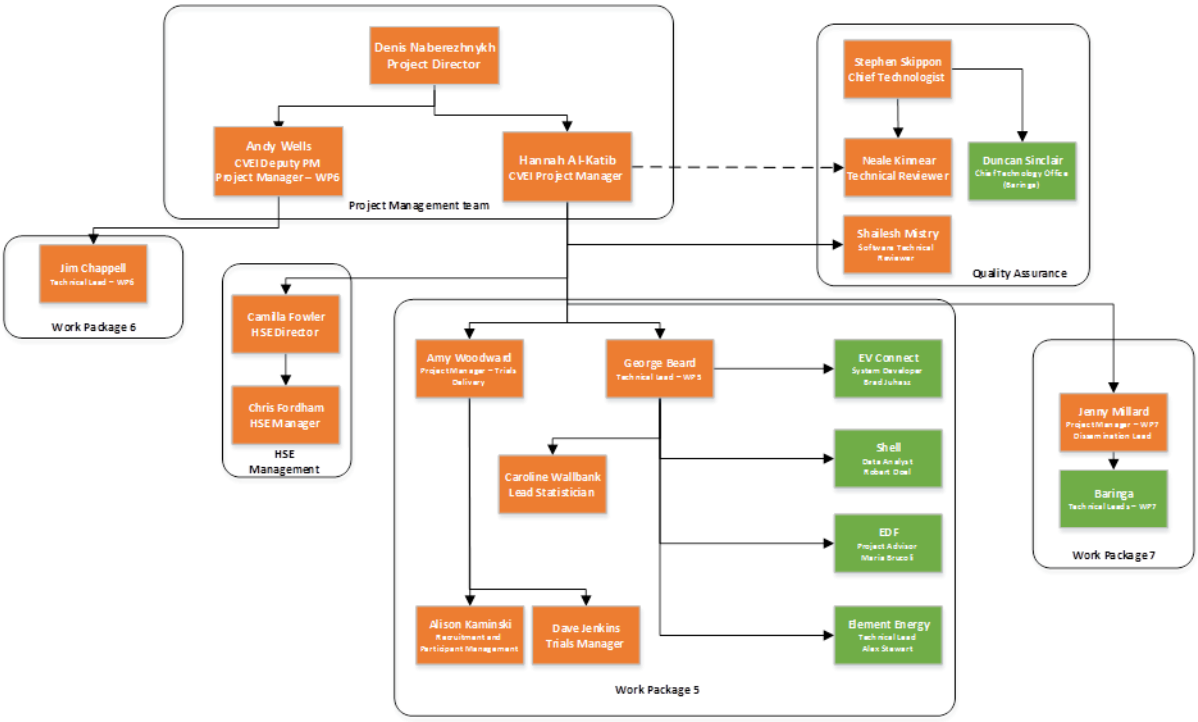

Figure 36: CVEI Stage 2 project team structure

The project will also utilise the services of a number of suppliers. These will include:

- **Rolec** will supply Mode 3 chargepoints, and associated electrical installation services, to ensure participants in Consumer Charging Trials can charge their vehicles safely from their home
    - **ChargedEV** (a trading name of Hybrid Energy Solutions Ltd, company registration no. 09666725) will be subcontracted by Rolec to provide electrical installation services.
- **VW Group Leasing (VGL)** via VW Financial Services (VWFS) will provide lease vehicles for the purposes of the trial (45 VW e-Golfs and 45 VW Golf GTEs).
- **FleetCarma** will provide the vehicle telematics system to deliver the required data for the trial.
- **Accent Limited** will provide online hosting services for the questionnaire and choice experiment elements of the trial.

- Recruitment surveys (Filter Survey 1 and Filter Survey 2) will be hosted by **SmartSurvey**

4.2 Health, safety and environment

During the initial design phase of Stage 2, the project team developed a Health, Safety and Environment (HSE) Plan. The objective of preparing an HSE Plan is to ensure the protection of the people involved in the project, or those who could be affected by it, the environment, and project or company assets. This will be achieved by adopting and implementing the highest possible design standards to mitigate potential HSE issues and to ensure that all risks are reduced As Low As Reasonably Practicable (ALARP). The Plan also ensures compliance with necessary HSE legislation including The Construction (Design and Management) (CDM) Regulations 2015.

The project team developed the HSE Plan during the design stage of the project is to ensure:

- all Health, Safety and Environmental requirements are addressed at the early concept and design stage;
- the trial complies with all relevant Health and Safety Laws and Environmental Laws; and
- the project has clearly defined roles and responsibilities in relation to the management of health, safety and the environment.

In accordance with the requirements of the contract, TRL, as Principal Designer and Client, has prepared the project pre-construction stage HSE Plan in accordance with The CDM Regulations 2015. The HSE Plan was prepared for the construction and removal stages and describes the project's objectives, scope, and methodology as well as TRL's approach to HSE.

During the design phase the HSE Team has worked closely with the Project Management team, WP5 Lead and the Trial Logistics Manager to ensure that HSE considerations are fully integrated into the trial design. The HSE Team have also engaged with relevant project partners, in particular Cenex and Rolec (the chargepoint supplier and installer) to make sure that there is sufficient coordination between project partners so that HSE is managed consistently throughout the project. Full details of the project's approach to managing health, safety and environment are described in the HSE Plan.

4.3 Research ethics

Ethical approval is required for all projects using human participants. This includes all projects that involve observation of human participants or collection of information from them or about them. It also includes projects that require access to information on identifiable individuals that is already held by TRL or another organisation. Projects in which human beings participate in other ways – for example, by being subjected to experimental situations or driving instrumented vehicles – are also covered.

TRL has a rigorous ethics procedure informed by EPSRC's Guide to Good Practice in Science and Engineering Research. All staff at TRL are required to comply with ethical guidelines to protect and enhance the ethical and professional reputation of research activities performed by TRL. The standard of this ethical procedure is designed to satisfy the ethical standards of relevant professional bodies, government and other clients, and other funding bodies.

The TRL ethics process is summarised in Figure 37 below. TRL projects involving human participants are first formally assessed by the Project Manager and Technical Reviewer using a simple ethics checklist. Proposals that appear to follow recognised ethical principles will then be judged by a "light touch" internal Mini Ethics Panel. Potentially problematic projects require approval from the TRL Research Ethics Committee. The TRL Research Ethics Committee involves an external participant and also monitors the decisions of the Mini Ethics Panels.

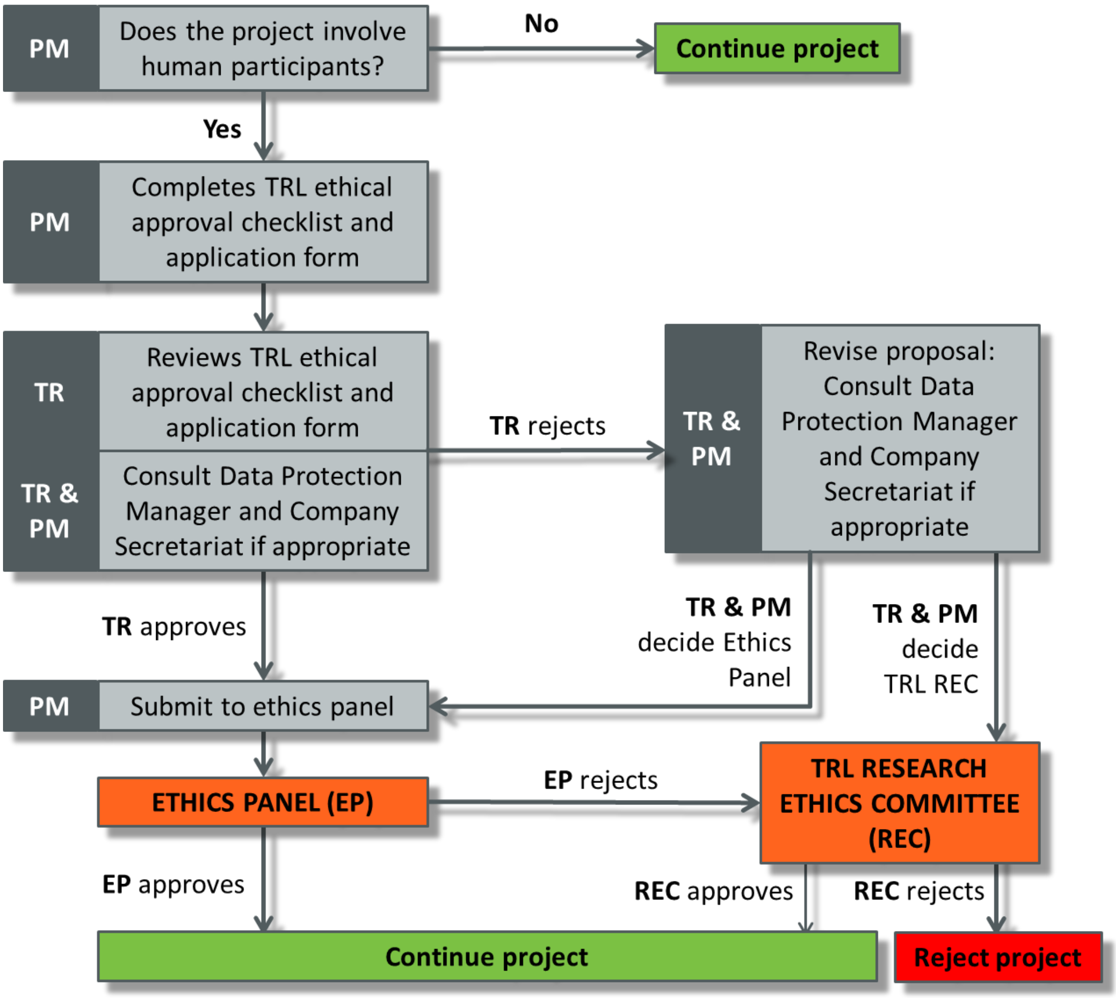

Figure 37: TRL Ethics Process

The Chair of the TRL Ethics committee was consulted with and has confirmed that the “Mini Ethics Panel” pathway will be used for the Project. A first round of ethics approval was undertaken as part of Stage 1. In March 2017, TRL Chief Scientist Dr Alan Stevens, project Technical Reviewer Dr Neale Kinnear, and Project Manager Andy Wells will undertake a further Mini Ethics Panel review of the proposed trial design and research instruments

During the design phase of Stage 2, TRL Chief Scientist Dr Alan Stevens, project Technical Reviewer Dr Neale Kinnear, and Project Manager Andy Wells undertook a Mini Ethics Panel review of the proposed trial design and research instruments. The Mini Ethics Panel approved the trial design method and materials.

4.4 Project risks

TRL maintains a Risk Register for the CVEI project which tracks risk probability, proximity and resulting impact on Health & Safety, Data Protection, time, quality and cost should the risk occur. A function of the probability, proximity and maximum impact is used to provide a Risk Rating for each risk. Based upon the Risk Rating, the frequency at which the risk must be reviewed by the Project Management team is calculated. The Risk Register sets out avoidance and mitigation measures for each risk.

If a Risk is escalated to an Issue then the following items are tracked within the Issues tab in the Risk Register:

- Detail of Issue
- Impact Issue will have
- Issue Severity
- Assigned to action
- Date assigned
- How will this be resolved
- Date last reviewed
- Date to resolve by
- Date Issue Resolved
- Change Request ID if this is confirmed as Change in scope.

Alongside the Risks and Issues, the Risk Register also tracks dependencies between tasks and deliverables.

The Project Management team provides a monthly project report to the ETI’s Project Manager, in which all Risks and Issues are reported.

4.5 Data privacy and protection

4.5.1 What data will be collected?

TRL regard’s the lawful and sensitive treatment of personal information as critical to the success of TRL’s operations, and has implemented formal procedures since 1988. TRL’s Data Protection and Information Security Policy covers TRL’s obligations under the Data Protection Act, Freedom of information Act and Environmental Information Regulations. TRL’s Procedures comply with the information security standard ISO/IEC 27000 and reflect government publications such as the Data Handling Procedures in Government Report and the Data Sharing Review. They also comply with the Cross Government Actions: Minimum Mandatory Measures as outlined by the Cabinet Office.

The project will only collect and use Personal Information for the purposes of delivering the CVEI project. Consent will be obtained from participants, as outlined in section 2.2.

Table 20 provides an overview of the data that will be collected during the Consumer Charging Trials.

Table 20: Data to be collected during the project and purpose

Type of Data	Source	Purpose
Contact, personal details, driving history (Name; DoB; Address; Sex; Email address; status of driving license; vehicle ownership)	Filter Survey 1	To communicate with the participant during recruitment and during the trial. To determine whether the participant meets the basic requirements of the trial. To enable analysis on the basis of demographics to answer the project research questions.
Personal demographics; Travel habits; Household profile	Filter Survey 2	To determine whether the participant meets the full requirements of the trial. To enable analysis on the basis of demographics, travel habits and household profile to answer the project research questions.
Consent to participate; participant signature	Signed consent form	To ensure the participant understands and accepts the terms of participation in the trial, and to maintain a record of that consent.
Actual charging patterns	On chargepoint data capture	To understand mainstream consumer charging behaviour and to answer the core research questions of the trials (see section 2.10)
Actual travel patterns Fuel state (inc. charge)	On vehicle data capture (telematics)	To understand mainstream consumer vehicle usage patterns (see section 2.11)
Attitudinal responses Personal options and choice selection	Questionnaires / Choice experiment / User App data	To understand mainstream consumer attitudes and preferences, to provide supplementary understanding of the charging behaviour observed in the trial (see sections 2.12, 2.13 and 2.14)

4.5.2 Who will have access to the data?

Table 21 below (page 160) summarises which organisations will have access to the various data collected over the course of the project. Partners will only have access to data required for the achievement of the Tasks set out in the contract and necessary for the achievement of project objectives. Data will be anonymised wherever possible whilst permitting the required data analysis to answer the research questions and provide reporting and insight to the ETI.

The TRL project team will have access to data through the project SharePoint site. Access to the SharePoint site is restricted to project team members only. All data will be stored in the project area. Databases of participants will be password protected within this SharePoint area as a further data protection safeguard.

Following completion of Filter Survey 1, each participant will be assigned a Participant ID. All subsequent data collected will be linked to the Participant ID, rather than a participant's name or other personal details, in order to anonymise data.

Personal contact details of the participants will only be shared with Cenex if the participant will be managed by Cenex. Cenex will not have access to the personal contact details of participants who will be managed by TRL.

EV Connect will undertake data cleaning of vehicle telematics. This data will be linked to a participant ID, not the participant's name or other personal details. These processed datasets will then be passed to TRL for analysis.

TRL will also share the datasets with Baringa, Element Energy and Shell for analysis. Baringa and Element Energy will have access to processed vehicle telematics and charge point data. This data will be linked to a participant ID, not the participant's name or other personal details.

Shell will have access to processed vehicle telematics. This data will be linked to a participant ID, not the participant's name or other personal details.

TRL will be responsible for data cleaning of questionnaire data. Element Energy will be responsible for cleaning of choice experiment data.

The ETI will have access to questionnaire, telematics, and charge point data (linked together via Participant IDs). This will be provided on an encrypted hard-disk and delivered to the ETI by-hand, along with a document setting out who is permitted to access the data and for what purpose.

Table 21: Proposed data structures and intended content of the anonymised data

Data source	Type of data	How collected?	Who has access?						
			TRL	Cenex	Rolec	EV Connect	FleetCarma	Baringa/ Element	Shell
Filter Survey 1	Name; DoB; Address; Sex; Email address status of driving license; vehicle ownership	SmartSurvey online questionnaire	X						
Filter Survey 2	Personal demographics; Travel habits; Household profile	SmartSurvey online questionnaire	X						
Contact information	Name; Address; Email; Phone No	Filter Survey 1	X	X	X				
Consent form	Consent to participate; participant signature	Information letter	X						
Questionnaires	Attitudinal responses, personality scales, purchasing decisions, trial feedback	Online questionnaire tool	X						
Choice experiment	Personal options and choice selection	Online questionnaire tool	X					X	
On vehicle data capture	Actual travel patterns Fuel state (inc. charge)	Vehicle telematics	X			X	X	X	X
On chargepoint data capture	Actual charging patterns	Chargepoint	X		X	X		X	

4.5.3 What will happen to the data at the end of the project?

Table 22 outlines the protocol for each partner at the end of the project. TRL will confirm to the ETI at the end of the project that personal information has been destroyed in accordance with this protocol.

Table 22: End of project protocol for data

Partner	What will happen to data held?
TRL	All personal data will be destroyed at the end of the project. Questionnaire, telematics and chargepoint / user interface data (linked together via Participant IDs) will be shared with the ETI as part of the final deliverables for the project and stored by TRL for seven years for audit purposes, in accordance with the Stage 2 contract between the ETI and TRL.
Cenex	All data held will be destroyed at the end of the project.
EV Connect	All data held will be passed to TRL and destroyed at the end of the project.
Rolec	Personal information will be held for 12 months after chargepoint installation, for warranty purposes. Data will then be destroyed.
FleetCarma	All data held will be passed to TRL and destroyed at the end of the project.
Baringa	All data held will be destroyed at the end of the project.
Element Energy	All data held will be destroyed at the end of the project.
Shell	All data held will be destroyed at the end of the project.
ETI	All data held by ETI stored securely. Data will not be shared externally.

4.5.4 What processes are in place for managing data protection?

4.5.4.1 TRL's data protection processes

All data will be stored and shared securely in ways which are fully compliant with TRL Code of Practice for Handling Personal and Sensitive Information, which is compliant with the Data Protection Act 1998 and ISO 27001.

The Code of Practice demonstrates TRL's ability to control data and enforces mechanisms to allow TRL to control and protect information that may be personal, sensitive or protectively marked.

The TRL Integrated Management System and TRL Information Security Management System specify the company policies, procedures, risk management, safe working methods and guidance in direct response to the requirements and the TRL certification to ISO 9001, 14001, 18001 and 27001 standards and seek to demonstrate its commitment to continual improvement.

Electronic data will be stored in TRL's secure project area on SharePoint. Any physical data generated will be stored in TRL's Crowthorne House office, in locked cabinets. TRL's compliance team undertakes regular audits in order to ensure compliance by project teams with TRL's protocols and procedures.

Any data protection issues or breaches identified during the trials will be immediately reported to the Project Manager. This will include actual or suspected breaches of:

- the Data Protection Laws;
- TRL's(or any subcontractor's) data protection policies or protocols; and
- any accidental or unauthorised access to Personal Information.

The Project Manager will promptly report to the ETI the issue and will inform TRL's Compliance Manager and, if necessary, the Mini Ethics Panel to agree appropriate actions to manage the issue. The Project Manager will fully inform the ETI of any data protection matters or issues as specified in the Contract.

4.5.4.2 Rolec's data protection processes

TRL has reviewed Rolec's data protection processes as part of the Supplier Information Questionnaire, which all suppliers must complete. As part of this, Rolec has provided TRL with copies of its data protection policy and ISO 27001 certification.

Rolec will be provided with the contact details of participants in order to be able to install chargepoints in participants' homes. TRL will request permission from participants to share their contact details with Rolec prior to doing so.

Rolec will retain the contact details of individuals for a period of 12 months, as the warranty for the chargepoint will transfer to the participant on completion of the trial. Thereafter contact information will be destroyed.

4.5.4.3 Cenex's data protection processes

TRL has reviewed Cenex's data protection processes as part of the Supplier Information Questionnaire, which all suppliers must complete. Cenex is registered under the Data Protection Act, and has named senior staff responsible for data security across the company. They ensure that customer information, including personal information is collected, held and maintained in a secure and confidential manner. Cenex will dispose of project data safely and securely at the end of the project.

4.5.4.4 EV Connect's data protection processes

Data Security

EV Connect's platform is hosted within a Virtual Private Cloud (VPC) at Amazon Web Services (AWS). All key services are load-balanced among geographically distributed redundant servers located in the US-Oregon and US-Virginia data centres.

All user access to the VPC is strictly controlled and login credentials are limited to specific trusted personnel using pre-shared keys (no username / passwords). External to internal communication to the VPC is managed by a Sophos firewall which monitors and performs domain, traffic type and packet filtering. All communications are handled over HTTPS secured by SSL SHA-256 encryption.

Servers with specific, non-externally facing tasks and business logic are isolated in a subnet to prevent any external access and function under their own unique set of security and access rules.

EV Connect's platform utilizes a MongoDB (noSQL) database which is not susceptible to database insertion attacks.

EV Connect is currently undergoing penetration ("Pen") testing as part of its internal security procedures, and will provide documentation of the results of this audit upon completion.

AWS Data Centre Security

All of AWS's data centres are state of the art, utilising innovative architectural and engineering approaches. Amazon has many years of experience in designing, constructing, and operating large-scale data centres. This experience has been applied to the AWS platform and infrastructure. AWS data centres are housed in nondescript facilities.

- **Physical Access** - physical access is strictly controlled both at the perimeter and at building ingress points by professional security staff utilising video surveillance, intrusion detection systems, and other electronic means.
- **Personnel Access** - authorised staff must pass two-factor authentication a minimum of two times to access data centre floors. All visitors and contractors are required to present identification and are signed in and continually escorted by authorised staff. AWS only provides data centre access and information to employees and contractors who have a legitimate business need for such privileges. When an employee no longer has a business need for these privileges, his or her access is immediately revoked, even if they continue to be an employee of Amazon or Amazon Web Services. All physical access to data centres by AWS employees is logged and audited routinely.
- **Fire Detection and Suppression** - automatic fire detection and suppression equipment has been installed to reduce risk. The fire detection system utilises smoke detection sensors in all data centre environments, mechanical and electrical infrastructure spaces, chiller rooms and generator equipment rooms. These areas are protected by either wet-pipe, double-interlocked pre-action or gaseous sprinkler systems.
- **Power** - the data centre electrical power systems are designed to be fully redundant and maintainable without impact to operations, 24 hours a day, and seven days a week. Uninterruptible Power Supply (UPS) units provide back-up power in the event of an electrical failure for critical and essential loads in the facility. Data centres use generators to provide back-up power for the entire facility.
- **Climate and Temperature** - climate control is required to maintain a constant operating temperature for servers and other hardware, which prevents overheating and reduces the possibility of service outages. Data centres are conditioned to maintain atmospheric conditions at optimal levels. Personnel and systems monitor and control temperature and humidity at appropriate levels.

- **Management** - AWS monitors electrical, mechanical, and life support systems and equipment so that any issues are immediately identified. Preventative maintenance is performed to maintain the continued operability of equipment.
- **Storage Device Decommissioning** - when a storage device has reached the end of its useful life, AWS procedures include a decommissioning process that is designed to prevent customer data from being exposed to unauthorized individuals. AWS uses the techniques detailed in DoD 5220.22-M ("National Industrial Security Program Operating Manual ") or NIST 800-88 ("Guidelines for Media Sanitization") to destroy data as part of the decommissioning process. All decommissioned magnetic storage devices are degaussed and physically destroyed in accordance with industry-standard practices.

AWS is certified against four ISO standards:

- ISO 27001: Information Security Management Systems (ISMS)
- ISO 27017: Cloud-specific security control guidance
- ISO 27018: Protection of Personally Identifiable Information
- (PII) in public clouds
- ISO 9001: Quality management systems

AWS is also audited and certified against the Service Organization Control (SOC) standards:

- SOC – 1 (commonly referred to as SSAE16, ISAE 3402, or SAS 70)
- SOC – 2
- SOC – 3

Transferring data outside of the EEA

Data transfer between vehicle telematics (FleetCarma) and EV Connect, and chargepoint telematics and EV Connect will be via Secure HTTP.

TRL has previously transferred data to the United States. This process was managed under the U.S.-Swiss Safe Harbor Framework and the TRL Code of Practice for Handling Personal and Sensitive Information was followed.

TRL's Head of Risk, Compliance & Business Improvement has reviewed the EU-US Privacy Shield principles and has confirmed that TRL complies with them. EV Connect and FleetCarma have provided confirmation to TRL that they will fully comply with the EU-US Privacy Shield arrangements. In addition, EV Connect has agreed to adhere to TRL's Code of Practice for the duration of the CVEI project.

FleetCarma data protection processes

Telematics data will be collected through the FleetCarma telematics system. FleetCarma uses a Microsoft Azure storage system based in the US. This is Privacy Shield certified and has extensive data security measures, this has permitted the collection and storage of personal data for FleetCarma's UK research partners in the past[50].

[50] Information on server security is available at: https://www.microsoft.com/en-us/trustcenter/security/

FleetCarma's privacy policy can be found at: www.fleetcarma.com/privacy

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6 List of appendices in Part 4

The following appendices to this study plan are provided in Part 4 of Deliverable D5.1.

Appendix A Recruitment adverts

Appendix B Recruitment screening questionnaires

Appendix C Vehicle comparison table

Appendix D Participant Information Pack

Appendix E Researcher protocol

Appendix F Rolec / ChargedEV installation process

Appendix G Rolec Chargepoint Portal

Appendix H Slide Pack for briefing participants at handover

Appendix I In-vehicle Information Pack

Appendix J Questionnaires

Appendix K Choice experiment supporting information

Appendix L Vehicle condition form

Appendix M Design for Admin Portal

Appendix N FleetCarma telematics device specification

Appendix O Telematics data fields

Appendix P Participant debrief letter

Appendix Q Deliverable D7.1 supporting documentation

Deliverable D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

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RPN3873

PROJECT REPORT

CVEI Stage 2

D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Part 4 – Appendices for the Consumer Charging Trials

Report details

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H Al-Katib (Project Manager)		S Skippon (Technical Reviewer)	

Disclaimer

This document is provided to the ETI under, and is subject to the terms of, the Energy Technologies Institute's Agreement for the Consumers, Vehicles and Energy Integration (CVEI) Project – Stage 2.

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6.0	19/09/17	Final version delivered to client	GB	NK
6.1	22/09/2017	Revised version delivered to client	GB	AW

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Document last saved by:	Al-Katib, Hannah

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Preface

The purpose of the Consumers, Vehicles and Energy Integration (CVEI) project is to investigate challenges and opportunities involved in transitioning to a secure and sustainable low carbon vehicle fleet. The project explores how the integration of vehicles with the energy supply system can benefit vehicle users, vehicle manufacturers and those involved in the supply of energy.

The objective of the project is to inform UK Government and European policy and to help shape energy and automotive industry products, propositions and investment strategies. In addition to developing new knowledge and understanding, the project aims to develop an integrated set of analytical tools that can be used to model future market scenarios in order to test the impact of future policy, industry and societal choices.

This report is “Deliverable 5.1: Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials” for Stage 2 of the CVEI project.

There are four parts to this report:

- Part 1: Consumer Uptake Trial Study Plan
- Part 2: Appendices to Consumer Uptake Trial Study Plan
- Part 3: Consumer Charging Trials Study Plan
- Part 4: Appendices to Consumer Charging Trials Study Plan (this document)

This document covers Part 4, the Appendices to the Consumer Charging Trials Study Plan. The other parts of Deliverable 5.1 are provided in separate documents.

The contents of this document provide example copies of the materials which will be used throughout the trial (such as recruitment adverts, questionnaires, and participant information packs).

Appendix A Recruitment adverts

A.1 Flyers

THE FUTURE OF TRANSPORT

What will I have to do?

You will need to trial one or more vehicles as part of your everyday driving.

Who is the research for?

The research will be undertaken by TRL.

When will it be?

Trials will take place between April and December 2017.

What do I get for my time?

If you take part in the trial you will receive **at least £200** and will also be entered into a prize draw for the chance to **win a further £2,500**, as a thank you from us for taking part.

Am I suitable?

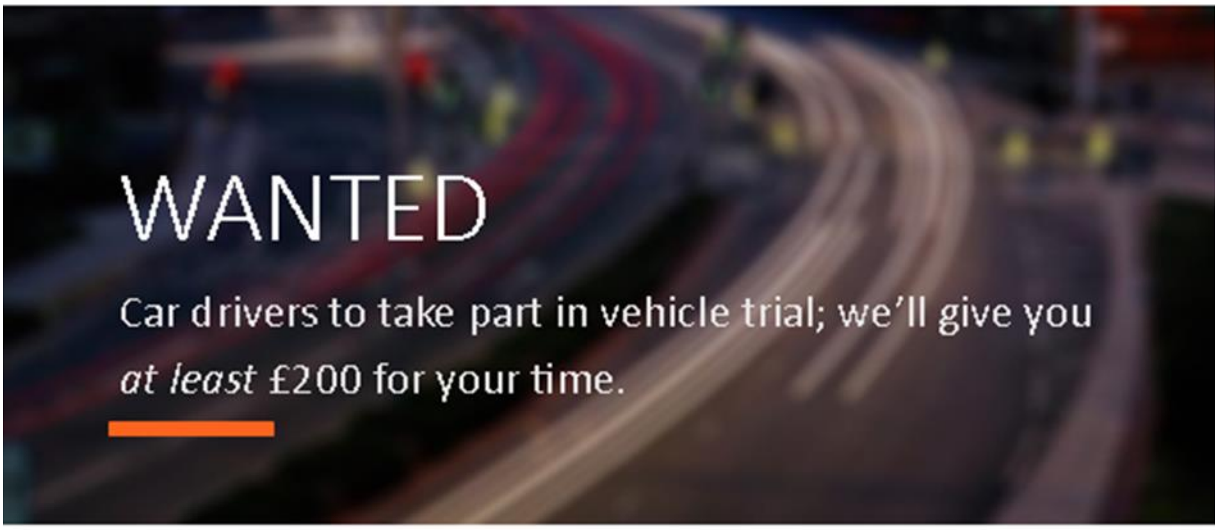
We are looking for car drivers of all ages who have held a valid UK licence for more than two years.

How do I sign up?

All you need to do is complete a short survey by using the QR code or visit [insert URL] to register your interest.

TRL is the global centre for innovation in transport and mobility. It provides world-leading research, technology and software solutions for surface transport modes and related markets of automotive, motorsport, insurance and energy. More information can be found at www.trl.co.uk

THE FUTURE OF TRANSPORT



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How do I sign up?

All you need to do next is complete a short survey by using the QR code or visit [insert URL] to register your interest.

TRL is the global centre for innovation in transport and mobility. It provides world-leading research, technology and software solutions for surface transport modes and related markets of automotive, motorsport, insurance and energy. More information can be found at www.trl.co.uk

A.2 Social media adverts

A.2.1 Twitter

TRL's "@NewsfromTRL" Twitter account (with over 3,000 followers) and Cenex's "@CenexLCFC" Twitter account (with around 800 followers) will be used to advertise the trial and invite prospective participants to register their interest by completing Filter Survey 1. Example Tweets which will be posted are shown in Figure 1 below.

Research needs you! We're looking for volunteers to take part in a vehicle trial [**Insert URL**]

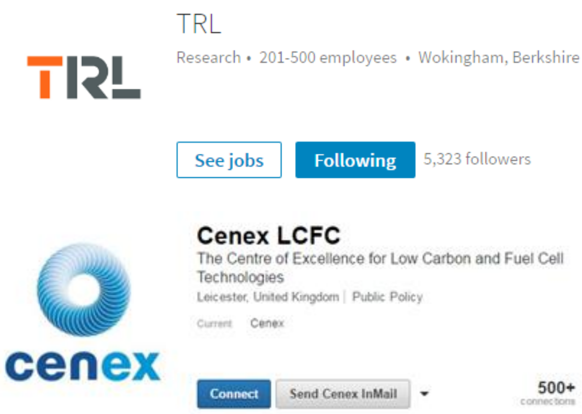
Volunteer for our latest #research trial and we'll give you at least £200 for your time [**Insert URL**]

Car drivers wanted! We're looking for drivers to take part in vehicle trial [**Insert URL**]

Figure 1: Example Twitter adverts

A.2.2 LinkedIn

TRL's LinkedIn page has over 5,000 followers; this will also be used to advertise the trial and invite prospective participants to register their interest by completing Filter Survey 1. Example posts are shown in Figure 1 below.



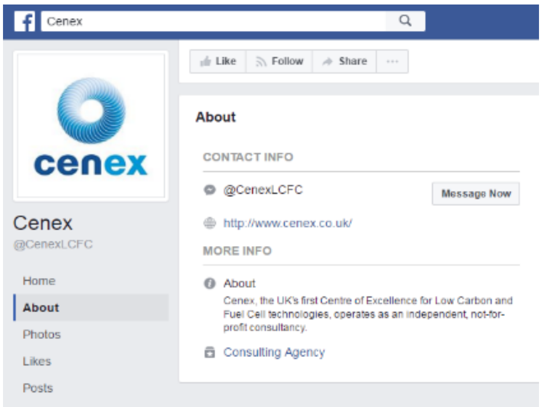
We're looking for volunteers to take part in a vehicle research trial; participants will get at least £200 for their time. Please register your interest here! [**Insert URL**]

Car drivers wanted! We're looking for drivers to take part in cutting-edge vehicle research. Please register your interest here! [**Insert URL**]

Figure 2: Example LinkedIn adverts

A.2.3 Facebook

Cenex's Facebook page (www.facebook.com/CenexLCFC) will be used to post adverts. An example advert is shown in Figure 3 below.



We're looking for drivers who would be willing to trial one or more vehicles as part of their everyday driving.

If you take part in the trial you will receive at least £200 as compensation and will also be entered into a prize draw with a chance to win a further £2,500 as a thank you from us for taking part.

We are looking for car drivers of all ages who have held a valid UK licence for more than 2 years. If you are interested in taking part you will need to complete a short survey: **[Insert URL]**

Figure 3: Example Facebook advert

A.3 Adverts on TRL website

TRL's website (www.trl.co.uk) will also be used to post adverts about the Consumer Uptake Trial. The website provides opportunity for more information to be given to prospective participants than the limited space available with posts on Twitter and LinkedIn. An example advert from a separate research project is shown in Figure 4 below, for illustrative purposes.

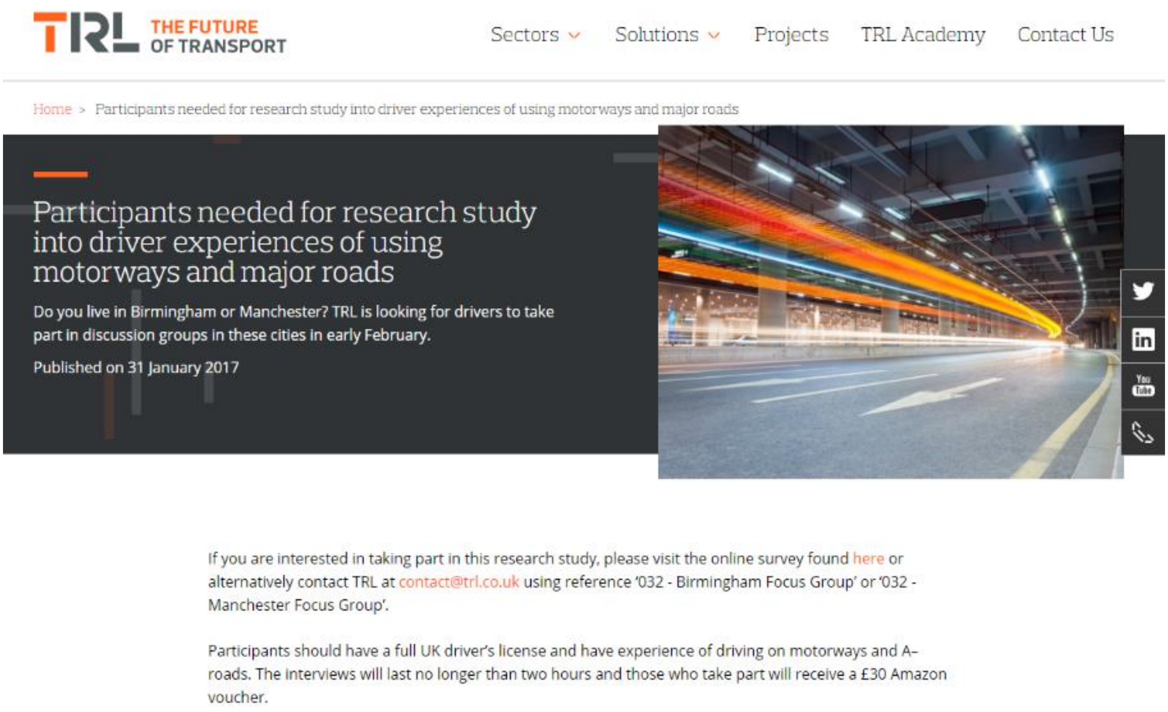


Figure 4: Example research advert posted on TRL website

A.4 Email adverts for participants on TRL participant database

TRL has a participant database of over 2,000 volunteers who have agreed to be contacted about participating in future TRL projects. An email containing a copy of the flyer and a link to Filter Survey 1 will be emailed to all participants on the database. An example email is shown in **Figure 5** below.

> Dear [Name]
>
> You have previously indicated that you would be interested in being contacted for TRL research. We are contacting you as we are currently recruiting for a new study which may be of interest.
>
> For more information about the trial and how to get involved, click on the link below. This will take you to an online information sheet and recruitment survey.
>
> [**Insert URL**]
>
> Kind regards,
>
> TRL

Figure 5: Example email to be sent to participants on TRL participant database

A.5 Email for flyer distribution

An email containing a copy of the flyer will be emailed to organisations in the advertising database. An example email is shown in **Figure 5** below.

> Dear Sir/Madam,
>
> I am contacting you on behalf of TRL (the UKs Transport Research Laboratory). We are currently recruiting participants for a vehicle trial.
>
> [**Insert flyer**]
>
> It would be greatly appreciated if you could share the attached flyer within your organisation by posting it on your intranet and/or notice boards.
>
> If you would like any additional information, please email vehicletrials@trl.co.uk.
>
> Kind regards,
>
> TRL

Figure 6: Example email to be sent to with flyer

Appendix B Recruitment screening questionnaires

B.1 Filter Survey 1

B.1.1 Participant information

Thank you for taking an interest in this research.

The research will involve you trialling one or more vehicles during your everyday driving. Trials will take place between April and December 2017.

Participants who take part in the trial will receive at least £200 as compensation for participating in the trial and will also be entered into a prize draw with a chance to win a further £2,500 as a thank you for taking part.

When you click next at the bottom of this page, you will be taken to a short survey where we will ask you a few questions about yourself and your driving patterns. This will allow us to see if you might be suitable to take part in this research.

Your response to this survey will register your interest and we will then contact you about your potential involvement in the trial and provide you with more information.

All data collected through this survey will be stored securely and will not be used for any purposes other than this research.

If you have any questions, please email vehicletrials@trl.co.uk using “Vehicle trial - Recruitment step 1” as the subject line and we will get back to you as soon as possible.

B.1.2 Survey

B.1.2.1 Driving history

1. **How long have you held a valid UK driving licence?**

- Less than 2 years [Skip logic: End survey]
- 2 – 4 years
- 4 – 6 years
- 6 – 8 years
- 8 – 10 years
- 10+ years

2. **How many penalty points do you have on your driving licence? (this information is required for insurance purposes and will be subject to a DVLA check if you are selected to participate in the trial)**
- 0
- 1
- 2
- 3
- 4 [Skip logic: End survey]
- 5+ [Skip logic: End survey]

3. **Have you had any at fault claims within the last 3 years?**
- Yes [Skip logic: End survey]
- No

4. **How often do you drive?**
- Every day
- Almost every day
- Once every two or three days
- About once a week [Skip logic: End survey]
- About once a fortnight [Skip logic: End survey]
- About once a month [Skip logic: End survey]
- Less than once a month [Skip logic: End survey]

5. **Are you currently a car owner? (e.g. outright purchase, lease, hire-purchase, personal contract purchase)** [Single answer]
- Yes
- No [Skip logic: End survey]

If you own more than one car, please answer the following questions about your main car i.e. the car you use most often.

6. **Is your car a company car? (i.e. a car provided by your organisation)** [Single answer]
- Yes [Skip logic: End survey]
- No

7. **Do you have access to off street parking (private driveway, carport, or garage) for your car?** [Single answer]
- Yes
- No [Skip logic: End survey]

8. **Have you owned or regularly driven (i.e. more than once per year) a Battery Electric Vehicle (e.g. the Nissan Leaf) or a Plug-in Hybrid Electric Vehicle (e.g. Toyota Prius Plug-in Hybrid) within the last 5 years?** [Single answer]

- Yes [Skip logic: End survey]
- No

9. **Do you intend to acquire an electric vehicle in the next 6 months?**

- Yes [Skip logic: End survey]
- No

B.1.2.2 Information about you

10. What is your postcode?

Please complete in two boxes below. For example, if your postcode is RG40 3GA, you would write RG40 in the first box, and 3GA in the second box.

Please be assured that this information will only be used for this research.

Please provide us with your…

11. Age

- 19-24 [Skip logic: If answered 19-24 for this question and >0 for Q2, end survey]
- 25-29
- 30-34
- 35-39
- 40-44
- 45-49
- 50-54
- 55-59
- 60-64
- 65-69
- 70+

12. Gender

- Male
- Female
- Other
- Prefer not to say

13. Please provide your current contact details so that we can contact you about the trial and provide you with more information.

First name

Last name

Contact number

Email address

B.1.2.3 End

Thank you for taking the time to complete this survey!

We will contact you soon with more information.

B.2 Filter Survey 2

B.2.1 Participant information

Thank you for taking an interest in this research. The answers you provided in survey 1 indicate that you may be a good fit with the needs of the research; we just need a little bit more information before we can formally invite you to participate.

What is involved in the research?

The research is made up of two separate trials:

Trial 1 aims to understand the views and opinions of the general public towards vehicles including petrol vehicles, plug-in hybrid electric vehicles (which have both a petrol engine and a re-chargeable electric powertrain) and fully battery electric vehicles (which have a re-chargeable electric powertrain only). Trial participants will be asked to use each of the three vehicles for four days (in back-to-back slots over a 12 day period) for their regular day-to-day journeys in replacement of their current car. This trial will take place between the end of April and September 2017.

Trial 2 aims to understand electric vehicle usage and charging. Participants will be given either a plug-in hybrid electric car or a battery electric car (dependent on suitability) for a period of 8 weeks to use for their day-to-day journeys. This trial will take place between July and December 2017.

For both trials, we will arrange for a chargepoint to be installed at participants' homes (free of charge). These can be kept by participants or removed after the trial.

Participants will only be able to take part in **one** of the two trials.

Remind me why I should participate?

By participating in this research you will gain direct experience of using modern vehicles for your everyday driving needs, providing valuable data for a project that is at the forefront of the future of transport.

Participants will receive £200 as compensation for participating in Trial 1, or up to £250 as compensation for participating in Trial 2. All participants who take part in the trial will also be entered into a prize draw with a chance to win a further £2,500 as an additional thank you for taking part.

What is this survey for?

This short survey will allow us to see whether you are suitable for one of the trials as well as gather some further necessary information. It should only take a few minutes to complete.

All data collected through this survey will be stored securely and will not be used for any purposes other than this research.

If you have any questions, please email vehicletrials@trl.co.uk using "Vehicle trial - Recruitment step 2" as the subject line and we will get back to you as soon as possible.

B.2.2 Survey

Please enter your unique reference number. This can be found in the email inviting you to complete this survey.

B.2.2.1 Trial interests

1. **Which trial(s) are you interested in participating in?** [Single answer]

- Either
- Trial 1 (using three different vehicles for 4 days each)
- Trial 2 (using a fully battery electric vehicle or plug-in hybrid electric vehicle for 8 weeks)

2. **Looking at the list below, which best describes your current living arrangements?** [Single answer]

- Home owner
- Tenant
- House share
- Living with parents
- Other (please describe):

3. **For the trial you will need a vehicle chargepoint installed where you live. Are you willing to have one installed (subject to the permission of the homeowner)?**

- Yes
- No

* As mentioned on the information page, this will be free of charge and can be uninstalled after the trial if requested.

B.2.2.2 Your car(s)

4. **How many cars are registered to your address?**

5. **How many licensed drivers are there in your household?**

If you own multiple cars, please answer the following questions about your <u>main</u> car (i.e. the one you drive most often).

6. Which of the car types listed below best describes your main car?

	**Mini** e.g. Hyundai i10, Volkswagen up!	☐
	**Supermini** e.g. Ford Fiesta, Vauxhall Corsa, Volkswagen Polo	☐
	**Lower Medium** e.g. Ford Focus, Vauxhall Astra, Volkswagen Golf	☐
	**Upper Medium** e.g. BMW 3 Series, Vauxhall Insigna, Audi A4	☐
	**Executive** e.g. Mercedes- Benz C Class / E Class, BMW 5 Series	☐
	**Luxury** e.g. Mercedes- Benz S Class, Jaguar XJ, Mercedes- Benz SL	☐
	**Specialist Sports** e.g. Audi TT, Mercedes- Benz SLK, Volkswagen Scirocco	☐
	**Dual Purpose** e.g. Kia Sportage, Range Rover Evoque, Honda CR-V	☐

	**MPV** e.g. Vauxhall Zafira, Ford C-Max, Ford B-Max, Ford S-Max	☐

7. How many people typically drive this car?

8. What is your approximate annual mileage?

- Less than 5,000
- 5,000 – 7,500
- 7,501 – 10,000
- 10,001 – 12,500
- 12,501 – 15,000
- 15,001 – 20,000
- 20,001 – 30,000
- More than 30,000

9. How often do you make a journey that is over 80 miles long? [Single answer]

- Every day
- Almost every day
- Once every two or three days
- About once a week
- About once a month
- A few times a year
- Once a year at most
- Almost never

B.2.2.3 Domestic energy information

10. Do you have an Android or iOS (Apple) smart phone?

- Yes
- No

11. I

12. **s your household electricity supply on an Economy 7 tariff or a pre-paid card energy meter?** [Single answer]

- Yes
- No

13. **Does your household have solar panels that provide electricity to the home supply (Photovoltaic solar panels)?** [Single answer]

- Yes
- No

B.2.2.4 End

Thank you for taking the time to complete this survey!
If you are suitable to take part in the research we will contact you soon with more information.

Appendix C Vehicle comparison table

Type	BEV	PHEV	PHEV
Model name	e-Golf	Golf GTE	Golf GTE
Model year	2017	2016	2017
Style	Hatchback	Hatchback	Hatchback
Engine	Electric motor	1.4 TSI (petrol)	1.4 TSI (petrol)
Gearbox	Direct drive	6 speed auto DSG	6 speed auto DSG
Decal	Blue trim in front grille	Blue trim in front grille	Blue trim in front grille
Doors	5	5	5
Wheels	16" alloy	17" alloy	17" alloy
Wheel design	5-spoke alloys, silver calipers	5-spoke alloys, blue calipers	5-spoke alloys, blue calipers
Number of seats	5	5	5
Seat design	Sports seats	Sports seats	Sports seats
Seat fabric	Cloth - black	Cloth – black with blue stitching	Cloth – black with blue stitching
Power (PS)	136 @ 3000rpm	204 @ 5000rpm	204 @ 5000rpm
Acceleration (0-62) (s)	9.6	7.6	7.6
Top speed (mph)	93	138	138
Fuel tank capacity (litres)	n/a	40	40
Fuel economy (mpg)	n/a	156.9 (combined)	156.9 (combined)
Emissions (CO_2 g/km)	0	40	40
Units to charge (kWh) (nominal capacity)	35.8	8.7	8.7
Maximum AER	186	31	31
Expected AER	175	25	25
Charge time (AC) 2.3kW (hrs)	17	3.75	3.75
Charge time (AC) 3.6kW (hrs)	10.5	2.25	2.25
Charge time (DC) for 80% (hrs)	0.75	n/a	n/a
Adaptive cruise control	✓	✓	✓
Nav/radio	✓		
Front and rear parking sensors	✓	✓	✓
LED headlights	✓	✓	✓
Remote central locking	✓	✓	✓
Front and rear electric windows	✓	✓	✓
Heated rear windscreen	✓	✓	✓
Bluetooth	✓	✓	✓
ABS	✓	✓	✓
Curtain airbags	✓	✓	✓
ESC	✓	✓	✓
Perimeter and interior alarm	✓	✓	✓
Climate control	✓	✓	✓

Heated and adjustable door mirrors	✓	✓	✓
Electronic parking brake	✓	✓	✓
Sunroof			
Central arm rest	✓	✓	
Cup holders	✓	✓	✓
Retractable cover for cup holders	✓	✓	
Touchscreen infotainment system	✓	✓	✓
Hard buttons on side of infotainment system		✓	
Capacitive touch sensitive buttons on side of infotainment system	✓		✓
Digital display dash instruments			✓
Analog display dash instruments	✓	✓	

Appendix D Participant Information Pack

D.1 BEV Charging Trial Information letter

Participant Information Letter – BEV Charging Trial

Thank you for your interest in this project. We really value your time and input, which will make an important contribution to this research.

This research is looking at how consumers use and charge an electric vehicle. We will give you a Battery Electric Vehicle (BEV) to use for your day-to-day journeys for 8 weeks – we will also organise the installation of a dedicated chargepoint at your home. You will be allocated a VW e-Golf hatchback for the period of the trial, replacing the vehicle you normally drive.

In addition to having the opportunity to use the vehicle above, you will receive **up to £250** for taking part in the study. You will also be entered into a prize draw to win **£2,500**. You will be free to withdraw from the trial at any point.

This letter explains what you will need to do before, during and after the trial:

When?	What will I have to do?
Before the trial	• Complete the consent form for participating in the trial confirming you agree to the requirements for taking part • Undergo a driving licence check through the DVLA website • Provide a consent form and driving licence check for an additional driver (if you require) • Have a dedicated chargepoint installed in your home for safe charging of the trial vehicle
During the trial	• Replace your car with the BEV for a period of 8 weeks • Collect the vehicle from TRL • Drive the vehicle responsibly • Charge the vehicle at home (and elsewhere, as required) • Complete questionnaires at the start before taking the vehicle
After the trial	• Return the vehicle to TRL • Complete the final questionnaire • Decide whether you would like to keep the chargepoint

What will I have to do before the trial?

Complete the consent form for participating in the trial

You have been sent a web link to an online consent form, which you will need to complete to take part in the trial. The consent form makes sure you understand all of the requirements for taking part in the trial, and confirms that you agree to all of them. The requirements are explained in this letter and the insurance summary sheet.

If you have any queries regarding the insurance policy or any of the trial requirements, please do not hesitate to contact the research team (vehicletrials@trl.co.uk or 01344 70014).

