WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

Customer Research and Trial Update Report
Electric Nation

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Contents

Glossary

Abbreviation	Term
BEV	Battery Electric Vehicles
EV	Electric Vehicle
HV	High Voltage
NIA	Network Innovation Allowance
PIV	Plug-In Vehicle
PHEV	Plug-In Hybrid Electric Vehicle

1 Introduction

This report provides an update on the customer-facing aspects of Electric Nation ("the Project") – both the customer research questionnaires and trials of smart charging. As detailed below the project aims to show the technical feasibility and benefits of smart charging and customer acceptance of the concept.

At the time of writing the Project is still in the recruitment stage. Over four hundred smart charger installations have been completed, and approximately 150 customers are under routine demand management at the time of writing. Participants receive their first survey (the Recruitment survey) a fortnight after installation and the Baseline survey between two and six weeks later to establish routine charging behaviour. Customer research industry, insight provided by the projects highly experienced customer research contractor Impact Utilities, suggests that the response rates of both surveys are very good when compared to industry averages for this type of research. Consequently, the Project has already received a significant amount of data about EV drivers, their attitudes, and their charging habits. Data is also being collected from chargers, showing each transaction and meter values (current made available to the charge point and current drawn by the vehicle).

1.1 The Electric Nation Project

Electric Nation is a Western Power Distribution and Network Innovation Allowance funded project. WPD's collaboration partners in the project are EA Technology, DriveElectric, Lucy Electric GridKey and TRL.

Electric Nation, the world's largest electric vehicle (EV) trial, is revolutionising domestic plug-in vehicle charging. By engaging 500-700 plug-in vehicle drivers in trials, the project is answering the challenge that when local electricity networks have 40% - 70% of households with electric vehicles, at least 32% of these networks across Britain will require intervention.

The project is developing and delivering a number of smart charging solutions to support plug-in vehicle uptake on local electricity networks. A key outcome will be a tool that analyses plug-in vehicle related stress issues on networks and identifies the best economic solution. This 'sliding scale' of interventions will range from doing nothing to smart demand control, from taking energy from vehicles and putting it back into the grid, to traditional reinforcement of the local electricity network where there is no viable smart solution.

The development of the project deliverables is being informed by a large-scale trial involving plug-in vehicle drivers that will:

- Expand current understanding of the demand impact of charging at home, on electricity distribution networks, of a diverse range of plug-in electric vehicles - with charge rates of up to 7kW, and a range of battery sizes from 20kWh to 80kWh+.
- Build a better understanding of how vehicle usage affects charging behaviour.
- Evaluate the reliability and acceptability to EV owners of smart charging systems and the influence these have on charging behaviour. This will help to answer such questions as:

- Would charging restrictions be acceptable to customers?
- Can customer preference be incorporated into the system?
- Is some form of incentive required?
- Is such a system 'fair'?
- Can such a system work?

The results of this project will be of interest and will be communicated to the GB energy/utility community, to UK government, to the automotive and plug-in vehicle infrastructure industry and to the general public.

To be eligible to participate in the project Electric Nation participants are required to already have an EV, or to be about to take ownership of an EV. They must live in the WPD licence area (the Midlands, South West and South Wales). In return for taking part in the project the participants receive a smart charger. Trial participants are recruited via a recruitment campaign that has utilised social media, internet presence, traditional PR, attendance at EV events and creating links with EV retailers.

1.2 Purpose and Structure of Report

The purpose of this report is to provide an update on the progress of the trial aspects of Electric Nation, both the smart charging roll-out and customer research. It also sets out the next steps for the project.

The structure of the report and the contents of each section is as follows:

- Section 1: an introduction to the document and its purpose.
- Section 2: the customer research approach, the surveys which customers will complete and data collected by the trial to date.
- Section 3: insight into results of the Recruitment survey to date, showing the demographic data for Electric Nation trial participants.
- Section 4: insight into results of the baseline survey to date, showing participants reported charging behaviour.
- Section 5: the trial design including the process being followed to move customers into demand management.
- Section 6: progress in moving both CrowdCharge and GreenFlux customers into demand management and the results of smart charging completed to date.
- Section 7: the next steps for both customer research and the smart charging trial.