Undergo a driving licence check through the DVLA website

Before we hand over the vehicle, you will be required to supply us with your driving licence details and an authorisation code so we can check your licence with the DVLA (please see https://www.gov.uk/view-driving-licence). This allows us to check that your licence is valid with the DVLA in order to add you to the vehicle insurance for the duration of the trials. To obtain the authorisation code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence. Click here or type https://www.gov.uk/view-driving-licence into your browser to obtain the authorisation code. You will be required to provide us with this code as part of your online consent form.

Provide a consent form and driving licence check for an additional driver

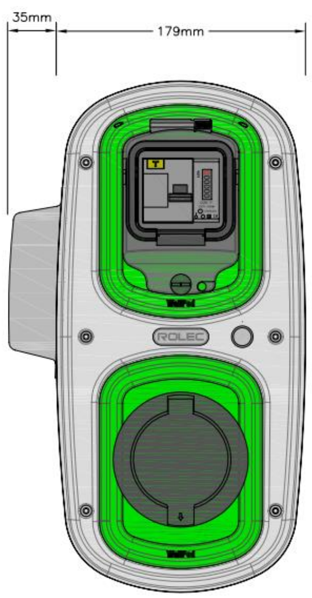
We expect you to be the main driver of the trial vehicle and you will be the only person automatically added to the insurance. However, **you may add one other person** in your household to the insurance if they also require use of the vehicle during the trial period. You would need to provide their driving licence details and the authorisation code from the DVLA and they will need to complete an additional driver consent form. They will also be required to meet minimum eligibility criteria for insurance (please see the insurance summary sheet).

Have a dedicated chargepoint installed in your home for safe charging of the trial vehicle

For safety purposes, we require you to agree to the installation of a dedicated chargepoint at your property to charge the electric vehicle. If you do not own the property, you will need to seek permission from the homeowner.

The chargepoint must be fitted in a suitable location (i.e. a location that would allow you to charge the trial vehicle without the charging cable passing over land which is not an exclusive part of your property, such as a public footway). For example, the chargepoint might be fitted in your garage or to the side of your house near where you park your car.

The chargepoint and installation will be provided by Rolec Ltd (an approved electric vehicle chargepoint provider) and Rolec's installation partner, ChargedEV. This process will be managed and paid for by TRL. We will put you in contact with ChargedEV to arrange a convenient time for installation of the chargepoint.

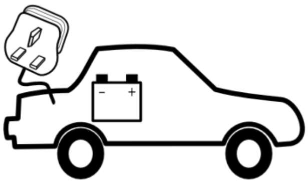


What will I have to do during the trial?

Replace your car with the trial vehicle for 8 weeks

Depending on your current household car usage and storage requirements, you may be asked to replace your current vehicle with the trial vehicle for an 8 week period; during this time your vehicle will be stored by TRL in a secure location. If you do not store your current vehicle with the project team for the duration of the trial, we will ask you to send us photographic evidence of the mileage of your vehicle at the start and end of the trial. This is to serve as a check that you use the trial vehicle your everyday travel needs, in place of your current vehicle.

The vehicle you will drive:

VW e-Golf hatchback	**Battery Electric Vehicle (BEV)** which has an electric motor only	

Collect and return the vehicle to TRL/Cenex

You will be required to come to TRL (Crowthorne: RG40 3GA) / Cenex (Loughborough: LE11 3QF) to collect and return the vehicle.

We will be in contact with you to arrange and agree vehicle hand over times beforehand (these will be available from 07:30 – 20:00 to suit your availability).

The vehicle hand over session should take approximately 1-1.5 hours.

During the hand over session, we will:

- talk you through the vehicle controls and how to charge the vehicle;
- accompany you on a short familiarisation drive to ensure that you feel comfortable with the vehicle and with how to charge the vehicle safely;
- answer any questions you may have.

Your safety during the trial is our priority. At vehicle handover, we will provide you with an in-vehicle information pack containing:

- the vehicle manufacturer's guidance documents;
- what to do in an emergency;
- who to contact in the event of an issue or incident; and
- details of breakdown cover.

What do I need to bring when I collect the vehicle?

When you collect the vehicle, please remember to bring:	✓
Your driving licence (and photographic ID if you have a paper licence only);	
An additional form of ID with proof of address (e.g. utility bill or bank statement)	
Signed Vehicle Possession Consent Form	
Any corrective eyewear you require for driving (e.g. contact lenses, glasses)	
Bank Details claim form	

The driving licence, authorisation check code and additional proof of address for one other driver, should you wish them to be insured on the vehicle (subject to restrictions outlined in this letter).	
Your smartphone (so we can demonstrate the smartphone app)	

In addition, if you are not storing your vehicle with TRL for the duration of the trial, please ensure you have emailed photographs of your own vehicle's mileage to the project team prior to coming in for handover. Please note you will also need to send updated photographs of your own vehicle's mileage at the end of the trial when you return the trial vehicle.

Drive the vehicle responsibly

You will be required to drive the vehicle responsibly and legally, not smoke in the vehicle, and return the vehicle in the same condition as you received it. As the driver of the vehicle, you are liable for any driving offences, penalties and fines (including parking fines) incurred whilst you are in possession of the vehicle.

If, during the trial, you have any issues with the vehicle or charging equipment that cannot be resolved using information in the in-vehicle information packs, ***please stop using the vehicle and charging equipment and contact us as soon as possible.***

Charging the vehicle

You will be required to regularly charge the vehicle at your home (using the dedicated chargepoint). You will also be able to charge at other locations such as at work, or at public chargepoints (a charging card will be supplied with the vehicle to provide access to public chargepoints). The research team will explain how vehicle charging works when you collect the vehicle.

When charging at home, you will be responsible for paying for your electricity use.

Use of smartphone app

We will ask you to use a smart phone app during the trial – you will be given a demonstration of how to use the app when you come to collect the vehicle. The app is an essential part of taking part in the trial. You must bring your phone when you come to pick up the vehicle. Since this is a trial, please note that you will not be able to use vehicle manufacturer specific smartphone apps to interact with the vehicle and the charging equipment.

Complete questionnaires

You will be asked to complete the following questionnaires during the trial:

- Pre-collection questionnaire (30-45 mins): completed online in your own time before you collect the vehicle.
- Final questionnaire (30-45 mins): completed online in your own time after the 8-week experience with the vehicle.

What will I have to do after the trial?

Please ensure that the vehicle is returned with as much charge as possible. If you did not store your vehicle with TRL for the duration of the trial, please send updated photographs of your own vehicle's mileage before you return the trial vehicle.

Following the trial, the chargepoint can be kept and re-used. Using the sockets for any purpose other than charging the trial vehicle should only be undertaken once the trial is complete. Alternatively, you can have the socket removed (at no cost to you) if you prefer.

What data will we collect and how will we manage it?

Questionnaires

We will collect your questionnaire data (see above), linked to your participant ID. This will not be linked to your name and questionnaire data will be anonymised.

Vehicle data collection

All vehicles used in this study will have telematics devices fitted to them to collect a variety of data while you use them. The data will be collected for research purposes only (it will not be used to make any assessment of your driving). Data which will be collected include GPS (geographical coordinate) data and data about journey distances, journey duration, vehicle speed, charging events and battery consumption.

Data protection

All information obtained about you for this project will be kept private in compliance with the Data Protection Act. Information related to fair processing of your data (in line with the Data Protection Act) is provided below:

Who is the data controller?	The Transport Research Laboratory (TRL)
Who can you contact regarding your data?	The TRL research team on 01344 770014
How will your data be used and what is the likely outcome of its use?	The data will be used to understand people's use of electric vehicles, including how they are charged. Results will be used to inform future policy recommendations related to personal transport and the energy system.
Who else will use your data? • Your address and contact details will be passed to ChargedEV in order to arrange installation of a chargepoint at your home. • If you are collecting the vehicle from Cenex, your personal details will be passed to Cenex in order for them to undertake DVLA driving licence checks. • Vehicle telematics data will be collected by FleetCarma and passed onto TRL for data analysis purposes. Data retained by FleetCarma will be securely erased at the end of the project.	

- Vehicle telematics data, questionnaire data and all other personal data will be stored securely and anonymised (you will be assigned a participant ID number and data will only be linked to that number and never directly to your personal details).
- Anonymised data (from telematics and questionnaires) will be shared with our project partners (Element Energy, Baringa, EV Connect and Shell) for data analysis purposes.
- Data will be shared with our client (the Energy Technologies Institute) and its agents and successors at the end of the project.
- The results of the study will be shared with our client (the Energy Technologies Institute) and its agents and successors and project partners (Element Energy, Baringa EV Connect and Shell). Results are likely to be published (your identity or personal information will never be disclosed in the published results).

What happens next?

If you are happy to take part in the trial, please complete the online consent form (link given within the covering email). When we receive the completed consent form, one of our researchers will contact you to arrange the chargepoint installation and your vehicle exchange timetable.

If you have any questions, concerns or issues which are not covered by the information provided in this letter or the in-vehicle information packs, please do not hesitate to contact the research team on 01344 770014, who will be available between 9am and 5pm Monday to Friday (excluding public holidays) to answer any questions or queries.

Please remember that you may withdraw from this study at any point.

Many thanks,

The Research Team

D.2 PHEV Charging Trial Information Letter

Participant Information Letter – PHEV Charging Trial

Thank you for your interest in this project. We really value your time and input, which will make an important contribution to this research.

This research is looking at how consumers use and charge an electric vehicle. We will give you a Plug-in Hybrid Electric Vehicle (PHEV) to use for your day-to-day journeys for 8 weeks – we will also organise the installation of a dedicated chargepoint at your home. You will be allocated a VW Golf GTE hatchback for the period of the trial, replacing the vehicle you normally drive.

In addition to having the opportunity to use the vehicle above, you will receive **up to £250** for taking part in the study. You will also be entered into a prize draw to win **£2,500**. You will be free to withdraw from the trial at any point.

This letter explains what you will need to do before, during and after the trial:

When?	What will I have to do?
Before the trial	• Complete the consent form for participating in the trial confirming you agree to the requirements for taking part • Undergo a driving licence check through the DVLA website • Provide a consent form and driving licence check for an additional driver (if you require) • Have a dedicated chargepoint installed in your home for safe charging of the trial vehicle
During the trial	• Replace your car with the PHEV for a period of 8 weeks • Collect the vehicle from TRL • Drive the vehicle responsibly • Charge the vehicle at home (and elsewhere, as required) • Complete questionnaires at the start before taking the vehicle
After the trial	• Return the vehicle to TRL • Complete the final questionnaire • Decide whether you would like to keep the chargepoint

What will I have to do before the trial?

Complete the consent form for participating in the trial

You have been sent a web link to an online consent form, which you will need to complete to take part in the trial. The consent form makes sure you understand all of the requirements for taking part in the trial, and confirms that you agree to all of them. The requirements are explained in this letter and the insurance summary sheet.

If you have any queries regarding the insurance policy or any of the trial requirements, please do not hesitate to contact the research team (vehicletrials@trl.co.uk or 01344 70014).

Undergo a driving licence check through the DVLA website

Before we hand over the vehicle, you will be required to supply us with your driving licence details and an authorisation code so we can check your licence with the DVLA (please see https://www.gov.uk/view-driving-licence). This allows us to check that your licence is valid with the DVLA in order to add you to the vehicle insurance for the duration of the trials. To obtain the authorisation code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence. Click here or type https://www.gov.uk/view-driving-licence into your browser to obtain the authorisation code. You will be required to provide us with this code as part of your online consent form.

Provide a consent form and driving licence check for an additional driver

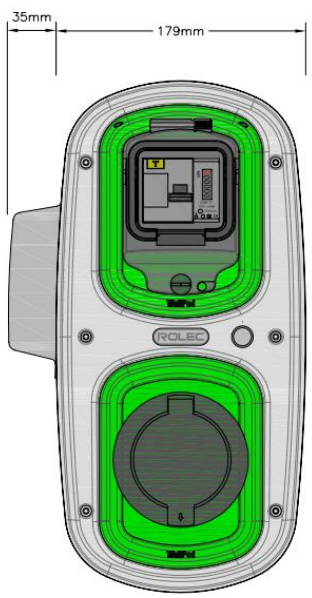
We expect you to be the main driver of the trial vehicle and you will be the only person automatically added to the insurance. However, **you may add one other person** in your household to the insurance if they also require use of the vehicle during the trial period. You would need to provide their driving licence details and the authorisation code from the DVLA and they will need to complete an additional driver consent form. They will also be required to meet minimum eligibility criteria for insurance (please see the insurance summary sheet).

Have a dedicated chargepoint installed in your home for safe charging of the trial vehicle

For safety purposes, we require you to agree to the installation of a dedicated chargepoint at your property to charge the electric vehicle. If you do not own the property, you will need to seek permission from the homeowner.

The chargepoint must be fitted in a suitable location (i.e. a location that would allow you to charge the trial vehicle without the charging cable passing over land which is not an exclusive part of your property, such as a public footway). For example, the chargepoint might be fitted in your garage or to the side of your house near where you park your car.

The chargepoint and installation will be provided by Rolec Ltd (an approved electric vehicle chargepoint provider) and Rolec's installation partner, ChargedEV. This process will be managed and paid for by TRL. We will put you in contact with ChargedEV to arrange a convenient time for installation of the chargepoint.

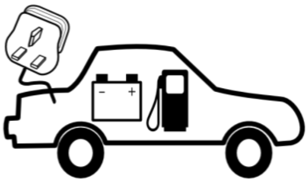


What will I have to do during the trial?

Replace your car with the trial vehicle for 8 weeks

Depending on your current household car usage and storage requirements, you may be asked to replace your current vehicle with the trial vehicle for an 8 week period; during this time your vehicle will be stored by TRL in a secure location. If you do not store your current vehicle with the project team for the duration of the trial, we will ask you to send us photographic evidence of the mileage of your vehicle at the start and end of the trial. This is to serve as a check that you use the trial vehicle your everyday travel needs, in place of your current vehicle.

The vehicle you will drive:

VW Golf GTE hatchback	**Plug-in Hybrid Electric Vehicle (PHEV) -** which has both a petrol engine and an electric motor)	

Collect and return the vehicle to TRL/Cenex

You will be required to come to TRL (Crowthorne: RG40 3GA) / Cenex (Loughborough: LE11 3QF) to collect and return the vehicle.

We will be in contact with you to arrange and agree vehicle hand over times beforehand (these will be available from 07:30 – 20:00 to suit your availability).

The vehicle hand over session should take approximately 1-1.5 hours.

During the hand over session, we will:

- talk you through the vehicle controls and how to charge the vehicle;
- accompany you on a short familiarisation drive to ensure that you feel comfortable with the vehicle and with how to charge the vehicle safely;
- answer any questions you may have.

Your safety during the trial is our priority. At vehicle handover, we will provide you with an in-vehicle information pack containing:

- the vehicle manufacturer's guidance documents;
- what to do in an emergency;
- who to contact in the event of an issue or incident; and
- details of breakdown cover.

What do I need to bring when I collect the vehicle?

When you collect the vehicle, please remember to bring:	✓
Your driving licence (and photographic ID if you have a paper licence only);	
An additional form of ID with proof of address (e.g. utility bill or bank statement)	
Signed Vehicle Possession Consent Form	
Any corrective eyewear you require for driving (e.g. contact lenses, glasses)	
Bank Details claim form	

The driving licence, authorisation check code and additional proof of address for one other driver, should you wish them to be insured on the vehicle (subject to restrictions outlined in this letter).	
Your smartphone (so we can demonstrate the smartphone app)	

In addition, if you are not storing your vehicle with TRL for the duration of the trial, please ensure you have emailed photographs of your own vehicle's mileage to the project team. prior to coming in for handover. Please note you will also need to send updated photographs of your own vehicle's mileage at the end of the trial when you return the trial vehicle.

Drive the vehicle responsibly

You will be required to drive the vehicle responsibly and legally, not smoke in the vehicle, and return the vehicle in the same condition as you received it. As the driver of the vehicle, you are liable for any driving offences, penalties and fines (including parking fines) incurred whilst you are in possession of the vehicle.

If, during the trial, you have any issues with the vehicle or charging equipment that cannot be resolved using information in the in-vehicle information packs, ***please stop using the vehicle and charging equipment and contact us as soon as possible.***

Charging the vehicle

You will be required to regularly charge the vehicle at your home (using the dedicated chargepoint). You will also be able to charge at other locations such as at work, or at public chargepoints (a charging card will be supplied with the vehicle to provide access to public chargepoints). The research team will explain how vehicle charging works when you collect the vehicle.

When charging at home, you will be responsible for paying for your electricity use. You will also be responsible for paying for the petrol you use.

Use of smartphone app

We will ask you to use a smart phone app during the trial – you will be given a demonstration of how to use the app when you come to collect the vehicle. The app is an essential part of taking part in the trial. You must bring your phone when you come to pick up the vehicle. Since this is a trial, please note that you will not be able to use vehicle manufacturer specific smartphone apps to interact with the vehicle and the charging equipment.

Complete questionnaires

You will be asked to complete the following questionnaires during the trial:

- Pre-collection questionnaire (30-45 mins): completed online in your own time before you collect the vehicle.
- Final questionnaire (30-45 mins): completed online in your own time after the 8-week experience with the vehicle.

What will I have to do after the trial?

Please ensure that the vehicle is returned with as much charge as possible and with the same fuel level as when you received the vehicle. If you did not store your vehicle with TRL for the duration of the trial, please send updated photographs of your own vehicle's mileage before you return the trial vehicle.

Following the trial, the chargepoint can be kept. Using the sockets for any purpose other than charging the trial vehicle should only be undertaken once the trial is complete. Alternatively, you can have the socket removed (at no cost to you) if you prefer.

What data will we collect and how will we manage it?

Questionnaires

We will collect your questionnaire data (see above), linked to your participant ID. This will not be linked to your name and questionnaire data will be anonymised.

Vehicle data collection

All vehicles used in this study will have telematics devices fitted to them to collect a variety of data while you use them. The data will be collected for research purposes only (it will not be used to make any assessment of your driving). Data which will be collected include GPS (geographical coordinate) data and data about journey distances, journey duration, vehicle speed, charging events and battery consumption.

Data protection

All information obtained about you for this project will be kept private in compliance with the Data Protection Act. Information related to fair processing of your data (in line with the Data Protection Act) is provided below:

Who is the data controller?	The Transport Research Laboratory (TRL)
Who can you contact regarding your data?	The TRL research team on 01344 770014
How will your data be used and what is the likely outcome of its use?	The data will be used to understand people's use of electric vehicles, including how they are charged. Results will be used to inform future policy recommendations related to personal transport and the energy system.

Who else will use your data?

- Your address and contact details will be passed to ChargedEV in order to arrange installation of a chargepoint at your home.
- If you are collecting the vehicle from Cenex, your personal details will be passed to Cenex in order for them to undertake DVLA driving licence checks.
- Vehicle telematics data will be collected by FleetCarma and passed onto TRL for data analysis purposes. Data retained by FleetCarma will be securely erased at the end of the project.
- Vehicle telematics data, questionnaire data and all other personal data will be stored securely and anonymised (you will be assigned a participant ID number and data will only be linked to that number and never directly to your personal details).
- Anonymised data (from telematics and questionnaires) will be shared with our project partners (Element Energy, Baringa, EV Connect and Shell) for data analysis purposes.

- Data will be shared with our client (the Energy Technologies Institute) and its agents and successors at the end of the project.
- The results of the study will be shared with our client (the Energy Technologies Institute) and its agents and successors and project partners (Element Energy, Baringa EV Connect and Shell). Results are likely to be published (your identity or personal information will never be disclosed in the published results).

What happens next?

If you are happy to take part in the trial, please complete the online consent form (link given within the covering email). When we receive the completed consent form, one of our researchers will contact you to arrange the chargepoint installation and your vehicle exchange timetable.

If you have any questions, concerns or issues which are not covered by the information provided in this letter or the in-vehicle information packs, please do not hesitate to contact the research team on 01344 770014, who will be available between 9am and 5pm Monday to Friday (excluding public holidays) to answer any questions or queries.

Please remember that you may withdraw from this study at any point.

Many thanks,

The Research Team

D.3 Insurance summary sheet

Insurance Summary Sheet

What are the policy details?

The insurance cover for this trial is **comprehensive** and is provided by Aviva. The insurance includes cover for accidental damage to the vehicle, fire and theft cover and third party cover (cover for injury to other people or damage to their property).

Who is covered by the insurance?

In order to be insured for this trial, **you must confirm that you**:

- are aged **at least 19 years old**;
- have held a **full UK driving licence for at least 2 years;**
- have had **no "at fault" accidents** (where a collision was deemed your fault) within the last 3 years; and
- have received **no penalty points if you are under 25 *OR* no more than 3 penalty points if you are aged 25 and over.**

Only named driver(s) are covered by this insurance policy. You must complete the consent form and undergo a DVLA licence check in order to be a named driver. You will be automatically added to the insurance policy, but please note that **no other driver is insured to drive the vehicle** unless confirmed by TRL prior to the trials. If someone claims to have their own insurance cover, it will **not** provide cover for driving this vehicle while it is being used as part of a trial.

You may add one other person in your household to the insurance if they also require use of the vehicle(s) during the trial period. They will be required to meet minimum eligibility criteria described above, complete the additional driver consent form and undergo a DVLA licence check.

Your responsibilities as the driver

You are responsible for driving safely, responsibly and legally, as well as maintaining the condition of the vehicle for the duration of the trial. You, as the driver of the vehicle, are **liable for any driving offences, penalties and fines (including parking fines)** incurred whilst you are in possession of the vehicle.

In the event of accidental damage, theft or fire damage, **you as the driver will be responsible for paying an excess of £250 per claim if you are aged 25 or over or £500 per claim if you are under 25 years old. Should TRL have to make a claim for any damage to the vehicle following the trial, you will be responsible for paying the excess amount.** If the incident is proven to have been caused by another party and the excess is recovered from them, we will reimburse you for the amount of excess that you paid, once the claim has been settled by the other party's insurer. You will be responsible for ensuring that full details of the accident and the other party are passed to TRL in the event of such a claim; and for cooperating with and providing information to TRL's insurers in order to process the claim effectively.

What to do in the event of a collision or breakdown

During vehicle handover, you will be given a booklet detailing what you should do in the event of a collision or breakdown. This provides you with a step-by-step guide on what to do and contains the necessary forms you will need to complete.

In the event of a collision:

1. Call 999 if anyone is injured or the road is blocked / damaged.
2. Call Aviva claims line immediately from the scene on 0800 246 876 (this is a free 24 hour number)
3. If the vehicle cannot be driven and needs to be recovered, please call Driverline on 0844 2091 962 to arrange suitable recovery.
4. Once it is safe to do so, please also inform TRL of the incident on 01344 770014, or vehicletrials@trl.co.uk

In the event of a breakdown:

1. For all breakdowns, in the first instance call Driverline on 0844 2091 962 to arrange suitable recovery.
2. Once it is safe to do so, please also inform TRL of the breakdown on 01344 770014, or vehicletrials@trl.co.uk

D.4 Forms

The following forms will be hosted online; participants will be provided with a link to the forms via email.

D.4.1 Main consent form

Please complete this consent form once you have read the materials in the Participant Information Pack and delete YES or NO as appropriate in the spaces provided:

Have you been given enough information about this study, as well as an opportunity to ask questions?	Yes / No
Do you understand that you may withdraw from the study at any time without having to give reason for withdrawing?	Yes / No
Do you understand that only you (and any others registered and whose driving licence has been checked by TRL/Cenex[1] and the DVLA) are insured to drive the vehicles?	Yes / No
Do you accept that as the main driver, you are responsible for ensuring that any additional person in the household who will drive the vehicle has had their driving licence checked by by TRL/Cenex and the DVLA?	Yes / No
Do you accept the terms and conditions of the insurance documentation?	Yes / No
Do you understand that you are responsible for the condition of the vehicle for the duration of the trial, and may be liable to pay insurance excess for any claims in the event of a collision or damage?	Yes / No
Do you understand that TRL/Cenex has **not** provided you with any driver training and you are expected to drive safely, responsibly and legally?	Yes / No
Do you understand that you are liable for any driving offences and fines (including parking fines) associated with the vehicle during the trial period?	Yes / No
Do you understand that you cannot smoke in the vehicle and agree not to do so?	Yes / No
Do you confirm that the installed charging socket is to be used only with the trial vehicles and for no other purpose, until after the trial is complete?	Yes / No
Do you (or the person who owns your home) consent to installation of a dedicated charging socket at your home?	Yes / No
I confirm that the information I have given is correct to the best of my knowledge and agree to inform you of any changes to the information that I have provided to you that could affect participation in the trial?	Yes / No

[1] One location will be deleted as required; applies throughout this form.

Do you consent to TRL passing on your contact details to Cenex for the purposes of arranging vehicle collection?[2]	Yes / No
Do you consent to TRL passing on your contact details to ChargedEV for the purposes of installing the electric vehicle chargepoint?	Yes / No
Do you consent to TRL passing on your data to the Energy Technologies Institute (and any of its agents and successors) at the end of the project for the purposes of the research project?	Yes / No
Do you consent to GPS geographical coordinate information being collected by FleetCarma through the onboard telematics device in the vehicle?	Yes / No
Do you confirm that you are not an employee of TRL, Cenex or the ETI?	Yes / No

YOU SHOULD ONLY AGREE TO TAKE PART IN THIS STUDY IF YOU ANSWER 'YES' TO ALL OF THE ABOVE QUESTIONS

Are you happy to take part in this study?

☐ Yes, I consent to take part in the study

☐ No, I do not consent to take part in the study

PLEASE PROVIDE US WITH:

Your driving licence number	
Your DVLA authorisation check code, obtained from: https://www.gov.uk/view-driving-licence (please note that in order to obtain the code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence)	

[2] Will be included for Cenex participants only

D.4.2 Vehicle possession consent form

For this trial, TRL are leasing the trial vehicles from Volkswagen. Therefore, we require all participants to comply with the lease agreements. Please complete this form to confirm that you are willing to comply with this agreement and bring it with you to the vehicle handover, deleting YES or NO as appropriate in the spaces provided:

Statement:	**I agree**
You do not/will not own the vehicle. You are not allowed to attempt to sell, lease or hire the vehicle to anyone else.	Yes / No
You may not make any changes to the vehicle without TRL's prior agreement or interfere with the workings of the vehicle.	Yes / No
You will return the vehicle to TRL/Cenex in the same condition that you received it, whether you complete the trial or not.	Yes / No
You will not use the vehicle illegally, and you will not use the vehicle to commit any illegal activity.	Yes / No
You will not use the vehicle for the purposes of making money. The only business purpose you may use the vehicle for is your normal commute to work or travelling to meetings. You will not use the vehicle for work if the work activity requires you to drive (for example as a taxi or delivery service).	Yes / No
You will not display any forms of advertising, signs or other forms of display or promotion on the vehicle for any purpose	Yes / No
You will not use the vehicle to enter into any form of motorsport or competition.	Yes / No
You will not take the vehicle outside of the United Kingdom.	Yes / No
You may not use the vehicle to secure any loan or agreement.	Yes / No
You will make sure that you carry out necessary safety checks before driving the vehicle such as screen wash, oil, water and anti-freeze levels. TRL will undertake these checks before providing you with the vehicle, but you are responsible for these checks during your possession of the vehicle.	Yes / No

If you do not comply with any of the above requirements, you are responsible for any costs required by TRL to return the vehicle in to the state in which you received it, or the costs of replacing the vehicle.

Signed	
Date	

D.4.3 Additional driver form

Any additional drivers who wish to be added to the vehicle insurance for the duration of the trial must complete and return the following form. It is the responsibility of the main participant to pass on any relevant information about the vehicle and chargepoint operation, the responsibilities as a driver, and the terms and conditions of the vehicle insurance.

Do you understand that only you (and any others registered and whose driving licence has been checked by TRL/Cenex[3] and the DVLA) are insured to drive the vehicles?	Yes / No
I confirm that the information I have given is correct to the best of my knowledge and agree to inform you of any changes to the information that I have provided to you that could affect participation in the trial?	Yes/No
Do you accept the terms and conditions of the insurance documentation?	Yes / No
Do you understand that you cannot smoke in the vehicle and agree not to do so?	Yes / No
Do you consent to the collection of vehicle data for the purposes of this research, including the collection of GPS data and data about journey distances, journey duration, vehicle speed, charging events and fuel/battery consumption?	Yes / No
Do you consent to vehicle data being shared with the project partners (Element Energy, Shell, EV Connect and Baringa) for the purposes of the project analysis?	Yes / No
Do you consent to TRL passing on your data to the Energy Technologies Institute (and any of its agents and successors) at the end of the project for the purposes of the research project?	Yes / No

YOU SHOULD ONLY AGREE TO TAKE PART IN THIS STUDY IF YOU ANSWER 'YES' TO ALL OF THE ABOVE QUESTIONS

Are you happy to take part in this study?

- ☐ Yes, I consent to take part in the study
- ☐ No, I do not consent to take part in the study

PLEASE PROVIDE US WITH:

Your driving licence number	
Your DVLA authorisation check code, obtained from: https://www.gov.uk/view-driving-licence (please note that in order to obtain the code, you will need your driving licence number, your National Insurance number and the postcode on your driving licence)	

[3] One location will be deleted as required; applies throughout this form.

Appendix E Researcher protocol

CVEI Consumer Charging Trials: Researcher protocol

This protocol details the standardised vehicle handover process which will be used for the Consumer Charging Trials.

Pre-trial stage

a) Once Rolec have confirmed safe installation of the chargepoint, confirm the date and time of the participant's arrival for the handover by email or phone.
b) Send a reminder that they need to bring with them:
   I. Driving licence (and photographic ID if they have a paper licence only) and their DVLA authorisation check code, obtained from here: https://www.gov.uk/view-driving-licence
   II. Additional form of ID with proof of address (such as utility bill or bank statement)
   III. Any corrective eyewear they require for driving (e.g. contact lenses, glasses)
   IV. Driving licence, authorisation check code and additional proof of address for any other drivers they wish to be insured on the vehicle
c) The participant should have received the Participant Information Pack and completed the online consent form to signal that they are fully signed up to the trial. Before the participant arrives, check that they have done this, and that they have completed the Pre-trial questionnaire. If they are not leaving their own vehicle with the research team for the duration of the trial, they should also have sent in photographic evidence of their current vehicle mileage.
d) If any are missing, have a copy with you for the participant to complete, or if there is time, send a reminder email to the participant to complete online before they arrive.
e) Ensure that you have a high-visibility jacket for yourself and for the participant when they arrive.
f) Ensure that you have read and understood the "In-vehicle information pack" including the vehicle and charging guides for safe use of the vehicle and charging equipment.
g) Ensure that you are familiar with the vehicle controls and have read and understood the user guides, charging guides and vehicle checklists.
h) Ensure that you are familiar with how to carry out licence, eyesight and vehicle checks.
i) Ensure that the vehicle condition check has been performed and recorded as safe for handover.
j) Ensure that you have read and understood the project risk assessment.
k) Ensure that you have read and understood the TRL (and/or Cenex where applicable) policies and procedures, particularly on lone working, safe driving, working hours, fatigue and alcohol and drugs.
l) Ensure that you have read and understood the requirements for accident, incident and near miss reporting in line with the Project Incident Protocol (PIP).

m) Ensure that you have a means of contacting the Trial Manager, or other suitable persons on the trials team. and any designated emergency contacts.

Handover: participant arrives to collect the vehicle

a) On arrival at the trial headquarters (TRL or Cenex), the participants will be met by the Trial Manager, a researcher from the team or yourself. If working alone, you should follow the lone working procedure and inform/phone a colleague to confirm the start of car collection or drop-off process and how long you expect to be with the participant.

b) If necessary, direct participants to the secure parking area (where their personal vehicles will be stored for the duration of the trial) and ensure the following:
   a. Their vehicle is parked in safe location to avoid conflict with other site users
   b. There is sufficient space around the vehicle to carry out a walk-around check.

c) Once the participant is out of their vehicle, provide them with a high visibility jacket to wear.

d) Accompany the participant on a walk-around of their personal vehicle to record the existing condition of the vehicle. Use the Vehicle condition form to record of the following:
   1. Participant name and number
   2. A summary of the condition of the vehicle (inside and outside)
   3. Any damage to the vehicle (inside and outside)
   4. The mileage of the vehicle
   5. Fuel level
   6. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

e) Ask the participant to sign the form confirming the current condition of their vehicle.

f) Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

g) Take the keys to the participant's vehicle and add a key tag with the vehicle details. Store the keys in the secure location specified by the Trials Manager.

h) Ask the participant for their driving licence and check code. Verify the licence details online at https://www.gov.uk/check-driving-information

Enter the last eight characters from the driving licence and the "check code" in the relevant boxes.

i) Ensure the licence is valid and meets trial requirements. Repeat the check for any additional driver in the household where the participant provides a copy of their driving licence

j) If the driving licence does not meet the requirements of the trial, the participant cannot take part.

***In the event that the licence does not meet the requirements of the trial**, alert the Trial Manager to the situation and the participant will be notified that they will not be able to take part in the trial by the Trial Manager.*

k) Ask the participant for the additional form of ID with proof of address (and additional photo ID if their licence is paper only). Scan copies of all ID items, including their driving licence (and that of any additional driver), and save in the secure project area.

l) Check the participant's eyesight using a test vehicle registration plate. This must be undertaken in a safe location and the participant must be standing 20 metres from the plate (there should be a mark on the ground). If they are unable to successfully pass this test they will not be allowed to drive the vehicle. Give them the option of either not participating in the trial or returning at a later time and trying again with their corrective eyewear. If they have their corrective eyewear with them, re-test their eyesight whilst they are wearing the corrective eyewear. If the participant still cannot read the vehicle registration plate then they cannot take part in the trial.

   ***In the event that the participant can no longer take part in the trial**, alert the Trial Manager to the situation and the participant will be notified that they will not be able to take part in the trial by the Trial Manager. The participants should receive a £10 cash payment as compensation for travel expenses to the handover site.*

m) Check whether the participant has completed the Time Point 1 questionnaire. If they have not, ask them to complete it now.

n) Show the participant to the trial briefing presentation area. Tell the participant that this presentation will cover the background information about the trial, what is expected of the participant and a comprehensive health and safety briefing. Indicate that if they have any questions they should ask these in the briefing presentation.

o) Whilst the participant is in the briefing, ensure that you have stored the following in the specified secure areas:

   1. Vehicle condition form
   2. Any photos of the participant's personal vehicle
   3. Copies of the participant's driving licence and proof of address, and the driving licence for an additional driver, if applicable.
   4. The participant's personal vehicle keys (if applicable)

p) Make sure you have identified who your assigned participant is, their participant number and which vehicle they are to be assigned as per the checklist.

PARTICIPANT ARRIVAL CHECKLIST	Tick
1. Consent forms completed	
2. Pre-trial questionnaire completed	
3. Time Point 1 questionnaire completed	
4. Buddy informed as per lone working procedure (if working alone)	

5. Participant's vehicle parked in a safe and secure location	
6. Hi-vis for yourself and participant	
7. Inspection of participant's personal vehicle	
8. Collection of participant's vehicle keys	
9. Driving licence check and ID check	
10. Additional driver licence check (if applicable)	
11. Eyesight check	
12. Participant has had trial briefing presentation	
13. All ID, photos and forms scanned and stored securely	

Vehicle handover

a) At the end of the trial briefing presentation meet your assigned participant. Confirm their participant number with them.

b) Check with them whether they have any further questions following the presentation, and answer any questions they have using the supplementary information you have.

c) Ensure the participant is wearing a high visibility jacket and take them to the trial vehicle that they will be using. Ensure the vehicle is parked in a safe location for a walk round (and charging demonstration if necessary). If it is not, inform the Trial Manager and request that the vehicle is moved to a safe location.

d) Accompany the participant on a walk-around of the trial vehicle they have been assigned to record the existing condition of the vehicle. Use the Vehicle condition form to record of the following:

   1. Participant name and number
   2. A summary of the condition of the vehicle (inside and outside)
   3. Any damage to the vehicle (inside and outside)
   4. The mileage of the vehicle
   5. Fuel level (if applicable)
   6. Battery charge level
   7. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

e) Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

f) Check that all key equipment in the vehicle is present:

   1. Vehicle handbook/manual
   2. In-vehicle information pack
   3. First aid kit
   4. Locking wheel nut
   5. Hi-vis vest
   6. Charging cables (where applicable)

Static familiarisation with the vehicle

a) Show the participant the vehicle key and the purpose of each button. **Be sure to explain that the vehicle has keyless entry. The button on the door handle locks/unlocks the door if the key is in the vicinity of the vehicle.**

b) Give the participant the vehicle key and ask them to unlock the vehicle.

c) Show the participant how to adjust the driver's seat before they get into the vehicle.

d) Ask the participant to get into the driver's seat and set up their own driving position (seat position, steering wheel, mirrors). Assist them as necessary.

e) Show the participant where the main controls and features can be found and how to operate them. This information is provided in the basic controls document.

Main controls checklist	Tick
Lights and main beam	
Fog lights	
Indicators	
Windscreen wipers & wash	
Wing mirror adjustment	
Electric windows	
Bonnet release	
Boot release	
Fuel filler release (if applicable)	
Vehicle charging port access	

f) Demonstrate to the participant how to turn on the vehicle (**show them the 'Vehicle Guide' in the 'In-Vehicle Information Pack' at this point and talk them through it**). All vehicles are <u>automatic</u> transmission.

   a. With the right foot on the foot brake, press the power button/turn the key, and then remove foot from brake. Indicate to the participant that even though it is silent, the car engine is now on.

g) Show the participant that when the vehicle is in 'P' (for Park) the vehicle will not move. Demonstrate the parking brake (see Vehicle guide for instructions). Then show the participant how to work the gear selector.

h) You need to show them the features and controls unique to the BEV and PHEV vehicles (the in-vehicle fuel and power displays of battery SOC and range) as per the Vehicle guide document. **Show the participant the 'Charging Guide' in the 'In-Vehicle Information Pack' at this point and talk them through it**. Whilst you are talking them through, you then need to show them:

   1. How to access the charging port on the vehicle.
   2. Locating the charging cable.
   3. How to safely plug in the charging cable at both the vehicle *and* the charge point.

4. How to safely remove the charging cable on completion of charging.
5. Explain that it is important to use safe connections to charge the vehicle only (i.e. the installed charge point at their home or a dedicated PiV chargepoint).

i) Inform the participant of the AER of the vehicle and the likely impact when operating it under various driving conditions (e.g. urban driving vs. motorway driving). This is included in the 'Vehicle Guide' in the 'In-Vehicle Information Pack'.

j) **For the PHEV:** point out that the vehicle has a full tank of fuel.

k) Point out the SOC (it will be at least 80%, if it is not then inform the Trial Manager). **Tell participants that they are required to return the vehicle with the same amount of fuel (PHEV only) and with as much charge as possible.**

Familiarisation drive

a) Once you have completed the static vehicle familiarisation exercise with the participant, ask them if they are ready to undertake a short familiarisation drive. If they are not ready, continue the static vehicle familiarisation exercise until they are comfortable to take the familiarisation drive.

b) Tell the participant that you will accompany them on the familiarisation drive and direct them.

c) Indicate that the drive is for the comfort of the participant to ensure they are comfortable with the operation of the vehicle. They are not being assessed. Specify that if they feel uncomfortable after their first loop, the familiarisation drive can be extended or if they feel unable to drive, they can stop in a safe place and you will drive the vehicle back.

d) With the participant driving, and you in the passenger seat, take them on the following familiarisation drive. This is an opportunity for you, the researcher, to check that the participant's driving is safe (and legal). If you feel uncomfortable with the participant's style of driving then the familiarisation drive may be stopped and you may take over as the driver and return with the participant to the trial headquarters. Alternatively if the participant does not feel they can continue to drive, you should drive the participant back to the trial headquarters. On your return to the trial headquarters, alert the Trial Manager to the situation.

TRL site instructions

1. Drive off the 'TRL' site (over the bridge and down to the roundabout with Nine Mile Ride).
2. **Turn left** at the roundabout onto **Nine Mile Ride**.
3. Carry on to the next roundabout and then **turn left** onto **Old Wokingham Road**.
4. Drive on for about 0.7 miles, past the old TRL site (note that there is the potential for construction traffic at this site and warn the participant in advance) and then turn left onto **Brookers Row**.

5. At the next junction, **turn left** on to **Bracknell Road.**
6. Continue ahead for a short while, then **bear left and merge** on to **Foresters Way.**
7. Stay in the **left hand lane** up to the roundabout.
8. At the roundabout, **turn left** on to **Nine Mile Ride.**
9. Continue ahead to the next roundabout. If the participant is happy then **turn left** back onto the **TRL site.** If the participant would like to do another lap, **continue straight** at the next roundabout and refer to Step 3 above for further directions.

Cenex site instructions

1. Head out of the multi-storey car park and turn right (across duel carriage way on campus)
2. Drive up **University Road** to the T-junction, and **turn right** (University Road)
3. At the roundabout take the **3rd exit**, passing through the security barriers. You are no longer on university property (normal speed restrictions apply)
4. Proceed along **Holywell Way** for 150 meters
5. At the **roundabout take the second exit** (turn right)
6. Proceed down **A512 Ashby Road** for 500 meters
7. Keep in the left lane and **turn left onto Schofield Road** at the traffic lights
8. Continue along **Schofield Road** and at the mini roundabout go **straight ahead onto Thorpehill**
9. Follow **Thorpehill** round to the right, where it changes name to **Alan Moss Road**
10. At the roundabout take the **third exit onto A6004**
11. Keep in the right-hand lane and at the roundabout take the **third exit back onto A512 Ashby Road**
12. Stay on **A512 Ashby Road** for 1.4km
13. **Turn right** at the turn off prior to the roundabout onto **Holywell Way**
14. Pass through the security barriers. You are now on university property (15mph speed restriction applies)
15. At the roundabout turn right onto **University Road**
16. Take the **second left** (University Road)
17. After 100m **turn left** into the multi-storey car park

In-vehicle information pack

a) Once the participant has completed a successful familiarisation drive, issue them with the full 'In-Vehicle Information Pack' (which should already be in the vehicle). Inform the participant that this contains all the information they should need during the trial.

Remind them that this includes the 'Vehicle Guide' and 'Charging Guide' that you have already talked them through when they were getting familiar with the vehicle.

b) Run through each document with the participant. In addition to the documents the participant has already seen there is the 'Polar+ Charging Guide' which gives more information on finding and using public charging.

c) The In-vehicle information pack also contains the information they need in the event of a breakdown or accident. The VW Driverline information sheet contains the details for what they should do in the event of a breakdown and the Aviva accident guidance booklet tells them what to do in the event of an accident.

d) It is important to remind the participant that:

    1. In the event of an emergency they should call 999
    2. In the event of a breakdown, in addition to the VW Driverline, they should also contact TRL to report the incident.
    3. In the event of an accident, they should first follow the Aviva accident guidance booklet and then report the incident to the VW Driverline and to TRL.
    4. They have agreed to the trial insurance requirements and are therefore liable for any driving offences, penalties and fines including parking fines incurred whilst you are in possession of the vehicle; are responsible for paying the initial excess in the event of an insurance claim; and are responsible for the condition of the vehicle during the trial. This is detailed in the Insurance Details in the 'In-Vehicle Information Pack'.

e) Run through the FAQ's sheet. This contains the details on what to do when returning vehicles. Check whether the participant has any further questions. If they do, point them to the relevant guidance document in the 'In-Vehicle Information Pack'.

Final consent

a) On completion of all briefing and handover activities, ask the participant whether they have any questions. Once all questions have been answered, ask them to sign a consent form.

b) Check-out the vehicle on the admin portal noting the Participant ID and the Vehicle ID.

c) Remind the participant that they should use the vehicle for their normal day-to-day journeys over the 8 week period and return it to TRL/Cenex at the pre-arranged time at the end of that period.

d) If the participant is happy, they can now leave the trial headquarters with trial vehicle.

Handover checklist	Tick
1. Vehicle Guide (a simple guide on how to use the vehicle).	
2. Charging Guide	

3. User App Guide	
4. VW Driverline information sheet and card	
5. Insurance details	
6. Aviva accident guidance booklet	
7. FAQs	
8. Consent form completed and signed	
9. Scan and save vehicle condition forms and photos (Participant vehicle and trial vehicle)	
10. Email vehicle condition forms to participant (Participant vehicle and trial vehicle)	

Return of the vehicle

a) Meet the participant at the pre-arranged time at the trial headquarters. Have a high-visibility jacket for both you and the participant. Take the vehicle condition form signed at handover with you specifying the condition of the vehicle at the start of the trial.

a) Prior to undertaking a walk-around you must ensure that it is safe to do so and the vehicle is parked in a safe location. Accompany the participant on a walk-around of the vehicle and interior inspection to check the condition of the returned trial vehicle against the condition of the vehicle when it was taken away. Mark (using a different colour of pen) the following down on the form:

1. Participant name and number
2. A summary of the condition of the vehicle (inside and outside)
3. **Any damage to the vehicle (inside and outside)**
4. The mileage of the vehicle
5. Fuel level (if applicable)
6. Battery charge level (if applicable)
7. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

g) If there is any damage to the vehicle, ask the participant to provide an explanation of how the damage occurred on the Vehicle condition form, being as detailed as they can. Inform the participant that if the damage to the vehicle requires repair, then the participant will be notified that they may be liable for any costs up to the agreed maximum excess.
Alert the Trials Manager if necessary.

h) Ask the participant to sign the form, indicating that they agree with the description of the vehicle condition. Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

i) Check all the original equipment is still with the vehicle. This includes:
    1. Vehicle handbook/manual
    2. In-vehicle information pack
    3. First aid kit
    4. Locking wheel nut
    5. Hi-vis vest
    6. Charging cables (where applicable)
j) Check that the participant has not left any personal items in the vehicle.
k) Once this is complete, check-in the vehicle to the admin portal noting the Participant ID and the Vehicle ID.

Vehicle return checklist	Tick
1. Vehicle condition inspection	
2. Equipment check: • Vehicle handbook/manual • In-vehicle information pack • First aid kit • Locking wheel nut • Hi-vis vest • Charging cables	
3. Check for personal items in vehicle	
4. Participant payment	
5. Signing of participant payment form	
6. Scan and save vehicle condition form	
7. Email vehicle condition form to participant	

Participant close-out/ debrief

a) Check the User App database to confirm the total amount of reward points the participant accumulated during the trial; confirm the amount with the participant and inform them that this will be converted to cash and transferred to them via BACS.
b) Collect the keys to the participant's personal from the secure location and accompany the participant back to their personal vehicle. You need to have a high visibility vest or jacket for both you and the participant to wear, plus the original **'Vehicle condition form**' completed at the beginning of the trial.
c) Accompany the participant on a walk-around of their personal vehicle to record the condition of the vehicle. Use the original vehicle condition form to check the following, noting any changes:
    1. A summary of the condition of the vehicle (inside and outside)
    2. Any damage to the vehicle (inside and outside)
    3. The mileage of the vehicle

4. Fuel level
5. If necessary, take photos of the vehicle to accompany this form and save these in the secure project area.

If the participant highlights anything they are unhappy with, i.e. new damage, alert the Trial Manager and they will notify the participant that an investigation will be undertaken and that TRL will organise and cover the costs of any repairing of damage that is required.

d) If there are no changes in the vehicle condition, ask the participant to sign the form confirming the condition of their vehicle.

e) Log the date and time of collection of the participant's personal vehicle on the Vehicle condition form.

f) Inform the participant that they will receive a copy of this form by email. Scan the signed form, save in the secure project area and email a copy to the participant.

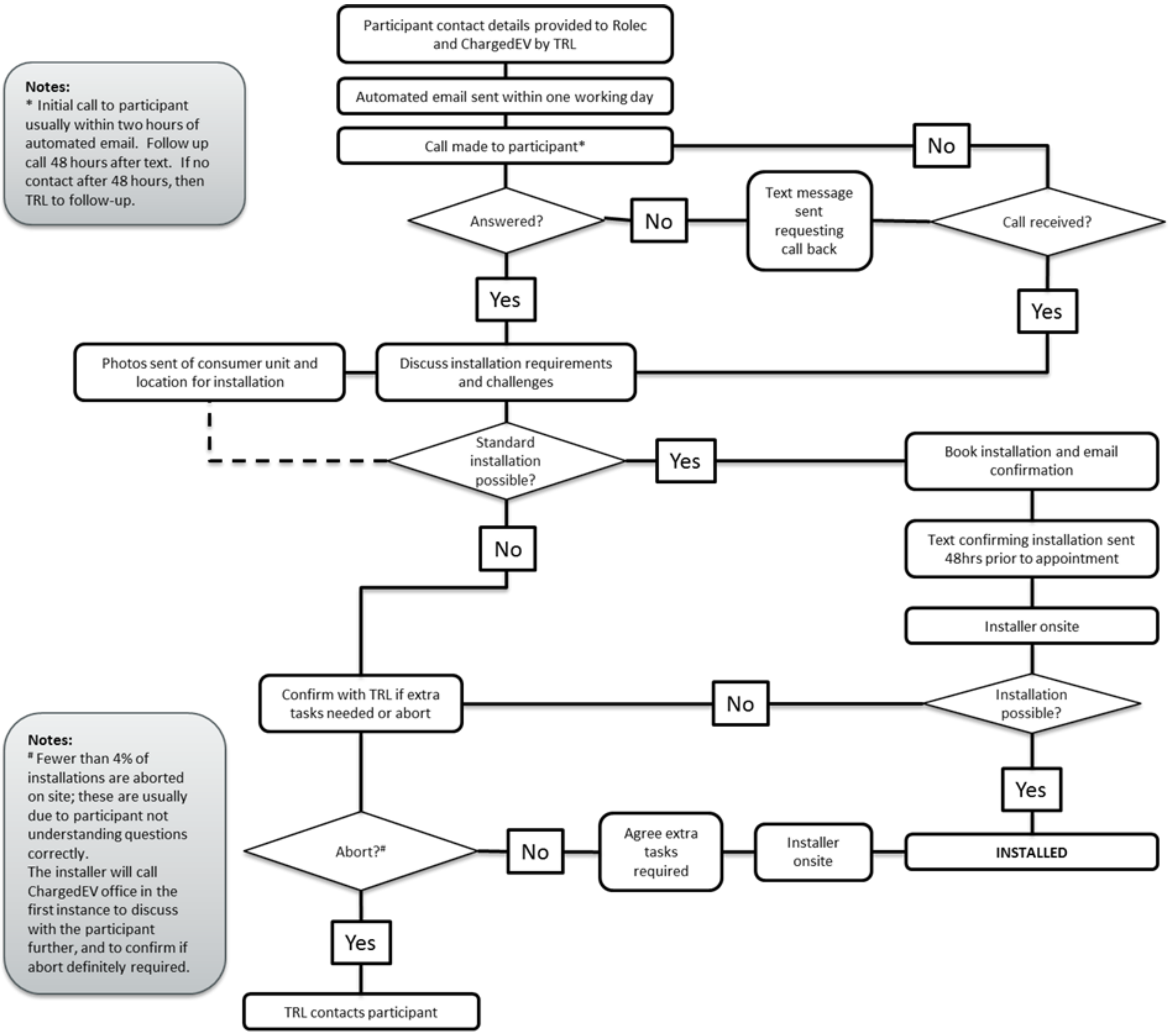
g) Notify the participant that the final (Time point 2) questionnaire will be sent to them by email within one week and that upon completion they will receive the outstanding balance of their payment (£50 voucher plus the Final "top-up" payment). Participants should also send in photographic evidence of their own vehicle's mileage, in the event that they did not leave the vehicle with the research team for the duration of the trial.

h) Provide the participant with a BACS form to complete in order for the money to be transferred to them. Inform them that this BACS transfer will take place within 4 weeks of their completed questionnaire being received.

i) Tell the participant that they will be sent a debrief letter by email which will confirm final payment. This letter will confirm what will happen to their data and where the findings of the research will be published.

j) Thank the participant and direct them on how to safely depart the trial headquarters.