2 Customer Research and Data Collection

2.1 Customer Research

Customer research is one of the many data sources being gathered by the Electric Nation trial (others include vehicle telematic data, charge point data, data from apps or demand control preference systems and participant enquiries). This research is being undertaken by Impact Utilities. These sources of information will be used to provide an answer to the overall customer objective of the trial:

> To prove which, if any 'Managed EV Charging to Support Local Electricity Networks' regime applied to trial participants is most likely to be satisfactory to all customers.

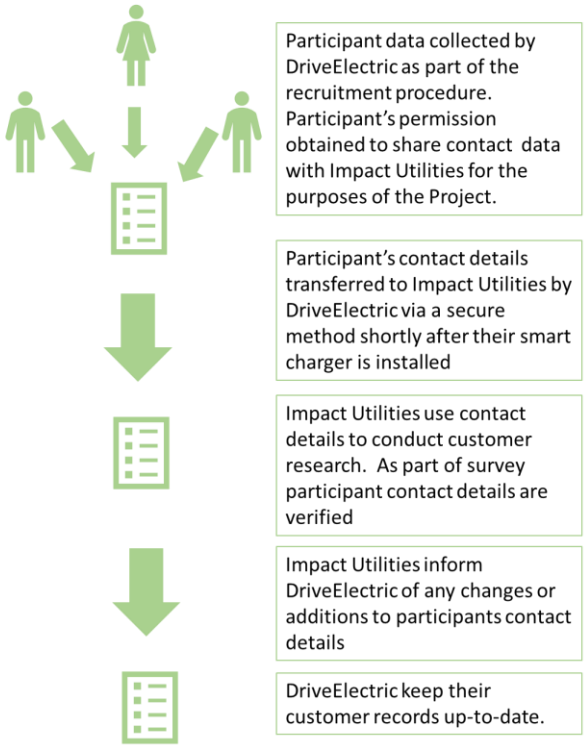
A condition of taking part in the Electric Nation trial[1], requires participants to complete a number of surveys during the course of the Project to enable the Project to understand participants' attitudes toward charging their EVs and their level of acceptance of varying degrees of managed charging. As the trial progresses and the level of managed charging/systems used to manage charging changes, the customer research will map any alterations in the participants' attitudes towards charging their vehicles and managed charging.

Participants contact details are collected by DriveElectric, the project partner responsible for participant recruitment and associated data protection[2], as part of the enrolment process. DriveElectric clearly explain to trial participants before they enrol in the Electric Nation trial that they are obligated to complete customer research surveys. The graphic below demonstrates the exchange of participant data between DriveElectric and Impact Utilities.

[1] This condition is highlighted in project publicity literature, such as the Project website and brochure (which can be accessed via the Project website http://www.electricnation.org.uk

[2] The Projects Data Protection Strategy can be found at: http://www.electricnation.org.uk/wp-content/uploads/2016/11/NIA_WPD_013-CarConnect-Data-Protection-Strategy-FINAL.pdf

Figure 1: Exchange of participant data between DriveElectric and Impact Utilities



Shortly after the installation of a participant's smart charger they are asked to complete the Recruitment survey (see Appendix 1). This survey concentrates on collecting demographic and socio-economic data, information about the participants, their plug-in vehicle (PIV) and their level of satisfaction with their smart charger installation experience. Participants are later (approximately-6 weeks) asked to complete a Baseline survey (see Appendix 2) to obtain data on their charging behaviour and their satisfaction with this.

Further surveys will be conducted towards the end of each managed charging cycle, and then a final survey will be conducted at the end of the trial. The first survey to ask participants about their experiences under managed charging will be issued at the end of November 2017.

2.2 Data Collection

Recruitment in the trial (and, so, installations of smart chargers into participant's homes) started in January 2017. The final installations are expected to be completed in January 2018. This will be ahead of the schedule.

This report is based on the data collected from the Recruitment surveys of trial participants in the weeks after the installation of their Electric Nation smart charger and data collected from the first Baseline survey. The table below summarises the number of Recruitment surveys completed as of 5th October 2017.

	Surveys Sent	Surveys completed
%	100%	86%
N	391	338

Table 1: Recruitment surveys completed

A smaller number of participants have been in the Project long enough to be asked to complete Baseline survey 1. The table below summarises the number of Baseline surveys completed.