Appendix F Rolec / ChargedEV installation process



Appendix G Rolec Chargepoint Portal

Rolec Ltd, the chargepoint supplier for this project, will provide the research team with access to their online chargepoint management portal. This will allow TRL to keep track of where chargepoints have been installed, any problems with the chargepoints, and a high-level view of how the chargepoints are being used. Example screenshots from Rolec's generis host portal are shown below; the portal will be adapted for the purposes of this project so only relevant information is displayed.

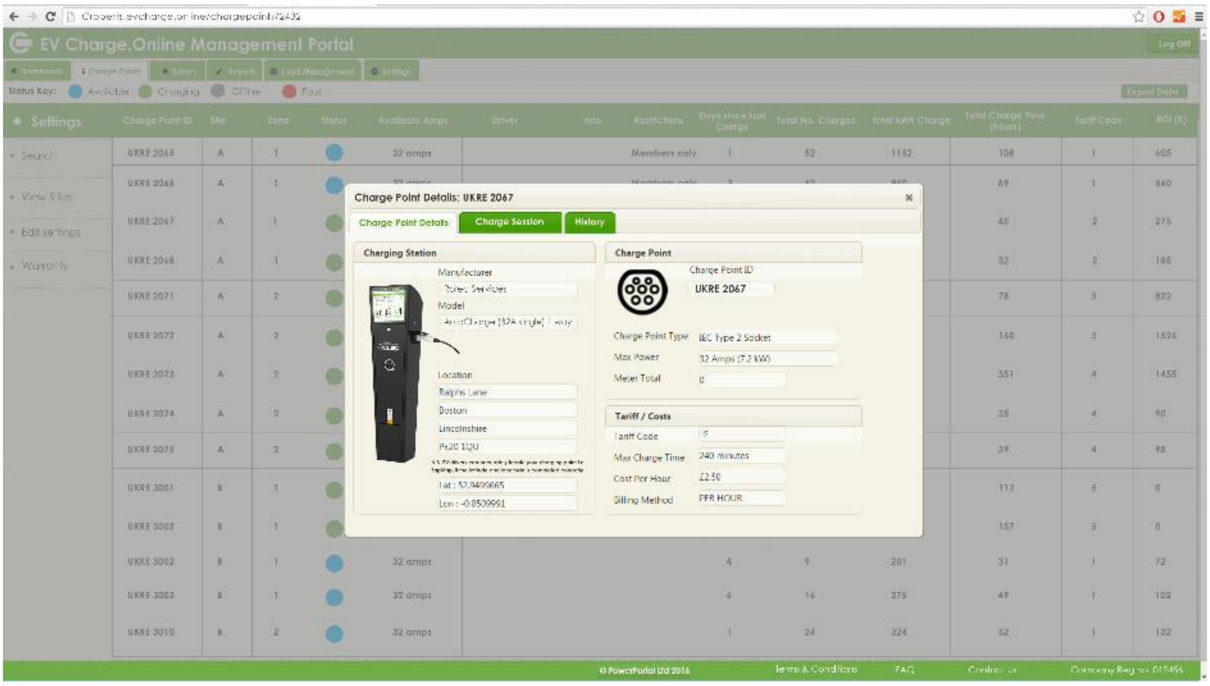


Figure 7: Example screenshot from Rolec host portal – Chargepoint view

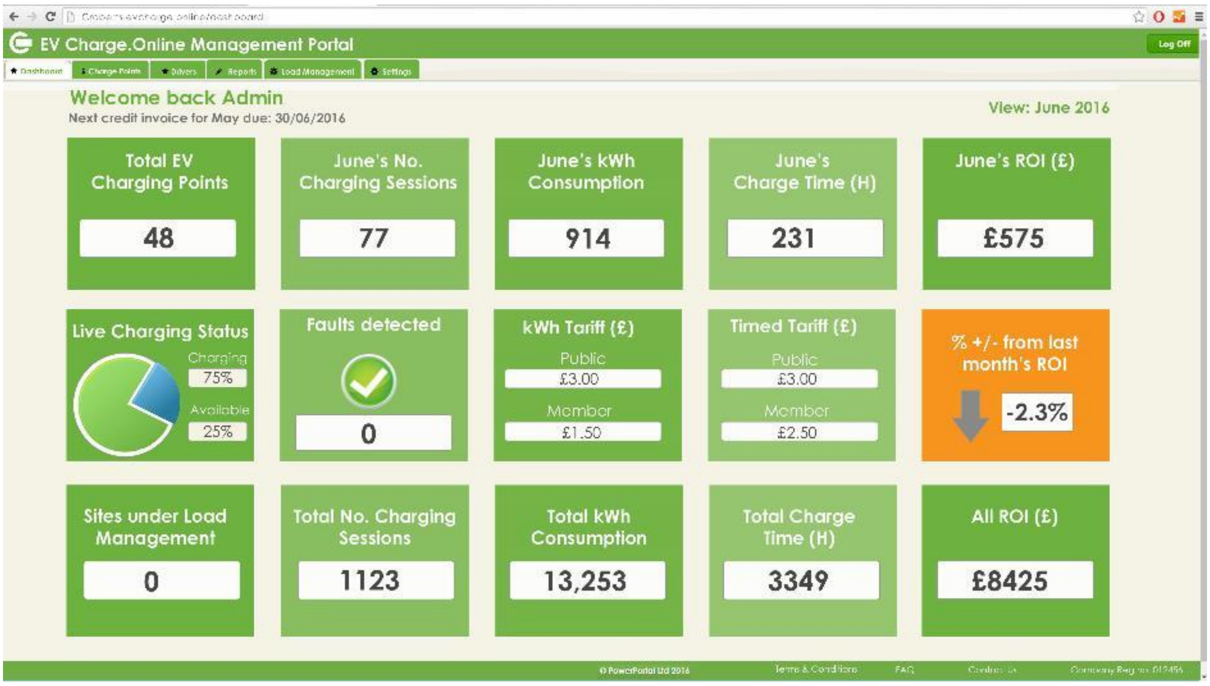


Figure 8: Example screenshot from Rolec host portal – Dashboard view

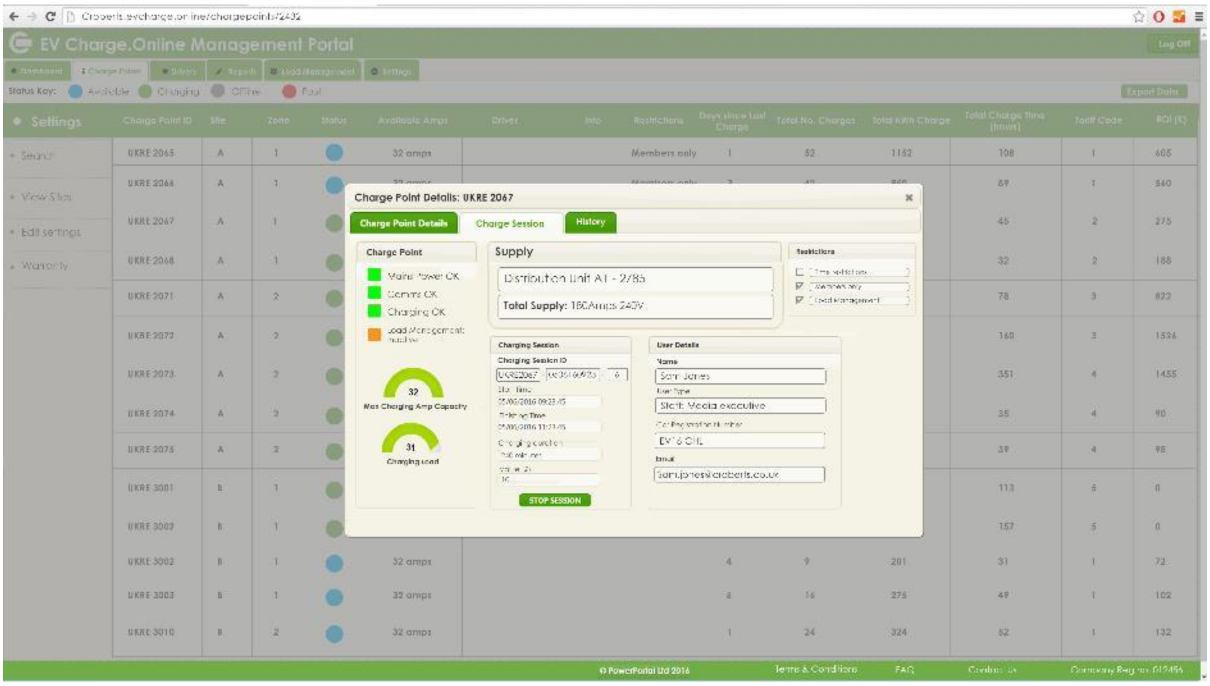


Figure 9: Example screenshot from Rolec host portal – Charge session view

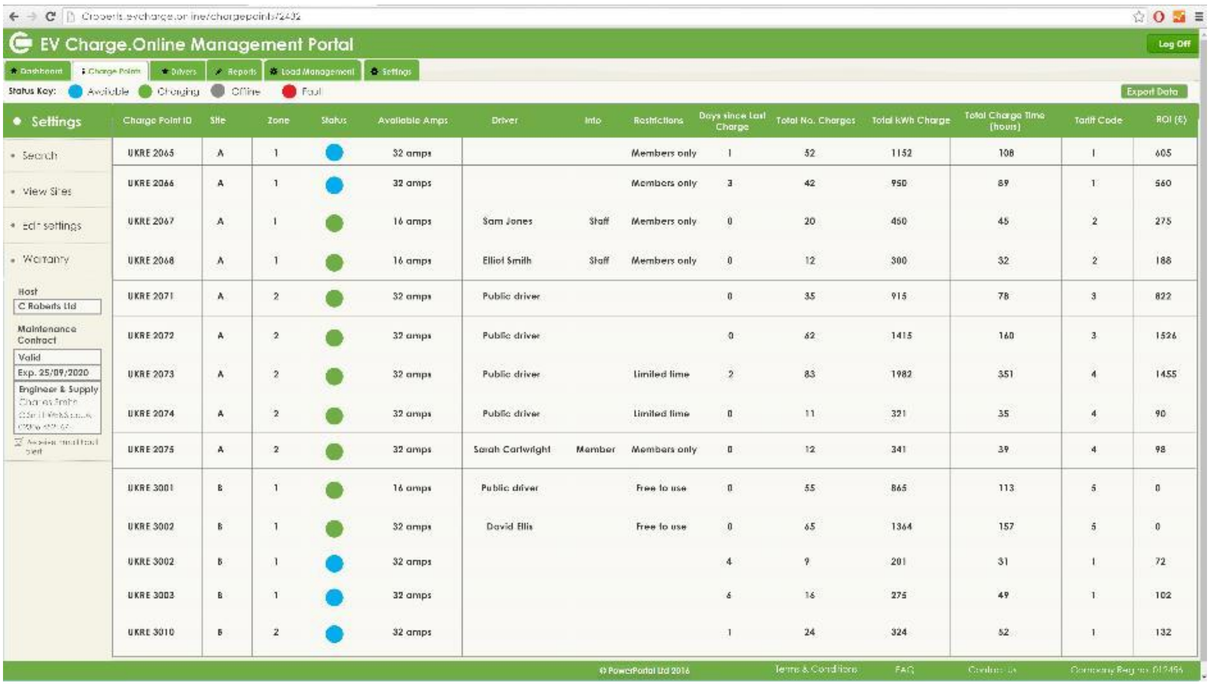


Figure 10: Example screenshot from Rolec host portal – Data view

Appendix H Slide Pack for briefing participants at handover

Today's presentation

- Introduction
- The trial
- In-vehicle information packs
- Insurance
- Breakdowns
- Accidents
- What will happen today
- Your responsibilities

2

Introduction

- Welcome to TRL
- Health and Safety

3

The Trial: Purpose of trial

- To provide you with real life experience of driving and charging an Electric / Plug-In Hybrid Vehicle
- To understand how you use and charge the vehicle and what your opinions are

4

The Trial: What you have to do

- Use the trial vehicle for 8 weeks
- Use for your regular day-to-day journeys
- Charge the vehicle
- Interact with the mobile app
- Complete some questionnaires

6

The trial vehicle

- VW Golf GTE hatchback (Plug-in Hybrid Electric Vehicle – PHEV – petrol and battery)

/

- VW e-Golf hatchback (Battery Electric Vehicle – BEV – battery only)

7

The Trial: Data collection and protection

- Telematics 'dongle' fitted (please don't remove)
- Mobile phone app
- Data collected for research purposes only
- All data fully anonymised
- No data will be linked to you as an individual

8

In-vehicle Information Packs

- Vehicle user and charging guidance documents - **Please read!**
- What to do in case of emergency or breakdown

- Guide to smartphone app and reward points system
  - Email notifications
- Anything not covered? Contact us!

9

Insurance

- **Only** named drivers are insured to drive the vehicles
- You must tell us of **anyone** else who needs to drive the trial vehicles
  - Up to 1 other person in your household can be added to the insurance

10

Insurance continued

Taking part in this trial, you must accept the terms and conditions of the insurance documentation:

- You are responsible for the condition of the vehicle for the duration of the trial
- Excess of £250 (£500 if under 25) for any claim made
- You are responsible for any driving offences, fines or penalty points incurred

11

Breakdown

- **Volkswagen Driverline** card and information sheet
- **0844 2091 962 - save to phone!**
- One number for everything – 24/7
- Please inform TRL as well

12

Accidents

- 999 if serious or injuries
- Insurance provided by **Aviva**- Call **Fleetline 0800 246 876** and follow instructions in the information booklet
- **Call Volkswagen Driverline** to let them know and for recovery if needed
- **Contact TRL** as soon as possible

13

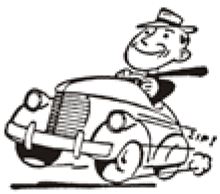
Technical issues with chargepoint

- **Contact TRL** as soon as possible
- TRL will reimburse any taxi costs incurred in the event that the vehicle has not been charged adequately due to a technical fault with chargepoint

14

What will happen today

- ID check and eyesight test ✓
- Vehicle familiarisation exercise (including charging where applicable)
- Run through vehicle information packs
- Final consent forms to sign
- Leave with the vehicle



14

Your responsibilities

- **Detailed in the consent forms, read carefully**
- **Look after the vehicle**
- Drive safely, responsibly and legally
- Liable for any driving offences and fines, including parking fines
- Inform TRL of any changes to your information

15

And finally

You are free to withdraw from the study at any time without having to give reason. If you wish to withdraw please contact us.

Thank you for listening, any questions?

18

Appendix I In-vehicle Information Pack

I.1 BEV vehicle guide (VW e-Golf)

Dashboard

When the ignition is switched on, the trip computer and electric vehicle information will be displayed in the centre of the dashboard. This will include the battery charge level and the approximate range available.

The left dial is the 'powermeter' and shows the current level of energy being used or regenerated. The right dial is the speedometer.

The dashboard provides a lot of information, so please read the vehicle manufacturer's handbook to familiarise yourself with it. The following key symbols to be aware of appear below the 'power availability' display:

	Battery is low (remaining range is approximately 20 miles). Charge as soon as possible.
	Charging cable is connected to vehicle charge port. Disconnect the charging cable & store it in the boot of the vehicle before driving.
	Brake pedal is released.
	Parking brake is engaged.
	Error. Stop the vehicle in a safe place as soon as possible and switch off the motor. If the error persists, please contact **Driverline** for assistance.

Switching the vehicle off

1. Bring the vehicle to a complete stop by pressing and holding down the brake pedal, whilst shifting the transmission into P (Park)
2. Apply the parking brake (see 'Operating the parking brake')
3. Turn the vehicle key towards you

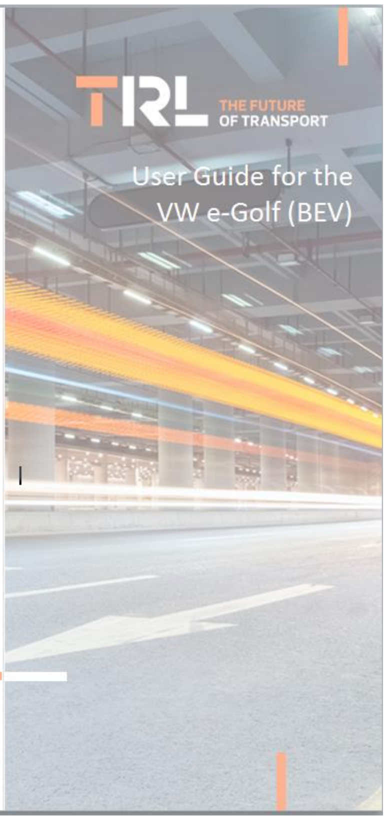
Key points to remember

The vehicle manufacturer's handbook (in the glovebox) should be your first point of call if you are unsure of any of the switches, controls or menus in the vehicle. Here are some key points to consider:

- Using B on the selector lever results in higher energy recuperation from braking. This means that the vehicle is charging whilst you brake. This should be used with caution, as it can impact the braking performance.
- If a red symbol / warning lamp appears on the dashboard while you are moving, pull over safely and do not continue driving. Contact **VW's Driverline on 0844 2091 962** for assistance and then inform TRL.
- Do not attempt to repair or adapt the vehicle. If the vehicle is in need of repair, call **VW's Driverline on 0844 2091 962** to arrange repair of the vehicle. Please also inform **TRL** of any faults **on 01344 770 014**

t +44 [0]1344 770014
e vehicletrials@trl.co.uk
w trl.co.uk

TRL Crowthorne House, Nine Mile Ride
Wokingham, Berkshire, UK, RG40 3GA



The VW e-Golf is a battery electric vehicle (BEV), which means the motor is powered only by electricity. The vehicle is driven like an automatic: it has an accelerator and brake pedal only.

This guide explains some of the key features of this vehicle. Please see the vehicle manufacturer's handbook in the glovebox for more detailed information about these and any other features of the vehicle.

Before you use the vehicle

- If the vehicle has been charging, ensure that the vehicle is disconnected from the chargepoint and that the charging cable is safely stowed in the boot (please refer to the charging guide provided in the In-vehicle Information Pack for further information about charging)
- Familiarise yourself with the dashboard and controls, as they differ to a conventional vehicle. Refer to the vehicle manufacturer's handbook for further information

Starting the vehicle

1. Insert the key and turn once (ignition is switched on, steering column lock is released)
2. To activate the electric motor, press the brake pedal and hold it down whilst you:
   a) Check the transmission is in Park (P) or Neutral (N)
   b) Turn and hold the key once more until the text message **READY** lights up on the instrument panel
   c) Release the key (the needle in the power display will move from **OFF** to **0**)
   d) Move the selector lever to position D (Drive) / B (regenerative Braking) / R (Reverse). See the 'Tips' section below for more details

3. Switch off the electronic parking brake (see 'Operating the parking brake') and release the brake pedal (please be aware that when both brakes are released, the vehicle will start to move forward)
4. Press the accelerator pedal to start moving the vehicle

Operating the parking brake

The electronic parking brake is the equivalent of a conventional handbrake. Always switch this on when the vehicle is parked.

To release the electronic parking brake, pull away in either Drive or Reverse mode (the electronic parking brake will auto-release) OR:

1. Switch the ignition on
2. Press the brake pedal, and then press the (P) button
3. Release the brake pedal and press the accelerator slightly (the yellow light in the lever will go out and the red (P) symbol on the instrument panel will go out)

To put the electronic parking brake on, pull up and hold the (P) button (the yellow light in the lever will come on and the red (P) symbol on the instrument panel will illuminate).

Operating modes

The driver can choose from 3 modes:

- Standard Drive
- Eco
- Eco+

These options progressively conserve battery usage by limiting the engine's power, dulling the throttle response and limiting the air-conditioning. Eco+ is the most efficient mode.

Electric range

The maximum range stated by the vehicle manufacturer is 186 miles (see charging specification in BEV Charging Guide for further details). The actual range you achieve depends on many factors and may be lower than the manufacturer's stated maximum range. Actual range is impacted by:

- Personal driving style (e.g. rapid acceleration will drain the battery faster than gentle acceleration; longer braking distances and gradual slowing will improve regenerative braking).
- Usage conditions (the range will be reduced in particularly high or low temperatures, with poor road conditions, when driving up hills or when driving at high speeds [e.g. on motorways]).
- Use of driver-controlled electrical features (e.g. air conditioning or heating).

I.2 PHEV vehicle guide (VW Golf GTE)

Dashboard

When the ignition is switched on, the trip computer and electric vehicle information will be displayed in the centre of the dashboard. This will include the battery charge level and the approximate range available.

The left dial is the 'powermeter' and shows the current level of energy being used or regenerated. The right dial is the speedometer.

The dashboard provides a lot of information, so please read the vehicle manufacturer's handbook to familiarise yourself with it. The following key symbols to be aware of appear below the 'power availability' display:

	Battery is low (remaining range is approximately 20 miles). Charge as soon as possible.
	Charging cable is connected to vehicle charge port. Disconnect the charging cable & store it in the boot of the vehicle before driving.
	Brake pedal is released.
	Parking brake is engaged.
	Error. Stop the vehicle in a safe place as soon as possible and switch off the motor. If the error persists, please contact **Driverline** for assistance.

Switching the vehicle off

1. Bring the vehicle to a complete stop by pressing and holding down the brake pedal, whilst shifting the transmission into P (Park)
2. Apply the parking brake (see 'Operating the parking brake')
3. Turn the vehicle key towards you

Key points to remember

The vehicle manufacturer's handbook (in the glovebox) should be your first point of call if you are unsure of any of the switches, controls or menus in the vehicle. Here are some key points to consider:

- Using B on the selector lever results in higher energy recuperation from braking. This means that the vehicle is charging whilst you brake. This should be used with caution, as it can impact the braking performance.
- If a red symbol / warning lamp appears on the dashboard while you are moving, pull over safely and do not continue driving. Contact **VW's Driverline on 0844 2091 962** for assistance and then inform TRL.
- Do not attempt to repair or adapt the vehicle. If the vehicle is in need of repair, call **VW's Driverline on 0844 2091 962** to arrange repair of the vehicle. Please also inform **TRL** of any faults **on 01344 770 014.**

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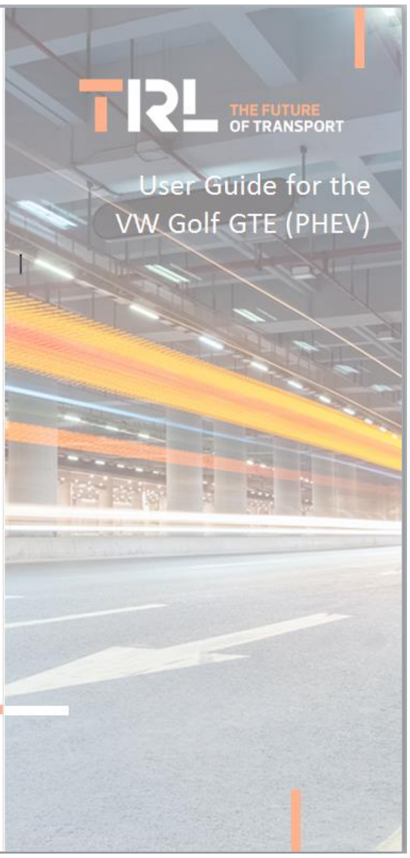

The VW Golf GTE is a plug-in hybrid electric vehicle (PHEV), which means it is powered by both electricity and petrol. The vehicle has an automatic gearbox (accelerator and brake pedal only).

This guide explains some of the key features of this vehicle. Please see the vehicle manufacturer's handbook in the glovebox for more detailed information about these and any other features of the vehicle.

Before you use the vehicle

- If the vehicle has been charging, ensure that the vehicle is disconnected from the chargepoint and that the charging cable is safely stowed in the boot (please refer to the charging guide provided in the In-vehicle Information Pack for further information about charging)
- Familiarise yourself with the dashboard and controls, as they differ to a conventional vehicle. Refer to the vehicle manufacturer's handbook for further information

Starting the vehicle

1. Insert the key and turn once (ignition is switched on, steering column lock is released)
2. To activate the electric motor, press the brake pedal and hold it down whilst you:
   a) Check the transmission is in Park (P) or Neutral (N)
   b) Turn and hold the key once more until the text message **READY** lights up on the instrument panel
   c) Release the key (the needle in the power display will move from **OFF** to **0**)
   d) Move the selector lever to position D (Drive) / B (regenerative Braking) / R (Reverse). See the 'Tips' section below for more details

3. Switch off the electronic parking brake (see 'Operating the parking brake') and release the brake pedal (please be aware that when both brakes are released, the vehicle will start to move forward)
4. Press the accelerator pedal to start moving the vehicle

Operating the parking brake

The electronic parking brake is the equivalent of a conventional handbrake. Always switch this on when the vehicle is parked.

To release the electronic parking brake, pull away in either Drive or Reverse mode (the electronic parking brake will auto-release) OR:

1. Switch the ignition on
2. Press the brake pedal, and then press the (P) button
3. Release the brake pedal and press the accelerator slightly (the yellow light in the lever will go out and the red (P) symbol on the instrument panel will go out)

To put the electronic parking brake on, pull up and hold the (P) button (the yellow light in the lever will come on and the red (P) symbol on the instrument panel will illuminate).

Operating modes

The driver can choose from 3 modes:

- E-MODE (electric mode only; uses combustion engine as little as possible)
- Hybrid mode (uses the electric and combustion engines equally)
- Battery charge mode (recharges the battery using the petrol engine whilst in motion)

Press the E-MODE button to toggle between the E-MODE and Hybrid modes.

The battery charge mode can be enabled only by pressing the corresponding function button in the Infotainment system. To return to hybrid mode, press the corresponding function button in the Infotainment system again.

Electric range

As stated by the vehicle manufacturer, the maximum range when using the electric motor only is 31 miles and the maximum range when using electric and petrol combined (hybrid) is 580 miles. The actual range you achieve depends on many factors and may be lower than the manufacturer's stated maximum range. Actual range is impacted by:

- Personal driving style (e.g. rapid acceleration will drain the battery faster than gentle acceleration; longer braking distances and gradual slowing will improve regenerative braking).
- Usage conditions (the range will be reduced in particularly high or low temperatures, with poor road conditions, when driving up hills or when driving at high speeds [e.g. on motorways]).
- Use of driver-controlled electrical features (e.g. air conditioning or heating).

I.3 BEV charging guide

Step-by-step guide to public charging

TRL have partnered with POLAR Plus to provide you with free access to a wide variety of public charge points. To see the locations of POLAR Plus charge points, please visit https://polar-network.com/map

1. The vehicle must be unlocked and will only charge if:
   a) The gear selector is in position P (Park)
   b) The electronic parking brake is switched on
   c) The engine is turned off
2. Plug the Mode 3 cable into the vehicle
3. Place your POLAR Plus card / key fob over the chargepoint's reader and hold for a few seconds.

4. Follow the instructions on the chargepoint screen. There are 3 modes available:
   a) Slow charging (up to 3kW, 6-8 hours overnight)
   b) Fast charging (7-22kW, 3-4 hours)
   c) Rapid charging units (43-50kW)

5. Blue LED lights will flash, identifying the socket to be used. Lift the flap of the selected socket.
6. Plug the cable into the socket, ensuring it is fully inserted. The LED lights will turn to green to indicate the charging has started. The plug will now be locked until charging is terminated.

To stop charging

1. Place the POLAR Plus card / key fob over the chargepoint's reader. The LED lights will turn blue and the plug will be unlocked.
2. Unplug the cable from the chargepoint and close the flap.
3. Unplug the cable from vehicle and store it in the boot.

If you need help using a charge point or are unsure of what to do, visit www.polar-network.com or call POLAR on 0330 016 5126 (open 24/7).

Key points to remember

- Always visually inspect equipment for any damage prior to use. Never use damaged equipment, including cables
- Never attempt to alter or repair cables or other electrical components. If equipment is damaged, contact TRL, who will repair or replace the equipment
- Only charge the vehicle using the following chargepoints
  - The Rolec chargepoint installed at your home
  - A POLAR Plus public chargepoint
  - Another dedicated electric vehicle chargepoint (e.g. at your workplace)
- Never charge the vehicle through any normal domestic 3-pin socket
- Never charge the vehicle via an extension cable
- Do not work on the vehicle (repair, clean etc) during charging
- Never let anybody stay in the vehicle while the vehicle is charging
- Always disconnect the charging cable completely from the vehicle before activating the electric motor
- Only use charging cables supplied in your vehicle, or cables supplied at charging stations
- Always stow your charging cable in the bags provided in the boot
- If the plug cannot be removed after unlocking the vehicle, unlock the vehicle while holding the immediate charging button, located within the battery charge port.

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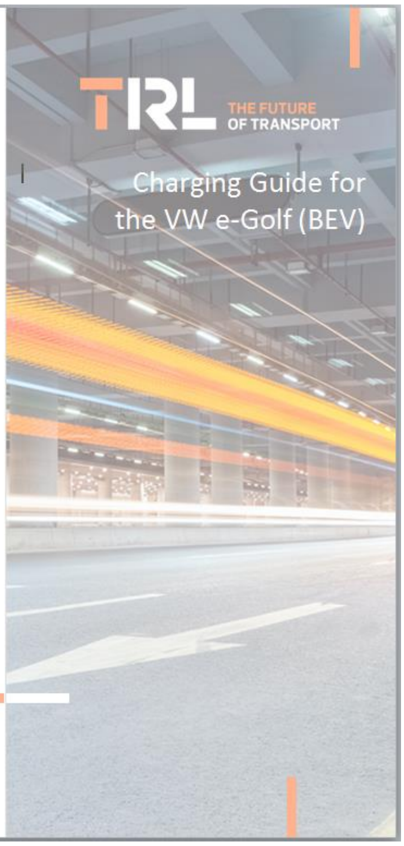


Charging specifications

Manufacturer reported specifications:

Nominal Capacity, i.e. units to full charge (kWh)	35.8
Maximum electric range (miles)	186
Expected electric range (miles)	175
Time to full charge using 3-pin socket (hours)	17
Time to full charge using EV-specific socket (hours)	10.5
Time to 80% charge (DC) (hours)	0.75

Rolec EV HomeSmart

The EV HomeSmart unit provided by Rolec is easy to use. *Do not under any circumstances use any domestic power sockets at home.*

Indicator status lights on socket:

Flashing blue	Ready for charging (no cable plugged in)
Fixed blue	Cable is plugged in, but not charging
Fixed green	Charging in progress (cable plugged in)
Flashing red	Fault indicated. Switch off the unit at the source, wait 20 seconds, then switch the unit back on again to see if the fault has cleared itself. If the fault persists, please call Rolec for assistance (see below).

IF YOU HAVE ANY PROBLEMS WITH YOUR ROLEC CHARGER, PLEASE CALL **01205 724754**.

Getting to know your vehicle

It is recommended that you read the vehicle manufacturer's handbook (in the glovebox) before charging. The handbook should also be referred to if any warning / indicator lights or text messages are shown on the instrument panel.

Where is the charge port on the vehicle?
The charge port is on the driver's side of the vehicle.

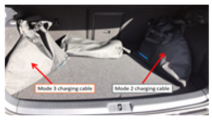
How do I open the charge port?
Unlock the vehicle and press on the flap of the charge port.

What do the indicator status lights on the vehicle mean?

Solid green	Charging complete
Flashing green	Battery is charging
Temporary yellow	Charging cable is connected and has been detected
Solid yellow	Charging cable has been unlocked automatically or no mains voltage has been detected
Flashing yellow	Vehicle transmission is not in P (Park)
Solid red	Charging cable may not be locked. Check the cable is plugged in correctly
Flashing red	Battery is not charging due to an error. If the error persists, please call Driverline for assistance.

Charging cables

Two types of charging cable can be found in the boot of the vehicle:



- The Mode 2 charging cable should not be used for charging at home; this should only be used on 3-pin sockets that have been approved for use with plug-in vehicles.
- The Mode 3 charging cable should be used for charging at home, and for charging from a public chargepoint or other electric vehicle specific socket (e.g. at your workplace)

Step-by-step guide to charging at home

1. The vehicle must be unlocked and will only charge if:
   a) The gear selector is in position P (Parked)
   b) The electronic parking brake is switched on
   c) The engine is turned off
2. Locate the Mode 3 charging cable.
3. Open the battery charge port cover, attach the charging plug into the vehicle and then insert the other end into the chargepoint.

4. To unplug the vehicle:
   a) *Firstly,* remove the plug from chargepoint
   b) *Secondly,* remove the plug from the vehicle

   It is important that you carry out the two steps in this order.
5. Store the cable in the boot of the vehicle and close the flap on the vehicle's charge port

See also the User app Guide for information on how to use the User App when charging.

I.4 PHEV charging guide

Step-by-step guide to public charging

TRL have partnered with POLAR Plus to provide you with free access to a wide variety of public charge points. To see the locations of POLAR Plus chargepoints, please visit https://polar-network.com/map

1. The vehicle must be unlocked and will only charge if:
   a) The gear selector is in position P (Park)
   b) The electronic parking brake is switched on
   c) The engine is turned off
2. Plug the Mode 3 cable into the vehicle
3. Place your POLAR Plus card / key fob over the chargepoint's reader and hold for a few seconds.

4. Follow the instructions on the chargepoint screen. There are 3 modes available:
   a) Slow charging (up to 3kW, 6-8 hours overnight)
   b) Fast charging (7-22kW, 3-4 hours)
   c) Rapid charging units (43-50kW) – **these are not compatible with the trial vehicles.**

5. Blue LED lights will flash, identifying the socket to be used. Lift the flap of the selected socket.
6. Plug the cable into the socket, ensuring it is fully inserted. The LED lights will turn to green to indicate the charging has started. The plug will now be locked until charging is terminated.

To stop charging

1. Place the POLAR Plus card / key fob over the chargepoint's reader. The LED lights will turn blue and the plug will be unlocked.
2. Unplug the cable from the chargepoint and close the flap.
3. Unplug the cable from vehicle and store it in the boot.

If you need help using a charge point or are unsure of what to do, visit www.polar-network.com or call POLAR on 0330 016 5126 (open 24/7).

Key points to remember

- Always visually inspect equipment for any damage prior to use. Never use damaged equipment, including cables
- Never attempt to alter or repair cables or other electrical components. If equipment is damaged, contact TRL, who will repair or replace the equipment
- Only charge the vehicle using the following chargepoints:
  - The Rolec chargepoint installed at your home
  - A POLAR Plus public chargepoint
  - Another dedicated electric vehicle chargepoint (e.g. at your workplace)
- Never charge the vehicle through any normal domestic 3-pin socket
- Never charge the vehicle via an extension cable
- Do not work on the vehicle (repair, clean etc) during charging
- Never let anybody stay in the vehicle while the vehicle is charging
- Always disconnect the charging cable completely from the vehicle before activating the electric motor
- Only use charging cables supplied in your vehicle, or cables supplied at charging stations
- Always stow your charging cable in the bags provided in the boot
- If the plug cannot be removed after unlocking the vehicle, unlock the vehicle while holding the immediate charging button, located within the battery charge port.

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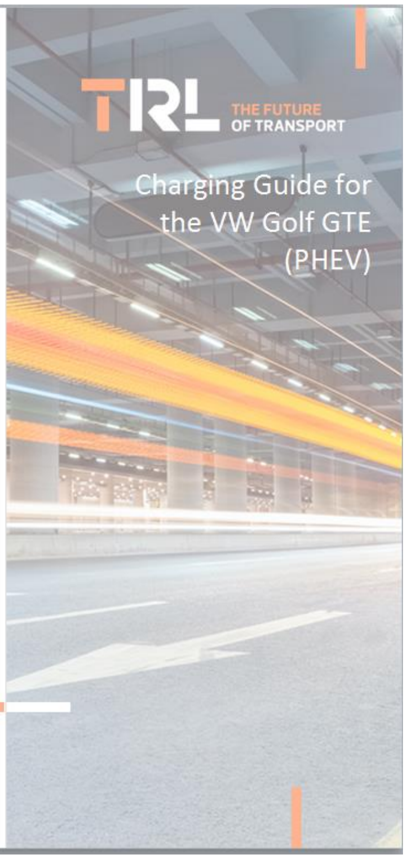


Charging specifications

Manufacturer reported specifications:

Nominal Capacity, i.e. units to full charge (kWh)	8.7
Maximum electric range (miles)	31
Expected electric range (miles)	25
Time to full charge using 3-pin socket (hours)	3.75
Time to full charge using EV-specific socket (hours)	2.25
Time to 80% charge (DC) (hours)	n/a

Rolec EV HomeSmart

The EV HomeSmart unit provided by Rolec is easy to use. *Do not under any circumstances use any domestic power sockets at home.*

Indicator status lights on socket:

Flashing blue	Ready for charging (no cable plugged in)
Fixed blue	Cable is plugged in, but not charging
Fixed green	Charging in progress (cable plugged in)
Flashing red	Fault indicated. Switch off the unit at the source, wait 20 seconds, then switch the unit back on again to see if the fault has cleared itself. If the fault persists, please call Rolec for assistance (see below).

IF YOU HAVE ANY PROBLEMS WITH YOUR ROLEC CHARGER, PLEASE CALL **01205 724754**.

Getting to know your vehicle

It is recommended that you read the vehicle manufacturer's handbook (in the glovebox) before charging. The handbook should also be referred to if any warning / indicator lights or text messages are shown on the instrument panel.

Where is the charge port on the vehicle?
The charge port is at the front under the VW badge in the radiator grille.

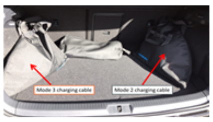
How do I open the charge port?
Unlock the vehicle and press on the flap of the charge port (you may have to push quite hard on the right-hand side of the badge).

What do the indicator status lights on the vehicle mean?

Solid green	Charging complete
Flashing green	Battery is charging
Temporary yellow	Charging cable is connected and has been detected
Solid yellow	Charging cable has been unlocked automatically or no mains voltage has been detected
Flashing yellow	Vehicle transmission is not in P (Park)
Solid red	Charging cable may not be locked. Check the cable is plugged in correctly
Flashing red	Battery is not charging due to an error. If the error persists, please call Driverline for assistance.

Charging cables

Two types of charging cable can be found in the boot of the vehicle:



- The Mode 2 charging cable should not be used for charging at home; this should only be used on 3-pin sockets that have been approved for use with plug-in vehicles.
- The Mode 3 charging cable should be used for charging at home, and for charging from a public chargepoint or other electric vehicle specific socket (e.g. at your workplace)

Step-by-step guide to charging at home

1. The vehicle must be unlocked and will only charge if:
   a) The gear selector is in position P (Parked)
   b) The electronic parking brake is switched on
   c) The engine is turned off
2. Locate the Mode 3 charging cable

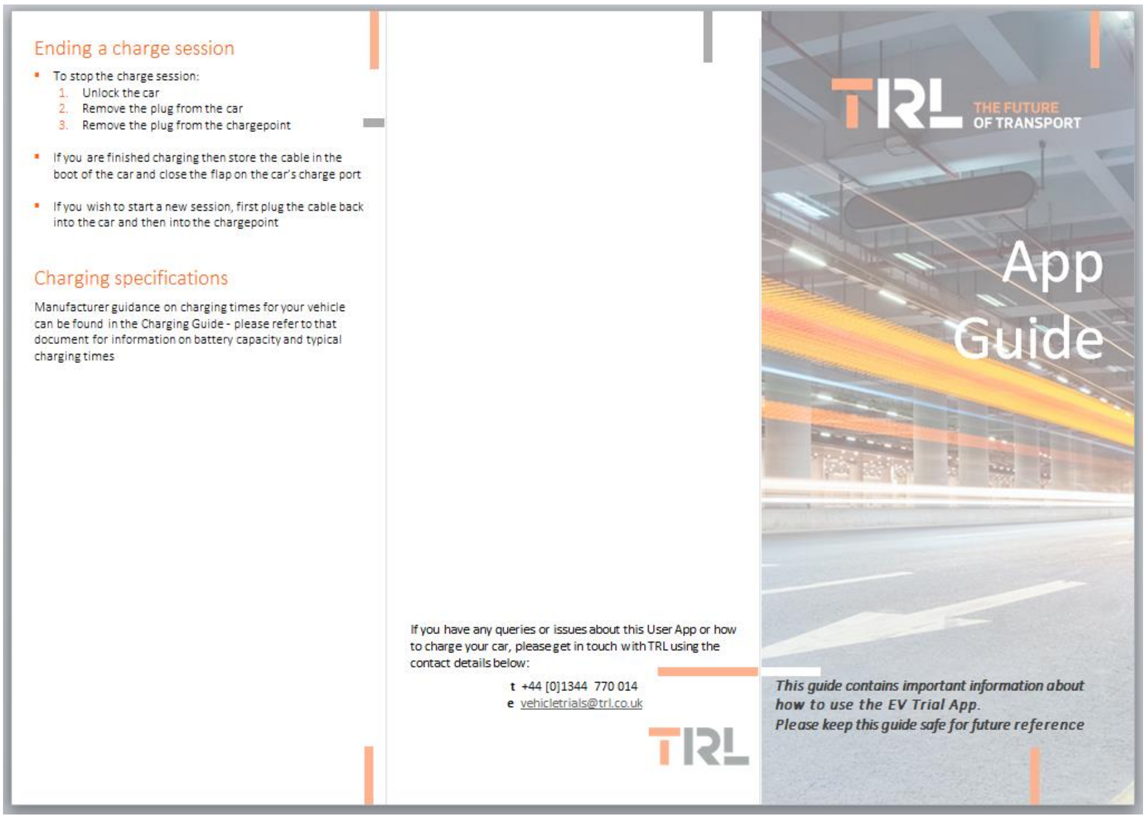
3. Open the battery charge port cover, attach the charging plug into the vehicle and then insert the other end into the chargepoint
4. To unplug the vehicle:
   a) *Firstly*, remove the plug from the chargepoint
   b) *Secondly*, remove the plug from the vehicle

   It is important that you carry out the two steps in this order.
5. Store the cable in the boot of the vehicle and close the flap on the vehicle's charge port

See also the User app Guide for information on how to use the User App when charging.

I.5 User App Guides

I.5.1 Control group



Ending a charge session

- To stop the charge session:
  1. Unlock the car
  2. Remove the plug from the car
  3. Remove the plug from the chargepoint
- If you are finished charging then store the cable in the boot of the car and close the flap on the car's charge port
- If you wish to start a new session, first plug the cable back into the car and then into the chargepoint

Charging specifications

Manufacturer guidance on charging times for your vehicle can be found in the Charging Guide - please refer to that document for information on battery capacity and typical charging times

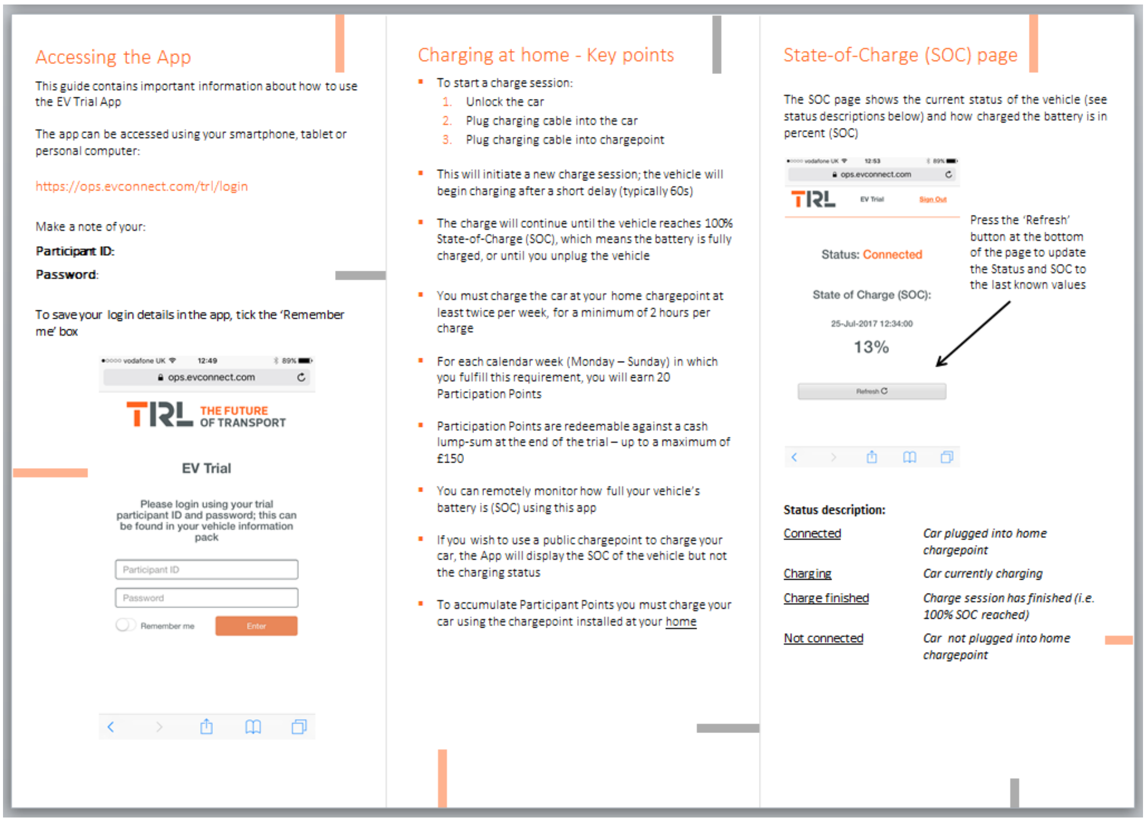
If you have any queries or issues about this User App or how to charge your car, please get in touch with TRL using the contact details below:

t +44 [0]1344 770 014
e vehicletrials@trl.co.uk

TRL THE FUTURE OF TRANSPORT

App Guide

This guide contains important information about how to use the EV Trial App.
Please keep this guide safe for future reference



Accessing the App

This guide contains important information about how to use the EV Trial App

The app can be accessed using your smartphone, tablet or personal computer:

https://ops.evconnect.com/trl/login

Make a note of your:

Participant ID:

Password:

To save your login details in the app, tick the 'Remember me' box

Charging at home - Key points

- To start a charge session:
  1. Unlock the car
  2. Plug charging cable into the car
  3. Plug charging cable into chargepoint
- This will initiate a new charge session; the vehicle will begin charging after a short delay (typically 60s)
- The charge will continue until the vehicle reaches 100% State-of-Charge (SOC), which means the battery is fully charged, or until you unplug the vehicle
- You must charge the car at your home chargepoint at least twice per week, for a minimum of 2 hours per charge
- For each calendar week (Monday – Sunday) in which you fulfill this requirement, you will earn 20 Participation Points
- Participation Points are redeemable against a cash lump-sum at the end of the trial – up to a maximum of £150
- You can remotely monitor how full your vehicle's battery is (SOC) using this app
- If you wish to use a public chargepoint to charge your car, the App will display the SOC of the vehicle but not the charging status
- To accumulate Participant Points you must charge your car using the chargepoint installed at your home

State-of-Charge (SOC) page

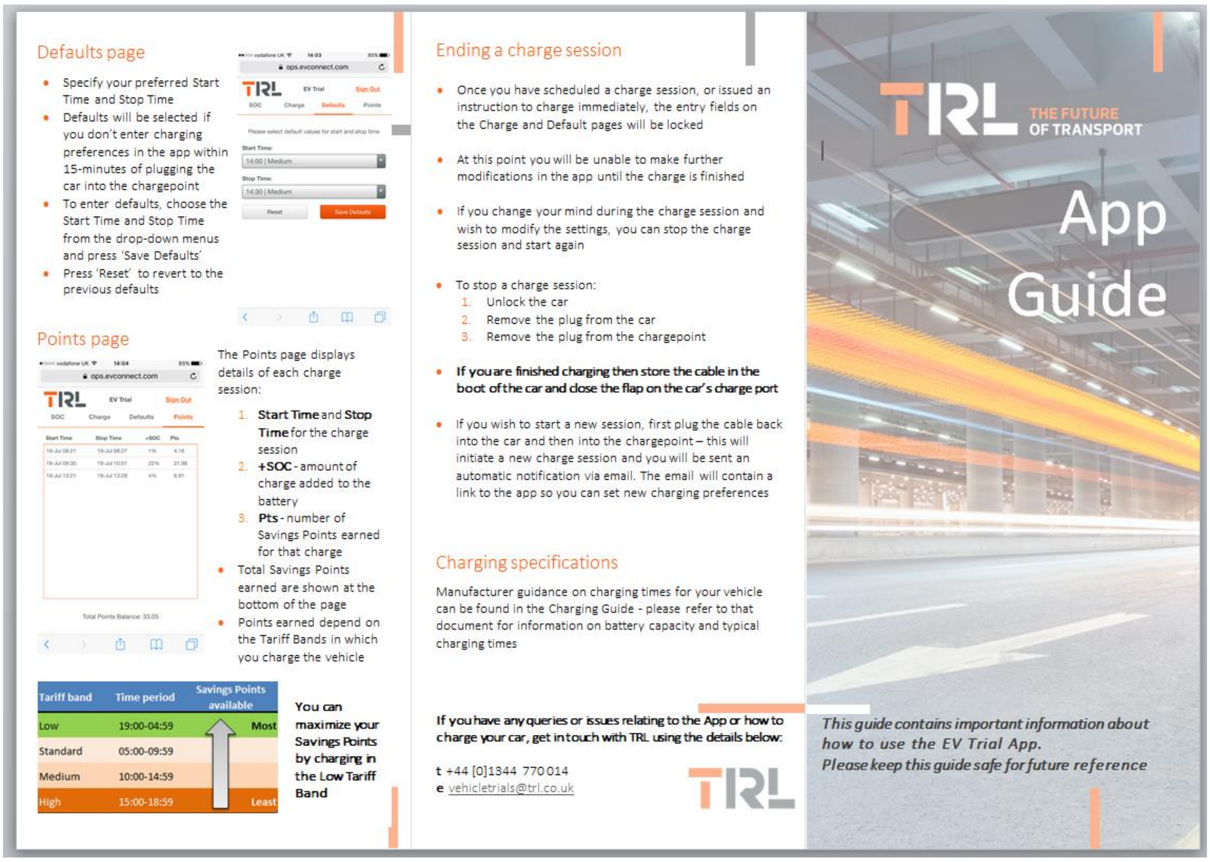
The SOC page shows the current status of the vehicle (see status descriptions below) and how charged the battery is in percent (SOC)

Press the 'Refresh' button at the bottom of the page to update the Status and SOC to the last known values

Status description:

Connected	*Car plugged into home chargepoint*
Charging	*Car currently charging*
Charge finished	*Charge session has finished (i.e. 100% SOC reached)*
Not connected	*Car not plugged into home chargepoint*

I.5.2 UMC Summer group



Defaults page

- Specify your preferred Start Time and Stop Time
- Defaults will be selected if you don't enter charging preferences in the app within 15-minutes of plugging the car into the chargepoint
- To enter defaults, choose the Start Time and Stop Time from the drop-down menus and press 'Save Defaults'
- Press 'Reset' to revert to the previous defaults

Points page

The Points page displays details of each charge session:

1. **Start Time** and **Stop Time** for the charge session
2. **+SOC** - amount of charge added to the battery
3. **Pts** - number of Savings Points earned for that charge

- Total Savings Points earned are shown at the bottom of the page
- Points earned depend on the Tariff Bands in which you charge the vehicle

Tariff band	Time period	Savings Points available
Low	19:00-04:59	Most
Standard	05:00-09:59	
Medium	10:00-14:59	
High	15:00-18:59	Least

You can maximize your Savings Points by charging in the Low Tariff Band

Ending a charge session

- Once you have scheduled a charge session, or issued an instruction to charge immediately, the entry fields on the Charge and Default pages will be locked
- At this point you will be unable to make further modifications in the app until the charge is finished
- If you change your mind during the charge session and wish to modify the settings, you can stop the charge session and start again
- To stop a charge session:
  1. Unlock the car
  2. Remove the plug from the car
  3. Remove the plug from the chargepoint
- **If you are finished charging then store the cable in the boot of the car and close the flap on the car's charge port**
- If you wish to start a new session, first plug the cable back into the car and then into the chargepoint – this will initiate a new charge session and you will be sent an automatic notification via email. The email will contain a link to the app so you can set new charging preferences

Charging specifications

Manufacturer guidance on charging times for your vehicle can be found in the Charging Guide - please refer to that document for information on battery capacity and typical charging times

If you have any queries or issues relating to the App or how to charge your car, get in touch with TRL using the details below:

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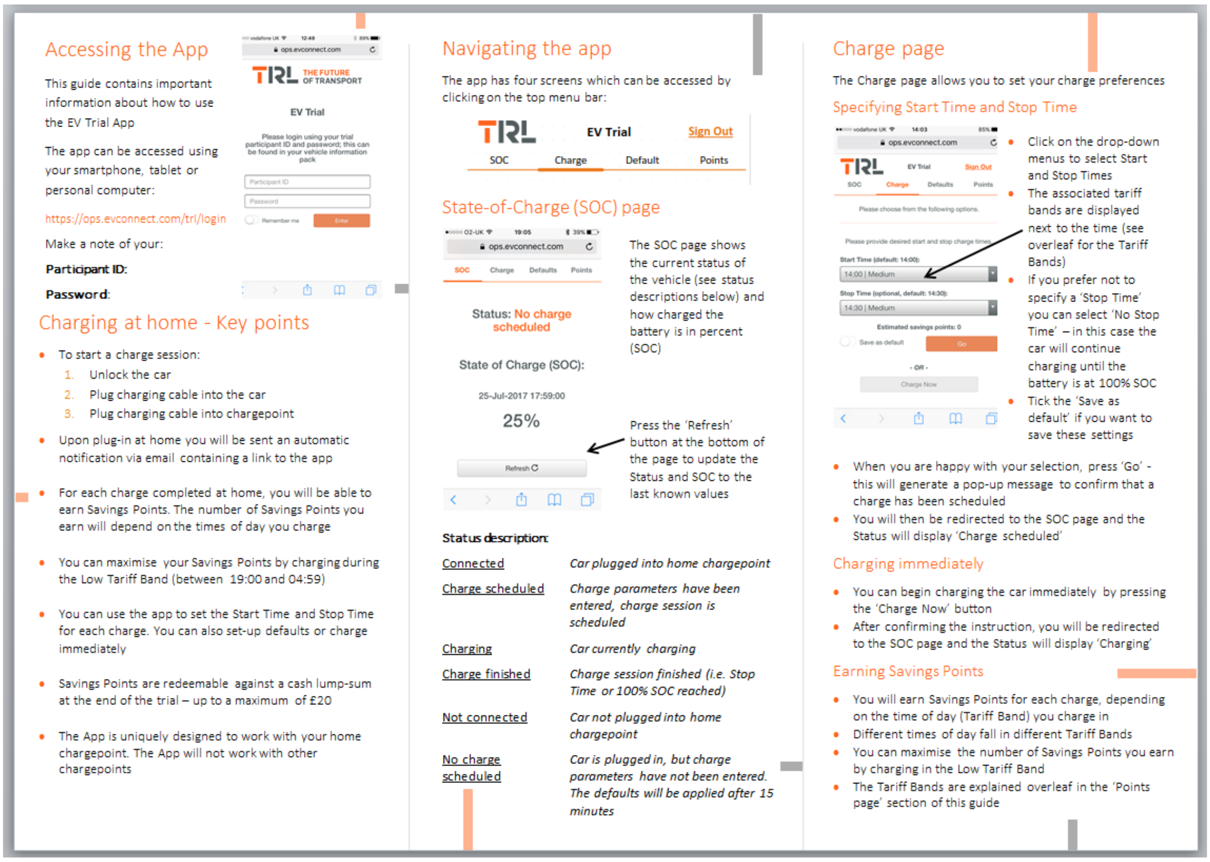
THE FUTURE OF TRANSPORT

App Guide

This guide contains important information about how to use the EV Trial App. Please keep this guide safe for future reference



Accessing the App

This guide contains important information about how to use the EV Trial App

The app can be accessed using your smartphone, tablet or personal computer:

https://ops.evconnect.com/trl/login

Make a note of your:

Participant ID:

Password:

Charging at home - Key points

- To start a charge session:
  1. Unlock the car
  2. Plug charging cable into the car
  3. Plug charging cable into chargepoint
- Upon plug-in at home you will be sent an automatic notification via email containing a link to the app
- For each charge completed at home, you will be able to earn Savings Points. The number of Savings Points you earn will depend on the times of day you charge
- You can maximise your Savings Points by charging during the Low Tariff Band (between 19:00 and 04:59)
- You can use the app to set the Start Time and Stop Time for each charge. You can also set-up defaults or charge immediately
- Savings Points are redeemable against a cash lump-sum at the end of the trial – up to a maximum of £20
- The App is uniquely designed to work with your home chargepoint. The App will not work with other chargepoints

Navigating the app

The app has four screens which can be accessed by clicking on the top menu bar:

EV Trial | Sign Out
SOC | Charge | Default | Points

State-of-Charge (SOC) page

The SOC page shows the current status of the vehicle (see status descriptions below) and how charged the battery is in percent (SOC)

Status: No charge scheduled

State of Charge (SOC):

25-Jul-2017 17:59:00

25%

Press the 'Refresh' button at the bottom of the page to update the Status and SOC to the last known values

Status description:

Connected	*Car plugged into home chargepoint*
Charge scheduled	*Charge parameters have been entered, charge session is scheduled*
Charging	*Car currently charging*
Charge finished	*Charge session finished (i.e. Stop Time or 100% SOC reached)*
Not connected	*Car not plugged into home chargepoint*
No charge scheduled	*Car is plugged in, but charge parameters have not been entered. The defaults will be applied after 15 minutes*

Charge page

The Charge page allows you to set your charge preferences

Specifying Start Time and Stop Time

- Click on the drop-down menus to select Start and Stop Times
- The associated tariff bands are displayed next to the time (see overleaf for the Tariff Bands)
- If you prefer not to specify a 'Stop Time' you can select 'No Stop Time' – in this case the car will continue charging until the battery is at 100% SOC
- Tick the 'Save as default' if you want to save these settings
- When you are happy with your selection, press 'Go' - this will generate a pop-up message to confirm that a charge has been scheduled
- You will then be redirected to the SOC page and the Status will display 'Charge scheduled'

Charging immediately

- You can begin charging the car immediately by pressing the 'Charge Now' button
- After confirming the instruction, you will be redirected to the SOC page and the Status will display 'Charging'

Earning Savings Points

- You will earn Savings Points for each charge, depending on the time of day (Tariff Band) you charge in
- Different times of day fall in different Tariff Bands
- You can maximise the number of Savings Points you earn by charging in the Low Tariff Band
- The Tariff Bands are explained overleaf in the 'Points page' section of this guide

I.5.3 UMC Winter group

Defaults page

- Specify your preferred Start Time and Stop Time
- Defaults will be selected if you don't enter charging preferences in the app within 15-minutes of plugging the car into the chargepoint
- To enter defaults, choose the Start Time and Stop Time from the drop-down menus and press 'Save Defaults'
- Press 'Reset' to revert to the previous defaults

Points page

The Points page displays details of each charge session:

1. **Start Time** and **Stop Time** for the charge session
2. **+SOC** - amount of charge added to the battery
3. **Pts** - number of Savings Points earned for that charge

- Total Savings Points earned are shown at the bottom of the page
- Points earned depend on the Tariff Bands in which you charge the vehicle

Tariff band	Time period	Savings Points available
Low	19:00-04:59	Most
Standard	05:00-09:59	
Medium	10:00-14:59	
High	15:00-18:59	Least

You can maximize your Savings Points by charging in the Low Tariff Band

Ending a charge session

- Once you have scheduled a charge session, or issued an instruction to charge immediately, the entry fields on the Charge and Default pages will be locked
- At this point you will be unable to make further modifications in the app until the charge is finished
- If you change your mind during the charge session and wish to modify the settings, you can stop the charge session and start again
- To stop a charge session:
  1. Unlock the car
  2. Remove the plug from the car
  3. Remove the plug from the chargepoint
- **If you are finished charging then store the cable in the boot of the car and close the flap on the car's charge port**
- If you wish to start a new session, first plug the cable back into the car and then into the chargepoint – this will initiate a new charge session and you will be sent an automatic notification via email. The email will contain a link to the app so you can set new charging preferences

Charging specifications

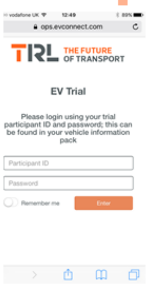
Manufacturer guidance on charging times for your vehicle can be found in the Charging Guide - please refer to that document for information on battery capacity and typical charging times

If you have any queries or issues relating to the App or how to charge your car, get in touch with TRL using the details below:

t +44 [0]1344 770014
e vehicletrials@trl.co.uk

This guide contains important information about how to use the EV Trial App.
Please keep this guide safe for future reference

Accessing the App



This guide contains important information about how to use the EV Trial App

The app can be accessed using your smartphone, tablet or personal computer:

https://ops.evconnect.com/trl/login

Make a note of your:

Participant ID:

Password:

Charging at home - Key points

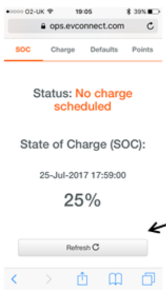
- To start a charge session:
  1. Unlock the car
  2. Plug charging cable into the car
  3. Plug charging cable into chargepoint
- Upon plug-in at home you will be sent an automatic notification via email containing a link to the app
- For each charge completed at home, you will be able to earn Savings Points. The number of Savings Points you earn will depend on the times of day you charge
- You can maximise your Savings Points by charging during the Low Tariff Band (between 19:00 and 04:59)
- You can use the app to set the Start Time and Stop Time for each charge. You can also set-up defaults or charge immediately
- Savings Points are redeemable against a cash lump-sum at the end of the trial – up to a maximum of £125
- The App is uniquely designed to work with your home chargepoint. The App will not work with other chargepoints

Navigating the app

The app has four screens which can be accessed by clicking on the top menu bar:

TRL EV Trial Sign Out
SOC | Charge | Default | Points

State-of-Charge (SOC) page



The SOC page shows the current status of the vehicle (see status descriptions below) and how charged the battery is in percent (SOC)

Press the 'Refresh' button at the bottom of the page to update the Status and SOC to the last known values

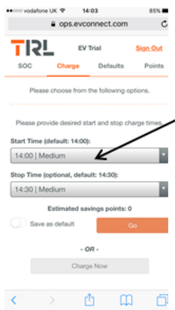
Status description:

Connected	*Car plugged into home chargepoint*
Charge scheduled	*Charge parameters have been entered, charge session is scheduled*
Charging	*Car currently charging*
Charge finished	*Charge session finished (i.e. Stop Time or 100% SOC reached)*
Not connected	*Car not plugged into home chargepoint*
No charge scheduled	*Car is plugged in, but charge parameters have not been entered. The defaults will be applied after 15 minutes*

Charge page

The Charge page allows you to set your charge preferences

Specifying Start Time and Stop Time



- Click on the drop-down menus to select Start and Stop Times
- The associated tariff bands are displayed next to the time (see overleaf for the Tariff Bands)
- If you prefer not to specify a 'Stop Time' you can select 'No Stop Time' – in this case the car will continue charging until the battery is at 100% SOC
- Tick the 'Save as default' if you want to save these settings
- When you are happy with your selection, press 'Go' - this will generate a pop-up message to confirm that a charge has been scheduled
- You will then be redirected to the SOC page and the Status will display 'Charge scheduled'

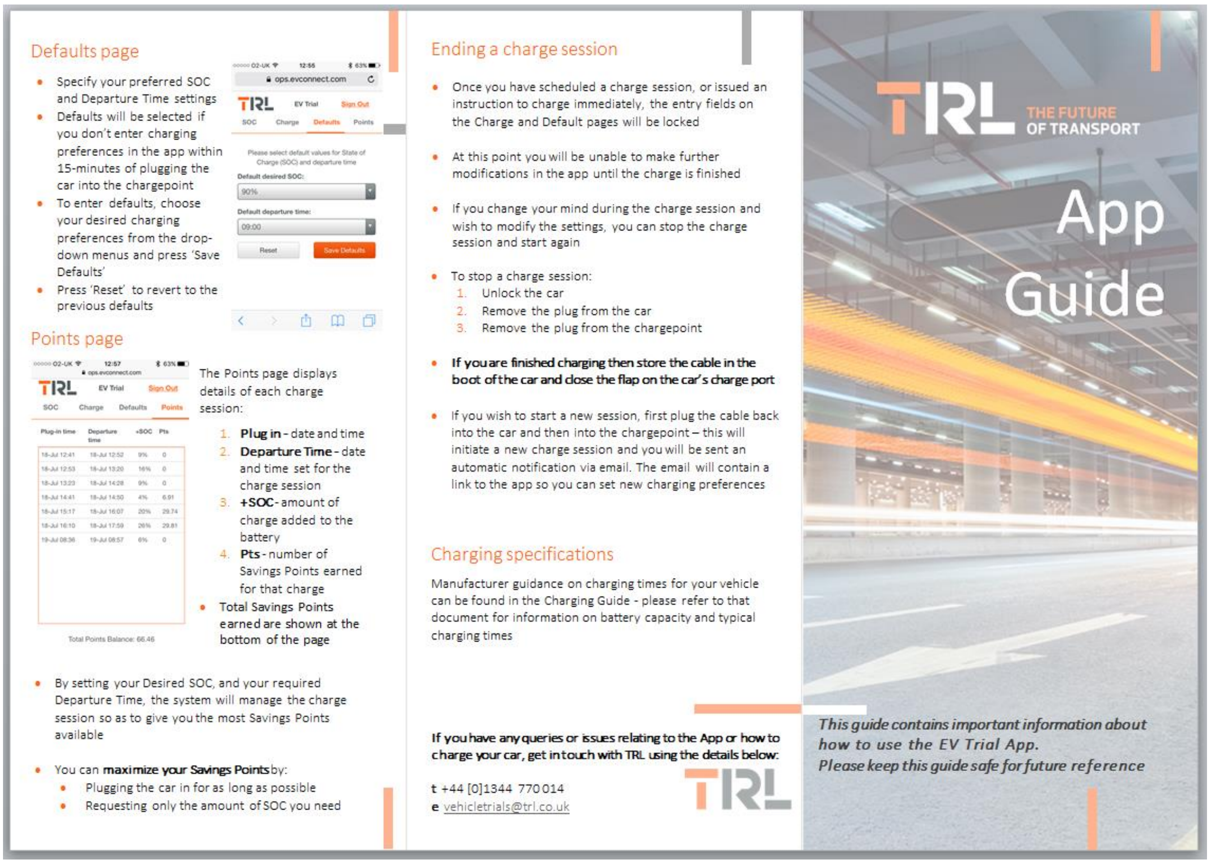
Charging immediately

- You can begin charging the car immediately by pressing the 'Charge Now' button
- After confirming the instruction, you will be redirected to the SOC page and the Status will display 'Charging'

Earning Savings Points

- You will earn Savings Points for each charge, depending on the time of day (Tariff Band) you charge in
- Different times of day fall in different Tariff Bands
- You can maximise the number of Savings Points you earn by charging in the Low Tariff Band
- The Tariff Bands are explained overleaf in the 'Points page' section of this guide

I.5.4 SMC Summer group



Defaults page

- Specify your preferred SOC and Departure Time settings
- Defaults will be selected if you don't enter charging preferences in the app within 15-minutes of plugging the car into the chargepoint
- To enter defaults, choose your desired charging preferences from the drop-down menus and press 'Save Defaults'
- Press 'Reset' to revert to the previous defaults

Points page

The Points page displays details of each charge session:

1. **Plug in** - date and time
2. **Departure Time** - date and time set for the charge session
3. **+SOC** - amount of charge added to the battery
4. **Pts** - number of Savings Points earned for that charge

- Total Savings Points earned are shown at the bottom of the page

- By setting your Desired SOC, and your required Departure Time, the system will manage the charge session so as to give you the most Savings Points available
- You can **maximize your Savings Points** by:
  - Plugging the car in for as long as possible
  - Requesting only the amount of SOC you need

Ending a charge session

- Once you have scheduled a charge session, or issued an instruction to charge immediately, the entry fields on the Charge and Default pages will be locked
- At this point you will be unable to make further modifications in the app until the charge is finished
- If you change your mind during the charge session and wish to modify the settings, you can stop the charge session and start again
- To stop a charge session:
  1. Unlock the car
  2. Remove the plug from the car
  3. Remove the plug from the chargepoint
- **If you are finished charging then store the cable in the boot of the car and close the flap on the car's charge port**
- If you wish to start a new session, first plug the cable back into the car and then into the chargepoint – this will initiate a new charge session and you will be sent an automatic notification via email. The email will contain a link to the app so you can set new charging preferences

Charging specifications

Manufacturer guidance on charging times for your vehicle can be found in the Charging Guide - please refer to that document for information on battery capacity and typical charging times

If you have any queries or issues relating to the App or how to charge your car, get in touch with TRL using the details below:

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THE FUTURE OF TRANSPORT

App Guide

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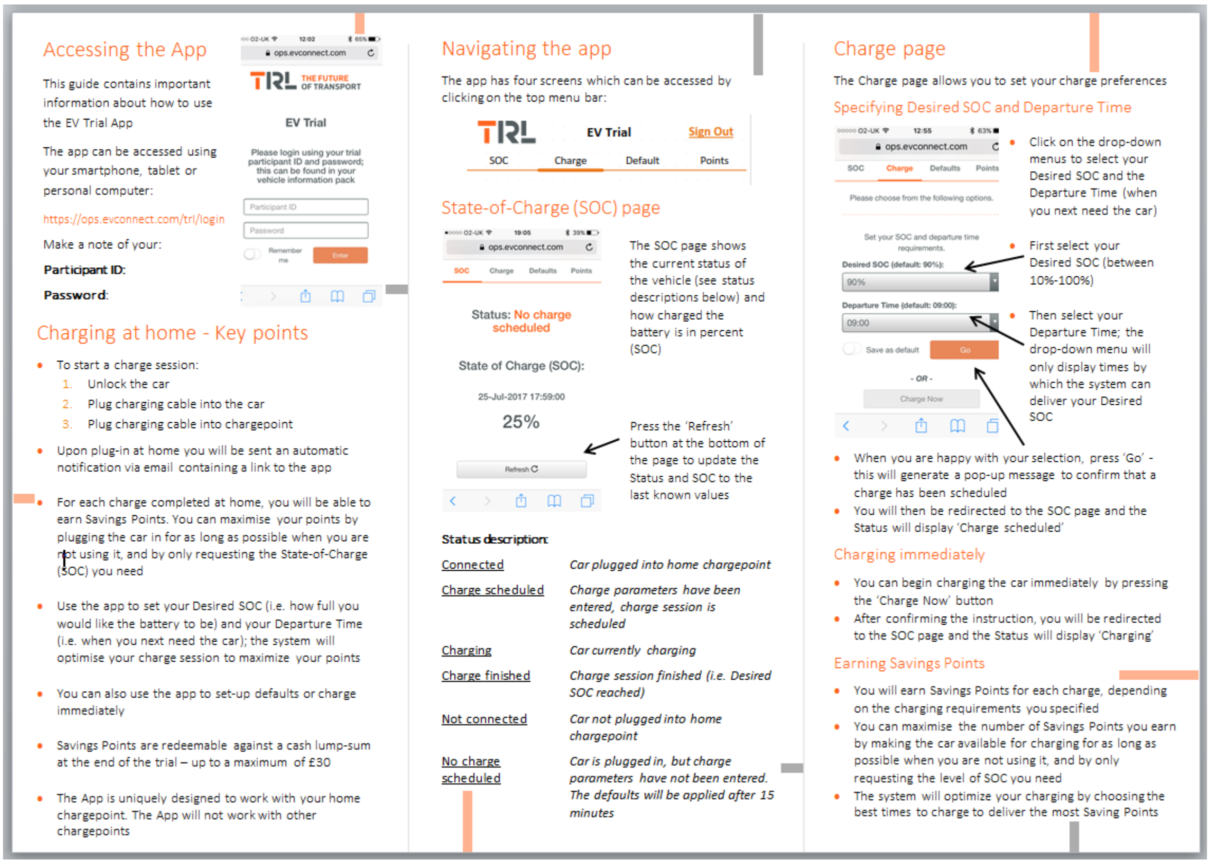

Accessing the App

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The app can be accessed using your smartphone, tablet or personal computer:

https://ops.evconnect.com/trl/login

Make a note of your:

Participant ID:

Password:

Charging at home - Key points

- To start a charge session:
  1. Unlock the car
  2. Plug charging cable into the car
  3. Plug charging cable into chargepoint
- Upon plug-in at home you will be sent an automatic notification via email containing a link to the app
- For each charge completed at home, you will be able to earn Savings Points. You can maximise your points by plugging the car in for as long as possible when you are not using it, and by only requesting the State-of-Charge (SOC) you need
- Use the app to set your Desired SOC (i.e. how full you would like the battery to be) and your Departure Time (i.e. when you next need the car); the system will optimise your charge session to maximize your points
- You can also use the app to set-up defaults or charge immediately
- Savings Points are redeemable against a cash lump-sum at the end of the trial – up to a maximum of £30
- The App is uniquely designed to work with your home chargepoint. The App will not work with other chargepoints

Navigating the app

The app has four screens which can be accessed by clicking on the top menu bar:

State-of-Charge (SOC) page

The SOC page shows the current status of the vehicle (see status descriptions below) and how charged the battery is in percent (SOC)

Press the 'Refresh' button at the bottom of the page to update the Status and SOC to the last known values

Status description:

Connected	*Car plugged into home chargepoint*
Charge scheduled	*Charge parameters have been entered, charge session is scheduled*
Charging	*Car currently charging*
Charge finished	*Charge session finished (i.e. Desired SOC reached)*
Not connected	*Car not plugged into home chargepoint*
No charge scheduled	*Car is plugged in, but charge parameters have not been entered. The defaults will be applied after 15 minutes*

Charge page

The Charge page allows you to set your charge preferences

Specifying Desired SOC and Departure Time

- Click on the drop-down menus to select your Desired SOC and the Departure Time (when you next need the car)
- First select your Desired SOC (between 10%-100%)
- Then select your Departure Time; the drop-down menu will only display times by which the system can deliver your Desired SOC

- When you are happy with your selection, press 'Go' - this will generate a pop-up message to confirm that a charge has been scheduled
- You will then be redirected to the SOC page and the Status will display 'Charge scheduled'

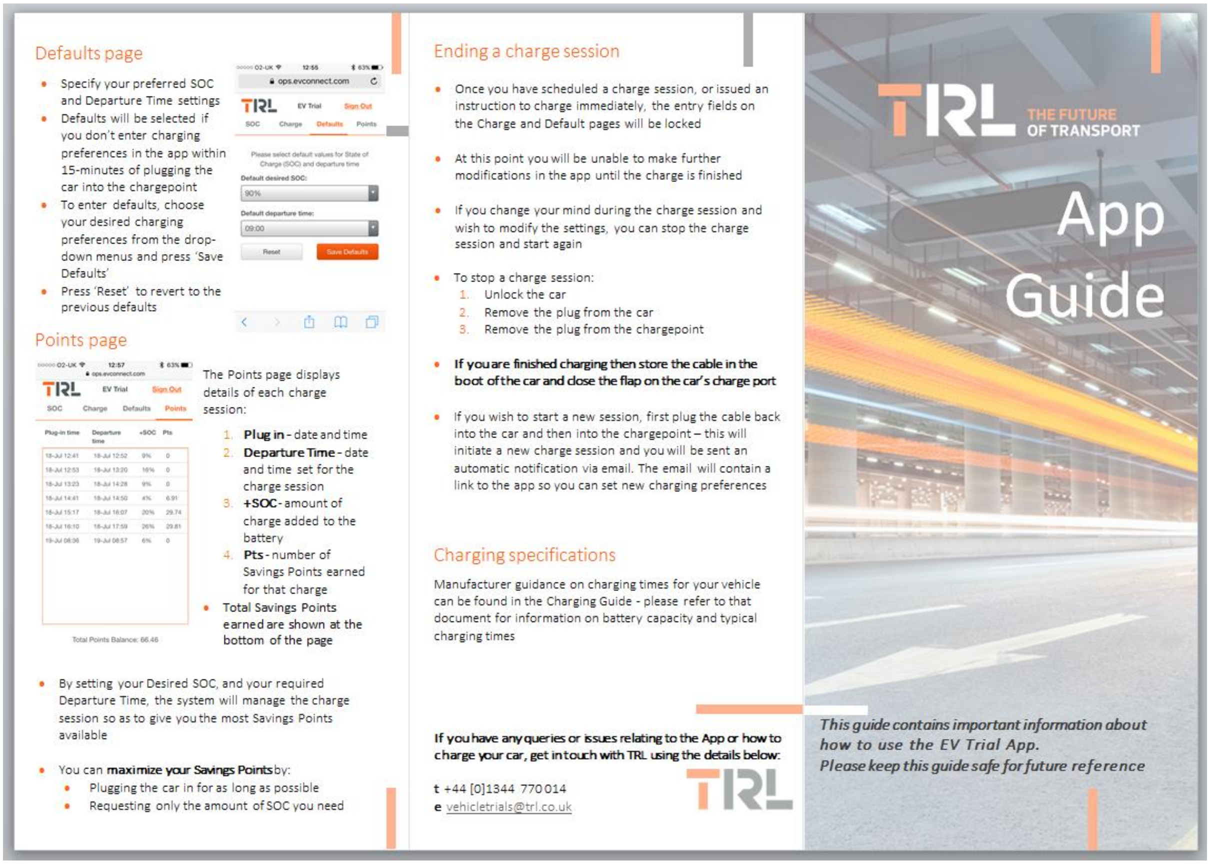
Charging immediately

- You can begin charging the car immediately by pressing the 'Charge Now' button
- After confirming the instruction, you will be redirected to the SOC page and the Status will display 'Charging'

Earning Savings Points

- You will earn Savings Points for each charge, depending on the charging requirements you specified
- You can maximise the number of Savings Points you earn by making the car available for charging for as long as possible when you are not using it, and by only requesting the level of SOC you need
- The system will optimize your charging by choosing the best times to charge to deliver the most Saving Points

I.5.5 SMC Winter group



Defaults page

- Specify your preferred SOC and Departure Time settings
- Defaults will be selected if you don't enter charging preferences in the app within 15-minutes of plugging the car into the chargepoint
- To enter defaults, choose your desired charging preferences from the drop-down menus and press 'Save Defaults'
- Press 'Reset' to revert to the previous defaults

Points page

The Points page displays details of each charge session:

1. **Plug in** - date and time
2. **Departure Time** - date and time set for the charge session
3. **+SOC** - amount of charge added to the battery
4. **Pts** - number of Savings Points earned for that charge

- Total Savings Points earned are shown at the bottom of the page

- By setting your Desired SOC, and your required Departure Time, the system will manage the charge session so as to give you the most Savings Points available
- You can **maximize your Savings Points** by:
  - Plugging the car in for as long as possible
  - Requesting only the amount of SOC you need

Ending a charge session

- Once you have scheduled a charge session, or issued an instruction to charge immediately, the entry fields on the Charge and Default pages will be locked
- At this point you will be unable to make further modifications in the app until the charge is finished
- If you change your mind during the charge session and wish to modify the settings, you can stop the charge session and start again
- To stop a charge session:
  1. Unlock the car
  2. Remove the plug from the car
  3. Remove the plug from the chargepoint
- **If you are finished charging then store the cable in the boot of the car and close the flap on the car's charge port**
- If you wish to start a new session, first plug the cable back into the car and then into the chargepoint – this will initiate a new charge session and you will be sent an automatic notification via email. The email will contain a link to the app so you can set new charging preferences

Charging specifications

Manufacturer guidance on charging times for your vehicle can be found in the Charging Guide - please refer to that document for information on battery capacity and typical charging times

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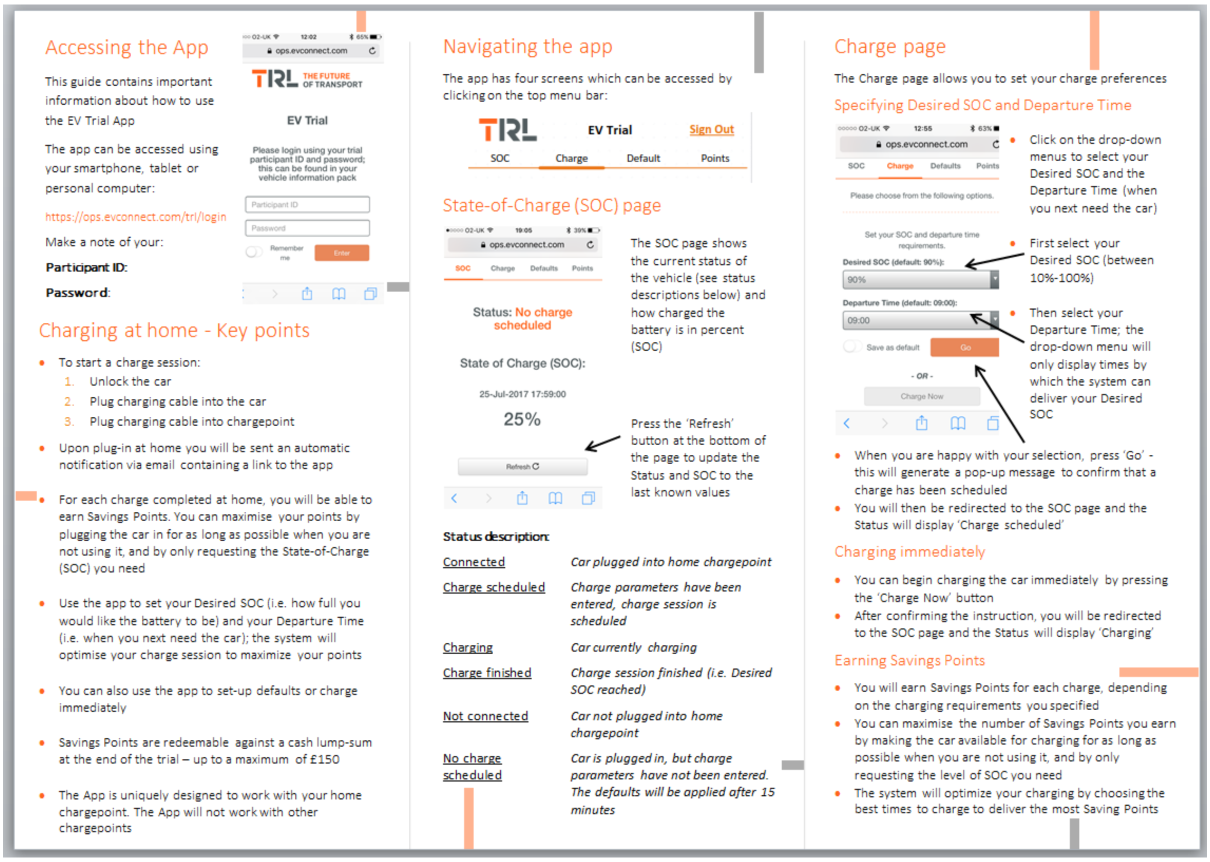

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Make a note of your:

Participant ID:

Password:

Charging at home - Key points

- To start a charge session:
  1. Unlock the car
  2. Plug charging cable into the car
  3. Plug charging cable into chargepoint
- Upon plug-in at home you will be sent an automatic notification via email containing a link to the app
- For each charge completed at home, you will be able to earn Savings Points. You can maximise your points by plugging the car in for as long as possible when you are not using it, and by only requesting the State-of-Charge (SOC) you need
- Use the app to set your Desired SOC (i.e. how full you would like the battery to be) and your Departure Time (i.e. when you next need the car); the system will optimise your charge session to maximize your points
- You can also use the app to set-up defaults or charge immediately
- Savings Points are redeemable against a cash lump-sum at the end of the trial – up to a maximum of £150
- The App is uniquely designed to work with your home chargepoint. The App will not work with other chargepoints

Navigating the app

The app has four screens which can be accessed by clicking on the top menu bar:

EV Trial — Sign Out — SOC — Charge — Default — Points

State-of-Charge (SOC) page

The SOC page shows the current status of the vehicle (see status descriptions below) and how charged the battery is in percent (SOC)

Press the 'Refresh' button at the bottom of the page to update the Status and SOC to the last known values

Status description:

Connected	*Car plugged into home chargepoint*
Charge scheduled	*Charge parameters have been entered, charge session is scheduled*
Charging	*Car currently charging*
Charge finished	*Charge session finished (i.e. Desired SOC reached)*
Not connected	*Car not plugged into home chargepoint*
No charge scheduled	*Car is plugged in, but charge parameters have not been entered. The defaults will be applied after 15 minutes*

Charge page

The Charge page allows you to set your charge preferences

Specifying Desired SOC and Departure Time

- Click on the drop-down menus to select your Desired SOC and the Departure Time (when you next need the car)
- First select your Desired SOC (between 10%-100%)
- Then select your Departure Time; the drop-down menu will only display times by which the system can deliver your Desired SOC
- When you are happy with your selection, press 'Go' - this will generate a pop-up message to confirm that a charge has been scheduled
- You will then be redirected to the SOC page and the Status will display 'Charge scheduled'

Charging immediately

- You can begin charging the car immediately by pressing the 'Charge Now' button
- After confirming the instruction, you will be redirected to the SOC page and the Status will display 'Charging'

Earning Savings Points

- You will earn Savings Points for each charge, depending on the charging requirements you specified
- You can maximise the number of Savings Points you earn by making the car available for charging for as long as possible when you are not using it, and by only requesting the level of SOC you need
- The system will optimize your charging by choosing the best times to charge to deliver the most Saving Points

I.6 Guidance for breakdowns or incidents

WHAT TO DO IN THE EVENT OF A BREAKDOWN OR INCIDENT

KEY NUMBERS

- **999** in an **emergency.** If on a motorway and you can see an emergency phone, use this to summon assistance, otherwise use a motorway marker post to help the emergency services to locate you
- **VW's Driverline** on **0844 2091 962** for all issues relating to breakdown, tyres, and glass
- **Aviva's claims line** on **0800 246 876** in the event of an incident
- **TRL** on **01344 770 014** to report any breakdowns or incidents once it is safe to do so

BREAKDOWNS

- Do not attempt to fix the vehicle yourself
- If safe to do so, park the vehicle off the road and use the hazard warning lights to alert other drivers.
- For all breakdowns, in the first instance call **VW's Driverline** on **0844 2091 962** to arrange suitable recovery
- Once it is safe to do so, please also inform **TRL** of the breakdown by calling **01344 770 014,** or by emailing vehicletrials@trl.co.uk

Breakdown on a motorway

- Pull onto the hard shoulder or try and reach the nearest Emergency Refuge Area (ERA). If this is not possible, stop as far to the left as possible.
- Exit the vehicle from the passenger side. It is safer not to wait in the vehicle, as the biggest danger is from passing vehicles – you should try to stand at least 1.2m behind the safety barrier in a position to the rear of your vehicle so you can face oncoming traffic.
- If you can see an emergency phone, use this to summon assistance, otherwise use a motorway marker post to help the emergency services to locate you.

Tyre-related breakdown

- Do not attempt to fix or change the tyre yourself. However, if you are in an emergency situation, there is a tyre pump in the boot.

INCIDENTS

- In the event of an accident, no matter how trivial, the driver must stop and stay calm. Call **999** if anyone is injured or the road is blocked / damaged.
- Do not attempt to tackle a fire; contact the emergency services.
- Accidents involving injuries to people, dogs, livestock or horses must be reported to police as soon as possible or within 24 hours.
- Under no circumstances should the driver discuss the cause of, or blame for an accident with the other party or parties involved or with any person.
- Use the **Incident Reporting Form** within the yellow **Motor Accident Guide** produced by Aviva (in the glovebox of your vehicle). Use this form to try to obtain information such as:
    - Names and addresses of other drivers/owners of other vehicles
    - Other persons involved and any witnesses.
    - Details of vehicle types and registration numbers
    - Insurance company names (and policy details if possible)
- Comprehensive insurance is provided to you by Aviva and in the event of a collision please call their claims line immediately on **0800 246 876**.
- Once it is safe to do so, please also inform **TRL** of the incident by calling **01344 770 014**, or by emailing vehicletrials@trl.co.uk

I.7 Post-familiarisation consent form

Please complete this form after you have completed the familiarisation drive, deleting YES or NO as appropriate in the spaces provided:

Have you had an opportunity to drive the vehicle?	Yes / No
Do you feel comfortable to drive the vehicle unaccompanied?	Yes / No
Have you been given manufacturer guidance for safe operation of the vehicle?	Yes / No
Have you been given manufacturer guidance for safe charging of the vehicle?	Yes / No
Do you understand that it is your responsibility to read the manufacturer's guide?	Yes / No
Are you satisfied that you have enough information to allow you to drive and charge the vehicle safely?	Yes / No
Do you understand that you must notify TRL by telephone within 24 hours in the event of a breakdown or accident?	Yes / No
Have you been given contact details in case of breakdown or emergency?	Yes / No
Do you understand that, whilst you are welcome to discuss use of the vehicle with friends and family, you should not post comments or blogs about your trial experience online?	Yes / No

Signed	
Date	

Appendix J Questionnaires

The following questionnaires are provided in a separate document: see 'Consolidated questionnaires appendix'.

J.1 Pre-trial questionnaire

J.2 Time point 1 questionnaire

J.3 Time point 2 questionnaire

Appendix K Choice experiment supporting information

K.1 Literature review

The attributes explored in the choice experiment must be representative of the inconveniences and benefits of each managed charging scheme. A literature review of choice experiments related to managed charging was carried out to provide guidance on which aspects to include.

Relevant managed charging studies were sought through an online literature search of Science Direct (www.sciencedirect.com) and Taylor & Francis Online (www.tandfonline.com) using the following search terms:

Table 1: Search terms used in managed charging choice experiment literature review

Search field 1		Search field 2
stated preference	AND	(managed OR smart) AND charging
(stated OR discrete) AND choice		(electric OR plug-in) AND vehicle charging
choice AND (model OR survey OR experiment)		demand response
consumer AND (preference OR behaviour OR attitude OR perception)		
"willingness to pay" OR willingness-to-pay		
design + (space OR game)		

This process yielded four previous choice experiments investigating some form of managed EV charging. The attributes each of these explored are summarised in Table 2.

Parsons, Hidrue, Kempton, & Gardner (2014) surveyed a random national sample of 3,029 people from the US to measure their willingness to pay for a vehicle-to-grid (V2G) enabled electric vehicle and an associated V2G contract. V2G-enabled vehicles can feed electricity back into the grid to supplement electrical generators, thus acting as a source of power during times of peak demand. Since this requires ceding of charging control to a third party, from the consumer perspective has aspects in common with the supplier-managed charging proposed in this study.

The survey was conducted in 2009 and so it was assumed that most participants would not have a good understanding of electric vehicles. To improve comprehension, the survey included two choice experiments. The first asked participants to choose between their preferred conventional petrol car and two similarly configured non-V2G BEVs. As well as measuring participant's willingness to pay for BEVs and their attributes, this served to familiarize them with how they differ to conventional petrol cars. The second choice experiment then asked participants to choose between two identical V2G-enabled BEVs with different contract terms and their preferred conventional petrol vehicle. Other than the attributes shown (range, charge time, acceleration, pollution, and fuel cost) the V2G-enabled BEVs were said to be identical to the preferred petrol vehicle. However, in addition the BEVs were presented with the terms of their V2G contracts which included guaranteed minimum range after charge, average length of day car must be plugged in, cash payment received per year and the additional cost of the vehicle. To offer positive utility, the annual revenue had to be high enough to compensate for both this increased inconvenience and additional purchase price. Average choice coefficients revealed that participants were willing to pay $2.1 upfront per $1 (£2.1 per £1) of annual cash revenue. This was slightly less than the $2.8 they were willing to pay for a $1 reduction in fuel costs (£2.1 per £1), suggesting participants viewed potential savings from V2G as riskier than the fuel cost savings from switching from a petrol to a battery electric car. The value of guaranteed range decreased at higher values, for example at 125 miles, additional range was valued at $10/mile (£7/mile), compared with $88/mile (£63/mile) at 25 miles. This is consistent with the non-linear relationship observed in Element Energy for DfT (2015), whereby the value of additional range falls significantly once participants perceive the range is enough to carry out their daily driving needs. Likewise, increasing average required plug-in time from 5 hrs to 10 hrs per day requires compensation of $1,411 (£1,004), and increasing from 15 hrs to 20 hrs requires $4,050 (£2,881). The large values suggest that participants view plug-in time as a potential source of inconvenience, rather than an opportunity to make use of vehicle idle time, which the study states is on average 23 hrs per day, although this is not necessarily all spent at home.

The authors do acknowledge a shortcoming of the study is that charging time was held constant at 1 hr/50 miles (approximately 15 kW). Although this is faster than most home charging rates, it does not test consumers' willingness to accept V2G under faster charge rates, which is likely to be greater in an environment of high rapid charging availability.

Parsons et al. (2014) used the results of their choice experiments to calculate what level of annual revenue or purchase price discount would be required for V2G to increase the market share of BEVs. A number of contracts are assessed with guaranteed range and require plug-in time varying between 25-75 miles and 5-20 hours respectively. The median annual cash-back required ranges from $2,400 (£1,700) for 75 miles and 5 hrs of plug-in time per day, and $8,600 (£6,100) for 25 miles and 20 hours. For the latter contract, the authors estimate the value to aggregators of $2,900 (£2,100) per year, suggesting that the savings from V2G do not cover the required compensation to increase demand for BEVs. However, the choice experiment revealed that participants heavily discounted ongoing cash revenue and so the authors propose that a purchase price discount would be more effective. For the consumer segment they identified as most willing to accept V2G, they found the required discount came out as $2,190 (£1,600) when annualized with a 5% discount rate. This suggest that, for this segment at lease, an upfront discount could provide a feasible business model for supplier-managed charging with V2G.

Bailey & Axsen (2015) focus on the potential for overnight supplier-managed charging to facilitate acceptance of intermittent renewable sources amongst domestic electricity consumers. This choice experiment formed part of the 2014 Canadian Plug-in Electric Vehicle Survey (Axsen et al., 2015), and focussed on "Early Mainstream" car buyers who were defined by the authors as the next buyers of plug-in vehicles, after the "PEV Pioneer" group, over the next 10-15 years but were unlikely to have had experience of these vehicles. Like Parsons et al. (2014), supplier-managed charging in this case included V2G, and the choice experiment also presented guaranteed minimum range as an attribute of the charging scheme. The other attributes were the proportion and source of "green" electricity in the electricity supply, and the monthly electricity bill. This final attribute was pivoted on the participants' actual electricity usage but included the additional electricity cost from owning a plug-in vehicle and savings from accepting supplier-managed charging. Unlike Parsons et al. (2014), this choice experiment also explored the appetite for managed charging with PHEVs, as well as BEVs.

Note that the choice experiment does not explore the impact of changing purchase price on willingness to accept managed charging, and so it is valued in terms of monthly electricity cost.

For BEVs, increasing guaranteed range from 53 miles is valued at an average of 9.4 CAD$/mile (£4.8/mile) in additional annual electricity cost. However, for PHEVs this rises to 38.2 CAD$/mile (£19.5/mile) to increase range from 18 miles. Guaranteed minimum charge is therefore valued more highly with PHEVs, which is surprising given that their internal combustion engine makes them much less range constrained. It is possible that participants were pricing in the cost of additional fuel they could incur, however, the authors note that it is likely that participants simply did not fully understand what PHEV range meant due to the novelty of the technology.

The resultant logit model was used to calculate the likelihood of uptake for a range of supplier-managed charging schemes. Highest enrolment was observed for a contract offering 20% electricity cost savings with no reduction in guaranteed minimum range. This was calculated as 71% for PHEVs with a 64 km range, and 78% for BEVs with a 120 km range. This dropped to 63% and 69% respectively when guaranteed minimum range was reduced to 80%, which is still relatively high. However, this gives no indication of whether the presence of managed charging would encourage more people to purchase plug-in vehicles.

The two further choice experiments identified do not explore electric car charging explicitly, and instead investigate consumer acceptance of the broader service of smart electricity usage. However, this provides useful insights into other aspects of managed charging that consumers may perceive as inconveniences or benefits. In 2015, Richter & Pollitt (2016) carried out a choice experiment with 1,892 households in Great Britain investigating the willingness to pay for smart electricity contracts. Their study considered different levels of monitoring, control, technical support & data privacy and expected energy savings, and the monthly fee that consumers would be willing to pay. The results highlighted implications surrounding consumer attitudes towards data security, with personal data sharing with third parties for marketing purposes attracting the highest level of compensation at £3.37 per month. Remote monitoring and control of individual household appliances by a supplier also required relatively significant compensation of £2.19 per month. Although it did not form part of the choice experiment, Bailey & Axsen (2015) found in their pre-survey that participants were also concerned with privacy (24%) and “loss of control” (39%). However, since this is not something that will be varied within ECCo this is not something that should be included in the choice experiment in this study. Instead concerns over data privacy and control will be incorporated into the alternative specific constant for both managed charging regimes.

Finally, Kaufmann, Künzel, & Loock (2013), measured consumer acceptance of smart metering service amongst 87 domestic electricity consumers in Davos, Switzerland. The services included remote meter reading, real-time consumption feedback, remote appliance control and meter reading, home security functions and a range of peak/off-peak tariffs. With regards to tariff, it was found that willingness to pay decreased as the delta between peak and off-peak prices widened. Participants therefore valued the risk of having to use expensive peak electricity as higher than the potential cost savings. This may have implications for willingness to accept user-managed charging, with some users unwilling to take on the risk of having to occasionally charge during expensive peak times, even though the service may save them money overall.

Table 2: Relevant attributes used in choice experiments identified in literature related to managed charging

Reference	Sector	Tariff (peak / off peak)	Fee / revenue / saving per month	Level of monitoring	Level of control	Level of technical support	Data privacy	Guaranteed minimum e-range	Average required plug-in time	EV cost
Kaufmann et al. (2013)	Smart metering	X	X	X	X					
Parsons et al. (2014)	Vehicle to grid		X					X	X	X
Bailey & Axsen (2015)	Utility controlled charging		X					X		
Richter & Pollitt (2016)	Smart electricity usage		X	X	X	X	X			

Guaranteed minimum range and plug-in time per day are two key factors that describe the inconvenience of V2G managed charging. However, V2G shows several differences to the supplier-managed charging proposed in this study, and so these attributes are not necessarily directly transferrable. For example, due to the bi-directional flow of electricity, V2G-enabled vehicles always provide a service while plugged in, even if fully charged. Plug-in cars that simply offer demand-side response can no longer be utilised by DNOs once charged. Hence, required plug-in time per day is a suitable term for a V2G contract, but much less so for demand-side response only. Likewise, in the managed charging schemes used in the trial, consumers effectively define the end state of charge in both user and supplier-managed. Therefore, they do not need to tolerate a lower range as a result of managed charging.