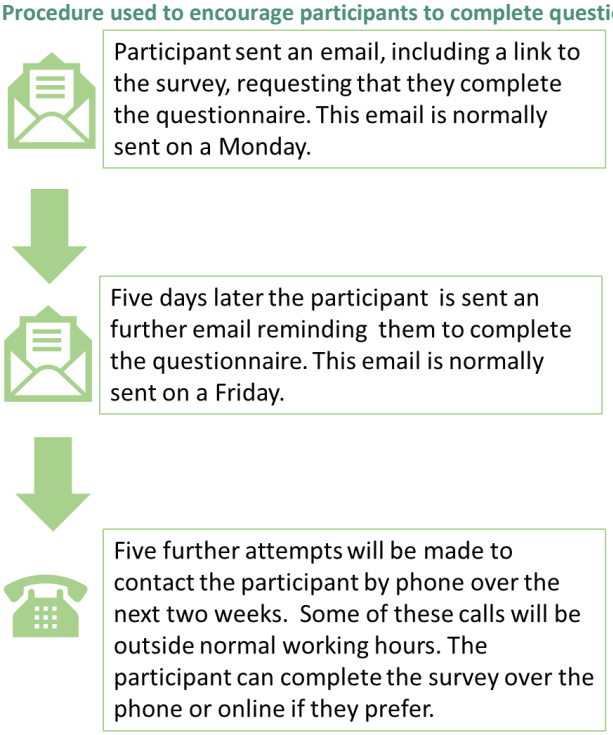
	Surveys Sent	Surveys completed
%	100%	79%
N	339	267

Table 2: Baseline surveys completed

The tables above represent a snapshot of the number of surveys completed at the time that this report was written. As commented above, the response rates have been very good. It was noticed that completion rates dipped during August (as was expected), however efforts were made to contact participants who had not completed surveys in August during September and this improved the response rate. The high level of survey responses can be attributed to a number of factors:

- A participant newsletter was sent to all participants (31st May 2017) reminding them of:
  - The importance of the customer research
  - Their obligations as trial participants
  - The details of the customer research contractor (Impact Utilities)
- Tweets to remind participants to complete the surveys
- DriveElectric reminding participants during the enrolment that under the terms of the trial, in return for the installation of a free “smart” EV charger at their home, they are asked to participate in customer research surveys
- DriveElectric are ensuring that participants are expecting communication for Impact as part of the trial
- DriveElectric are collecting personal email addresses from participants rather than work addresses that are more likely to reject Impact’s emails as Spam. They are also encouraging participants to put Impact’s email address into their contacts list, again to reduce the change that emails will be rejected as Spam
- Participants are given the flexibility to take part over the phone or online and with/without the assistance of a professional interviewer
- Impact Utilities proactive attempts to contact participants who have not completed their surveys. This procedure is outlined in the graphic below.
- Participants seem to be enthusiastic about participating in the trial and completing the surveys.
- Impact Utilities have designed the surveys so they are not unduly onerous for participants to complete.

Figure 2: Procedure used to encourage participants to complete questionnaires



For all trial surveys, the participant is sent a link to the questionnaire by email (Appendix 3 and 4). If they fail to complete the survey within an allotted period, then the link will be re-sent with a further email reminding them to complete the questionnaire. If the participant still does not complete the survey, then the survey company will attempt to contact the participant by telephone. The participant will be telephoned several times over the following weeks.

Participants will receive vouchers for an online store (such as Amazon) for completing each of the trial surveys. This excludes the Recruitment survey and the Baseline survey. Completion of the Recruitment survey and the Baseline survey are an obligatory condition of trial participation and therefore not rewarded. Participants will not be eligible for the vouchers above if they do not complete the Recruitment and Baseline surveys.

3 Recruitment Survey Results - Participant Demographics

The Recruitment survey provides demographic and socio-economic data about the trial participants. This survey provides the Project with a survey population and frame of reference against which all future survey measurements will be compared. It should be noted that:

- The survey population is representative of the population **who have had their smart charger installed to date.** Project recruitment is nearing completion, and it is expected that the final smart chargers will be installed in January 2018. Final statistics about the Electric Nation trial population will be available a few months thereafter.
- As seen below, the population recruited is skewed towards affluent males, aged 36-55, so is unlikely to be representative of the WPD regional customer base.
- The survey population demographic is also unlikely to be representative of the wider population of car owners.
- Surveys completed by participants after each demand management trial will be matched demographically to the Baseline survey population, so that the Project is always comparing a like for like population.