V2G offers a higher value grid service, but it also incurs a capital cost to enable the functionality in the vehicle and/or charger. Consumers must also trade this off against the cost savings, which markedly alters the consumer proposition of managed charging. Therefore, although the attributes and cost savings used in the studies of Parsons et al. (2014) and Bailey & Axsen (2015) provide some guidance, they are not directly relevant to investigating demand side response managed charging.

K.2 Choice experiment items

The following section will present the information that will be provided to choice experiment participants before they answer the questions, and an example of the choice question format. The structures of the two managed charging schemes (user-managed and supplier-managed) differ slightly from the schemes tested in the trial, as this allows testing of attributes that were not possible in this trial setting.

K.2.1 Information on managed charging schemes

This section contains information on the characteristics of different managed charging schemes. These are related to, but not exactly the same as, the scheme you may have experienced during the charging trial. It is therefore important that you read this information carefully so that you understand what each managed charging scheme involves.

In the future, the electricity supply will include more electricity generated from renewable sources such as wind power, whose outputs are more variable than those of conventional power stations. At some times there will be more electricity available and at other times less, so prices will vary much more than they do now. Prices also depend on how much electricity demand there is from users.

Managed charging is where the timing of vehicle charging is controlled to reduce its costs (by lowering its impact on the electricity supply grid). For example, this can involve shifting charging outside the periods of peak prices (which happen when there are lots of demands on the grid, or less supply is available) to periods with low prices (which happen when there are few demands on the grid, or more supply is available). Reducing the impact on the electricity grid provides savings for electricity suppliers which can be passed onto consumers to reward them for participating in managed charging. In turn, this reduces the running costs of plug-in cars.

This following table describes the characteristics of two distinct forms of managed charging, as well as unmanaged charging.

<table>
<tr><th>Unmanaged charging</th><th colspan="2">Managed Charging</th></tr>
<tr><th></th><th>User-managed charging</th><th>Supplier-managed charging</th></tr>
<tr>
<td>The price of electricity is set at a standard fixed rate
You are free to charge the car whenever you want
The car will begin charging immediately as soon as it is plugged into the charge point and charge continuously until the battery is full or you unplug it</td>
<td>The price you pay for electricity to charge the car varies during the day, in several bands. For example, during peak times (e.g. from 3pm to 7pm) electricity will be expensive, but then cheaper outside peak times
An example Time-of-Use tariff for user managed charging:
<table>
<tr><th>Time period</th><th>Price (p/kWh)</th></tr>
<tr><td>5am - 10am</td><td>10</td></tr>
<tr><td>10am - 3pm</td><td>12</td></tr>
<tr><td>3pm - 7pm</td><td>34</td></tr>
<tr><td>7pm - 5am</td><td>9</td></tr>
</table>
You decide during which hours your vehicle is charged
You can do this through the car infotainment system or use an app to turn charging on/off</td>
<td>Each time you plug your car into your home charge point you specify when you next need the car and what battery state of charge you will require.
The external Charge Supplier then controls the timing of charging to get you the biggest cost saving. The external Charge Supplier could be the electricity supplier or a standalone business entity that specialises in controlled charging.
The supplier will deliver the state of charge you asked for by the time you asked for it
If you unplug earlier, your car may not yet be charged to the state of charge you asked for</td>
</tr>
</table>

	at the time you have decided. The system will provide you with the price of electricity in each hour. • Charging during off-peak hours reduces the running cost of a plug-in car, but charging during peak hours will increase it • Maximising the amount of charging carried out during off-peak hours maximises the savings you can make by running a plug-in car with user-managed charging • The savings you can make will be bigger in Winter months than in Summer months	• You are rewarded with cheaper electricity bills. You make a larger saving if your car is plugged in at times of day when electricity is cheaper, like overnight. You also make a larger saving the longer your car is plugged in compared to the time needed to charge because this gives the supplier more flexibility to select optimum charge times (e.g. if 6 hours are needed to charge the car, the reward will be greater if the car is plugged in for 12 hours compared to 8 hours). • You can also set default values so you do not need to specify when you next need the car and what battery state of charge you require each time you plug in, unless it's different than the defaults you set • The savings you can make will be bigger in Winter months than in Summer months

K.2.2 Choice Experiment

For the following questions, we would like you to imagine that you own the plug-in vehicle that you used during the charging trial. In each question you will be given information on three charging schemes and asked to choose which one you would use to charge your car:

- **User-managed charging**
- **Supplier-managed charging**
- **Unmanaged charging**

These will not necessarily resemble the charging schemes you may have experienced during the charging trial. **The descriptions of the charging schemes will change in each question, so you will need to read the information each time before making your choice.**

For each question, you will be given the following information about the options:

Expected annual charging cost savings	This is the expected net saving you would make per year on the cost of electricity for charging your vehicle when you employ the charging scheme. This assumes that your trip patterns remain broadly similar from the point at which the estimate was made.

	In user-managed charging, the pricing tariff will change on a seasonal basis so, in Summer your savings per month will be lower than they are in Winter. These pricing tariffs are shown in advance so your savings can be estimated accurately. Over the course of a year, your total savings would be what is shown here. Your energy supplier may offer options to smooth these payments through fixed direct debit payments. In supplier-managed charging, the savings made per month will also vary with season. They will generally be substantially higher in Winter months than in Summer months. However, savings will be calculated after the charging event based on the actual benefit provided to the grid. Estimated total savings may therefore be less accurate. **For supplier-managed charging, the possible variation in actual net annual savings is shown in brackets** e.g. net annual savings £100 (+/- £25)
Availability of an override function	On occasions when the car is needed earlier than expected when setting the supplier-managed charging inputs, it is possible the battery will not have been charged to the level required. An override function will reduce the inconvenience caused by allowing you to change the settings mid-charge or simply begin charging immediately. The extent to which you can override the system will range between: • Override available with complete flexibility to change settings mid-charge. • Override available, but changing settings results in loss of all financial reward for that charge event • No override function available and settings cannot be changed once set. However, car can still be unplugged at any time **The override function applies only to supplier-managed charging**. For user-managed charging, the user remains in control of when the car is charged.
Access to rapid charging close to home (included only in the choice sets of BEV drivers)	If the car is needed earlier than expected under either user-managed or supplier-managed charging and the battery has not been charged enough, the inconvenience can be reduced if the car can easily be topped up at a nearby rapid charge point. Current rapid charge points are designed to recharge an empty battery to 80% within 30 minutes. In the choice questions, you will be told how long it would take you to drive to the nearest rapid charge point to your home. This will range between 5 minutes and 30 minutes, or there will be no rapid charge point available nearby
Access to public charging close to home (included only in the choice sets of PHEV drivers)	If the car is needed earlier than expected under either user-managed or supplier-managed charging and the battery has not been charged enough, the inconvenience can be reduced if the car can easily be topped up at a nearby public charge point. Public charge points can recharge an empty PHEV battery in 1-1.5 hours which may be slightly faster than a home charge point. In the choice questions, you will be told how long it would take you to drive to the nearest public charge point to your home. This will range between 5 minutes and 30 minutes, or there will be no charge point available nearby. [Note: A PHEV with a depleted battery can still be driven on engine power using liquid fuel i.e. petrol/diesel]

Anticipatory charging	If the user of supplier-managed charging selects an end state of charge lower than 100%, there may be occasions when this state of charge is met before the set finish time, and cheap electricity is still available. Under these circumstances, an *anticipatory charging function* would continue to charge the car to a higher state of charge. The user would benefit by receiving this additional electricity at low cost, and so make an additional saving. The exact amount of extra saving from anticipatory charging will be variable as it depends on a number of factors, such as the state of charge selected and frequency of unpredictable weather. For each supplier-managed charging scheme, the anticipatory charging function may or may not be available. If it is available, the maximum possible extra saving that can be made will be shown, but actual savings will probably be lower. If your required state of charge is always set to 100%, then no extra savings will be made. [Note: this function was unavailable to participants who experienced supplier-manged charging during the trial]
Additional cost of charging during peak hours relative to unmanaged charging	Under both supplier-managed and user-managed charging, there may be occasions when charging during peak hours is unavoidable. For example, if the car is used a high number of times on a particular day and requires charging between journeys. For user-managed charging, the additional cost of charging during peak hours is dependent on the peak-time price which may be substantially higher in Winter than Summer. In some supplier-managed charging schemes, the price of electricity may be set higher than for unmanaged charging. Charging during peak times and providing no flexibility would not be rewarded by suppliers and so the cost of electricity during this time would be higher than for unmanaged charging. In each managed charging scheme, this will be shown as either: • No additional cost compared with unmanaged charging standard fixed rate • 25% higher than the unmanaged charging standard fixed rate (e.g. 19 p/kWh) • 50% higher than the unmanaged charging standard fixed rate (e.g. 23 p/kWh) • Twice the price of the unmanaged charging standard fixed rate (e.g. 30 p/kWh) **The current standard fixed rate is about 15 p/kWh, which is equivalent to 2-3p per mile for electric driving.** The additional cost is the average throughout the year. For user-managed charging, peak prices in Winter will be higher than in Summer.

K.2.3 Example Question for a BEV driver

Here is an example question with two hypothetical charging schemes and an unmanaged charging option. Please read the information carefully and answer the question at the bottom.

For this and all the following choice questions, please assume that you own a **battery electric vehicle** like the you used during the trial.

	User-managed charging	*Supplier-managed charging*	*Unmanaged charging*
Expected annual charging cost savings	**£100** per year	**£150** (+/- £15) per year	*None*
Availability of an override function	*No override function necessary*	Override available with complete flexibility to change settings mid-charge	*N/A*
Access to rapid charging close to home	Rapid charge point within 5 minutes of house	No rapid charge point nearby	*N/A*
Anticipatory charging	*N/A*	Yes, giving up to £15 extra saving per year	*N/A*
Additional cost of charging during peak hours relative to unmanaged charging	50% higher than unmanaged charging rate	No additional cost compared with the unmanaged charging rate	*N/A*

If you could choose between these three charging schemes, which one would you choose?

☐ ☐ ☐

If you had to choose between one of the managed charging schemes, which one would you choose?

☐ ☐

After this example, you will be presented with the first choice question. The descriptions of the managed charging schemes will change in each question, so please remember to read the information each time before making your choice.

K.2.4 Example Question for a PHEV driver

Here is an example question with two hypothetical charging schemes and an unmanaged charging option. Please read the information carefully and answer the question at the bottom.

For this and all the following choice questions, please assume that you own a **plug-in hybrid electric vehicle** like the one you used during the trial.

	User-managed charging	*Supplier-managed charging*	*Unmanaged charging*
Net annual savings	**£50** per year	**£200 (+/- £100)** per year	*None*
Availability of an override function	*No override function necessary*	Override available, but changing settings results in loss of all financial reward for that charge event	*N/A*
Access to public charging close to home	Public charge point within 5 minutes of house	Public charge point within 15 minutes of house	*N/A*
Anticipatory charging	*N/A*	Yes, giving up to £40 extra saving per year	*N/A*
Additional cost of charging during peak hours relative to unmanaged charging	Twice the price of the unmanaged charging rate	25% higher than unmanaged charging rate	*N/A*

If you could choose between these three charging schemes, which one would you choose?

☐ ☐ ☐

If you had to choose between one of the managed charging schemes, which one would you choose?

☐ ☐

After this example, you will be presented with the first choice question. The descriptions of the managed charging schemes will change in each question, so please remember to read the information each time before making your choice.

Appendix L Vehicle condition form

VEHICLE CONDITION FORM

Participant ID	Vehicle ID	Vehicle reg.	Colour

CHECKLISTS

Condition check:	**Collection** Good condition? **√ or X**	**Return** Good condition? **√ or X**	**Notes**
Wheels and tyres			
Glass			
Interior			
Seatbelts			
Body work			
Lights			

Equipment and document check

Equipment and document check:	**Collection** Present? **√ or X**	**Return** Present? **√ or X**	**Notes**
Charging cable with conventional plug			
Charging cable with mode 3 connector			
First aid kit (complete)			
Yellow jacket			
Warning triangle			
Locking wheel nut			
Owner’s manual			
Vehicle information pack			
Driverline booklet			
Polar Plus Charging card			
Telematics dongle			

ASSESSMENT OF VEHICLE AT COLLECTION

Researcher	Date	Mileage

Fuel level (if applicable):

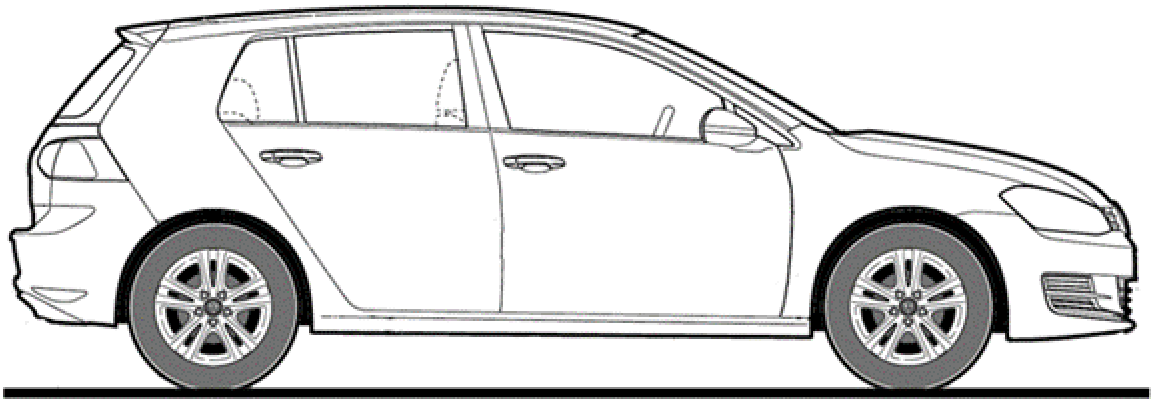
Empty	1/4	1/2	3/4	Full

Charge level (if applicable):

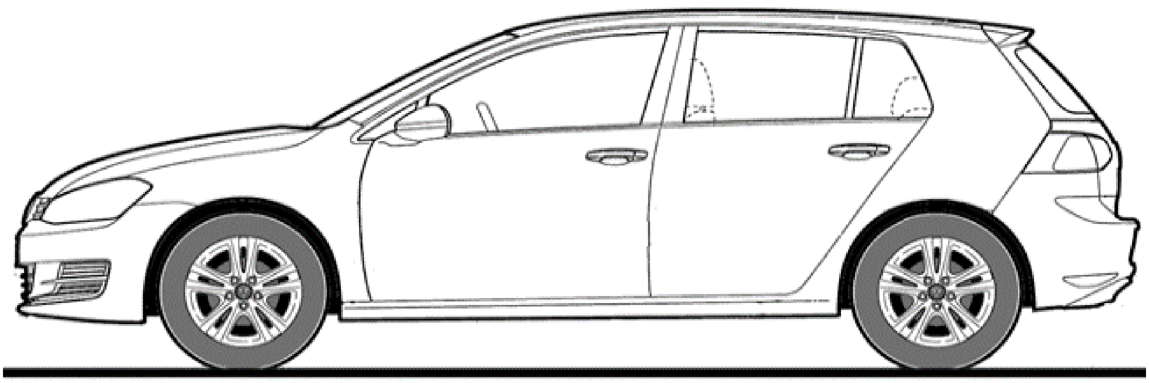
Empty	1/4	1/2	3/4	Full

Indicate any marks, scratches or damage on the vehicle on the corresponding pictures below. Add notes if necessary. **Participant and researcher to both sign on satisfactory completion of inspection**

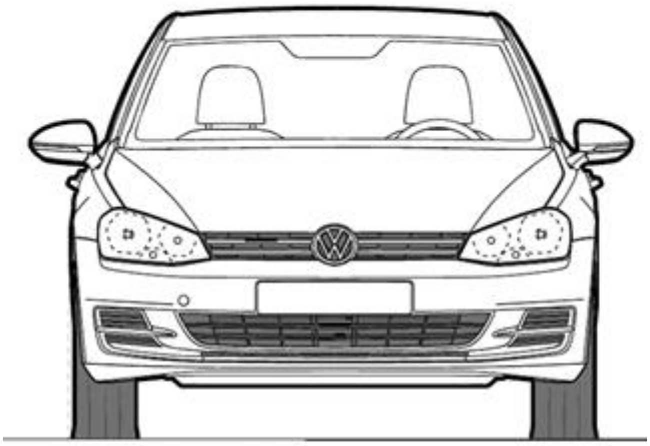
Driver's side:



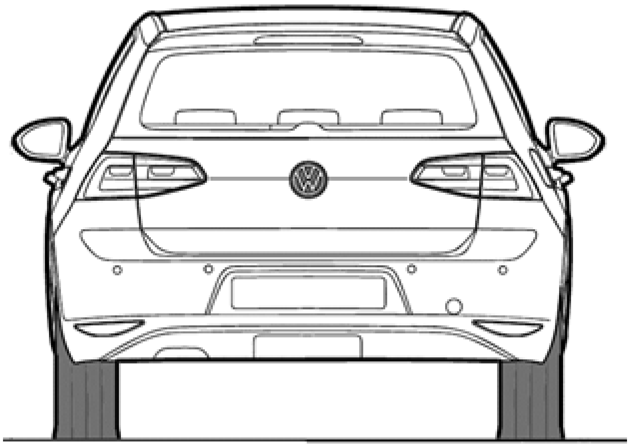
Passenger side:



Front:



Rear:



Notes:

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Declaration:

I have inspected the above vehicle and agree that:

- **The equipment indicated is present**
- **The only damage is that which is marked or noted in this form**

Participant signature:_______________________________________ Date:_________________

Researcher signature:_______________________________________ Date:________________

ASSESSMENT OF VEHICLE AT COLLECTION

Researcher	Date	Mileage

Fuel level (if applicable):

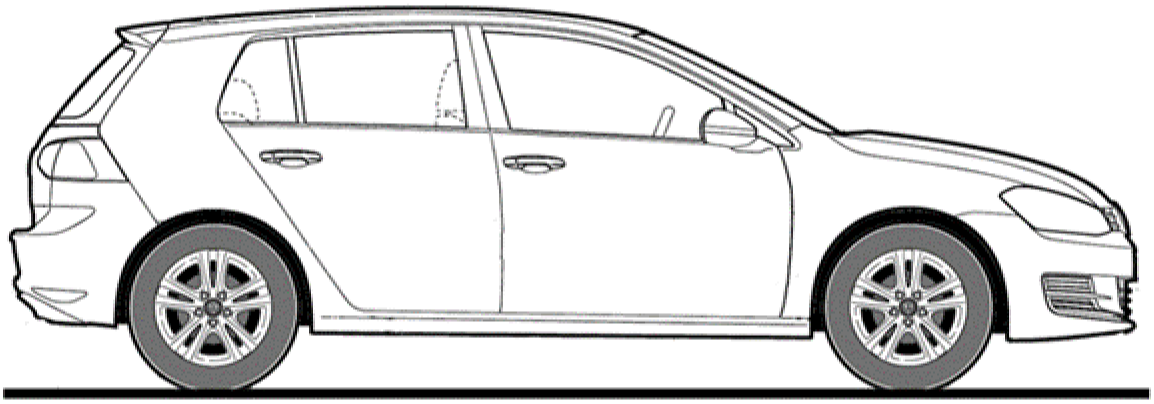
Empty	1/4	1/2	3/4	Full

Charge level (if applicable):

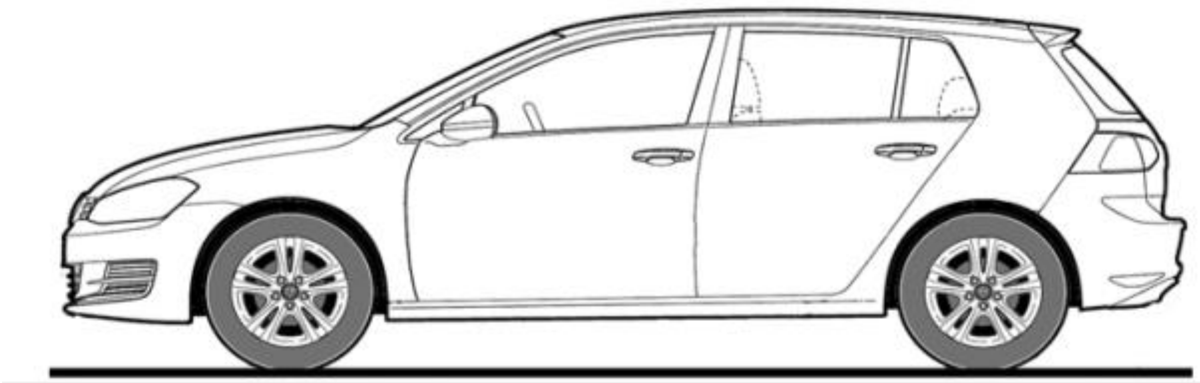
Empty	1/4	1/2	3/4	Full

Indicate any marks, scratches or damage on the vehicle on the corresponding pictures below. Add notes if necessary. **Participant and researcher to both sign on satisfactory completion of inspection**

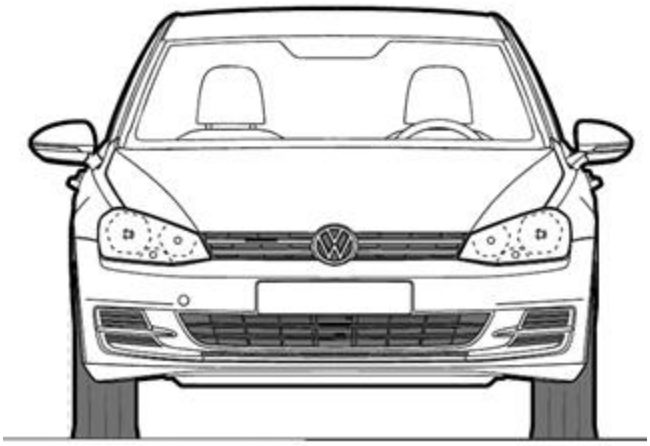
Driver's side:



Passenger side:



Front:



Rear:

Notes:

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Declaration:

I have inspected the above vehicle and agree that:

- **The equipment indicated is present**
- **The only damage is that which is marked or noted in this form**

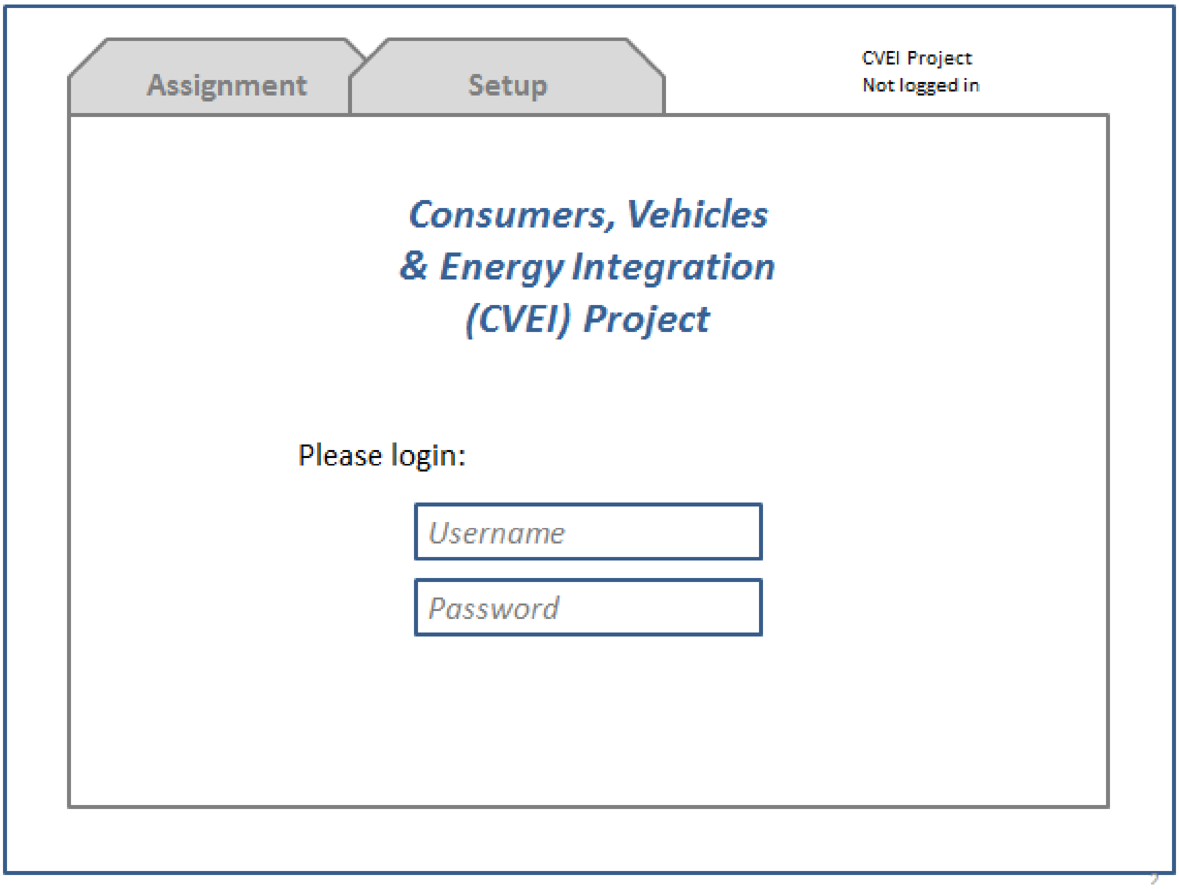
Participant signature:_______________________________________ Date:_________________

Researcher signature:_______________________________________ Date:________________

Appendix M Design for Admin Portal

TRL Admin Portal User Interface

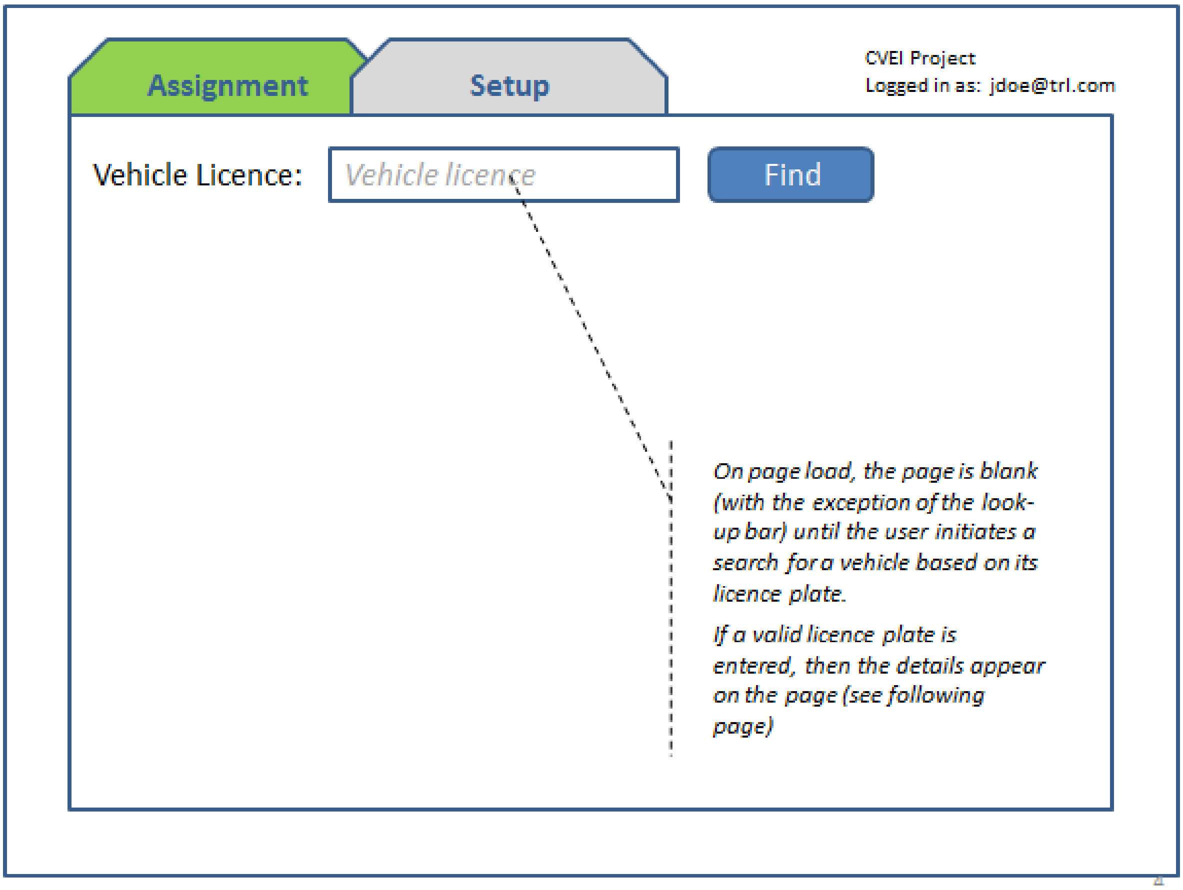
Log on page



Notes on Login

- Only accounts with Org Operator access or greater are allowed to login to the portal
  - No driver access
  - No customer support access

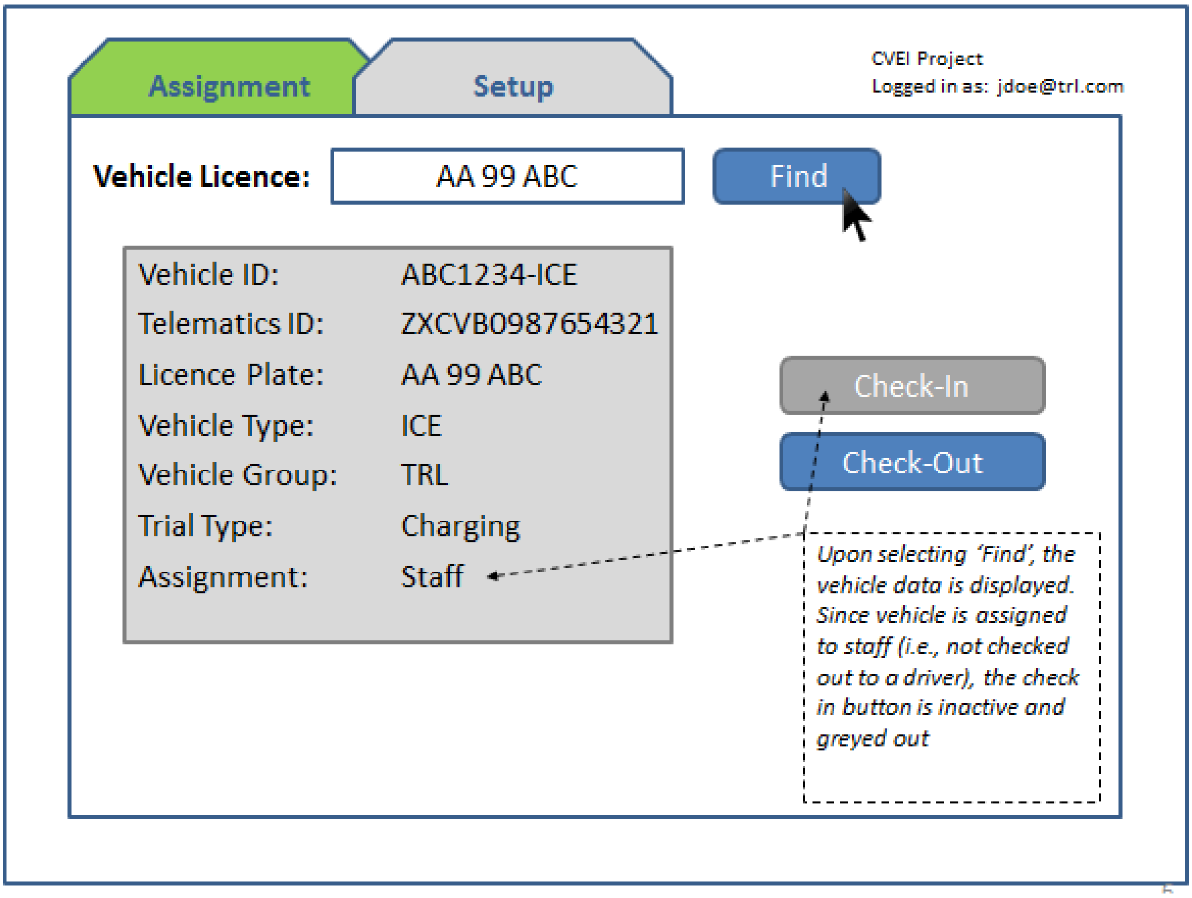
Assignment Tab: When page loads



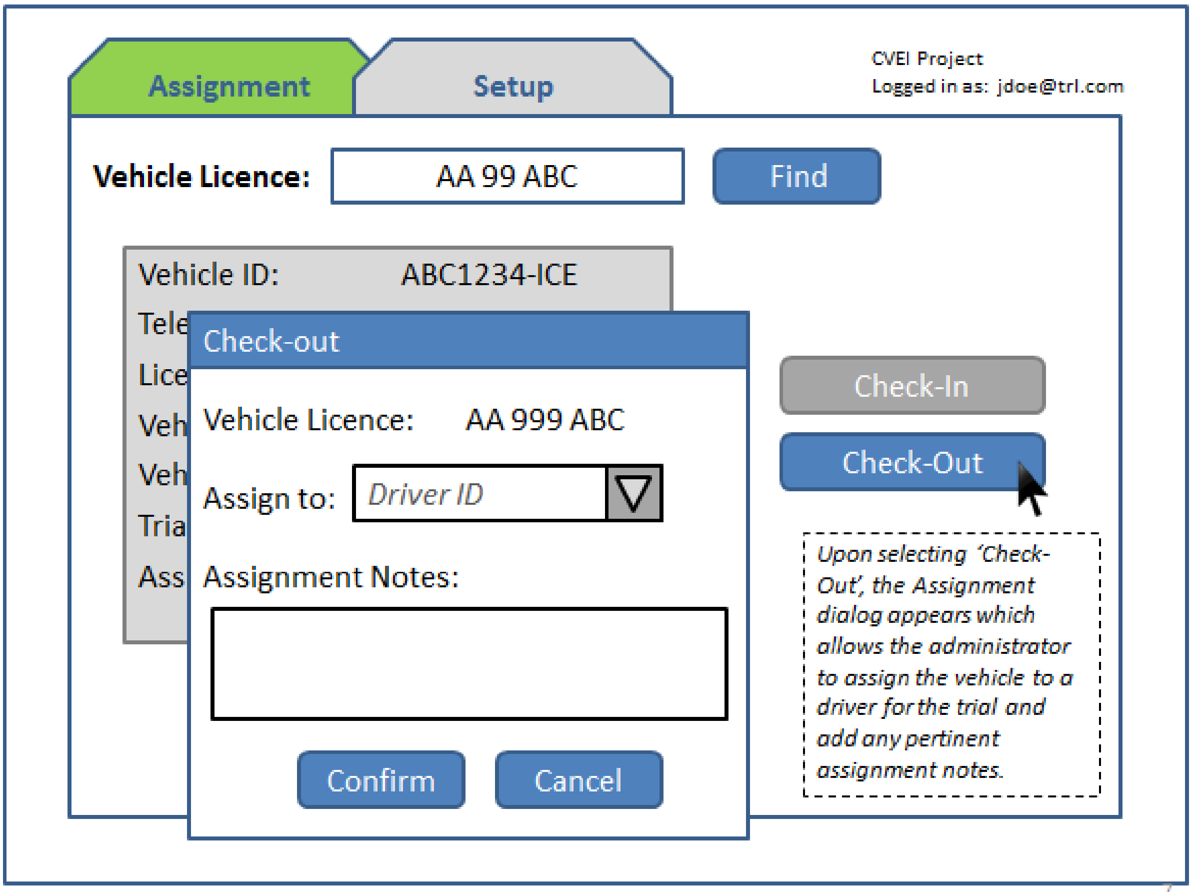
Notes on Look-Up

- The look-up field should actively search for vehicles that match the licence plate being entered in the field.
- The listing of licence plates should be sequential alphanumerically
- The look-up algorithm should disregard spaces in the licence plate number
    - E.g., AA 123 ABC is treated the same as AA123ABC
- If no vehicle exists with the entered licence plate, then the field should say, “no match found” or similar message.

Assignment Tab: Vehicle look-up



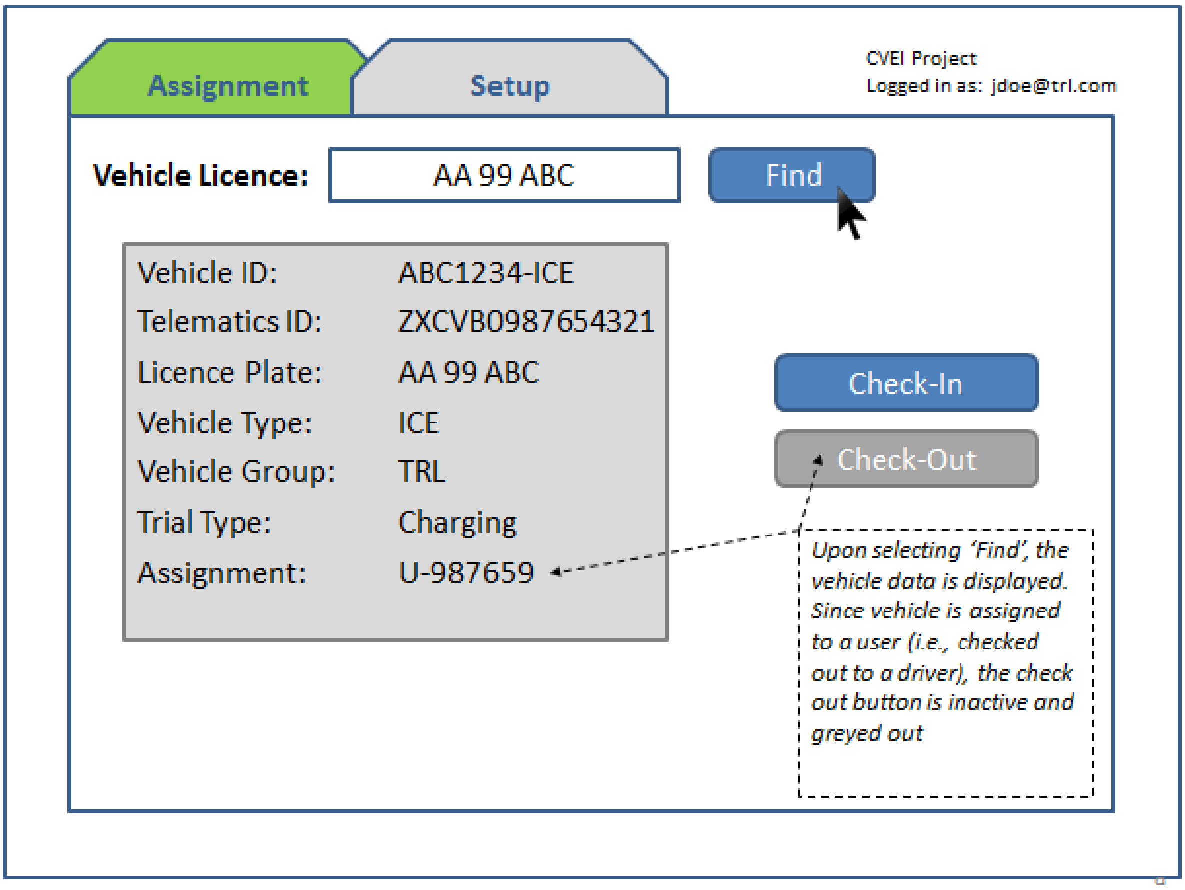
Assignment Tab: Vehicle check-out / driver assignment



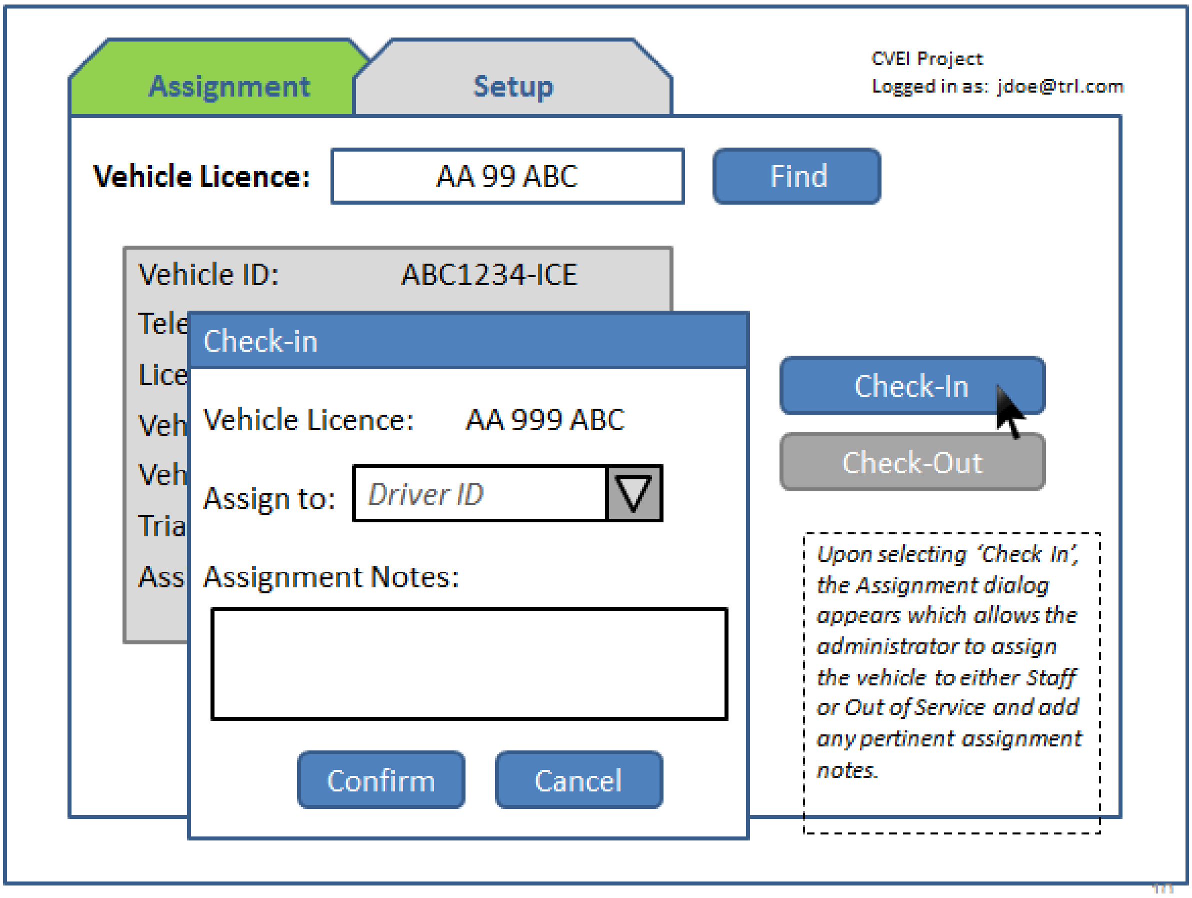
Notes on Check-Out

- Only vehicles that are currently assigned to 'Staff' or 'Out of Service', may be assigned to a Driver
- If the vehicle that is looked up is currently assigned to a driver, then the Check-Out button is grey and disabled
- If the vehicle that is looked up is currently assigned to Staff, then the Check-In button is grey and disabled
- Only drivers that are not currently assigned to a Vehicle will appear in the Driver ID drop down menu
- As there will be 450+ driver IDs, the driver IDs must be arranged in sequential alphanumeric order
- An entry in the Assignment Notes field is not required for completion of the form.
- When a vehicle is assigned via the Check-Out form and the form is submitted, the underlying vehicle information is updated to reflect the vehicle assignment / check-out
- The system will capture the state change in a log file which includes event type (check-out), date/time stamp, vehicle ID, user ID, assignment notes (if any)

Assignment Tab: Vehicle check-in



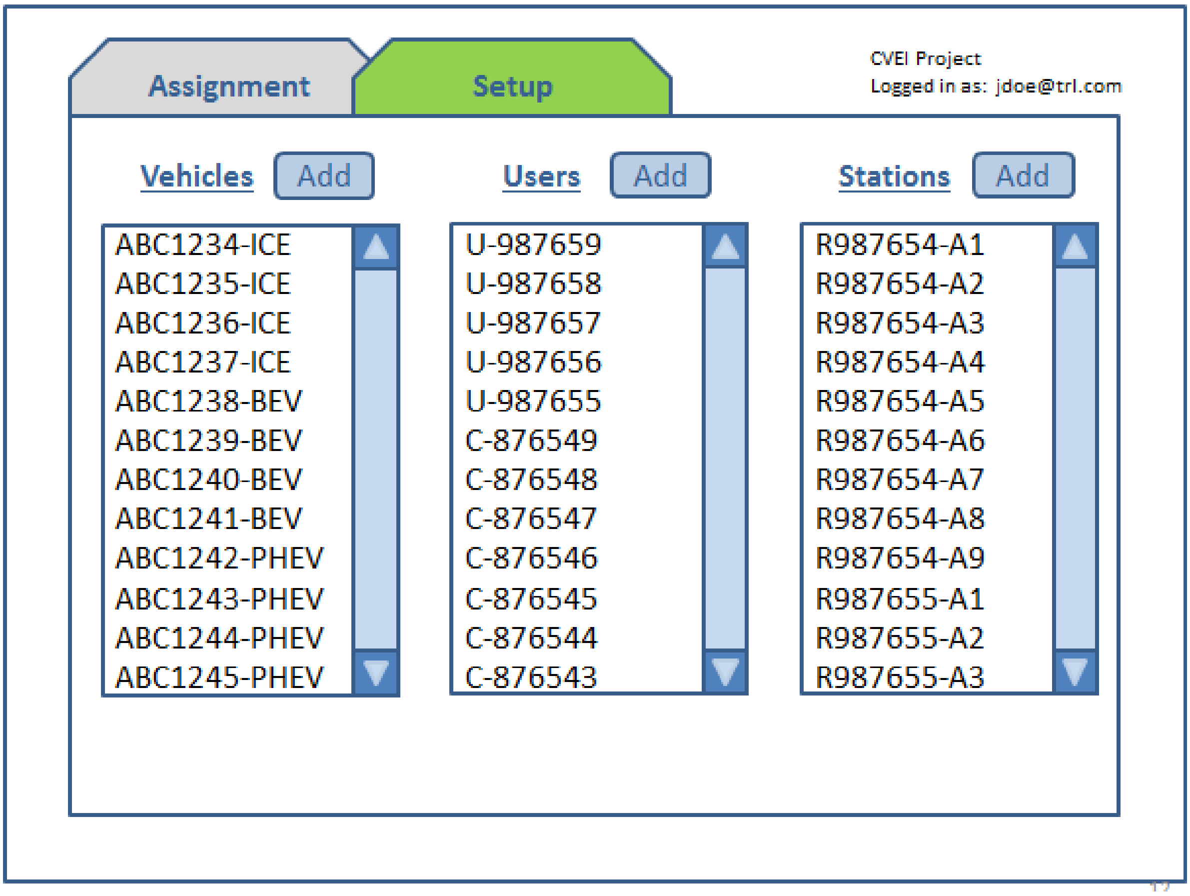
Assignment Tab: Vehicle check-in / Staff or Out of Service assignment



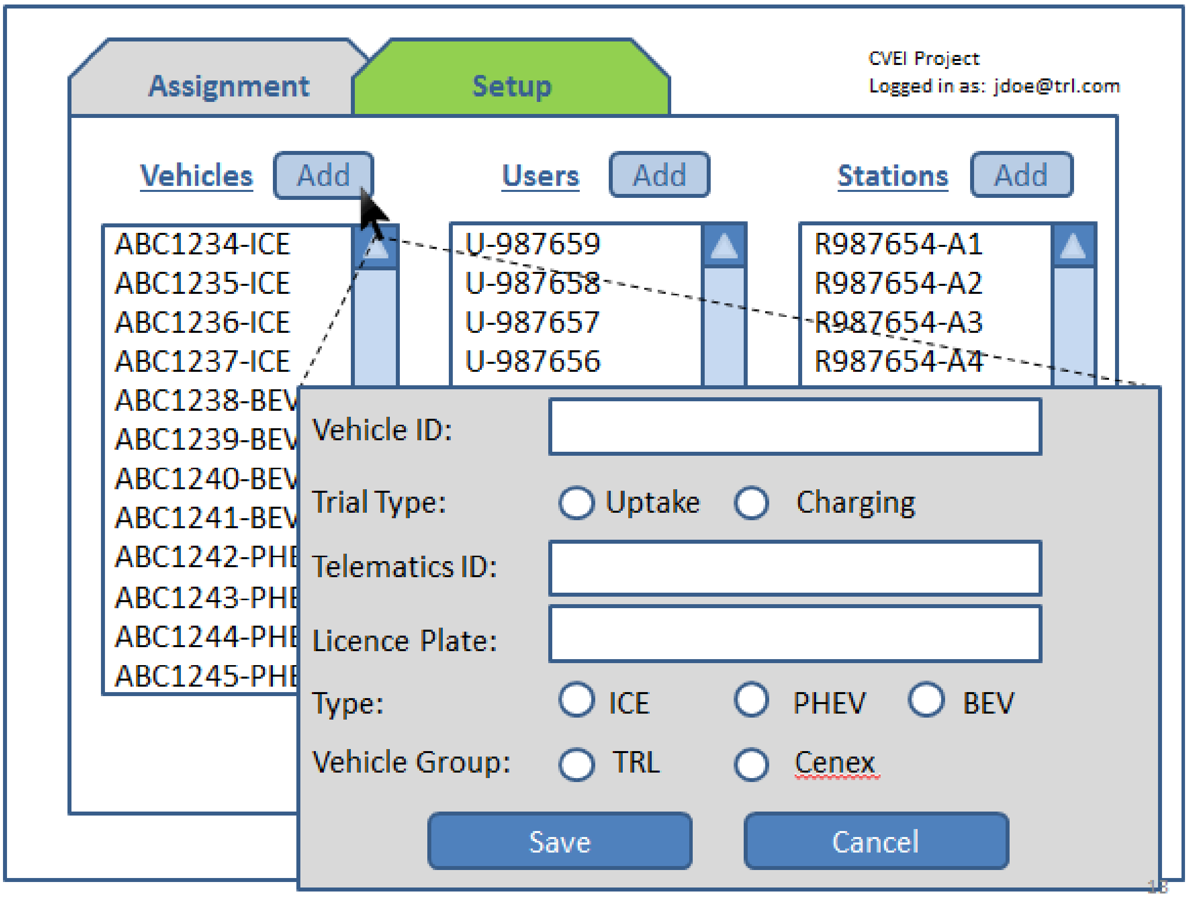
Notes on Check-In

- Only vehicles that are currently assigned to a User, may be checked in
- If the vehicle that is looked up is currently assigned to a driver, then the Check-Out button is grey and disabled
- If the vehicle that is looked up is currently assigned to Staff, then the Check-In button is grey and disabled
- The only 'drivers' that will appear in the Check-in dialog box are "Staff" and "Out of Service"
- An entry in the Assignment Notes field is not required for completion of the form.
- When a vehicle is assigned via the Check-In form and the form is submitted, the underlying vehicle information is updated to reflect the vehicle assignment / check-out
- The system will capture the state change in a log file which includes event type (check-in), date/time stamp, vehicle ID, assigned to (Staff or OoS), assignment notes (if any)

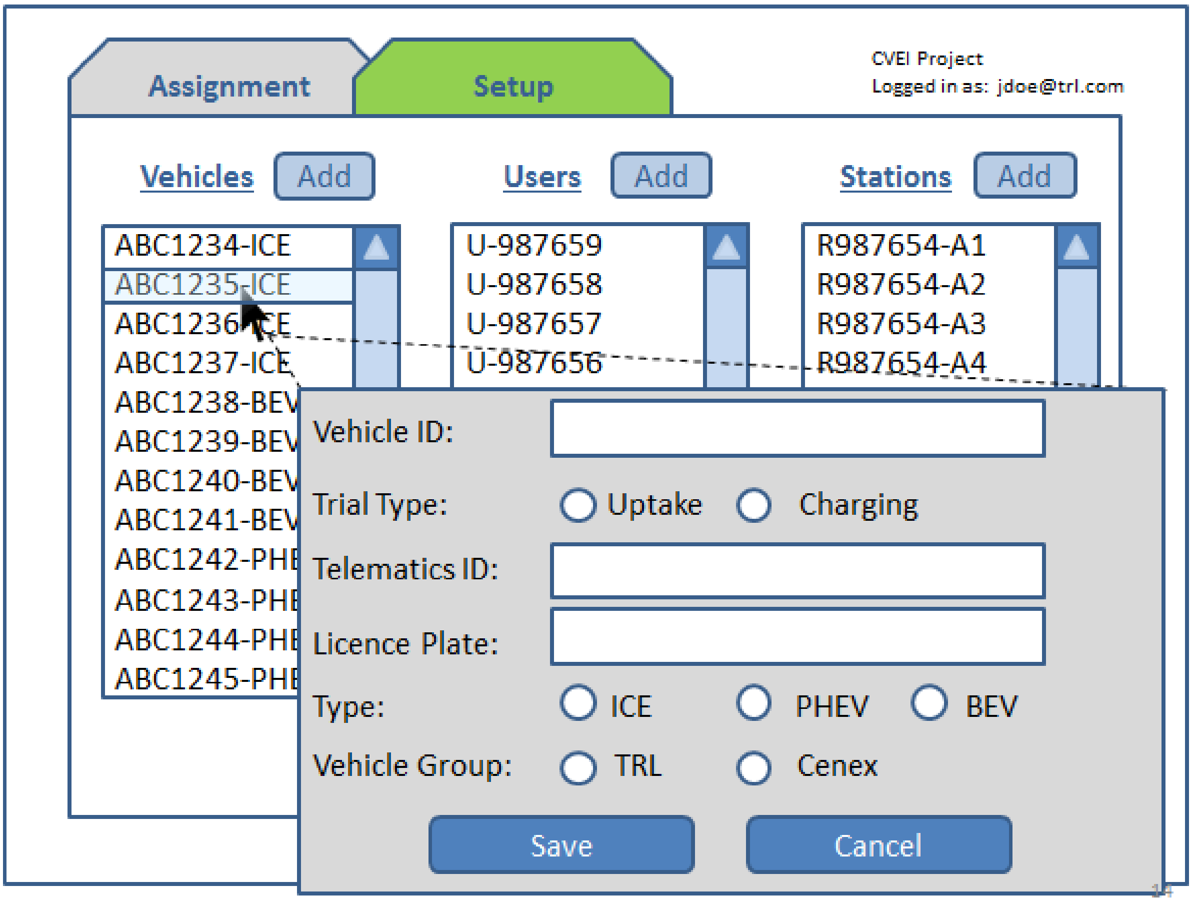
Setup Tab


Assignment
Setup
CVEI Project
Logged in as: jdoe@trl.com
Vehicles
Add
Users
Add
Stations
Add
ABC1234-ICE
ABC1235-ICE
ABC1236-ICE
ABC1237-ICE
ABC1238-BEV
ABC1239-BEV
ABC1240-BEV
ABC1241-BEV
ABC1242-PHEV
ABC1243-PHEV
ABC1244-PHEV
ABC1245-PHEV
U-987659
U-987658
U-987657
U-987656
U-987655
C-876549
C-876548
C-876547
C-876546
C-876545
C-876544
C-876543
R987654-A1
R987654-A2
R987654-A3
R987654-A4
R987654-A5
R987654-A6
R987654-A7
R987654-A8
R987654-A9
R987655-A1
R987655-A2
R987655-A3

Add new vehicle



Edit existing vehicle



Fields in Vehicle Form

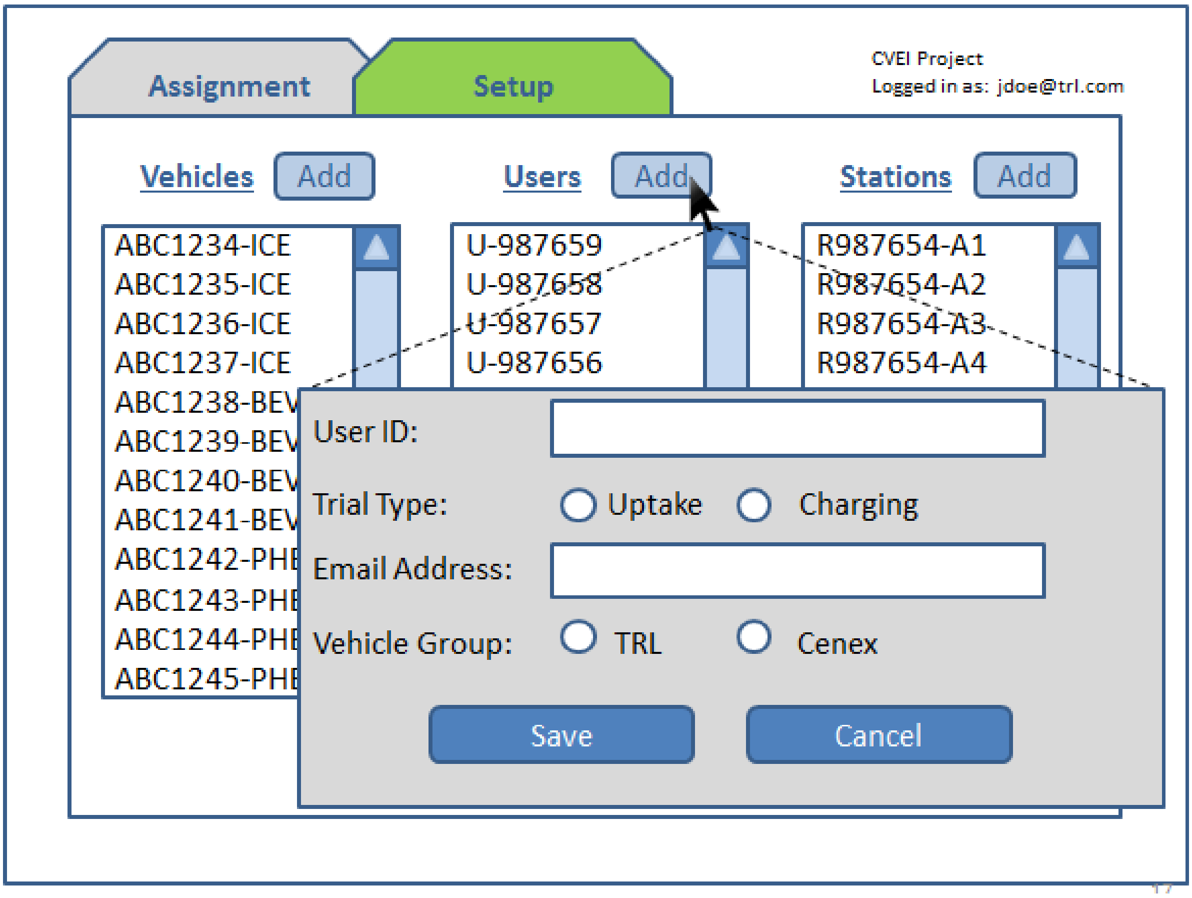
All fields are required

Field	Input format	Options (if applicable)
Vehicle ID	Text	
Trial Type	Check box	Uptake/Charging
Telematics ID	Text	
Licence Plate	Text	
Type	Check box	ICE/PHEV/BEV
Vehicle Group	Check box	TRL/Cenex

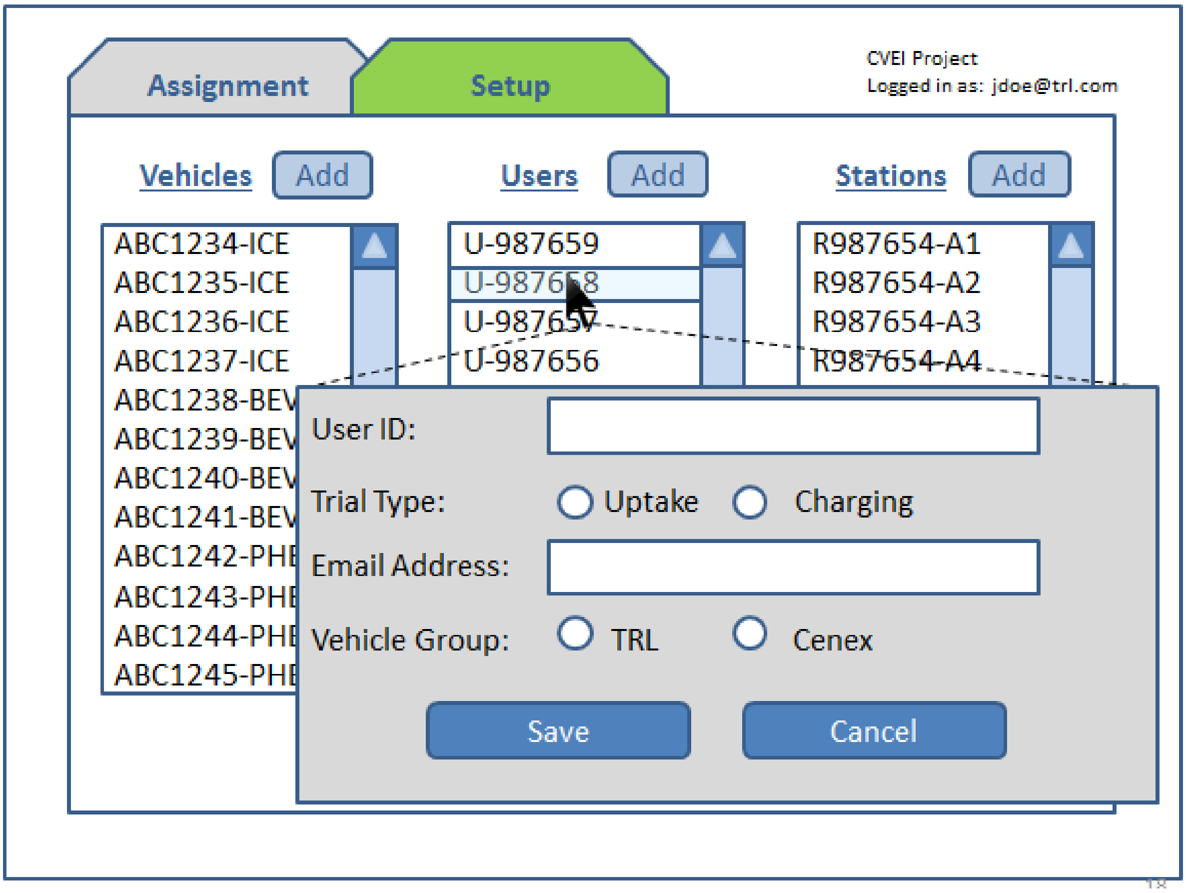
Notes on Vehicle Form

- When a new vehicle is created or an existing vehicle is edited, the system shall capture a log which includes event type (new/edit), date/time stamp, all fields in form

Add new user


Assignment
Setup
CVEI Project
Logged in as: jdoe@trl.com
Vehicles
Add
Users
Add
Stations
Add
ABC1234-ICE
ABC1235-ICE
ABC1236-ICE
ABC1237-ICE
ABC1238-BEV
ABC1239-BEV
ABC1240-BEV
ABC1241-BEV
ABC1242-PHE
ABC1243-PHE
ABC1244-PHE
ABC1245-PHE
U-987659
U-987658
U-987657
U-987656
R987654-A1
R987654-A2
R987654-A3
R987654-A4
User ID:
Trial Type:
Uptake
Charging
Email Address:
Vehicle Group:
TRL
Cenex
Save
Cancel

Edit existing user



Fields in User Form

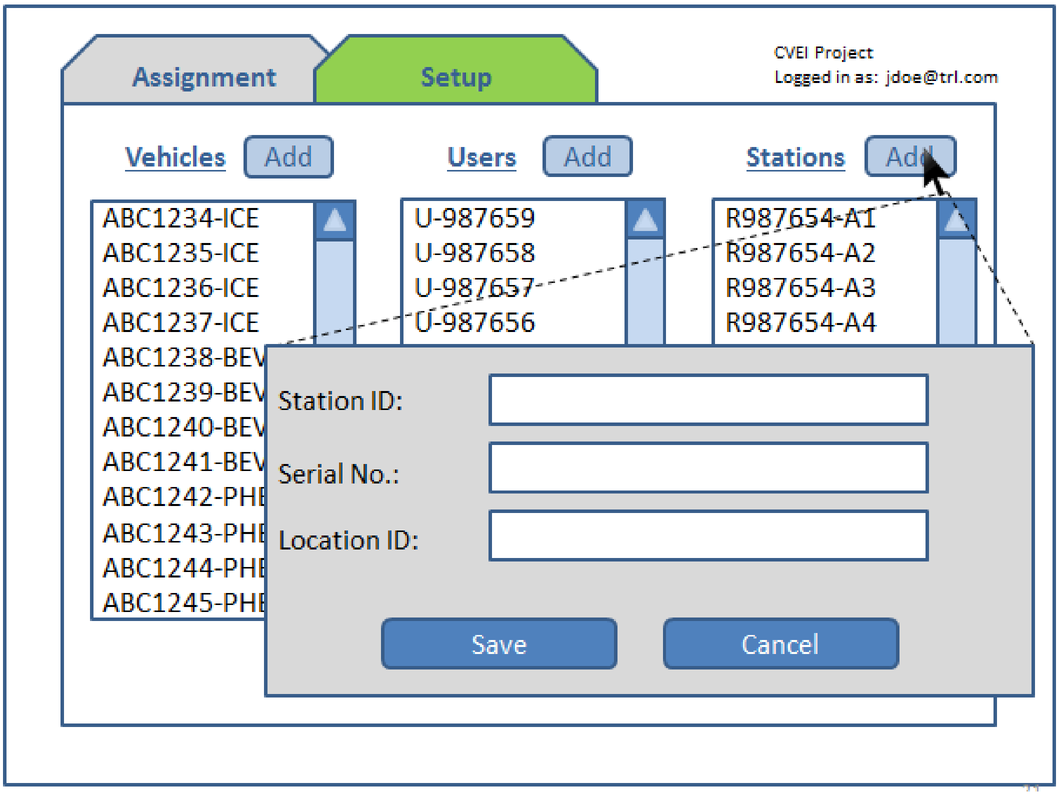
All fields are required unless otherwise noted

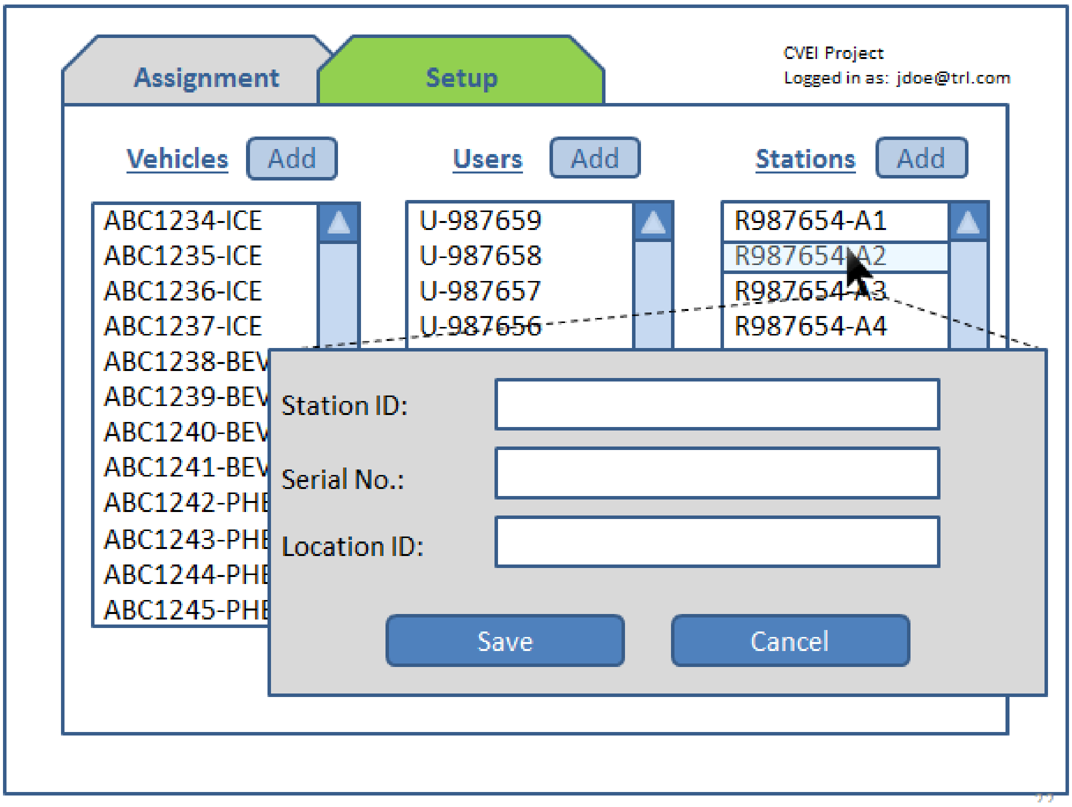
Field	Input format	Options (if applicable)
User ID	Text	
Trial Type	Check box	Uptake/Charging
Email Address	Text	
User Group	Check box	TRL/Cenex

Notes on User Form

- When a new user is created or an existing user is edited, the system shall capture a log which includes event type (new/edit), date/time stamp, all fields in form

Add new station





Fields in Station Form

All fields are required unless otherwise noted

Field	Input format	Options (if applicable)
Station ID	Text	
Serial No.	Text	
Location ID	Text	(Optional)

Notes on Station Form

- When a new Station is created or an existing Station is edited, the system shall capture a log which includes event type (new/edit), date/time stamp, all fields in form

Appendix N FleetCarma telematics device specification

FleetCarma C2

A plug-and-play vehicle telematics solution.

The FleetCarma C2 is a lightweight cellular data logger that clips into the OBD-II port and supports both conventional and electric vehicles.

Features

- Integrates with FleetCarma web portal for real-time vehicle status & location, along with historical energy, location, and vehicle diagnostics
- Electric vehicle support including trip & charging data, real-time state-of-charge, and smart charging capability
- Interfaces with J1979 OBD-II data
- Includes logging of GPS coordinates, speed, and elevation
- Low power consumption (extreme sleep: 2mA)
- Supports proprietary and enhanced signals (i.e. vehicle odometer)
- Compatible with all CAN and Legacy protocols dating back to 1996

Installation

- Simple integration by plugging into the OBD-II diagnostic port
- Automated setup via VIN retrieval

Connectivity

- High speed 3G cellular modem with support in over 150 countries

Dimensions

- 51.4mm x 62mm x 26mm / 2" x 2.4" x 1"

www.fleetcarma.com 1.800.975.2434 fleetcarma

Appendix O Telematics data fields

O.1 Raw data

O.1.1 Journey files

For each journey undertaken, a raw data file will be pushed from the FleetCarma dongle to TRL's Secure Server via an FTP. At the top of the worksheet in each raw data file, the following information will be coded:

--Meta Data--		
Start Time(UTC)	LoggerName	Vin
XX/XX/XXXX XX:XX:XX	XXXX-XXXX	XXXXXXXXX

This provides:

- The VIN for the vehicle
- The FleetCarma telematics unit ID number ('LoggerName')
- The start time and date of the journey

This information will enable cross-referencing with information entered into the Admin Portal in order to identify the participant for whom the data file relates.

Separate files will be generated for each journey – these will be combined into a single, holistic raw dataset by TRL in order to facilitate analysis (see section 3.2 of Part 3 of D5.1).

Each column in the data file provides a unique data field and each row represents a new recording during the journey. For example, the 'Vehicle speed [kph]' column will contain a new speed reading every 1 second during the journey. A screenshot showing an example file is provided in Figure 11. The key columns – all the data that will be used within the project - are listed in

Table 3, along with the sampling frequency and recording precision, and a short description on what journey data fields are provided. Note that some data fields reported in the raw data files from FleetCarma (such as NumberOfSatellites) have no relevance to the project so these are omitted from

Table 3. Also, the meanings of some of FleetCarma's column names are not intuitive; these have been changed in

Table 3 to make them more immediately meaningful. Finally, the example file shown in Figure 11 is iluustrative only and was not recorded within the project; the intervals between timestamped rows do not correspond to the sampling intervals to be used in this trial; those are shown in

Table 3.

Aggregated data for all journeys will also be provided in the Journey Logs which will be downloaded from the FleetCarma online portal (see Appendix O.2).

Table 3: Raw journey data

Column/ information in data file	Description	Units	Sampling interval (s)	Precision (decimal places)	Data fields provided / derived from column
Start Time (MetaData)	Start time and date of the journey	N/A	N/A	N/A	• Ignition on date & time
LoggerName (MetaData)	Unique telematics unit ID	N/A	N/A	N/A	• Enables linking to Participant ID
VIN (MetaData)	Vehicle Identification Number	N/A	N/A	N/A	• Enables linking to Participant ID
Timestamp(ms)	Timestamp (ms) for each row in dataset	Milliseconds	N/A	0	• Timestamp of data recordings in the file • Ignition off date & time (last row in column)
Odometer[kilometers]	Odometer reading (km)	km	30	0	• Odometer at start of journey (first row in column) • Odometer at end of journey (last row in column) • Journey distance travelled (current Odometer – starting Odometer) (all rows)
Vehicle Speed[kph]	Vehicle speed (kph)	kph	1	0	• Vehicle speed
RPM	Engine speed (PHEV)	RPM	1	0	• Engine speed
Fuel Level Input[%]	Nominal fuel tank liquid fill capacity as a percentage of the maximum The Golf GTE (PHEV) has 40 litre tank capacity (both 2016 and 2017 models).	%	10	5	• % liquid fuel level at ignition on (first row in column) • % liquid fuel level at ignition off (last row in column) • % liquid fuel level during journey (all rows)
ABS_ENGINE_LOAD	Absolute engine load (normalized air mass per intake stroke)	%	1	0	• Can be used to calculate instantaneous specific fuel consumption

					(combined with air-fuel ratio of gasoline)
HV Battery Current[A]	DC Electrical current measured at the high voltage battery terminal in amps. + is defined as charging the battery. – is discharging the battery.	Amps	1	5	• Maximum C-rate (HV Battery Current * HV Battery Voltage)
HV Battery Voltage[V]	DC electrical voltage measured at the high voltage battery terminal in volts. This number will always be positive, and will remain within a consistent range.	Volts	1	5	• Maximum C-rate (HV Battery Current * HV Battery Voltage)
HV Battery SOC[%]	State of Charge (SOC) (%)	%	10	0	• State of Charge (SOC) at ignition on (first row in column) • State of Charge (SOC) at ignition off (last row in column) • State of Charge (SOC) during journey (all rows)
HV Battery Temperature[degC]	High-voltage battery pack temperature (°C)	Degrees Celcius	60	1	• Battery pack temperature
OAT[DegC]	Ambient temperature (°C)	Degrees Celcius	60	0	• Ambient temperature during journey
Is Driving[bool]	Represents a 1 or a 0 to indicate if the vehicle is driving	N/A	1	0	• Indicator of driving status (1 = ignition on, 0 = ignition off)
Latitude[deg]	Latitude GPS coordinates	Degrees	10	5	• Location (GPS co-ordinates) of start of journey (first row in column) • Location (GPS co-ordinates) of end of

					journey (last row in column) • Journey route (GPS co-ordinates) (all rows)
Longitude[deg]	Longitude GPS coordinates	Degrees	10	5	• Location (GPS co-ordinates) of start of journey (first row in column) • Location (GPS co-ordinates) of end of journey (last row in column) • Journey route (GPS co-ordinates) (all rows)

--Meta Data--															
Start Time(UTC)	LoggerName	Pck	Vin												
05/16/2017 07:14:39	5160-09C8														
--Raw Data--															
Timestamp(ms)	Altitude[m]	C2 Input Voltage[V]	Fuel Level Input[%]	HDOP	HV Battery Current[A]	HV Battery SOC[%]	HV Battery Temperature [degC]	HV Battery Voltage[V]	Is Driving [bool]	Latitude [deg]	Longitude [deg]	NumberOf Satellites	OAT[DegC]	Odometer [kilometer s]	Vehicle Speed[k m/h]
900	62.70000076	13.228	0	1.06	0	0	0	0	1	51.3834	-0.783448	11	0	0	0
1200	62.70000076	13.228	0	1.06	0	20	0	0	1	51.3834	-0.783448	11	0	0	0
1300	62.70000076	13.228	0	1.06	0	20	0	346.5	1	51.3834	-0.783448	11	0	0	0
1400	62.70000076	13.228	0	1.06	-1.099975586	20	0	346.5	1	51.3834	-0.783448	11	0	0	0
1600	62.70000076	13.228	0	1.06	-1.099975586	20	0	346.5	1	51.3834	-0.783448	11	0	287	0
1800	62.70000076	13.228	0	1.06	-1.099975586	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
2000	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
3300	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
3400	62.70000076	13.228	72.15686	1.06	-1.300048828	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
5500	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
6500	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
8500	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
9600	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
11600	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
13700	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
14800	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
16800	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
18900	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
20000	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
22100	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
24200	62.70000076	13.228	72.15686	1.06	-1.099975586	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
25200	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
26200	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
27200	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0
28300	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
29400	62.70000076	13.228	72.15686	1.06	-0.700073242	20	22.5	346.200012	1	51.3834	-0.783448	11	18	287	0
30400	62.70000076	13.228	72.15686	1.06	-0.900024414	20	22.5	346.5	1	51.3834	-0.783448	11	18	287	0

Figure 11: Screenshot showing example raw telematics journey data file

O.1.2 Charge files

As with the journey data, for each charging event, a raw data file will be pushed from the FleetCarma dongle to TRL's Secure Server via an FTP. At the top of the worksheet in each raw data file, the following information will be coded:

--Meta Data--				
Start Time(UTC)	Charge Latitude[deg]	Charge Longitude[deg]	LoggerName	Vin
XX/XX/XXXX XX:XX:XX	XX.XXXXX	XX.XXXXX	XXXX-XXXX	XXXXXXXXX

This provides:

- The VIN for the vehicle
- The FleetCarma telematics unit ID number ('LoggerName')
- The start time and date of the charge
- The location of the charge (GPS coordinates)

This information will enable cross-referencing with information entered into the Admin Portal in order to identify the participant for whom the data file relates.

Separate files will be generated for each charge – these will be combined into a single, holistic raw dataset by TRL in order to facilitate analysis (see section 3.2 of Part 3 of D5.1).

Each column in the data file provides a unique data field and each row represents a new recording during the charge. For example, the 'HV Battery SOC[%]' column contains a new SOC reading every 10 seconds during the charge. The key columns are listed in Table 4, along with the sampling frequency and recording precision, and a short description on what charge data fields are provided. A screenshot showing an example data file is provided in Figure 12.

Aggregated data for all charge events will also be provided in the Charge Logs which will be downloaded from the FleetCarma online portal (see Appendix 0).

Table 4: Raw charge data

Column/ information in data file	Description	Units	Sampling frequency (s)	Precision (number of decimal places)	Data fields provided
Start Time (MetaData)	Start time and date of the charge	N/A	N/A	N/A	• Charge start date & time
LoggerName (MetaData)	Unique telematics unit ID	N/A	N/A	N/A	• Enables linking to Participant ID
VIN (MetaData)	Vehicle Identification Number	N/A	N/A	N/A	• Enables linking to Participant ID
Timestamp(ms)	Timestamp (ms) for each row in dataset	Milliseconds	N/A	0	• Timestamp of data recordings in the file • Charge end date & time (last row in column)
HV Battery Current[A]	DC Electrical current measured at the high voltage battery terminal in amps. + is defined as	Amps	1	5	• Battery current during the charge

	charging the battery. – is discharging the battery.				
HV Battery Voltage[V]	DC electrical voltage measured at the high voltage battery terminal in volts. This number will always be positive, and will remain within a consistent range.	Volts	1	5	• Battery voltage during the charge
HV Battery SOC[%]	State of Charge (SOC) (%)	%	120	0	• State of Charge (SOC) at charge start (first row in column) • State of Charge (SOC) at charge end (last row in column) • State of Charge (SOC) during charge (all rows)
HV Battery Temperature[degC]	High-voltage battery pack temperature (°C)	Degrees Celcius	60	1	• Battery pack temperature
Is Charging[bool]	Represents a 1 or a 0 to indicate if the vehicle is charging	N/A	1	0	• Indicator of charging status (1 = charge flowing into battery, 0 = no charge flowing into battery)
Latitude[deg]	Latitude GPS coordinates	Degrees	300	5	• Location (GPS co-ordinates) of charge event
Longitude[deg]	Longitude GPS coordinates	Degrees	300	5	• Location (GPS co-ordinates) of charge event

--Meta Data--											
Start Time(UTC)	Charge Latitude[deg]	Charge Longitude[deg]	LoggerName	Pck	Vin						
05/16/2017 07:40:56	51.38352194	-0.7836025	5160-09C8								
--Raw Data--											
Timestamp(ms)	Altitude[m]	C2 Input Voltage[V]	HDOP	HV Battery Current[A]	HV Battery SOC[%]	HV Battery Temperature [degC]	HV Battery Voltage [V]	Is Charging [bool]	Latitude [deg]	Longitude [deg]	NumberOf Satellites
400	81.5	13.27799988	0.790000021	0	0	0	0	1	51.3835	-0.783644	12
700	81.5	13.27799988	0.790000021	0	31.5	0	0	1	51.3835	-0.783644	12
800	81.5	13.27799988	0.790000021	0	31.5	0	352.2	1	51.3835	-0.783644	12
900	81.5	13.27799988	0.790000021	8.59997559	31.5	0	352.2	1	51.3835	-0.783644	12
1400	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
2900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
3900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
4000	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
6000	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352	1	51.3835	-0.783644	12
6100	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
7000	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
9200	81.5	13.27799988	0.790000021	9	31.5	22.5	352.2	1	51.3835	-0.783644	12
10200	81.5	13.27799988	0.790000021	9	31.5	22.5	352	1	51.3835	-0.783644	12
11200	81.5	13.27799988	0.790000021	9	31.5	22.5	352.2	1	51.3835	-0.783644	12
11300	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
12200	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
16500	81.5	13.27799988	0.790000021	9	31.5	22.5	352	1	51.3835	-0.783644	12
17600	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352	1	51.3835	-0.783644	12
18600	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
21900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
22900	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12
23800	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.7	1	51.3835	-0.783644	12
24000	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.7	1	51.3835	-0.783644	12
24800	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
25900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352	1	51.3835	-0.783644	12
26900	81.5	13.27799988	0.790000021	8.79992676	31.5	22.5	352.2	1	51.3835	-0.783644	12
27100	81.5	13.27799988	0.790000021	8.59997559	31.5	22.5	352.2	1	51.3835	-0.783644	12

Figure 12: Screenshot showing example raw telematics charge data file

O.2 Journey Logs

This dataset contains aggregated data per journey which will be processed by FleetCarma uploaded to their online portal. Data from each vehicle will be downloaded from the portal by TRL at the end of each participant's 4-day trial experience. The data are detailed and described in

Table 5. A screenshot showing an example data file is provided in Figure 13.

Table 5: Aggregated journey data ('Journey Logs')

Data field (column heading)	Example data	Sampling frequency	Precision (number of decimal places)	Description
TripId	5697782	1 per journey	N/A	Unique ID for each journey; different journeys saved on different rows within the dataset
Date	February 27 2017 06:12:16 AM	1 per journey	N/A	Start date and time for each journey
Duration	00:33:12	1 per journey	HH:MM:SS	Total duration of journey (ignition on to ignition off)
Trip distance (mi or km)	18.74	1 per journey	2	Total distance of journey (ignition on to ignition off)
Fuel consumed (gal or litres)	0.8	1 per journey	2	Total fuel consumed during journey
Fuel consumption (MPG or L/100km)	24.91	1 per journey	2	Average fuel consumption in journey (this is calculated in the portal by dividing the number of miles driven by the total gallons of petrol used)
Electricity consumed (kWh)	0.27	1 per journey	1	Total electricity used during journey
Energy consumption (Wh/mi)	1367	1 per journey	2	Average electricity consumption in journey
Start SOC (%)	15	1 per journey	2	Vehicle SOC at start of journey
End SOC (%)	9.5	1 per journey	2	Vehicle SOC at end of journey
Ambient temperature (°F or °C)	44.6	1 per journey	1	Average ambient temperature during journey
Average speed (mph or kph)	33.87	1 per journey	1	Average speed during journey
Max speed (mph or kph)	71.46	1 per journey	1	Maximum speed reached during journey
EV-Fraction	27	1 per journey	2	Proportion of time during journey in which PHEV was powered by the electric motor as compared to the ICE (PHEV only)
Auxiliary load (kW)	0	1 per journey	2	Amount of energy consumed from the battery for non-driving functions, such as HVAC (PHEV and BEV only)
% Hard Acceleration	15	1 per journey	0	Total percentage of all acceleration events that are classified as "hard" acceleration.
% Hard Braking	17	1 per journey	2	Total percentage of all braking events that are classified as "hard" braking.
% Time Idle	10%	1 per journey	0	Percentage of time during the journey in which the vehicle was idling (engine turned on but stationary) (PHEV or ICE)

Number of Idle Events	0	1 per journey	0	The count of the total number of idling sessions, where the engine was operating but the vehicle was stationary for more than 60 seconds continuously (PHEV or ICE)

TripId	Date	Duration	Trip Distance (mi)	Starting Odometer (mi)	Ending Odometer (mi)	Fuel Consumed (gal)	Fuel Consumption (MPG)	Electricity Consumed (kWh)	Total Energy Consumption (MPGeq)	Start SOC	End SOC	Ambient Temperature (°F)	Average Speed (MPH)	Max Speed (MPH)	EV-Fraction	Auxiliary Load (kW)	% Hard Acceleration	% Hard Braking	% Time Idle	Number of Idle Events
6392615	May 17 2017 08:17:33 AM	00:12:12	2.55	182.68	185.79	0.1	44.46	0.65	33	80.5	71.5	59	12.54	53.44	78	0.2	8	4	22%	0
6386662	May 16 2017 06:28:31 PM	00:09:47	0	182.68	182.68	0		0.05		81	80.5	66.2	0	0		0.33			99%	0
6386545	May 16 2017 06:17:00 PM	00:10:51	1.82	180.82	182.68	0	158.8	0.49	70	88	81	68	10.07	36.66	83	0.17	20	11	42%	0
6384896	May 16 2017 04:19:00 PM	00:01:06	0	180.82	180.82	0		0.01		88	88	68	0	0		0.36			98%	0
6384876	May 16 2017 04:09:54 PM	00:08:44	2.76	178.33	180.82	0	138.05	0.69	68	98.5	88	68	18.94	47.85	87	0.07	28	7	16%	0
6381794	May 16 2017 10:41:05 AM	00:02:58	0.09	178.33	178.33	0		0.09		100	98.5	71.6	1.91	9.32	100	0.41	0	0	24%	0
6381389	May 16 2017 08:14:39 AM	00:01:21	0	178.33	178.33	0		0.01		20	20	64.4	0	0		0.31			95%	0
6381374	May 16 2017 07:51:40 AM	00:18:22	8.81	169.63	178.33	0.3	32.74	1.47	28	43	20	60.8	28.8	72.08	55	0.09	16	13	11%	0
6381347	May 16 2017 07:39:26 AM	00:05:12	0.43	169.01	169.63	0		0.43		50	43.5	60.8	5.01	26.72	96	1.03	0	19	43%	0
6376891	May 15 2017 08:06:36 PM	00:01:10	0	169.01	169.01	0		0.01		50.5	50.5	64.4	0	0		0.45			93%	0
6376743	May 15 2017 08:01:28 PM	00:01:13	0	169.01	169.01	0		0.02		50.5	50.5	62.6	0.09	1.24	100	0.98	0	0	63%	0
6376723	May 15 2017 07:50:33 PM	00:10:14	2.09	166.53	169.01	0.1	20.43	-0.25	22	46	50.5	59	12.27	38.53	8	-0.18	4	4	20%	0
6376505	May 15 2017 07:34:13 PM	00:08:07	1.24	165.28	166.53	0.1		-0.13		44	46	60.8	9.15	27.34	26	-0.14	13	5	18%	0
6376280	May 15 2017 07:06:14 PM	00:17:24	2.94	162.18	165.28	0.2	15.65	-0.33	17	39.5	44	59	10.12	35.42	11	-0.21	11	5	31%	0
6373930	May 15 2017 05:43:44 PM	00:05:27	1.45	160.94	162.18	0	6084.22	0.38	124	46	41	60.8	15.93	32.31	99	0.25	16	19	11%	0
6373756	May 15 2017 05:11:08 PM	00:26:47	10.76	150.37	160.94	0	14547.18	3.67	98	100	46	62.6	24.11	72.7	100	0.17	11	11	19%	0
6369619	May 15 2017 01:06:28 PM	00:01:13	0.09	149.75	150.37	0		0.05		42.5	42	59	4.26	13.05	100	0.26	0	0	16%	0
6369785	May 15 2017 01:06:28 PM	00:01:13	0.09	149.75	150.37	0		0.05		42.5	42	59	4.26	13.05	100	0.26	0	0	16%	0
6368625	May 15 2017 12:59:48 PM	00:02:06	0.03	149.75	149.75	0		0.03		43	42.5	59	0.94	8.7	100	0.27	0	0	71%	0
6350446	May 12 2017 05:38:42 PM	00:01:17	0.09	149.75	149.75	0		0.05		44	43	62.6	3.98	10.56	100	0.29	0	0	17%	0
6346061	May 12 2017 09:47:03 AM	00:15:48	6.11	143.54	149.75	0	869.76	1.85	99	70	44	57.2	23.21	45.98	99	0.05	12	28	6%	0
6338457	May 11 2017 04:32:07 PM	00:19:42	5.92	137.94	143.54	0	16004.67	1.78	111	96.5	70	64.4	18.03	45.36	100	0.18	18	23	15%	0
6316578	May 09 2017 01:45:52 PM	00:01:16	0	137.94	137.94	0		0.01		97	96.5	53.6	0	0		0.42			93%	0
6316575	May 09 2017 01:43:35 PM	00:02:15	0	137.94	137.94	0		0.01		97	97	53.6	0	0		0.38			96%	0
6282321	May 05 2017 02:16:03 PM	00:07:55	0	137.94	137.94	0		0.04		97.5	97	71.6	0	0		0.32			99%	0
6261584	May 03 2017 05:47:53 PM	00:01:27	0.06	137.94	137.94	0		0.14		100	98	48.2	2.67	11.18	100	1.55	0	0	29%	0
6258241	May 03 2017 01:05:35 PM	00:13:36	5.77	131.73	137.94	0	15613.21	2.31	84	68.5	36	50	25.48	42.25	99	0.08	9	26	2%	0
6250865	May 02 2017 06:29:09 PM	00:14:12	5.93	126.14	131.73	0	2674.17	1.99	97	97	68.5	55.4	25.07	45.36	99	0.04	9	21	2%	0
6208537	April 27 2017 06:57:46 PM	00:01:50	0.17	125.52	126.14	0		0.19		100	97	48.2	5.49	15.53	100	0.91	0	0	20%	0
6205829	April 27 2017 03:26:15 PM	00:06:51	2.54	123.03	125.52	0	286.11	0.96	68	80	66.5	50	22.24	49.09	97	0.16	26	21	7%	0
6205731	April 27 2017 03:15:55 PM	00:06:08	1.91	121.17	123.03	0	643.9	0.92	63	94.5	80.5	48.2	18.64	41.01	98	0.18	4	25	6%	0
6148106	April 21 2017 03:23:19 PM	00:06:01	0	121.17	121.17	0		0.1		96.5	95	59	0.02	1.86	100	0.9	0	0	96%	0
6128184	April 19 2017 05:40:21 PM	00:03:12	0.21	121.17	121.17	0		0.14		98.5	96.5	62.6	4.02	16.78	100	0.53	0	0	46%	0

Figure 13: Screenshot showing example Journey Log data file

O.3 Charge Logs

This dataset contains aggregated data per journey which will be processed by FleetCarma and uploaded to their online portal. Data from each vehicle will be downloaded from the portal by TRL at the end of each participant's 4-day trial experience. The data are detailed and described in Table 6. A screenshot showing an example data file is provided in Figure 14.

Table 6: Aggregated charge data ('Charge Logs')

Data field (column heading)	Example data	Sampling frequency	Precision (number of decimal places)	Description
Charge Session ID	871004	1 per charge event	N/A	Unique ID for each charge session; different charge sessions saved on different rows within the dataset
Start Date	February 27 2017 09:35:50 AM	1 per charge event	N/A	Start date and time for each charge session
Duration	00:03:31	1 per charge event	HH:MM:SS	Total duration of charge session (charge start to charge stop)
Charging Power	2	1 per charge event	0	Power output of the charger, categorised in levels (Level 2 is a 270 V charger; Level 3 is a DC Fast Charger)

Charger Energy (kWh)	0.2	1 per charge event	2	The total amount of energy the vehicle gains during the charging session
Charger Loss (kWh)	0.02	1 per charge event	2	The total amount of energy lost during charging due to heat and other factors
Start SOC (%)	60	1 per charge event	1	Vehicle SOC at start of charge session
End SOC (%)	62.5	1 per charge event	1	Vehicle SOC at end of charge session
Latitude	51.3836	1 per charge event	4	Latitude GPS coordinates of charge session
Longitude	-0.7833	1 per charge event	4	Longitude GPS coordinates of charge session

ChargeSessionId	Start Date	Duration	Charging Power	Charger Energy (kWh)	Charger Loss (kWh)	Start SOC (%)	End SOC (%)	Latitude	Longitude
978313	May 17 2017 07:57:54 AM	01:13:56	2	4.19	0.44	15	67	51.3835	-0.7835
977210	May 16 2017 02:54:41 PM	01:13:35	2	4.17	0.45	8	59.5	51.3835	-0.7835
969064	May 10 2017 08:51:54 AM	01:55:13	2	6.44	0.67	19.5	100	51.3835	-0.7836

Figure 14: Screenshot showing example Charge Log data file

Appendix P Participant debrief letter

Dear XXX,

Thank you for taking part in our vehicle trials. We really appreciate your time and effort and hope you have enjoyed taking part.

Now that the trial is completed you should have received your final payment. If you have not yet received it please contact vehicletrials@trl.co.uk to let us know.

Your contribution to this project will contribute to policy making in the future. The project is due to end mid-2018, and the project reports will be made publically available following approval from our client, the Energy Technologies Institute (ETI).

All of the data and information obtained during this study will be kept private and the findings will be shared with our client. While the findings will be published, your identity will never be revealed in the results.

If you have any further questions please do not hesitate to contact us either by email at: vehicletrials@trl.co.uk or by phone on: 01344 770 014.

We would like to thank you again for your participation,

Kind regards,

The TRL research team

Appendix Q Deliverable D7.1 supporting documentation

Overview

Baringa

Version, Contacts and Copyright

This report is delivered under the Consumers, Vehicles and Energy Integration project, commissioned and funded by the Energy Technologies Institute

Version

Version	Date	Description	Prepared by	Approved by
V1_0	16/02/2017	Draft	JG, NB, OR (Baringa)	SS (TRL)
V2_0	12/04/2017	Final	NB, OR (Baringa)	SS (TRL)
V3_0	24/07/2017	Updated for comments	NB (Baringa)	SS (TRL)
V4_0	31/08/17	Updated for comments	HAK (TRL)	SS (TRL

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Contents

Baringa

These slides outline the methodology behind the calculations of price and tariff data that are to be used in the Consumer Charging Trials. The price and tariff data will be used in the participant reward points system that will be used for User-Managed Charging (UMC) and Supplier-Managed Charging. This system is explained in D5.1 Part 3 section 2.8 .

3

Savings Points (D7.1) – UMC Methodology

Baringa

Points are accrued based on comparing cost of charging at scheduled time vs. cost of charging in highest price band

UMC Charging Cost Savings

- The UMC trial uses 'block prices' instead of hourly prices, representing a time of use tariff. There are four blocks across the day and the block prices are an average of the prices across the year for the hours in each block (i.e. aligned to the SMC hourly prices).
- The prices differ by block by characteristic day – Summer/Winter and weekday/weekend.
- The participant accrues Charging Cost Savings Points, based on the difference between the cost of the charging carried out at the time chosen by the participant, versus the cost of completing the same amount of charging in the highest priced band of the day (see D5.1 Part 3 section 2.8.4).
- The price differences between blocks have been compared against other sources.

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Savings Points (D7.1) – SMC Methodology

Baringa

Points are accrued as a combination of Charging Cost Savings and Option Value

SMC Charging Cost Savings

- Based on the difference between the minimum cost of meeting the Charging Requirement in the Time Window in which the vehicle is plugged-in, versus the cost of meeting the Requirement by charging the vehicle immediately upon plug-in (see D5.1 Part 3 section 2.8.3).
- The hourly cost of retail electricity supply is an output from a Price Series Model for the selected year (2030), and the resulting Points will **vary each day** (for the same plug-in/charging pattern).

SMC Option Value

- The Option Value is the expected value to the Supplier of having the vehicle plugged in and available at certain times of day that are most valuable to the aggregator, determined in advance based on historical behaviour of retail cost to supply.
- Values differ hourly by characteristic day – Summer/Winter and weekday/weekend.
- The total for each charge is the sum of the highest Option Values across the Time Window (of plug-in) for the number of hours needed to charge, and is **the same** for each day (for the same season, weekday/weekend and plug-in/charging pattern) (see D5.1 Part 3 section 2.8.3).

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Savings Points (D7.1) – Further Information

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Prices

- Based on a Narrative from the Stage 1 modelling
- In 2030, a central point along the pathway to 2050
- Assuming some Managed Charging has already occurred by this time
- Elements of the cost stack added to create retail prices, adding shape (some costs are charged primarily in Winter evenings mirroring current regimes)
- For simplification, ancillary services and components assumed to have a flat shape (e.g. balancing services use of system costs) are not included

Option Values

- The value of the option (to shift charging to a different hour) is the difference between the retail price in that hour and the average price across all hours in the 9 week series
- This is a simplification as the actual option value would have additional 'extrinsic' value due to volatility, and is a more complex function of the specific set of hours in the Time Window and Charging Requirement, not independent values for each hour.

Trial Series

- Two 9 week series have been selected: 'Summer' participants will accrue Savings Points based on prices with low volatility and 'Winter' participants will be shown Savings Points based on prices with high volatility

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Appendix

Detailed slides

Acronyms

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BEV	Battery Electric Vehicle
BSUoS	Balancing Services Use of System
CCGT	Combined Cycle Gas Turbine
CfD	Contract for Difference
CM	Capacity Market
DUoS	Distribution Network Use of System
LDN	Local Distribution Network
LEC	Levy Exemption Certificate
NHH	Non Half-Hourly
NTS	National Transmission System
OCGT	Open Cycle Gas Turbine
PHEV	Plug-in Hybrid Electric Vehicle
ROC	Renewables Obligation Certificate
SMC	Supplier Managed Charging
SRMC	Short Run Marginal Cost
TNUoS	Transmission Network Use of System
ToU	Time of Use
UMC	User Managed Charging

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Basis of Prices

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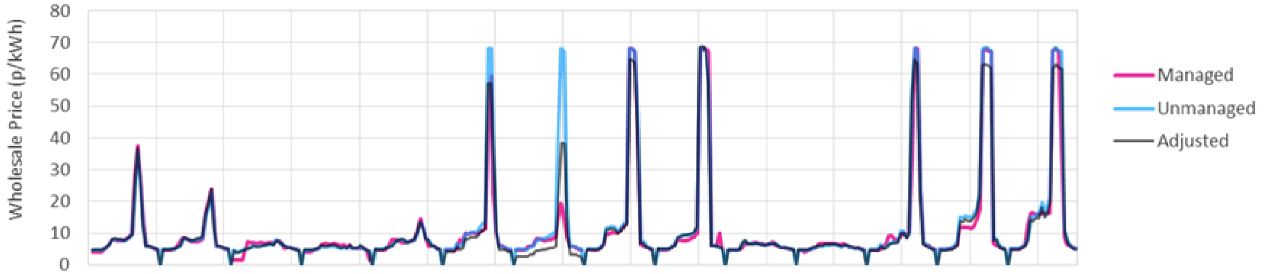
An hourly price series has been constructed for the year 2030 based on a Stage 1 Narrative, assuming a degree of managed charging

- **Narrative:** 'OEM'.
  - This Narrative is **similar to 'Business as Usual' with ULEV subsidies continued** to 2050
    - PiVs represent 35% of the vehicle parc in 2030 vs. 34% to 40% across the Narratives (excluding H2P at 13% and BaU at 20%).
  - This Narrative **reaches a high proportion of low carbon vkm without the highest gap in Government revenues**
    - 62% of vkm are low carbon by 2050 vs. 42% to 62% across the Narratives (excluding H2P at 68% and BaU at 38%)
    - The gap in Government revenues is £287bn over the pathway to 2050 vs. £135bn to £332bn across the Narratives (excluding H2P at £378bn)
- **Year:** 2030.
  - This year is around the **middle of the pathway to 2050** and is **fully represented** in ESME, in which 10 year intervals are modelled post 2030.
- **Demand**
  - OEM is a Narrative with unmanaged charging. The unmanaged demand shape is used to create the prices and scarcity[1] is incorporated to provide more volatility in the series, thus incentivising participants to shift their charging to cheaper hours. The actual prices are then scaled down based on a managed demand shape[2] to reflect that prices will be lower on average when some demand has been shifted ('managed') by the Aggregator or Consumer[3]. An example of the resulting 'adjusted' price is shown below.