These points should be taken into consideration when drawing conclusions from the survey data.

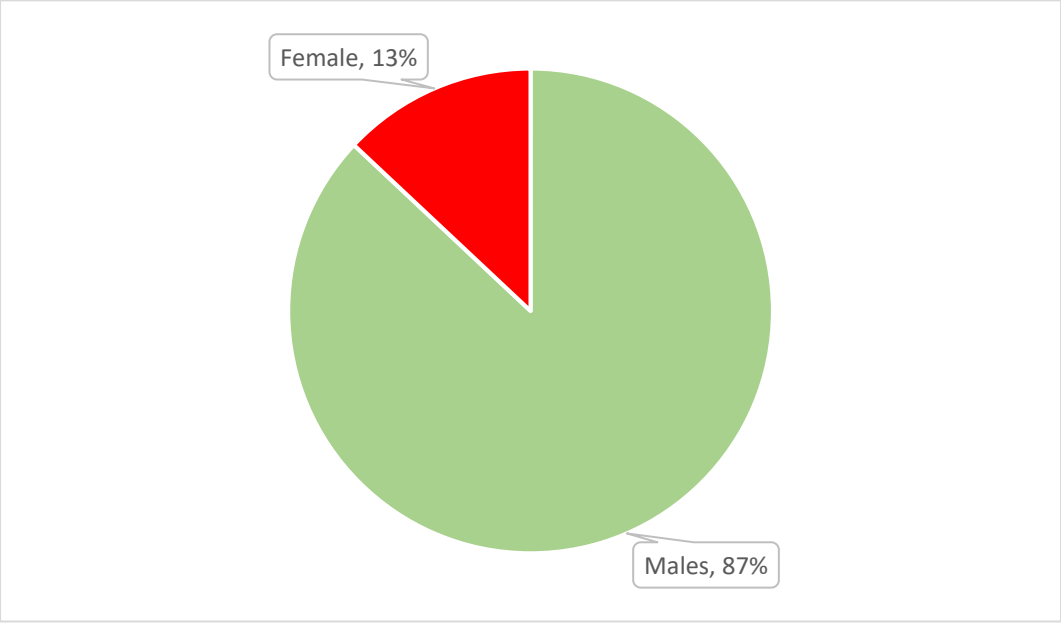
Data provided in this section is for the whole project population who have responded to this survey. As the project moves into the demand management phase participants are split into groups, however the make-up of these groups has not been finalised yet.

Recruitment for the trial is progressing at a healthy rate. More than half the expected number of participants have now had their smart chargers installed (405 on Monday 2nd October out of an upper target of 700). The recruitment data presented here is not however necessarily representative of the final participant population. The charts and graphs below illustrate the demographics of the trial participants who have completed the Recruitment survey to date. Once smart charger installations have been completed the trial population demographics will be compared to the wider WPD customer base. It is expected that the data to complete this comparison may be available in late Spring 2018.

3.1 Gender

There is a pronounced gender split amongst participants. Of the 338 participants who have completed the Recruitment survey 87% are male, compared with 13% females.