Wholesale Prices for Week 1 and 2 in January



1 – Scarcity is the uplift above SRMC, which is calibrated based on historically observed capacity margins, historic system SRMC and actual outturn spot prices.
2 – Unmanaged daily price shape applied on managed daily average price.
3 – As more vehicles are connected to the grid and their load is managed, this will affect the value in connecting further vehicles at that point as opposed to other time periods. However, for the purpose of the trial, the shape of prices with unmanaged demand is maintained in order to incentivise shifting and test participants behaviour to a wide range of peak to off-peak price differentials.

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Adding the Retail Price Components

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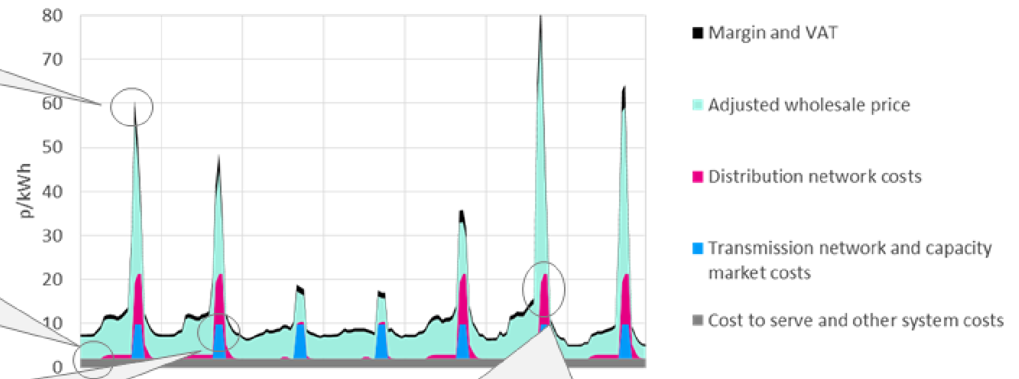
Wholesale prices have been converted to retail prices using the component values from the Narrative in 2030

Retail prices for week 1 in January[1]



VAT (5%) and supplier margin (3.1%) are added on top of all other costs

The **supplier cost to serve is fixed at 2.11 p/kWh**, set as a fixed assumption in Stage 1, and the **other system costs (carbon capture, transmission and storage) account for 0.07 p/kWh** in 2030

The **transmission system costs and capacity market costs are charged between 4-7pm** on every day across the year, **mirroring current charging** of NTS costs:

- TNUoS charges are based on demand in the three highest demand (Triad) periods but are spread over consumers' demand from 4-7pm throughout the year. It is assumed that consumers will by HH metered by 2030 and thus exposed to this cost.
- Currently, the CM costs are based on the supplier demand in the period 4-7pm on working days between November and February and suppliers may take different approaches to passing these to consumers.

LDN costs are based on the current shape of DUoS charging, on average across the 14 DNOs for 'Economy 7' tariffs, reflecting some shifting due to managed charging. The timing of the winter weekday peak demand in 2030 is considered similar enough to today's peak for this to be appropriate. In the scenario used, the 2030 winter weekday peak is lower than that in 2015 but occurs around the same time of day. It is the shape that is used to determine when to charge retail cost components, rather than the scale of the peak.

Components of the price stack that have been **excluded** are **low carbon generation subsidies and BSUoS**, all of which are **assumed to have a flat shape** and therefore not impact the charging cost calculation in either the UMC or SMC cases

1 – The data is simulated and the simulated year begins on a Thursday.

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Variation in Hourly Prices across the Year

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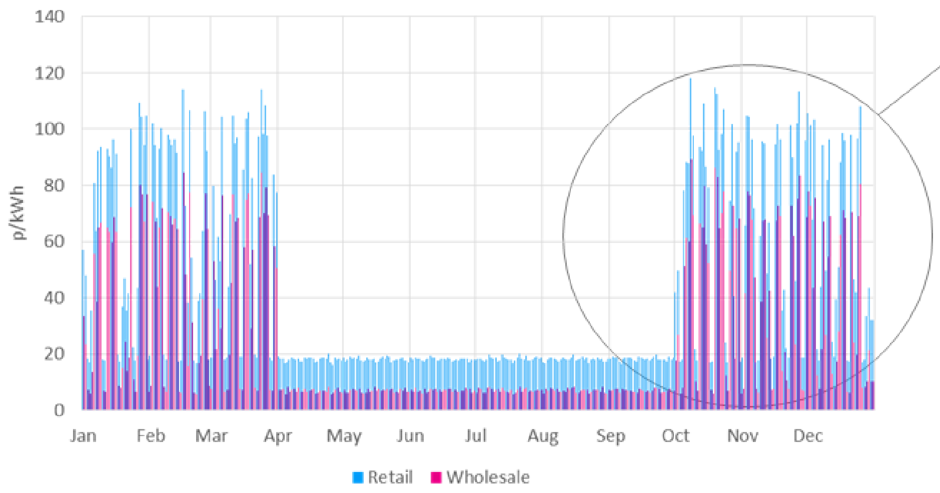
An hourly price series has been constructed for the whole year. There are distinct 'Summer' and 'Winter' periods in the hourly price series thus equal proportions of 'Summer' and 'Winter' prices should be used in the trial period.

Wholesale and retail prices for 2030[1]



It is important that an equal proportion of 'Summer' and 'Winter' periods are reflected in the trial by:

- Offsetting prices
- Using a composite 9 week series
- Applying a 'Summer' series to half of the users and a 'Winter' series to the other half

These prices have been compared with the Baringa Decarbonisation Scenario, which has similarly low volatility in Summer.

- The volatility is primarily driven by the wind profiles (varying hourly), the demand in each hour (the same per hour of each characteristic day), the prices in neighbouring countries (varying hourly) and the level of scarcity applied to prices (as a function of the capacity margin in each hour).

1 – The hourly prices have been calculated in PLEXOS using the capacity mix, demand and commodity prices from the Analytical Framework, which includes ESME and ECCo amongst other tools.

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Difference between Summer and Winter Prices

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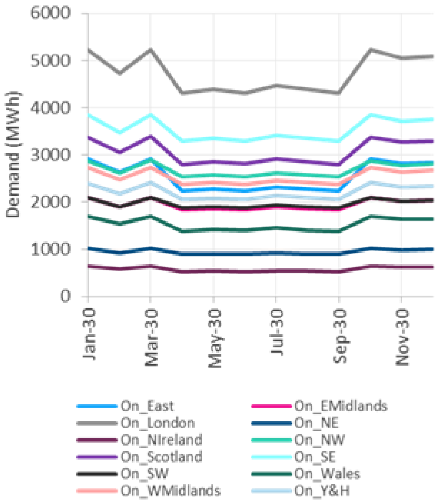
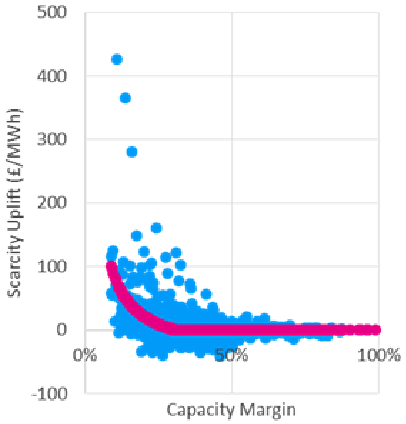
Explanation

- The reduction in price and volatility in Summer compared to Winter is primarily driven by the demand. In all regions, the demand is reduced in the Summer period. This is a function of the **use of characteristic days in ESME**, thus all Summer Weekdays will have the same demand (varying per hour per region) and all Winter Weekdays the same, etc. Similarly the scarcity added is calibrated separately for Summer and Winter periods.
- In Winter, the **higher demand is met partly through use of OCGTs**, which are not generating in Summer periods. **OCGTs have a relatively high SRMC** (c.£70/MWh) and this, **coupled with scarcity at times of low capacity margin**, increases the market price significantly.
- The **low volatility in Summer is also driven by the low installed wind capacity**. The wind capacity in the ESME (Patchwork) database is lower that the Baringa Reference Case and Decarbonisation scenarios. In the Baringa Decarbonisation scenario, prices go negative at times due to high renewable generation but **there are no negative prices in the OEM narrative.**
- The granularity in the analysis is consistent with defining characteristic 8 week Summer and Winter periods.

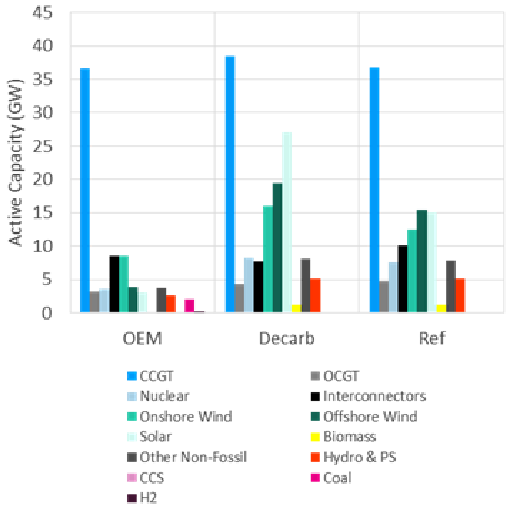
Comparison of demand across regions



Scarcity function example



Comparison of capacity mix across scenarios



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Volatility of Summer and Winter Prices

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Characteristic 9 week periods for Summer and Winter are very different in terms of volatility

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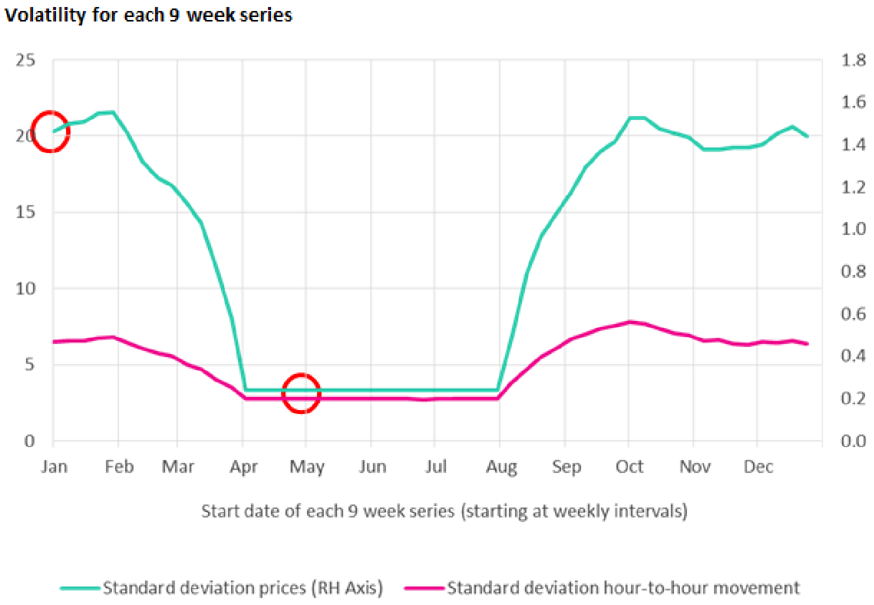
Selecting a High and Low Volatility Price Series

However, within each season the volatility is similar across each 9 week series. Characteristic 9 week periods have been selected based on the overall metrics below.



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SMC Prices

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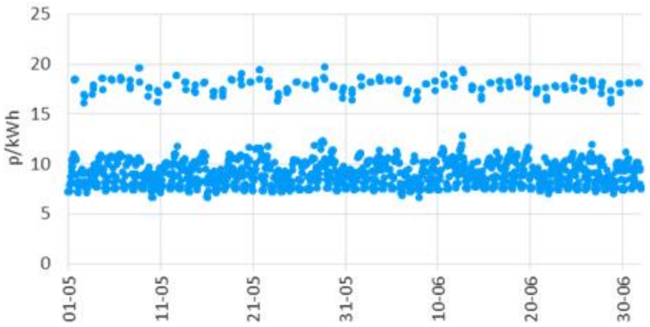
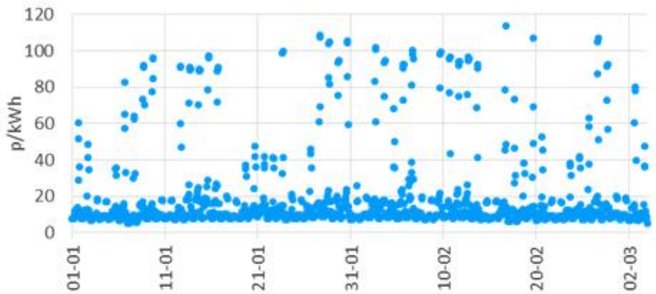
Half of the participants will have their points calculated based on a 'low volatility' price series and the other half a 'high volatility' price series, covering a range of peak to daily average ratios

Low volatility ('Summer') price series[1]

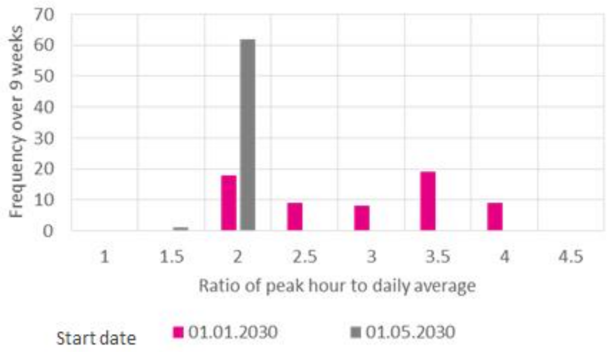


High volatility ('Winter') price series



- The **proposed low volatility price series starts on 1st May and the high volatility series on 1st January,** as these are closest to the average of the standard deviation in prices and in hour-to-hour movement across these seasons
- In the low volatility series the price in the peak hour is most often around 2x the daily average price
- The spread of ratios is higher for the 'high volatility' series selected than for the 'low volatility' series
- The ratio of the highest to lowest hours of the day is much higher

Ratio of peak price to daily average



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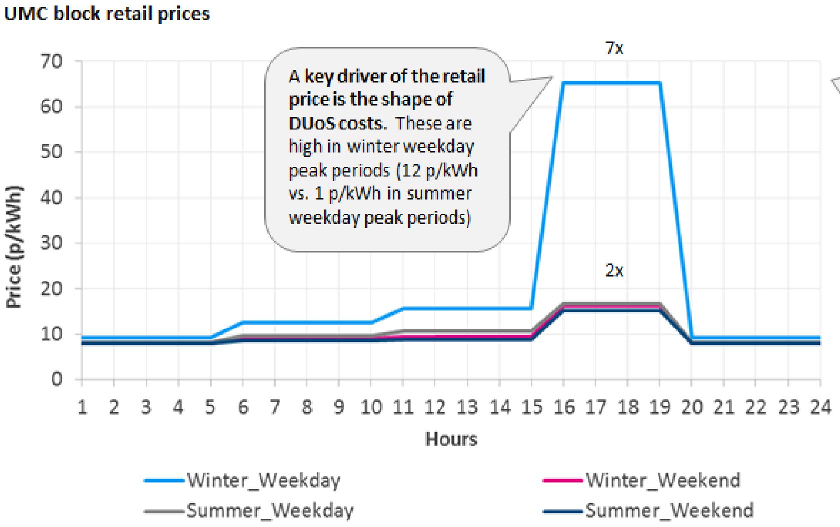
UMC Prices

'Block' prices for characteristic days have been created from the hourly price series

- **Prices:** The block prices have been created by taking a simple **average of the hourly price series across the year.**
  - At this stage, the different levels of risk and potential premiums charged by an Aggregator or Supplier have not been incorporated. The intention is to explore different risk and reward levels in the Demand Management Aggregator Business Model analysis.
- **Blocks:** There are four blocks in the day called Evening, Mid-Day, Morning and Overnight.



The trial should test a wide range of peak to super off-peak ratios. Some current examples are:

- A sample of **today's Economy 7** (ToU) tariffs shows that in general, the day price is around **2x the overnight price**
- In the recently introduced TIDE ToU tariff, the peak price is **5x the overnight price** and just over 2x the price throughout the rest of the day
- San Diego Gas & Electric Company's multi-year EV Pricing and Technology Study tested ToU tariffs with the peak price set to **2x, 4x and 6x the super off-peak price**
- Baringa's Decarbonisation Scenario has ratios of around **2x, 2.5x and 4x** depending on the characteristic day

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UMC Trial Inputs

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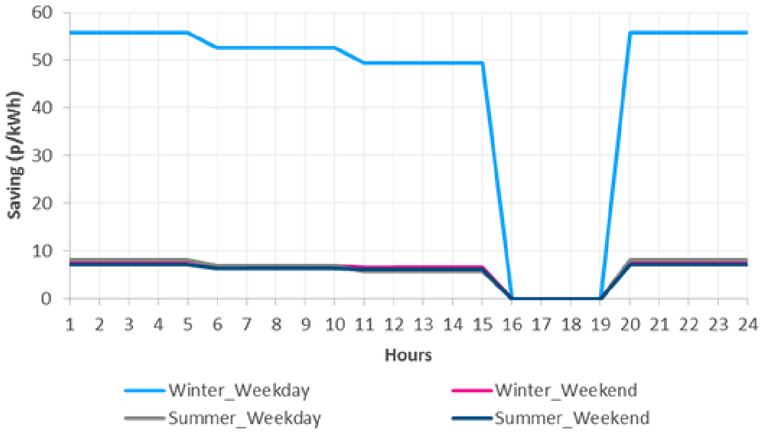
Variable cost savings versus a baseline tariff

- A function of the savings to the supplier associated with the actual charging for that day (Z)
  - The **Actual Charging Cost (A)** will therefore be determined by the sum of those prices identified from the Tariff Model. To estimate the value of savings achieved by the system for each given charge event, the Actual Charging Cost will be compared to the **Baseline Cost (B_3)**. The Baseline Cost will be determined by the cost of charging if the user was on a flat-rate tariff (the Baseline Tariff) which may be different for weekdays and weekend days (see slide 4 and D5.1 Part 3 section 2.8.4).

Charging cost savings for each hour in UMC



- The **flat tariff is taken to be the highest block tariff,** such that the participant makes zero charging cost savings for charging in the highest cost block
- This means **the highest savings ratio can be tested, from peak to off-peak ratio.**
- **In reality the user would be penalised for charging in the highest block relative to a flat average tariff** but **no negative savings points will be used in the trial.**
- As the trial is concerned about the relative savings, rather than the actual tariff cost, the preference is to **test the maximum savings achievable (peak to off-peak)** rather than better reflect reality but only test average to off-peak savings.

- A pass through factor set by the supplier (k_3)[1]
  - This factor represents the level of savings that the supplier passes through to the customer, taking into account target margin and risk premiums.
  - Retail cost stack components have been added on, including a fixed margin (no assessment of varying risk premium at this stage) (see D5.1 Part 3 section 2.8.4)

1 - The reward points that can be accrued by the trial participants due to their charging profile are based on the charging cost savings. They do not account for the use of controlled charging by a Supplier or Aggregator to provide balancing and ancillary services. This is not possible to capture within the structure of the trial and will be considered further in developing the Aggregator business model as part of Stage 2.

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SMC Trial Inputs

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The charging cost savings include variable savings compared to charging straight away and fixed savings based on the available window and amount of charging required

- **Variable savings based on actual charging costs incurred (X) – Variable Cost Savings**
  - The **Actual Charging Cost (A)** will be determined by the sum of the lowest prices identified from the Price Series Model. For each given charge event, the Actual Charging Cost will then be compared to the **Baseline Cost (B_{SMC}). The Baseline Cost will be determined by the cost of charging if the Charging Requirement was delivered as soon as possible within the Time Window** (see D5.1 Part 3 section 2.8.3).

- **Fixed savings for making vehicle available to charge at optimum times of day (Y) – Option Value**
  - For the reasons above, Savings Points will also incorporate an element, Y, which represents **Estimated Option Values** to the supplier associated with the available window for charging, taking into account the time of day and length of the window. The value of Y will not be subject to day-to-day uncertainty: **if the participant has the same Charging Requirement and makes the vehicle available for the same Time Window on two different days, they will receive the same Y Savings Points.** This will provide stronger reinforcement learning through experience in the trial.
  - Basing Y points only on width of the Time Window, and not also on the Charging Requirement, would provide a perverse incentive for participants to plug in for extended Time Windows when negligible charging was actually required.

- **Pass through factors set by the supplier (k_1 and k_2)[1]**
  - These factors represent the level of savings that the supplier will pass through to the customer, taking into account target margin and risk premiums.
  - Retail cost stack components have been added on, including a fixed margin (no assessment of varying risk premium at this stage) (see D5.1 Part 3 section 2.8.3).

- **Weighting factors (w_1 and w_2)**
  - The weighting factors w_1 and w_2 will be used to create the required balance between the "variable" X and the "static" Y. There is no ex-ante way to define the optimum split, so it is proposed to set these as $w_1 = w_2 = 0.5$ (see D5.1 Part 3 section 2.8.3)

1 - The reward points that can be accrued by the trial participants due to their charging profile are based on the charging cost savings and the option value. They do not account for the use of controlled charging by a Supplier or Aggregator to provide balancing and ancillary services. This is not possible to capture within the structure of the trial and will be considered further in developing the Aggregator business model as part of Stage 2.

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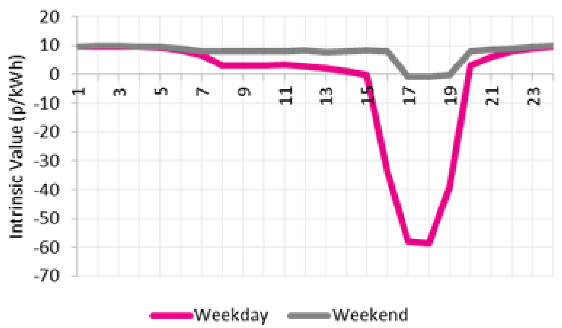
SMC Option Value

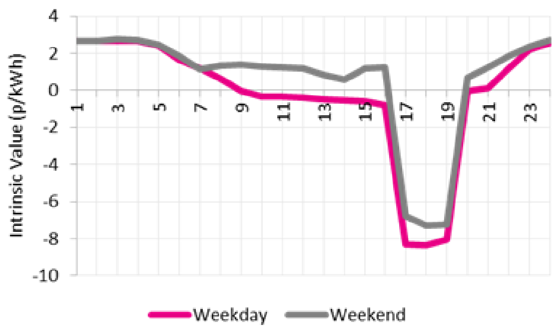
Preferred Approach

- The Option Value should reflect the **value to the Supplier of having the vehicle available for charging in specific hours.**
- The **basis of the Option is taken to be the daily average retail price across the series** (i.e. the 'seasonal' average price representing baseload power bought season ahead[1]).
- For a given hour, the **'intrinsic' value** of the Option is calculated as the average difference between the seasonal baseload price and within-day hourly price, reflecting the benefit of shifting charging to a given hour.
- The Option will also have some **'extrinsic' value** because the difference between the seasonal average price and the within-day hourly prices will vary from day to day. Ideally, this volatility would be represented through multiple price simulations to calculate the extrinsic value for each hour, or through using the actual, varying, within-day hourly prices across the series as a proxy.
- As this is complicated to implement, the preferred approach is that the **Option Value is based only on the intrinsic value** as shown in the figures below.
- In reality there will be **price and volume risks involved in creating the Option** which may be partly or fully passed through to the participants. For example:
  - The risk of fixing the price, i.e. the Supplier hedges in advance buying power to meet the expected demand shape at the 'seasonal' price which may then fall before delivery. A risk premium relating to this could be assigned as a discount on the hourly Option Values
  - The risk of fixing the shape, i.e. the Supplier buys the seasonal baseload power to meet an assumed demand shape and then the participants all shift their demand and available windows to times that have a negative Option Value. The penalty could be partly or fully passed through to the participant, however, it is assumed that in the trial participants will only receive a benefit from the Option Values

Average intrinsic values for 'Winter' series



Average intrinsic values for 'Summer' series



1 – The 'seasonal' average is based on the 9 week Summer or Winter series.

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SMC Option Value

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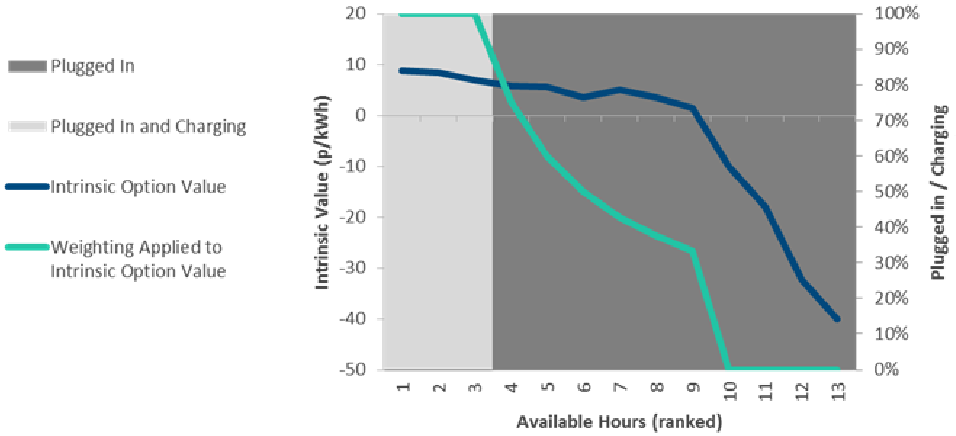
Implementing the Option Values

1. The **full intrinsic value should be given based on summing the Option Values for the highest value hours in the Time Window** as needed to meet the Charging Requirement. This means that:
   a) it rewards including high value times within the Time Window, and gives much smaller reward for including only low value hours
   b) the reward depends on Charging Requirement, so there is no perverse incentive to plug in for extended times when no substantial charge is needed
   c) the longer the Time Window, the greater the chance of including high value hours and so getting good reward

Note that, as it is an 'option', the hours used do not have to coincide with the cheapest retail price hours or the hours in which the participant actually charges.

2. **In the remaining hours there could be a reward given simply for providing further availability** by extending the time window (e.g. as shown below) as the Aggregator may also value having the flexibility to shift charging to these hours instead due to the unforeseen volatility. However, **the value for the additional hours is likely to be much lower thus for simplification it is preferred to based the reward on (1) only.**

Example of reducing reward for providing incremental availability



- Hours are ranked by intrinsic Option Value
- 100% of the Option Value is given for the number of hours needed to meet the Charging Requirement
- A reducing value per additional hour is given for the remaining hours in the available window[1]
- No penalty is assigned for hours with negative intrinsic value (i.e. zero weighting).

1 – For example, based on the ratio of the length of time required for charging to the length of time vehicle is plugged in and available for charging.

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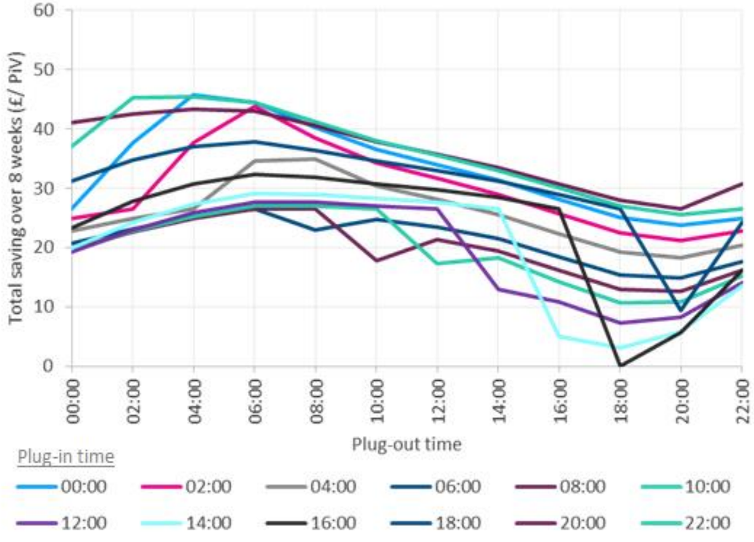
SMC Option Value

A normalised approach has been considered but is not preferred

- **A normalised approach has been considered,** whereby if a participant plugs in for 8 hours and charges for 4 hours, they receive **the average option value in all of the hours available multiplied by the length of time required for charging/the length of time the vehicle is plugged in and available for charging,** rather than the full value of the 4 highest option values in the available window.
- However, this means that **if a user extends their available window** to provide more available hours **but those hours have a lower option value** than the hours in the original window, **the total value is reduced** even though they are providing more flexibility

Savings based on a normalised approach – starting 1st Jan



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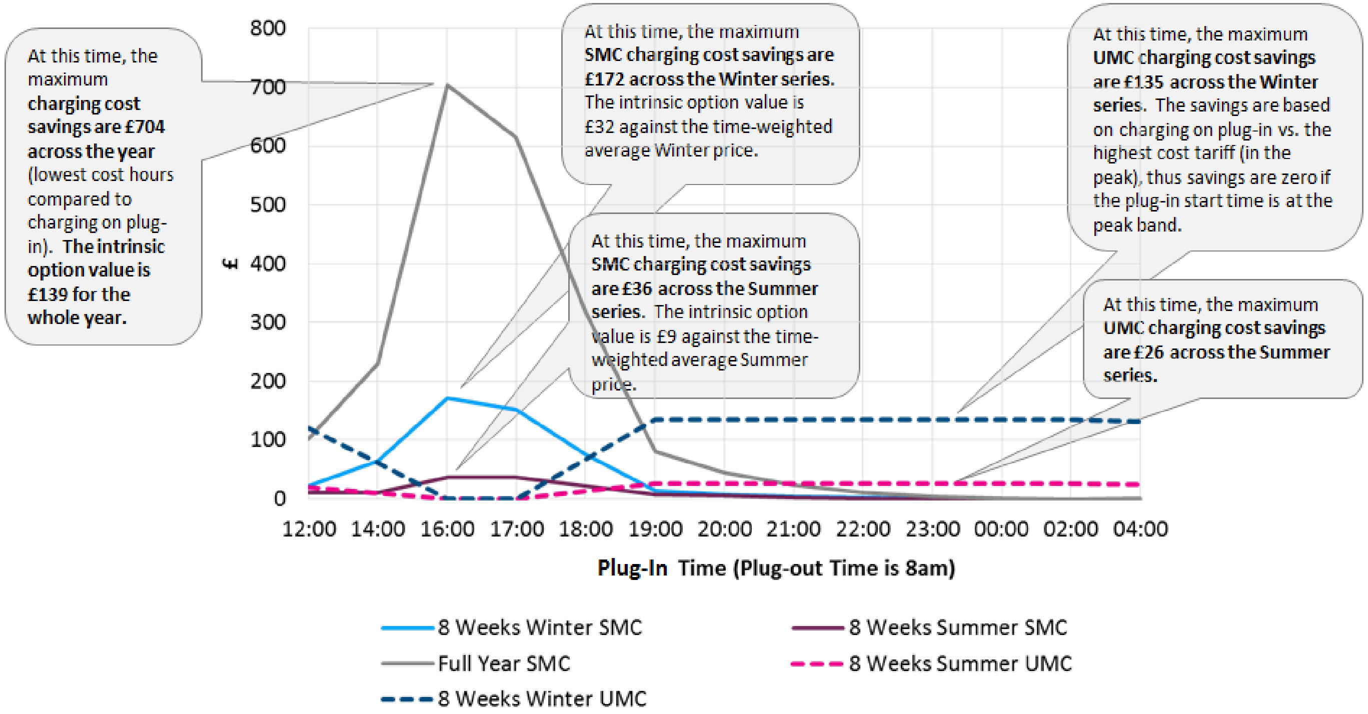
Summary of Potential Savings

Savings for a BEV with Average Mileage[1]



1 - Savings will be less for a PHEV and less if the user charges less per day. The savings are based on the latest vehicle data (updated in April 2017, ahead of the Technical Review). This gives an overview of potential savings in SMC and UMC for Summer and Winter and helps to inform the split of cash available between the conversion of reward points and the questionnaires. 27

Summary of Deliverables

D7.1 Charging Trial Input Data

- **The data required for D7.1 has been provided:**
  - UMC block prices for characteristic days
  - Hourly retail price series, with proposed 9 week periods of high and low volatility
  - Hourly option values for those 9 week periods by characteristic day
  - Calculations of savings under UMC and SMC to help inform the rewards split between the charging and the questionnaires
  - Supporting documentation (this pack)

D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

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RPN3873

PROJECT REPORT

CVEI Stage 2

Deliverable D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

Addendum to Part 4

Appendix J: Questionnaires for Consumer Charging Trial

Pre-trial questionnaire

Participant ID: _________

What is this questionnaire?
This Pre-Trial Questionnaire is the first in a series of questionnaires which we will ask you to complete as part of this trial. This questionnaire is designed to collect background information about you.

How long will it take to complete?
It will take approximately 25 minutes to complete.

What do you need from me?
Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

How to complete the questionnaire
Please use the at the bottom of each page to go forward. As soon as you do this your answer is saved.

If you need to go back, please use the button.

If you leave the survey idle for a while, you will be logged out automatically, but don't worry, your answers will be saved so long as you have completed a question by pressing the forward button

What other questionnaires will I have to complete for this trial?
A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

Questionnaire	Progress
Pre-trial questionnaire	In progress (this questionnaire)
Time point 1 questionnaire	To be completed 1 week before collecting the vehicle
Time point 2 questionnaire	To be completed 1 week after return of the vehicle

Thank you for taking part in this research. Your participation is extremely important.

Section 1: General background

1. Please indicate your <u>highest</u> educational qualification.

Start at the top of the list and select the first one you come to that applies to you.

Please tick one box only

- ☐ University Higher Degree (e.g. MSc; PhD) or Chartered status
- ☐ First degree level qualification (e.g. BA; BSc; PGCE)
- ☐ Diploma in higher education (HNC, HND, Nursing or Teaching qualification - excluding PGCE)
- ☐ A Level; AS Level: NVQ Level 3; GNVQ Advanced or equivalent
- ☐ GCSE; CSE, NVQ levels 1&2; GNVQ Foundation & Intermediate or equivalent
- ☐ None of the above

2. Please indicate your employment status.

Please tick one box only

- ☐ Employed full-time
- ☐ Employed part-time
- ☐ Self employed
- ☐ Unemployed and seeking work
- ☐ Looking after family or home / not seeking work
- ☐ Long term sick or disabled
- ☐ Maternity leave
- ☐ Retired
- ☐ In full-time education
- ☐ Other (please specify): ____________________________

3. Please indicate your TOTAL HOUSEHOLD income from all sources BEFORE tax and other deductions.

Household refers to you, your partner and/or family. If you share a property with others (e.g. a house share) then do not include them in your answer.

Please tick one box only

- ☐ Up to £9,999 per year (£199 per week)
- ☐ £10,000 to £19,999 per year (£200 - £389 per week)
- ☐ £20,000 to £29,999 per year (£390 - £579 per week)
- ☐ £30,000 to £39,999 per year (£580 - £769 per week)
- ☐ £40,000 to £49,999 per year (£770 - £969 per week)
- ☐ £50,000 to £74,999 per year (£970 - £1,449 per week)
- ☐ £75,000 to £99,999 per year (£1,450 – £1,959 per week)
- ☐ £100,000 to £149,999 per year (£1,960 - £2939 per week)
- ☐ £150,000 or more per year (£2,940 or more per week)
- ☐ Prefer not to say

4. Which of the following best describes your relationship status.

- ☐ Single
- ☐ Married / In a Civil partnership
- ☐ Cohabiting
- ☐ Separated / Divorced
- ☐ Widowed
- ☐ Other, please specify: ___________________________

5. Do you currently…

- ☐ Live alone
- ☐ Live with family/partner
- ☐ Live with other tenants
- ☐ Other, please specify: ___________________________

Section 2: Your household and cars

6. Including you, how many people in the following age groups live in your household?

Household refers to you, your partner and/or family. If you share a property with others (e.g. a house share) then do not include them in your answer.

- ☐ Under 2 years old __________
- ☐ 2 years – 16 years __________
- ☐ 17 years – 29 years __________
- ☐ 30-years – 39 years __________
- ☐ 40-years – 49 years __________
- ☐ 50-years – 64 years __________
- ☐ 65 + years __________

7. How many of the following cars are kept in this household?

Household refers to you, your partner and/or family. If you share a property with others (e.g. a house share) then do not include them in your answer.

a. Private cars ____________

b. Company cars ____________

[Please logic Q8-10 to offer the number of columns given as the sum of 7a + 7b.]

[If 7b=0, don’t ask about private /company in Q8]

8. Please select the option below that best matches the size/type of car, for each car in your household.
[Alternative text if 7a+7b=1: Please select the option below that best matches the size/type of your car.]
It is important that your answer for "Main Car" refers to the car that you use most of the time. We will refer to your 'Main Car' in future questions so please think about this car when answering. Please select the option below that best matches the size/type of your car. If you are unsure, please choose the option you feel is the closest fit to your car.

[Please logic to offer the number of columns given as the sum of 7a + 7b.]

	Main Car *the one that you are using most often*	**Car 2**	**Car 3**	**Car 4**	**Car 5**
 Mini e.g. Hyundai i10, Volkswagen up!	☐	☐	☐	☐	☐
 Supermini e.g. Ford Fiesta, Vauxhall Corsa, Volkswagen Polo	☐	☐	☐	☐	☐
 Lower medium e.g. Ford Focus, Vauxhall Astra, Volkswagen Golf	☐	☐	☐	☐	☐
 Upper medium e.g. BMW 3 Series, Vauxhall Insigna, Audi A4	☐	☐	☐	☐	☐

 Executive e.g. Mercedes-Benz E Class, BMW 5 Series, Jaguar XF	☐	☐	☐	☐	☐
 Luxury e.g. Mercedes-Benz S Class, Jaguar XJ	☐	☐	☐	☐	☐
 Specialist sports e.g. Audi TT, Mercedes- Benz SLK	☐	☐	☐	☐	☐
 Dual purpose / 4X4 e.g. Kia Sportage, Range Rover Evoque, Honda CR-V	☐	☐	☐	☐	☐
 MPV e.g. Vauxhall Zafira, Ford C-Max, VW Touran	☐	☐	☐	☐	☐
Is this a private (P) or a company (C) car?	Private / Company	Private / Company	Private / Company	Private / Company	Private / Company
Including you, where appropriate, how many drivers regularly use this car? (i.e. use it at least once per week)	____	____	____	____	____

What is the approximate proportion of time that you typically use this car compared to the other drivers in the household? *For example, you may be driving this car about 80% of the time and the rest (20%) would be shared among others (e.g. your partner or children).* **[Auto-fill boxes to sum to 100%]**	You ____% Others __%	You ____% Others __%	You ____% Others __%	You ____% Others __%	You ____% Others __%

9. For each of the cars you have identified above, please indicate the method you used to purchase the vehicle.
[Alternative text if 7a+7b=1: Please indicate the method you used to purchase your vehicle.]
[Please logic to offer the number of columns given as the sum of 7a + 7b.]

Please tick one box on each line	Main Car	Car 2	Car 3	Car 4	Car 5
Outright purchase	☐	☐	☐	☐	☐
Personal lease (Contract hire)	☐	☐	☐	☐	☐
Salary-sacrifice company lease scheme	☐	☐	☐	☐	☐
Hire Purchase (PCH)	☐	☐	☐	☐	☐
Personal Contract Purchase (PCP)	☐	☐	☐	☐	☐
Company car	☐	☐	☐	☐	☐
Don't know	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

DP: allow only one response per column

10. For each of the cars you have identified above, please indicate roughly how many miles YOU have driven each car in the past 12 months

[Alternative text if 7a+7b=1: Please indicate roughly how many miles YOU have driven in your car in the past 12 months]

[Please logic to offer the number of columns given as the sum of 7a + 7b.]

Please tick one box on each line	Main Car	Car 2	Car 3	Car 4	Car 5
0 miles	☐	☐	☐	☐	☐
1 - 5,000 miles	☐	☐	☐	☐	☐
5,001-10,000 miles	☐	☐	☐	☐	☐
10,001-15,000 miles	☐	☐	☐	☐	☐
15,001-20,000 miles	☐	☐	☐	☐	☐
20,001-25,000 miles	☐	☐	☐	☐	☐
25,001-30,000 miles	☐	☐	☐	☐	☐
30,001-35,000 miles	☐	☐	☐	☐	☐
Above 35,000 miles	☐	☐	☐	☐	☐

DP: allow only one response per column

11. In what year did you acquire your Main Car (i.e. the car that you use the most often)?

[Alternative text if 7a+7b=1: In what year did you acquire your Main Car?]

[dropdown menu “pre-1980” to 2017]

Don’t know

12. When you got your Main Car, how old was it approximately:

- ☐ Less than 1 year old
- ☐ 1-2 years old
- ☐ More than 2 years old
- ☐ Don’t know

13. What was the value of your Main Car when you acquired it?

Less than £5,000	£5,000-£10,000	£10,001-£15,000	£15,001-£20,000	£20,001-£25,000	£25,001-£30,000	£30,001-£35,000	£35,001–£40,000	More than £40,000	Don't know
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. How important or unimportant were the following factors when choosing your Main Car?

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Purchase price	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Size	☐	☐	☐	☐	☐
Acceleration	☐	☐	☐	☐	☐
Appearance	☐	☐	☐	☐	☐
Fuel economy	☐	☐	☐	☐	☐
Running costs	☐	☐	☐	☐	☐
CO2 emissions	☐	☐	☐	☐	☐
Other, please tick box and specify _____	☐	☐	☐	☐	☐

15. On average, how many miles per gallon (mpg) do you get in your Main Car in real world driving?

10 mpg or less	11 – 20 mpg	21 – 30 mpg	31 – 40 mpg	41 – 50 mpg	51 – 60 mpg	61 – 70 mpg	71 or more mpg	Don't know
☐	☐	☐	☐	☐	☐	☐	☐	☐

16. How satisfied or dissatisfied are you with the fuel economy / mpg of your Main Car?

Very dissatisfied	Quite dissatisfied	Neither satisfied nor dissatisfied	Quite satisfied	Very satisfied
☐	☐	☐	☐	☐

17. Generally speaking, which one of the following statements best describes your role when it comes to choosing a car for your household?

Please tick one box only

- ☐ I alone decide which car(s) to buy
- ☐ I have the main say, but take others' views into account
- ☐ I have an equal say in which car(s) to buy
- ☐ I have some influence, but someone else has the main say
- ☐ I have no say in which car(s) is/are bought
- ☐ I only decide about the car that I will drive, but have no/little influence regarding vehicles which are driven by other household members

Section 3: Your journeys

18. Do you commute to a workplace or place of education by driving a car?

- ☐ Yes
- ☐ No [Skip logic: Go to Q**Error! Reference source not found.**]

19. On how many days a week do you typically drive to work?

[Dropdown 1-7] days per week

20. What is the typical ONE WAY distance of your journey from home to work?

___________ miles

21. Thinking about a typical week in your life, please answer the following as best as you can?

a. My typical car driving mileage on a weekday is: ____________ miles

b. My typical car driving mileage on a day at the weekend is: ____________ miles

22. How often do you make journeys that are longer than 50 miles each way?

Please tick one box only

- ☐ More than 3 times a week
- ☐ 2 or 3 times per week
- ☐ Once per week
- ☐ Once every two weeks
- ☐ Once per month
- ☐ Once every 2 to 3 months
- ☐ 1-2 times per year
- ☐ Never

23. In a regular week, roughly, what percentage of your driving do you do in the following areas/road types:

Please select a percentage from the drop down menu

[Drop down options with auto-calculate. Three boxes must sum to 100%]

- ☐ Urban areas (town, city)
- ☐ Rural areas (e.g. out of town, country road)
- ☐ Motorway

24. Which of these services do you have convenient access to from your home:

Please tick all that apply

- ☐ bus
- ☐ train
- ☐ tube/tram
- ☐ None of these [DP: not with any other code]

25. For all journeys combined, in an average year, how frequently have you used each type of transport?

Please tick one box on each line

	Never	**Less than once per month**	**1-3 days per month**	**About 1 day per week**	**2-4 days per week**	**5-7 days per week**
household car as a driver	☐	☐	☐	☐	☐	☐
household car as a passenger	☐	☐	☐	☐	☐	☐
local bus, tram, tube	☐	☐	☐	☐	☐	☐
train	☐	☐	☐	☐	☐	☐
bicycle (on the road)	☐	☐	☐	☐	☐	☐
walk to/from a destination	☐	☐	☐	☐	☐	☐
scooter/motorcycle	☐	☐	☐	☐	☐	☐
taxi	☐	☐	☐	☐	☐	☐
car from a car club	☐	☐	☐	☐	☐	☐

26. Are you a member of any car clubs that enable you to book access to a car when you need one (e.g. City Car or Zipcar)?