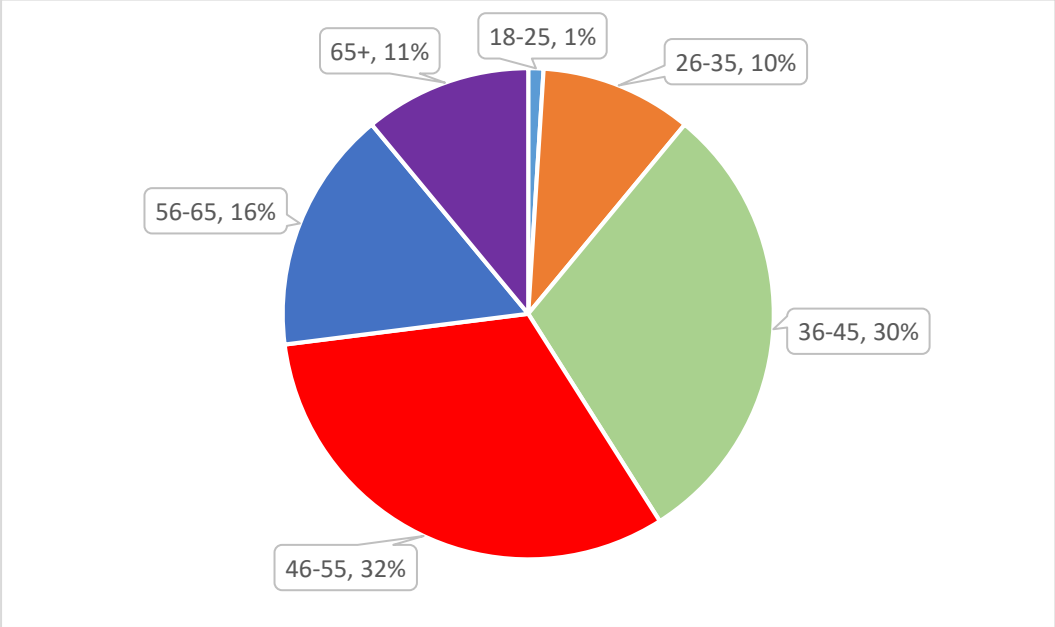
Figure 3: Gender split of participants (based on 338 surveys)



3.2 Age

The chart below demonstrates the age split of participants. The majority of participants are aged between 36 and 55 however the trial does include trial participants from all age groups.

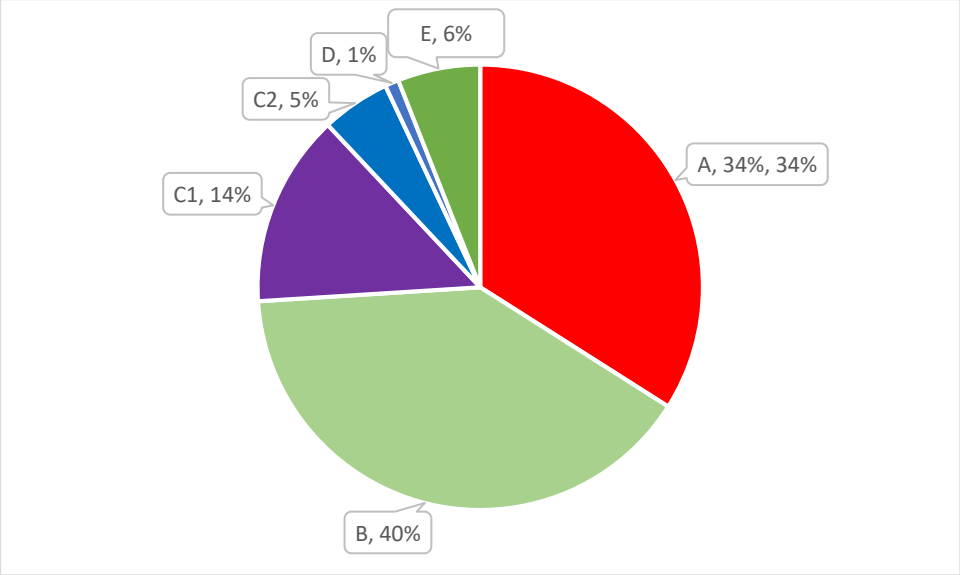
Figure 4: Age split of participants (based on 338 surveys)



3.3 Socio-economic data

The chart below shows the professional background of participants.

Figure 5: Social grade of participants (based on 338 surveys)



The table below provides a breakdown of the socio professional segmentations of the categories above.

Category	Definition
A	Higher Managerial, administrative, and professional
B	Intermediate Managerial, administrative, and professional
C1	Supervisory, clerical and junior managerial, administrative and professional
C2	Skilled manual workers
D	Semi-skilled and unskilled manual workers
E	State pensioners, casual and lowest grade workers, unemployed with state benefits only

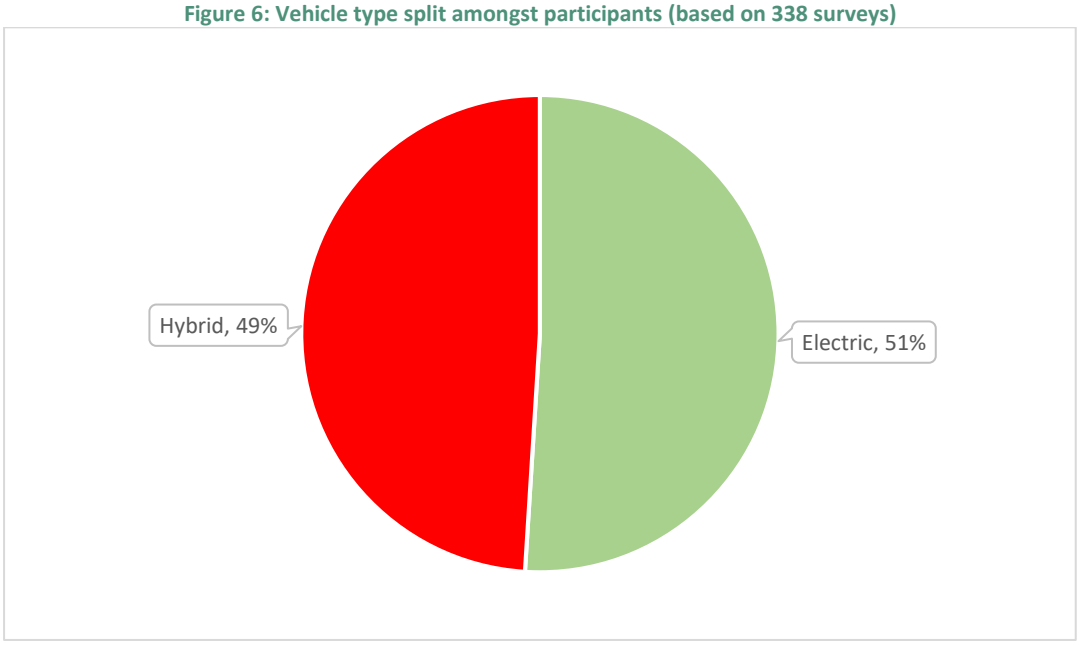
Table 3: Socio-professional categories

Most trial participants are engaged in Higher or Intermediate professions however trial participants have been recruited from all socio-economic categories.

3.4 Car type

The chart below shows the near equal split among participants who own Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs).

Figure 6: Vehicle type split amongst participants (based on 338 surveys)

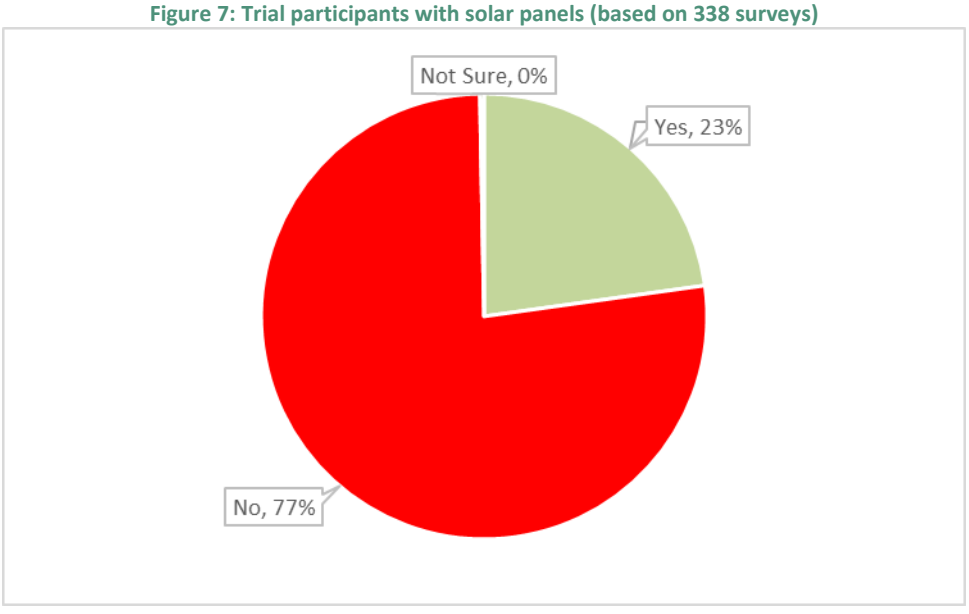


Participants with a PHEV can drive their vehicle despite the battery being empty. These participants may therefore be less concerned about having their charge managed. This will be explored later in the report.