- ☐ Yes
- ☐ No
- ☐ I don't know

27. Are you a current user of any on-demand transport services such as Uber?

- ☐ Yes
- ☐ No
- ☐ I don't know

28. How frequently do you use smartphone apps to plan your journeys? DP: Single code

Never	Rarely	Occasionally	Regularly	Always
☐	☐	☐	☐	☐

29. What proportion of the mileage which you drive in a car is for business/work trips (not including commuting, i.e. travelling to and from work)? DP: Single code

None	1-20%	21-40%	41-60%	61%-80%	81-100%
☐	☐	☐	☐	☐	☐

Section 4: Owning and driving a car

30. To what extent do you agree or disagree with the following statements?

This section lists a number of statements to do with owning and driving a car. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I couldn't manage without a car	☐	☐	☐	☐	☐
I would like to own a larger or faster car	☐	☐	☐	☐	☐
I find driving can be stressful sometimes	☐	☐	☐	☐	☐
I tend to buy the same type/ size of car (e.g. small car, family estate)	☐	☐	☐	☐	☐
I tend to stick to the same brand of car (e.g. Ford, Toyota, Nissan)	☐	☐	☐	☐	☐
Driving gives me a chance to express myself	☐	☐	☐	☐	☐
If I could, I would gladly do without a car	☐	☐	☐	☐	☐
I would pay more for a car with lower running costs	☐	☐	☐	☐	☐
A car provides status and prestige	☐	☐	☐	☐	☐
I enjoy driving on my own	☐	☐	☐	☐	☐
It doesn't matter to me which type of car I drive	☐	☐	☐	☐	☐
I don't like driving	☐	☐	☐	☐	☐
Getting good fuel economy out of my car gives me satisfaction	☐	☐	☐	☐	☐
You can tell something about a person by what car he/she has	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
My car says something about who I am	☐	☐	☐	☐	☐
I like to drive just for the fun of it	☐	☐	☐	☐	☐
When I feel fuel prices are getting too high, I try and reduce the amount I drive	☐	☐	☐	☐	☐

31. To what extent do the following statements describe you?

This section lists a number of statements concerning how people drive. Please read each statement carefully and indicate the extent to which each statement describes you.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

[Please highlight (e.g. bold) or note the difference (e.g. in instructions) in response options from previous question]

	Not at all	Very little	Little	Moderate	Much	Very much
I often do relaxing activities while driving	☐	☐	☐	☐	☐	☐
I often purposely closely follow other drivers	☐	☐	☐	☐	☐	☐
I often beep my horn or 'flash' the car in front as a way of expressing my frustration	☐	☐	☐	☐	☐	☐
I feel I have control over driving	☐	☐	☐	☐	☐	☐
I often drive through traffic lights that have just turned red	☐	☐	☐	☐	☐	☐
I usually enjoy the sensation of driving on the limit (dangerously)	☐	☐	☐	☐	☐	☐

	Not at all	Very little	Little	Moderate	Much	Very much
On a clear motorway, I usually drive at or a little below the speed limit	☐	☐	☐	☐	☐	☐
While driving I try to relax myself	☐	☐	☐	☐	☐	☐
When I am in a traffic jam and the lane next to mine starts to move, I try to move into that lane as soon as possible	☐	☐	☐	☐	☐	☐
Driving usually makes me feel frustrated	☐	☐	☐	☐	☐	☐
I often daydream to pass the time while driving	☐	☐	☐	☐	☐	☐
I often swear at other drivers	☐	☐	☐	☐	☐	☐
When a traffic light turns green and the car in front of me doesn't get going, I just wait for a while until it moves	☐	☐	☐	☐	☐	☐
I drive cautiously	☐	☐	☐	☐	☐	☐
Sometimes lost in thought or distracted, I fail to notice someone waiting at a zebra crossing/pedestrian	☐	☐	☐	☐	☐	☐
In a traffic jam, I think about ways to get through the traffic faster	☐	☐	☐	☐	☐	☐
When a traffic light turns green and the car in front of me doesn't get going immediately, I try to urge the driver to move on	☐	☐	☐	☐	☐	☐
At a junction where I have to give right-of-way to oncoming traffic, I simply wait patiently for traffic to pass	☐	☐	☐	☐	☐	☐

	Not at all	Very little	Little	Moderate	Much	Very much
When someone tries to pull in front of me on the road I drive in an assertive way in order to prevent it	☐	☐	☐	☐	☐	☐
I often fix my hair and/or makeup while driving	☐	☐	☐	☐	☐	☐
I am often distracted or preoccupied, and suddenly realise that the vehicle ahead has slowed down, and I have to slam on the brakes to avoid a collision	☐	☐	☐	☐	☐	☐
I like to take risks while driving	☐	☐	☐	☐	☐	☐
I base my behaviour on the motto "better safe than sorry"	☐	☐	☐	☐	☐	☐
I like the thrill of flirting with death and disaster	☐	☐	☐	☐	☐	☐
It worries me when driving in bad weather	☐	☐	☐	☐	☐	☐
I often meditate while driving	☐	☐	☐	☐	☐	☐
Lost in thoughts I often forget that my lights are on full beam until flashed by another motorist	☐	☐	☐	☐	☐	☐
When someone does something on the road that annoys me, I flash them with the full beam	☐	☐	☐	☐	☐	☐
I get a thrill out of breaking the law	☐	☐	☐	☐	☐	☐
I often misjudge the speed of an oncoming vehicle when overtaking	☐	☐	☐	☐	☐	☐
I feel nervous while driving	☐	☐	☐	☐	☐	☐
I get impatient during rush hour	☐	☐	☐	☐	☐	☐
I feel distressed while driving	☐	☐	☐	☐	☐	☐

	Not at all	Very little	Little	Modera te	Much	Very much
I often intend to switch on the windscreen wipers, but switch on the lights instead, or vice versa	☐	☐	☐	☐	☐	☐
I often attempt to drive away from traffic lights in third gear (or in neutral or park in an automatic car)	☐	☐	☐	☐	☐	☐
I often plan my route badly, so that I hit traffic that I could have avoided	☐	☐	☐	☐	☐	☐
I often use muscle relaxation techniques while driving	☐	☐	☐	☐	☐	☐
I plan long journeys in advance	☐	☐	☐	☐	☐	☐
I often nearly (or actually) hit something due to misjudging my gap in a parking space	☐	☐	☐	☐	☐	☐
I feel comfortable while driving	☐	☐	☐	☐	☐	☐
I am always ready to react to unexpected manoeuvres by other drivers	☐	☐	☐	☐	☐	☐
I tend to drive cautiously	☐	☐	☐	☐	☐	☐
I often beep my horn at others	☐	☐	☐	☐	☐	☐
I usually enjoy the excitement of dangerous driving	☐	☐	☐	☐	☐	☐

Section 5: New technology

32. To what extent do you agree or disagree with the following statements?

This section lists a number of statements concerning new technology. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
I like to buy new and different technologies	☐	☐	☐	☐	☐
I am not the type of person that needs to be the first to have the newest technology	☐	☐	☐	☐	☐
I generally know more than other people about new technology	☐	☐	☐	☐	☐
I am usually among the first to try new technology	☐	☐	☐	☐	☐
New technology excites me	☐	☐	☐	☐	☐
I often seek out information about new cars	☐	☐	☐	☐	☐
I don’t like to be the first to drive cars with the latest technology	☐	☐	☐	☐	☐
I tend to decide on what car to buy by relying on the opinions of friends who have already tried them	☐	☐	☐	☐	☐
When I am choosing a car, I find myself spending a lot of time checking out different models	☐	☐	☐	☐	☐
Prior to buying a new car, I seldom consult my friends/ family	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I often influence other people's opinions about cars	☐	☐	☐	☐	☐
When other people are choosing a car to buy, they turn to me for advice	☐	☐	☐	☐	☐
I like magazines / websites about new cars	☐	☐	☐	☐	☐
I am not the sort of person that looks to experience driving different cars	☐	☐	☐	☐	☐
I would prefer my car to be fuelled by something other than petrol or diesel	☐	☐	☐	☐	☐
I prefer my car to be distinctive in style so that it stands out	☐	☐	☐	☐	☐

Section 6: The environment

33. To what extent do you agree or disagree with the following statements?

This section lists a number of statements regarding your personal travel. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I like travelling in a car	☐	☐	☐	☐	☐
People should be allowed to use their cars as much as they like, even if it causes damage to the environment	☐	☐	☐	☐	☐
I find travelling by car can be stressful sometimes	☐	☐	☐	☐	☐
Being environmentally responsible is important to me as a person	☐	☐	☐	☐	☐
For the sake of the environment, car users should pay higher taxes	☐	☐	☐	☐	☐
Environmental threats such as global warming have been over exaggerated	☐	☐	☐	☐	☐
It is important to build more roads to reduce congestion	☐	☐	☐	☐	☐
I like travelling by bus	☐	☐	☐	☐	☐
I would like to travel by car more often	☐	☐	☐	☐	☐
The government should take more of a lead in protecting the environment, even if people don't like it	☐	☐	☐	☐	☐
The way I drive says a lot about the kind of person I am	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I am actively trying to use my car less	☐	☐	☐	☐	☐
Reducing my car use would make me feel good	☐	☐	☐	☐	☐
There are no practical alternatives to most of the car trips I make	☐	☐	☐	☐	☐
I would be willing to pay higher taxes on car use if I knew that the revenue would be used to support public transport	☐	☐	☐	☐	☐
When I am getting ready to go out, I usually don't think about how I am going to travel, I just get in my car	☐	☐	☐	☐	☐
I would only travel by bus if I had no other choice	☐	☐	☐	☐	☐
The car I own says a lot about the kind of person I am	☐	☐	☐	☐	☐
I am quite flexible about what types of transport I use	☐	☐	☐	☐	☐
I am not interested in reducing my car use	☐	☐	☐	☐	☐
It would be easy for me to reduce some of my car use	☐	☐	☐	☐	☐

34. To what extent do you agree or disagree with the following statements?

This section lists a number of statements regarding the environment. Please read each statement carefully and indicate the extent to which you agree or disagree with each statement.

There are no right or wrong answers, please be completely honest.

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Most people I know do their bit for the environment these days	☐	☐	☐	☐	☐
Being environmentally responsible is an important part of who I am	☐	☐	☐	☐	☐
It’s not worth me doing things to help the environment if others don’t do the same	☐	☐	☐	☐	☐
I feel a moral obligation to reduce my emission of greenhouse gases	☐	☐	☐	☐	☐
What I do in life doesn’t make any real difference to the environment	☐	☐	☐	☐	☐
I am not the type of person to worry about being ‘green’	☐	☐	☐	☐	☐
The so called ‘environmental crisis’ has been greatly exaggerated	☐	☐	☐	☐	☐
Sometimes I feel under pressure to say that I am doing more to help the environment than I am	☐	☐	☐	☐	☐
I am worried that the world is running out of oil	☐	☐	☐	☐	☐
Reducing my car’s environmental impact would make me feel good	☐	☐	☐	☐	☐
Reducing my car’s environmental impact would be good for society	☐	☐	☐	☐	☐
I would be willing to pay more for a car if I knew it was less harmful to the environment	☐	☐	☐	☐	☐
I would not buy a particular car just because it is environmentally friendly	☐	☐	☐	☐	☐
People should be allowed to use their car as much as they like	☐	☐	☐	☐	☐

THANK YOU – THAT IS THE END OF THIS SURVEY

We will send you a link to the next survey 7-10 days before you are due to collect the trial vehicle.

If you have any comments about this questionnaire then please note them here:

Time Point 1 questionnaire

Participant ID: _________

What is this questionnaire?

This Time Point 1 Questionnaire is designed to capture your opinions and perceptions of different types of electric vehicle.

How long will it take to complete?

It will take approximately 25 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

Before starting the questionnaire please take a little time to familiarise yourself with the information on the next page about different types of vehicles. You will be asked for your views on these vehicles in the questionnaire.

How to complete the questionnaire

Please use the  at the bottom of each page to go forward. As soon as you do this your answer is saved.

If you need to go back, please use the  button.

If you leave the survey idle for a while, you will be logged out automatically, but don't worry, your answers will be saved so long as you have completed a question by pressing the forward button 

To restart the questionnaire at the same stage, simply click the original link that was sent to you.

What other questionnaires will I have to complete for this trial?

A progress log for the full set of questionnaires is shown in the table below, along with information about when each part will need to be completed.

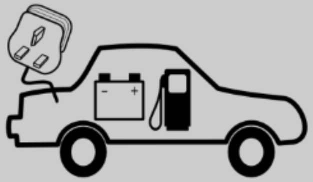
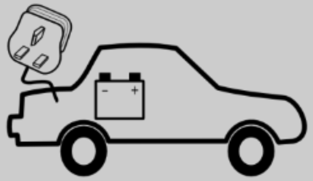
Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	In progress (this questionnaire)
Time point 2 questionnaire	To be completed 1 week after return of vehicle

Thank you for taking part in this research. Your participation is extremely important.

Types of electric vehicles and definitions for this questionnaire

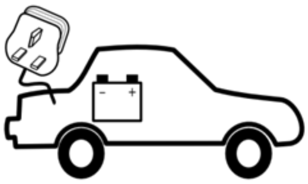
In this questionnaire we will ask you about your views of types of plug-in vehicles (PiVs). This table provides a summary of the differences between plug-in vehicles and non-plug-in (conventional) vehicles that you will be used to.

[table on following page – present on one page online]

Non-plug-in (conventional) vehicles		Plug-in Vehicles (PiVs)	
Conventional vehicle	**Hybrid Electric Vehicle (HEV)**	**Plug-in Hybrid Electric Vehicle (PHEV)**	**Battery Electric Vehicle (BEV)**
			
Typically powered by petrol / diesel only.	A non-plug-in Hybrid Electric Vehicle (HEV) has a petrol / diesel engine and an electric motor powered by a small battery. The battery gets charged when the engine is running. It does not need to (and cannot) be plugged in to an electrical socket to charge the battery. Battery power is mainly used at lower speeds, like when in traffic; this improves fuel consumption.	A Plug-in Hybrid Electric Vehicle (PHEV) is like a conventional HEV with both a petrol / diesel engine and an electric motor. BUT, the battery can be charged by plugging it in to a normal electrical socket (like you have at home) or dedicated charging point, as needed. The battery also gets charged when the engine is running. If you run out of charge you can continue driving as long as there is petrol or diesel in the tank. The car will use the electric motor whenever possible to save fuel, but also uses power from the petrol / diesel engine when required.	A Battery Electric Vehicle (BEV) is powered only by a battery. The battery is charged by plugging it in to a normal electric socket (like you have at home) or dedicated charging point, as needed. No petrol or diesel is required; once you run out of electrical charge in the battery you will no longer be able to operate the vehicle.

Section 1: Battery Electric Vehicles (BEVs)

This section will ask you about Battery Electric Vehicles (BEVs) only. Please think specifically about BEVs when answering the questions. If you need a reminder about what a BEV is then please click on the blue "i" icon where you see it and a description will pop-up. Here is an example [icon]



1. **To what extent do you agree or disagree with the following statements?**
   Please tick one box on each line to rate your agreement or disagreement with the statement
   [RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The chances of breaking down in a BEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to 'refuel' at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
BEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a BEV would give me a 'feel good factor' because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of BEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a BEV	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Having to remember to plug in a BEV would put me off buying one	☐	☐	☐	☐	☐
A BEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a BEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a BEV	☐	☐	☐	☐	☐
Adapting to charging a BEV would be difficult for me	☐	☐	☐	☐	☐
If I had a BEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a BEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a BEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a BEV	☐	☐	☐	☐	☐
When driving a BEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a BEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel would make me more likely to buy a BEV	☐	☐	☐	☐	☐

2. **The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.**
   These statements are not about you; instead please imagine the kind of person who would drive a BEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
   Please tick one box on each line
   [RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

3. To what extent do you agree or disagree with the following statements about BEVs?
Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
BEVs are a very exciting new technology	☐	☐	☐	☐	☐
BEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
BEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
BEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
BEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
BEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
BEVs are too new to be reliable	☐	☐	☐	☐	☐
BEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
BEVs perform better than a conventional car	☐	☐	☐	☐	☐
BEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
BEVs are good for the environment	☐	☐	☐	☐	☐
are pleasant to drive	☐	☐	☐	☐	☐
BEVs are impractical	☐	☐	☐	☐	☐
BEVs are a really good idea	☐	☐	☐	☐	☐
BEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
BEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
BEVs offer environmental benefits	☐	☐	☐	☐	☐
BEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐
BEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
BEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
BEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
BEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
BEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
BEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
BEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
BEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
BEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

Q3a Over the next 5 years, do you expect to be …

- …a one car household
- …a two car household
- ...a three or more car household

[Response to inform skip logic for all second car questions in TP1]

4. **Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) …**

   Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

5. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if it had a range when fully charged of:**

   Please choose 'yes' or 'no' for each row

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

6. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as a SECOND car in your household if it had a range when fully charged of:**

   Please choose 'yes' or 'no' for each row,

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

7. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

8. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the SECOND car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row,

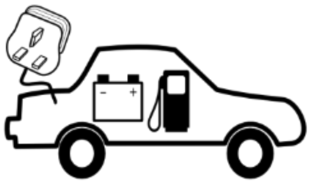
	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

9. **How informed do you currently feel about Battery Electric Vehicles?**

☐ Totally uninformed
☐ Quite uninformed
☐ Neither informed nor uninformed
☐ Quite informed
☐ Very informed

Section 2: Plug-in Hybrid Electric Vehicles (PHEVs)

This section will ask you about Plug-in Hybrid Electric Vehicles (PHEVs) only. Please think specifically about PHEVs when answering the questions. If you need a reminder about what a PHEV is then please click on the blue "i" icon and a description will pop-up. Here is an example [insert icon].



10. To what extent do you agree or disagree with the following statements?
Please tick one box on each line to rate your agreement or disagreement with the statement
[RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The chances of breaking down in a PHEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to 'refuel' at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
PHEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a PHEV would give me a 'feel good factor' because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of PHEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a PHEV	☐	☐	☐	☐	☐
Having to remember to plug in a PHEV would put me off buying one	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A PHEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a PHEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a PHEV	☐	☐	☐	☐	☐
Adapting to charging a PHEV would be difficult for me	☐	☐	☐	☐	☐
If I had a PHEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a PHEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a PHEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a PHEV	☐	☐	☐	☐	☐
When driving a PHEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a PHEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel as often would make me more likely to buy a PHEV	☐	☐	☐	☐	☐

11. The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.
These statements are not about you; instead please imagine the kind of person who would drive a PHEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
Please tick one box on each line
[RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

12. To what extent do you agree or disagree with the following statements about PHEVs?

Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PHEVs are a very exciting new technology	☐	☐	☐	☐	☐
PHEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
PHEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
PHEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
PHEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
PHEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
PHEVs are too new to be reliable	☐	☐	☐	☐	☐
PHEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
PHEVs perform better than a conventional car	☐	☐	☐	☐	☐
PHEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
are good for the environment	☐	☐	☐	☐	☐
PHEVs are pleasant to drive	☐	☐	☐	☐	☐
PHEVs are impractical	☐	☐	☐	☐	☐
PHEVs are a really good idea	☐	☐	☐	☐	☐
PHEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
PHEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
PHEVs offer environmental benefits	☐	☐	☐	☐	☐
PHEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐
PHEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
PHEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
PHEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
PHEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
PHEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
PHEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
PHEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
PHEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

13. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) …

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

14. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if it had an electric driving range when fully charged of:

Please choose 'yes' or 'no' for each row

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

15. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as a SECOND car in your household if it had an electric driving range when fully charged of:**

Please choose 'yes' or 'no' for each row, or

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

16. Please indicate whether you would consider owning a *<u>Plug-in Hybrid Electric Vehicle (PHEV)</u>* as the MAIN car in your household if the charging time required to provide 100 miles of electric driving range was:

Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

17. Show if Q7a+Q7b >1. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *<u>Plug-in Hybrid Electric Vehicle (PHEV)</u>* as the SECOND car in your household if the charging time required to provide 100 miles of electric driving range was:**

Please choose 'yes' or 'no' for each row,

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

18. How informed do you currently feel about Plug-in Hybrid Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 3: Next vehicle purchase

19. When do you next intend to buy your next car?

- ☐ Within the next year
- ☐ Between 1 and 2 years from now
- ☐ Between 2 and 5 years from now
- ☐ More than 5 years from now
- ☐ Not sure/don’t know

20. Do you expect to buy your car:

- ☐ Brand new (Less than 1 year old)
- ☐ Nearly new (1-2 years old)
- ☐ Used (More than 2 years old)
- ☐ Not sure / don’t know

Section 4: Home electricity use

21. Who typically pays the electricity bill for your household?

- ☐ Me
- ☐ Someone else in my household
- ☐ Someone outside my household (for example, a landlord)
- ☐ Other …

22. Approximately how much does your household typically spend on electricity per month?

Please report only electricity spending, not spending on gas. If your monthly cost varies considerably based on the time of year, you may use an estimate of your typical monthly spend between winter and summer, or possibly your regular Direct Debit amount.

- ☐ My household spends about £ [______] per month for electricity
- ☐ I don't know [skip to Q24]

23. How did you know the amount your household typically spends on electricity per month?

- ☐ I knew this off the top of my head
- ☐ I had to look at our bill or ask somebody
- ☐ I made a rough guess
- ☐ Not very accurate; I might be off by 50% or more

***24.* Would you consider changing the times when you use electricity if it could save you money?** *For example, would you do your laundry late at night instead of the daytime to save money?*

- ☐ Yes
- ☐ No
- ☐ I don't know

25. What do you think is the environmental impact of *your* home electricity use?

- ☐ No impact
- ☐ Minor impact
- ☐ Major impact
- ☐ I don't know

26. Please read each statement carefully and indicate the how often you are likely to engage in the following actions.

Please tick one box on each line

[RANDOMISE ORDER]

	Always	Often	Occasionally	Never
Turn off lights in areas of the house you're not using	☐	☐	☐	☐
Drive economically (e.g., braking or accelerating gently)	☐	☐	☐	☐
Walk, cycle or take public transport for short journeys (i.e., trips of less than 3 miles)	☐	☐	☐	☐
Use an alternative to travelling (e.g. shopping online)	☐	☐	☐	☐
Share a car journey with someone else	☐	☐	☐	☐
Cut down on the amount you fly	☐	☐	☐	☐
Buy environmentally-friendly products	☐	☐	☐	☐
Eat food which is organic, locally-grown or in season	☐	☐	☐	☐
Avoid eating meat	☐	☐	☐	☐
Deliberately buy products with less packaging	☐	☐	☐	☐
Recycle	☐	☐	☐	☐
Reuse or repair items instead of throwing them away	☐	☐	☐	☐
Compost your kitchen waste	☐	☐	☐	☐
Save water by taking shorter showers	☐	☐	☐	☐
Turn off the tap while you brush your teeth	☐	☐	☐	☐
Write to your MP about an environmental issue	☐	☐	☐	☐
Take part in a protest about an environmental issue	☐	☐	☐	☐
Put appliances such as the washing machine or tumble dryer on late at night	☐	☐	☐	☐

Section 5: Plug-in Vehicle charging

27. Are you aware of EV charging opportunities at any of the following locations that are either local to you or on routes you drive regularly?

Please select all that apply.

- ☐ My workplace
- ☐ A supermarket
- ☐ A retail store or retail estate
- ☐ A shopping mall
- ☐ A restaurant
- ☐ A gym/recreation facility or community centre
- ☐ An on-street parking bay
- ☐ A fee-charging car park (e.g. NCP)
- ☐ A government building
- ☐ A religious or spiritual building
- ☐ A motorway service area
- ☐ Other: ___________________
- ☐ I have never seen an electric vehicle recharge station

THANK YOU – THAT IS THE END OF THIS SURVEY

If you have any comments about this questionnaire then please note them here.

Time Point 2 questionnaire

Participant ID: _________

Please answer the following question before completing the Time Point 2 questionnaire.

Over the next 5 years, do you expect to be …

- o …a one car household
- o …a two car household
- o ...a three or more car household

[Response to inform skip logic for all second car questions in TP2]

What is this questionnaire?

This Time point 2 Questionnaire is the final questionnaire which you will be asked to complete as part of this study. This questionnaire is designed to capture information on your opinions and perceptions of different types of electric vehicle, and to report on your experience with the trial vehicle.

How long will it take to complete?

It will take approximately 30 minutes to complete.

What do you need from me?

Please read each question carefully and answer the questions as openly and honestly as you can. There are no right or wrong answers. All information obtained in this questionnaire will be kept private in compliance with the Data Protection Act. All data will be anonymised and stored securely; you will not be personally identifiable from your responses.

Before starting the questionnaire please take a little time to remind yourself of the information on the next page about different types of vehicles. You will be asked for your views on these vehicles in the questionnaire.

How to complete the questionnaire

Please use the at the bottom of each page to go forward. As soon as you do this your answer is saved.

If you need to go back, please use the button.

If you leave the survey idle for a while, you will be logged out automatically, but don't worry, your answers will be saved so long as you have completed a question by pressing the forward button

To restart the questionnaire at the same stage, simply click the original link that was sent to you.

What other questionnaires will I have to complete for this trial?

None. This is the final questionnaire.

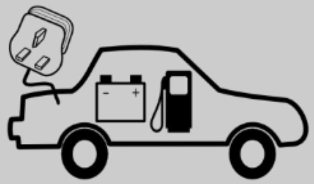
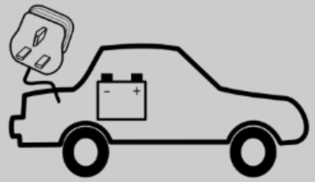
Questionnaire	Progress
Pre-trial questionnaire	**Completed**
Time point 1 questionnaire	**Completed**
Time point 2 questionnaire	In progress (this questionnaire)

Thank you for taking part in this research. Your participation is extremely important.

Types of electric vehicles and definitions for this questionnaire

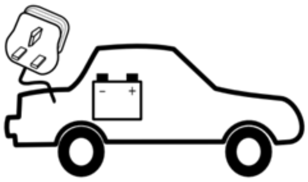
In this questionnaire we will ask you about your views of types of plug-in vehicles (PiVs). This table provides a summary of the differences between plug-in vehicles and non-plug-in (conventional) vehicles that you will be used to.

[table on following page – present on one page online]

Non-plug-in (conventional) vehicles		Plug-in Vehicles (PiVs)	
Conventional vehicle	**Hybrid Electric Vehicle (HEV)**	**Plug-in Hybrid Electric Vehicle (PHEV)**	**Battery Electric Vehicle (BEV)**
			
Typically powered by petrol / diesel only.	A non-plug-in Hybrid Electric Vehicle (HEV) has a petrol / diesel engine and an electric motor powered by a small battery. The battery gets charged when the engine is running. It does not need to (and cannot) be plugged in to an electrical socket to charge the battery. Battery power is mainly used at lower speeds, like when in traffic; this improves fuel consumption.	A Plug-in Hybrid Electric Vehicle (PHEV) is like a conventional HEV with both a petrol / diesel engine and an electric motor. BUT, the battery can be charged by plugging it in to a normal electrical socket (like you have at home) or dedicated charging point, as needed. The battery also gets charged when the engine is running. If you run out of charge you can continue driving as long as there is petrol or diesel in the tank. The car will use the electric motor whenever possible to save fuel, but also uses power from the petrol / diesel engine when required.	A Battery Electric Vehicle (BEV) is powered only by a battery. The battery is charged by plugging it in to a normal electric socket (like you have at home) or dedicated charging point, as needed. No petrol or diesel is required; once you run out of electrical charge in the battery you will no longer be able to operate the vehicle.

Section 1: Battery Electric Vehicles (BEVs)

This section will ask you about Battery Electric Vehicles (BEVs) only. Please think specifically about BEVs when answering the questions.



1. **To what extent do you agree or disagree with the following statements?**
   Please tick one box on each line to rate your agreement or disagreement with the statement
   [RANDOMISE ORDER]

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The chances of breaking down in a BEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to 'refuel' at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
BEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a BEV would give me a 'feel good factor' because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of BEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a BEV	☐	☐	☐	☐	☐
Having to remember to plug in a BEV would put me off buying one	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A BEV would suit my daily travel patterns	☐	☐	☐	☐	☐
Having a BEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a BEV	☐	☐	☐	☐	☐
Adapting to charging a BEV would be difficult for me	☐	☐	☐	☐	☐
If I had a BEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a BEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a BEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a BEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a BEV	☐	☐	☐	☐	☐
When driving a BEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a BEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel would make me more likely to buy a BEV	☐	☐	☐	☐	☐

2. **The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.**
   These statements are not about you; instead please imagine the kind of person who would drive a BEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
   Please tick one box on each line
   [RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

3. **To what extent do you agree or disagree with the following statements about BEVs?**
Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs are a very exciting new technology	☐	☐	☐	☐	☐
BEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
BEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
BEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
BEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
BEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
BEVs are too new to be reliable	☐	☐	☐	☐	☐
BEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
BEVs perform better than a conventional car	☐	☐	☐	☐	☐
BEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
BEVs are good for the environment	☐	☐	☐	☐	☐
are pleasant to drive	☐	☐	☐	☐	☐
BEVs are impractical	☐	☐	☐	☐	☐
BEVs are a really good idea	☐	☐	☐	☐	☐
BEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
BEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
BEVs offer environmental benefits	☐	☐	☐	☐	☐
BEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
BEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐
BEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
BEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
BEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
BEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
BEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
BEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
BEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
BEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
BEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
BEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

4. **Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Battery Electric Vehicle (BEV) …**

   Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

5. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if it had a range when fully charged of:**

   Please choose 'yes' or 'no' for each row

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

6. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as a SECOND car in your household if it had a range when fully charged of:**

   Please choose 'yes' or 'no' for each row,

	Yes	No
50 miles	☐	☐
100 miles	☐	☐
150 miles	☐	☐
200 miles	☐	☐
300 miles	☐	☐

7. **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the MAIN car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

8. **Show if Q3 not eq 1** (a one car household) **Please indicate whether you would consider owning a *Battery Electric Vehicle (BEV)* as the SECOND car in your household if the charging time required to provide 100 miles of range was:**
Please choose 'yes' or 'no' for each row,

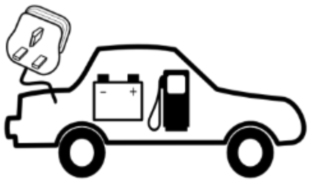
	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

9. **How informed do you currently feel about Battery Electric Vehicles?**

☐ Totally uninformed
☐ Quite uninformed
☐ Neither informed nor uninformed
☐ Quite informed
☐ Very informed

Section 2: Plug-in Hybrid Electric Vehicles (PHEVs)

This section will ask you about Plug-in Hybrid Electric Vehicles (PHEVs) only. Please think specifically about PHEVs when answering the questions.



10. To what extent do you agree or disagree with the following statements?
Please tick one box on each line to rate your agreement or disagreement with the statement
[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The chances of breaking down in a PHEV are higher than in a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if there were plenty to choose from among the main car manufacturers	☐	☐	☐	☐	☐
I like the idea of being able to ‘refuel’ at home rather than have to go to petrol stations	☐	☐	☐	☐	☐
I would like to be less dependent on oil companies for fuelling my car	☐	☐	☐	☐	☐
PHEVs are a good thing because they make us less dependent on oil	☐	☐	☐	☐	☐
Driving a PHEV would give me a ‘feel good factor’ because of its green credentials	☐	☐	☐	☐	☐
The environmental benefits of PHEVs have been over exaggerated	☐	☐	☐	☐	☐
I am the type of person who would drive a PHEV	☐	☐	☐	☐	☐
Having to remember to plug in a PHEV would put me off buying one	☐	☐	☐	☐	☐
A PHEV would suit my daily travel patterns	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Having a PHEV would mean I would have to plan journeys carefully	☐	☐	☐	☐	☐
I would prefer to drive a conventional car than a PHEV	☐	☐	☐	☐	☐
Adapting to charging a PHEV would be difficult for me	☐	☐	☐	☐	☐
If I had a PHEV, it would be unlikely to be my main or only car	☐	☐	☐	☐	☐
Many people I know would be attracted to owning a PHEV	☐	☐	☐	☐	☐
I would be prepared to pay more for a PHEV than a conventional car	☐	☐	☐	☐	☐
I would only consider a PHEV if I knew I had access to a rapid charging point (i.e. somewhere it would charge to 80% in around 30 minutes)	☐	☐	☐	☐	☐
I would feel embarrassed to drive a PHEV	☐	☐	☐	☐	☐
When driving a PHEV, I would always be worried about running out of charge	☐	☐	☐	☐	☐
I would feel proud of having a PHEV outside my house	☐	☐	☐	☐	☐
Not having to go to a petrol station to refuel would make me more likely to buy a PHEV	☐	☐	☐	☐	☐

11. The following statements are part of a standardised question set designed to understand your views. Please give your instinctive response and try not to overthink the answer.
These statements are not about you; instead please imagine the kind of person who would drive a PHEV. Now describe what that person is like, by indicating to what extent the following statements fit the type of person:
Please tick one box on each line
[RANDOMISE ORDER]

	Doesn't fit the driver	Only fits the driver a little	Fits the driver moderately	Fits the driver well	Fits the driver very well
Likes to tidy up	☐	☐	☐	☐	☐
Has a lot of fun	☐	☐	☐	☐	☐
Has a low status job	☐	☐	☐	☐	☐
Sympathises with the homeless	☐	☐	☐	☐	☐
Is female	☐	☐	☐	☐	☐
Likes philosophical discussions	☐	☐	☐	☐	☐
Frequently has casual sexual relationships	☐	☐	☐	☐	☐
Feels able to deal with things	☐	☐	☐	☐	☐
Makes rash decisions	☐	☐	☐	☐	☐
Is physically unattractive	☐	☐	☐	☐	☐
Prefers to stick to things that he or she knows	☐	☐	☐	☐	☐
Has a high income	☐	☐	☐	☐	☐
Feels uncomfortable around people	☐	☐	☐	☐	☐
Is aged 35 or under	☐	☐	☐	☐	☐
Gets back at others	☐	☐	☐	☐	☐
Is physically attractive	☐	☐	☐	☐	☐
Worries about things	☐	☐	☐	☐	☐
Is in a long term relationship with a spouse or partner	☐	☐	☐	☐	☐

12. To what extent do you agree or disagree with the following statements about PHEVs?
Please tick one box on each line

[RANDOMISE ORDER]

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PHEVs are a very exciting new technology	☐	☐	☐	☐	☐
PHEVs are a current fad which will soon disappear	☐	☐	☐	☐	☐
PHEVs are more expensive to buy than conventional cars	☐	☐	☐	☐	☐
PHEVs are more expensive to run than conventional cars	☐	☐	☐	☐	☐
PHEVs are as safe for the driver and passengers as conventional cars	☐	☐	☐	☐	☐
PHEVs are more complicated than a conventional car	☐	☐	☐	☐	☐
PHEVs are too new to be reliable	☐	☐	☐	☐	☐
PHEVs are similar to a conventional car in most respects	☐	☐	☐	☐	☐
PHEVs perform better than a conventional car	☐	☐	☐	☐	☐
PHEVs are suitable for my lifestyle	☐	☐	☐	☐	☐
are good for the environment	☐	☐	☐	☐	☐
PHEVs are pleasant to drive	☐	☐	☐	☐	☐
PHEVs are impractical	☐	☐	☐	☐	☐
PHEVs are a really good idea	☐	☐	☐	☐	☐
PHEVs are a cheaper option over the longer term	☐	☐	☐	☐	☐
PHEVs are a danger to people outside the car because of the lack of engine noise	☐	☐	☐	☐	☐
PHEVs offer environmental benefits	☐	☐	☐	☐	☐
PHEVs emit less carbon dioxide than conventional cars	☐	☐	☐	☐	☐
PHEVs would have better acceleration from 0-30mph compared with a conventional car	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PHEVs will hold its value better than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less responsive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be more powerful than a conventional car	☐	☐	☐	☐	☐
PHEVs would be noisier when pulling away than a conventional car	☐	☐	☐	☐	☐
PHEVs would be quieter when cruising than a conventional car	☐	☐	☐	☐	☐
PHEVs would be smoother to drive when accelerating than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less smooth to drive when cruising	☐	☐	☐	☐	☐
PHEVs would be more reliable than a conventional car	☐	☐	☐	☐	☐
PHEVs would be less comfortable than a conventional car	☐	☐	☐	☐	☐
PHEVs will lose value more quickly than a conventional car	☐	☐	☐	☐	☐
PHEVs would have worse acceleration from 30-50mph compared with a conventional car	☐	☐	☐	☐	☐

13. Please indicate how likely or unlikely it is that in the next 5 years, I would choose to have a Plug-in Hybrid Electric Vehicle (PHEV) …

Please tick one box on each line

	Very unlikely	Fairly unlikely	Neither likely nor unlikely	Fairly likely	Very likely
…as my main car"	☐	☐	☐	☐	☐
Show if Q3 not eq 1 (a one car household) **… as a second car"**	☐	☐	☐	☐	☐

14. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if it had an electric driving range when fully charged of:

Please choose 'yes' or 'no' for each row

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

15. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as a SECOND car in your household if it had an electric driving range when fully charged of:**

Please choose 'yes' or 'no' for each row, or

	Yes	No
10 miles	☐	☐
25 miles	☐	☐
50 miles	☐	☐
75 miles	☐	☐
100 miles	☐	☐

16. Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the MAIN car in your household if the charging time required to provide 100 miles of electric driving range was:

Please choose 'yes' or 'no' for each row

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

17. Show if Q7a+Q7b >1. Show if Q3 not eq 1 (a one car household) **Please indicate whether you would consider owning a *Plug-in Hybrid Electric Vehicle (PHEV)* as the SECOND car in your household if the charging time required to provide 100 miles of electric driving range was:**

Please choose 'yes' or 'no' for each row,

	Yes	No
8 hours	☐	☐
6 hours	☐	☐
4 hours	☐	☐
2 hours	☐	☐
1 hour	☐	☐

18. How informed do you currently feel about Plug-in Hybrid Electric Vehicles?

☐ Totally uninformed

☐ Quite uninformed

☐ Neither informed nor uninformed

☐ Quite informed

☐ Very informed

Section 3: Next vehicle purchase

19. When do you next intend to buy your next car?

☐ Within the next year

☐ Between 1 and 2 years from now

☐ Between 2 and 5 years from now

☐ More than 5 years from now

☐ Not sure/don't know

20. Do you expect to buy your car:

☐ Brand new (Less than 1 year old)

☐ Nearly new (1-2 years old)

☐ Used (More than 2 years old)

☐ Not sure / don't know

21. Have you sourced information about PHEVs or BEVs from any of the following since starting this study?

Select all that apply

☐ Car magazines (e.g. CAR, Auto Express)
☐ TV motoring shows (e.g. Top Gear)
☐ The news (e.g. television or newspaper)
☐ Information from car dealers
☐ Television commercials
☐ Family and friends
☐ Personal research (internet, books, movies, talks)
☐ Government (ads, brochures, etc.)
☐ Other sources, please specify:_____________________
☐ None of these

Section 4: Your experience with the Plug-in Vehicle (PiV) vehicle

For the questions in this section, please think about your experience of using and charging the Plug-in Vehicle (PiV) you drove for the study.

We would like you to evaluate the vehicle based on your experience using it. There are no right or wrong answers, please be completely honest.

22. Please rate the extent to which the trial vehicle was suitable for your needs, on a scale of 1-10 where 1 is very unsuitable and 10 is very suitable:

- ☐ 1 – Very unsuitable
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 – Neither suitable nor unsuitable
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 – Very suitable

23. Please rate the performance of the car you used in the study.
Please read the following example before answering the next set of questions below.

Example (acceleration from 0mph to 20mph):

When giving your answer, please start with the verbal expression, “Very low”, “Moderate”, etc., and then choose a number. If your perception of the acceleration from 0 to 20mph was “very low”, rate it as 1. If your perception of the acceleration from 0 to 20 mph was “high”, rate it as 5, and so on. Please answer using your own perception of the acceleration from 0 to 20 mph, and not what you think other people might think of it, or what you think the answer “ought” to be. Please be as honest as possible and try not to under-estimate or over-estimate the acceleration.

Rate each aspect of the vehicle’s performance, by selecting one number on the scale provided.

Acceleration from 0 mph to 20 mph											
Not at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Responsiveness to the accelerator pedal											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Noise level when cruising											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Acceleration from 50mph to 70mph											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Noise level when stationary (e.g. at traffic lights)											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Sportiness of noise when accelerating											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

Smoothness when cruising											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high

0	0.5	1	2	3	4	5	6	7	8	9	10
Power											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Acceleration from 30mph to 50mph											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of safety when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of comfort when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Feeling of enjoyment when driving the car											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10
Overall performance											
None at all	Extremely low	Very low	Low	Moderate		High		Very High			Extremely high
0	0.5	1	2	3	4	5	6	7	8	9	10

24. Roughly, what percentages of journeys were you the driver of the plug-in vehicle?
Please select a percentage from the drop down menu

[Drop down options with auto-calculate]

I was the driver for *[0-100%]* of the journeys
Someone else in my household was the driver for *[0-100%]* of the journeys

25. Roughly, when putting the vehicle on charge at home, what percentage of occasions did you do this?
Please select a percentage from the drop down menu

[Drop down options with auto-calculate]

I plugged the vehicle in *[0-100%]* of charge occasions

Someone else plugged the vehicle in *[0-100%]* of charge occasions

26. Did you do any of the following actions to optimise the range of your PiV?
Please select all that apply

☐ Accelerating/decelerating smoothly

☐ Limiting the use of heating or cooling features (e.g. air conditioning)

☐ Taking routes to avoid steep hills or high speed roads

☐ Carrying less cargo

☐ Driving at or below the speed limit

☐ Using high efficiency vehicle modes (e.g. B mode)

☐ Other. Please specify:_______________

☐ None of these

27. How easy or difficult was it to charge the plug-in vehicle?

☐ Very easy

☐ Easy

☐ Neither easy nor difficult

☐ Difficult

☐ Very difficult

28. How would you rate your overall level of satisfaction with the charging tariff which you experienced during the trial?

- ☐ Very satisfied
- ☐ Satisfied
- ☐ Neither satisfied nor unsatisfied
- ☐ Unsatisfied
- ☐ Very unsatisfied

29. How would you rate your level of satisfaction with the amount of Savings Points available through the charging tariff?

- ☐ Very satisfied
- ☐ Satisfied
- ☐ Neither satisfied nor unsatisfied
- ☐ Unsatisfied
- ☐ Very unsatisfied

30. How often did you make use of the features on the smartphone app when charging the vehicle during the trial?

- ☐ I used the app for every charge
- ☐ I used the app for nearly every charge
- ☐ I used the app occasionally
- ☐ I used the app rarely
- ☐ I did not use the app

31. How would you rate your level of satisfaction with the charging tariff smartphone application?

- ☐ Very satisfied
- ☐ Satisfied
- ☐ Neither satisfied nor unsatisfied
- ☐ Unsatisfied
- ☐ Very unsatisfied

32. If you owned a BEV, how likely or unlikely would you be to choose this charging tariff?

☐ Very likely

☐ Likely

☐ Neither likely nor unlikely

☐ Unlikely

☐ Very unlikely

33. If you owned a PHEV, how likely or unlikely would you be to choose this charging tariff?

☐ Very likely

☐ Likely

☐ Neither likely nor unlikely

☐ Unlikely

☐ Very unlikely

34. Do you have any general feedback about the charging tariff or the smartphone application?

35. Are you aware of EV charging opportunities at any of the following locations that are either local to you or on routes you drive regularly?

Please select all that apply.

- ☐ My workplace
- ☐ A supermarket
- ☐ A retail store or retail estate
- ☐ A shopping mall
- ☐ A restaurant
- ☐ A gym/recreation facility or community centre
- ☐ An on-street parking bay
- ☐ A fee-charging car park (e.g. NCP)
- ☐ A government building
- ☐ A religious or spiritual building
- ☐ A motorway service area
- ☐ Other: ___________________
- ☐ I have never seen an electric vehicle recharge station

36. During the trial, how frequently did you charge the vehicle at the following locations?

Please tick one box on each line

	Never	Less than once per month	1-3 days per month	About once per week	2-4 days per week	5-7 days per week
My home	☐	☐	☐	☐	☐	☐
My place of work or education	☐	☐	☐	☐	☐	☐
A supermarket	☐	☐	☐	☐	☐	☐
A retail store or retail estate	☐	☐	☐	☐	☐	☐
A shopping mall	☐	☐	☐	☐	☐	☐
A restaurant	☐	☐	☐	☐	☐	☐
A gym/recreation facility or community centre	☐	☐	☐	☐	☐	☐
An on-street parking bay	☐	☐	☐	☐	☐	☐
A fee-charging car park (e.g. NCP)	☐	☐	☐	☐	☐	☐
A government / council building	☐	☐	☐	☐	☐	☐
A religious or spiritual building	☐	☐	☐	☐	☐	☐
Other, please specify: ____________________	☐	☐	☐	☐	☐	☐

37. In the future, if you owned a <u>BEV</u>, how often would you charge the vehicle in each of the following circumstances?
[DO NOT RANDOMISE, PRESENT AS SHOWN]

	Never	Rarely	Some of the time	Most of the time	Always
I would charge my BEV at **home**	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV **at work**	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at a **petrol station**	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV in a **supermarket** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at a **town centre** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my BEV at **roadside parking** places	☐	☐	☐	☐	☐

38. In the future, if you owned a PHEV, how often would you charge the vehicle in each of the following circumstances?
[DO NOT RANDOMISE, PRESENT AS SHOWN]

	Never	Rarely	Some of the time	Most of the time	Always
I would charge my PHEV at **home**	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at **work**	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at a **petrol station**	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV in a **supermarket** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at a **town centre** car park	☐	☐	☐	☐	☐
If there were charging points, I would charge my PHEV at **roadside parking** places	☐	☐	☐	☐	☐

Section 5: Charging tariffs

This section contains information on the characteristics of different managed charging schemes. These are related to, but not exactly the same as, the scheme you may have experienced during the charging trial. It is therefore important that you read this information carefully so that you understand what each managed charging scheme involves.

In the future, the electricity supply will include more electricity generated from renewable sources such as wind power, whose outputs are more variable than those of conventional power stations. At some times there will be more electricity available and at other times less, so prices will vary much more than they do now. Prices also depend on how much electricity demand there is from users.

Managed charging is where the timing of vehicle charging is controlled to reduce its costs (by lowering its impact on the electricity supply grid). For example, this can involve shifting charging outside the periods of peak prices (which happen when there are lots of demands on the grid, or less supply is available) to periods with low prices (which happen when there are few demands on the grid, or more supply is available). Reducing the impact on the electricity grid provides savings for electricity suppliers which can be passed onto consumers to reward them for participating in managed charging. In turn, this reduces the running costs of plug-in cars.

This following table describes the characteristics of two distinct forms of managed charging, as well as unmanaged charging.

<table>
<tr><th>Unmanaged charging</th><th colspan="2">Managed Charging</th></tr>
<tr><th></th><th>User-managed charging</th><th>Supplier-managed charging</th></tr>
<tr>
<td>

The price of electricity is set at a standard fixed rate
You are free to charge the car whenever you want
The car will begin charging immediately as soon as it is plugged into the charge point and charge continuously until the battery is full or you unplug it

</td>
<td>

The price you pay for electricity to charge the car varies during the day, in several bands. For example, during peak times (e.g. from 3pm to 7pm) electricity will be expensive, but then cheaper outside peak times
An example Time-of-Use tariff for user managed charging:

<table>
<tr><th>Time period</th><th>Price (p/kWh)</th></tr>
<tr><td>5am - 10am</td><td>10</td></tr>
<tr><td>10am - 3pm</td><td>12</td></tr>
<tr><td>3pm - 7pm</td><td>34</td></tr>
<tr><td>7pm - 5am</td><td>9</td></tr>
</table>

You decide during which hours your vehicle is charged
You can do this through the car infotainment system or use an app to turn charging on/off

</td>
<td>

Each time you plug your car into your home charge point you specify when you next need the car and what battery state of charge you will require.
The external Charge Supplier then controls the timing of charging to get you the biggest cost saving. The external Charge Supplier could be the electricity supplier or a standalone business entity that specialises in controlled charging.
The supplier will deliver the state of charge you asked for by the time you asked for it

</td>
</tr>
</table>

	at the time you have decided. The system will provide you with the price of electricity in each hour. • Charging during off-peak hours reduces the running cost of a plug-in car, but charging during peak hours will increase it • Maximising the amount of charging carried out during off-peak hours maximises the savings you can make by running a plug-in car with user-managed charging • The savings you can make will be bigger in Winter months than in Summer months	• If you unplug earlier, your car may not yet be charged to the state of charge you asked for • You are rewarded with cheaper electricity bills. You make a larger saving if your car is plugged in at times of day when electricity is cheaper, like overnight. You also make a larger saving the longer your car is plugged in compared to the time needed to charge because this gives the supplier more flexibility to select optimum charge times (e.g. if 6 hours are needed to charge the car, the reward will be greater if the car is plugged in for 12 hours compared to 8 hours). • You can also set default values so you do not need to specify when you next need the car and what battery state of charge you require each time you plug in, unless it's different than the defaults you set • The savings you can make will be bigger in Winter months than in Summer months

39. If you owned a BEV, which type of energy tariff would you choose?
[LINK TO POP-UP OF INFORMATION SHEET]

- ☐ Standard tariff
- ☐ User-managed charging tariff
- ☐ Supplier-managed charging tariff

40. If you owned a BEV, how important or unimportant would the following factors be when choosing an energy tariff?
Please tick one box on each line

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Cost of charging	☐	☐	☐	☐	☐
Convenience	☐	☐	☐	☐	☐
Simplicity	☐	☐	☐	☐	☐
Predictability of energy bill	☐	☐	☐	☐	☐
Compatibility with vehicle use and charging needs	☐	☐	☐	☐	☐
Ability to make savings	☐	☐	☐	☐	☐
Control over when your vehicle will charge	☐	☐	☐	☐	☐
Predictability of having a full charge when car is needed	☐	☐	☐	☐	☐
Control of charging via an app or website	☐	☐	☐	☐	☐
Other, please specify:	☐	☐	☐	☐	☐

41. If you owned a PHEV, which type of energy tariff would you choose?

[LINK TO POP-UP OF INFORMATION SHEET]
Please tick one box on each line

- ☐ Standard tariff
- ☐ User-managed charging tariff
- ☐ Supplier-managed charging tariff

42. If you owned a PHEV, how important or unimportant would the following factors be when choosing an energy tariff?
Please tick one box on each line

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Cost of charging	☐	☐	☐	☐	☐
Convenience	☐	☐	☐	☐	☐
Simplicity	☐	☐	☐	☐	☐
Predictability of energy bill	☐	☐	☐	☐	☐
Compatibility with vehicle use and charging needs	☐	☐	☐	☐	☐
Ability to make savings	☐	☐	☐	☐	☐
Control over when your vehicle will charge	☐	☐	☐	☐	☐
Predictability of having a full charge when car is needed	☐	☐	☐	☐	☐
Control of charging via an app or website	☐	☐	☐	☐	☐
Other, please specify:	☐	☐	☐	☐	☐

43. If a User-Managed Charging tariff were available, would this make you more likely to have a:
Please tick one box on each line

	Not at all	A little more likely	Somewhat more likely	Much more likely	Very much more likely
BEV as a main car	☐	☐	☐	☐	☐
BEV as a second car	☐	☐	☐	☐	☐
PHEV as a main car	☐	☐	☐	☐	☐
PHEV as a second car	☐	☐	☐	☐	☐

44. If a Supplier-Managed Charging tariff were available, would this make you more likely to have a:
Please tick one box on each line

	Not at all	A little more likely	Somewhat more likely	Much more likely	Very much more likely
BEV as a main car	☐	☐	☐	☐	☐
BEV as a second car	☐	☐	☐	☐	☐
PHEV as a main car	☐	☐	☐	☐	☐
PHEV as a second car	☐	☐	☐	☐	☐

Section 6: About you

45. How accurately do each of the statements below describe you?

Please use the rating scale to describe how accurately each of the below statements describes _you_.

Please describe yourself as you generally are now, not as you wish to be in the future.

Please describe yourself as you honestly see yourself, in relation to other people you know of the same sex and age (approximately).

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

[RANDOMISE ORDER]

	Very little	Little	Moderate	Much	Very much
Have a low status job	☐	☐	☐	☐	☐
Like to tidy up	☐	☐	☐	☐	☐
Sympathize with the homeless	☐	☐	☐	☐	☐
Feel uncomfortable around people	☐	☐	☐	☐	☐
I worry about things	☐	☐	☐	☐	☐
Like philosophical discussions	☐	☐	☐	☐	☐
Have a lot of fun	☐	☐	☐	☐	☐
Make rash decisions	☐	☐	☐	☐	☐
Prefer to stick to things that I know	☐	☐	☐	☐	☐
I am physically unattractive	☐	☐	☐	☐	☐
Have a high income	☐	☐	☐	☐	☐
I am physically attractive	☐	☐	☐	☐	☐
Feel that I'm able to deal with things	☐	☐	☐	☐	☐
Get back at others	☐	☐	☐	☐	☐

46. To what extent would you say each of the following is typical or 'characteristic' of you?

Please use the rating scale to indicate the extent to which each of the statements below are characteristic or uncharacteristic of you.

Please describe yourself as you generally are now, not as you wish to be in the future.

Please describe yourself as you honestly see yourself, in relation to other people you know of the same sex and age (approximately).

As noted previously, all answers are confidential and will be anonymised.

Please tick one box on each line

	Very uncharacteristic of me	Moderately uncharacteristic of me	Neither characteristic nor uncharacteristic of me	Moderately characteristic of me	Very characteristic of me
Starting a conversation with a stranger	☐	☐	☐	☐	☐
Making sure others are comfortable and happy	☐	☐	☐	☐	☐
Creating an artwork, piece of writing or music	☐	☐	☐	☐	☐
Preparing for things well in advance	☐	☐	☐	☐	☐
Feeling blue or depressed	☐	☐	☐	☐	☐
Planning social events or parties	☐	☐	☐	☐	☐
Insulting people	☐	☐	☐	☐	☐
Thinking about philosophical or spiritual questions	☐	☐	☐	☐	☐
Letting things get into a mess	☐	☐	☐	☐	☐
Feeling stressed or worried	☐	☐	☐	☐	☐
Using difficult words	☐	☐	☐	☐	☐
Sympathising with others' feelings	☐	☐	☐	☐	☐

THANK YOU – THAT IS THE END OF THIS SURVEY AND THE TRIAL

If you have any comments about this questionnaire then please note them here:

If you have any comments about the trial then please note them here:

D5.1 - Supplementary Details of Design, Materials and Management Arrangements for Consumer Trials

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