3.5 Ownership of solar PV panels

A quarter of participants have solar PV panels fitted to their properties.

Figure 7: Trial participants with solar panels (based on 338 surveys)

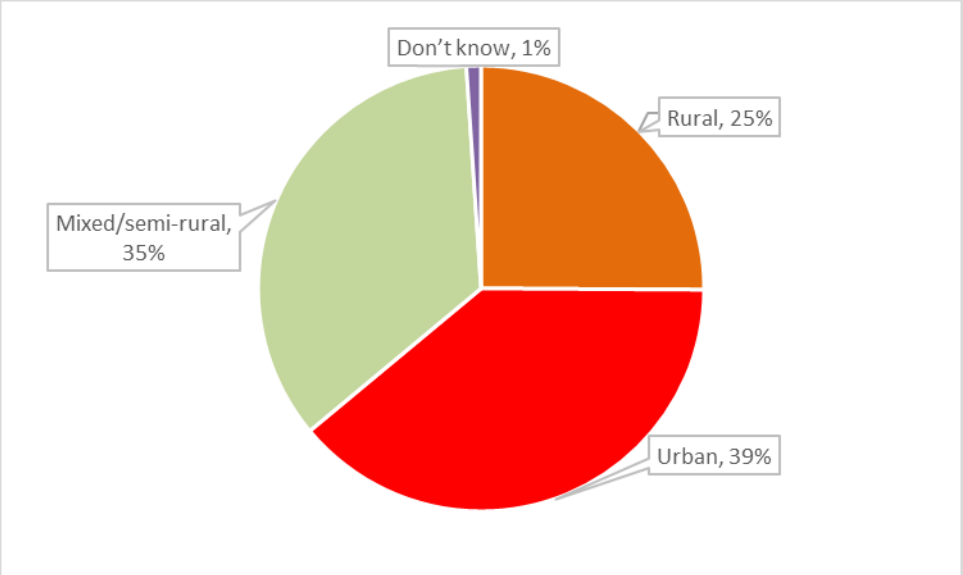


This is a larger proportion than the general population[3]. It **may** suggest that Electric Nation participants, as a whole, are more environmentally minded than the general population, have the financial means to invest in solar PV panels or have seen them as a good investment opportunity. The general shift towards renewable energy generation where households installing small scale generation sources such as PV could also suggest that the project participants are representative of a future customer base where these technologies are more prevalent.

3.6 Do you live in rural, suburban or urban area?

Trial participants were asked to classify whether they live in an urban, suburban or rural area.

Figure 8: Do you live in an urban, suburban or rural area? (283 respondents)



Most respondents state that they live in an urban area, however a quarter say that they live in a rural area. This data will be crosschecked at a later stage in the project using available postcode data on whether a participants' Local Authority is classified as rural or urban to nullify any bias in understanding of these terms.

The recruitment survey results so far suggest that the trial population is skewed towards affluent males aged 36 to 55 in higher or intermediate professions. A proportion of the group are environmentally minded This may change as more participants are recruited into the project. Given project timescales to recruit and complete the trial, and the current demographics of EV ownership, it will not be possible to remove the influence this bias completely via targeted enrolment.

[3] There were 886,000 households in England, Scotland & Wales with MCS certified Solar PV FIT installations by May 2017 (ONS). There are roughly 26.3 million households in the UK (ONS 2016). So, approximately 3% of households in England, Scotland & Wales have solar panels.

4 Baseline Survey Results

The Baseline survey is conducted approximately six weeks after a participant has had their smart charger installed – The purpose of the survey is to capture a baseline understanding of participants' charging behaviour, once they have been driving their plug-in vehicle for sufficient time to get used to it and overcome any immediate range anxiety issues they may have suffered as a new plug in vehicle driver.

The survey questions will also be used to monitor any changes in the participants charging habits as they experience demand management in comparison to their behaviour when experiencing unrestrained charging. It will also be used to reference the acceptability of demand management as opposed to unrestrained charging.

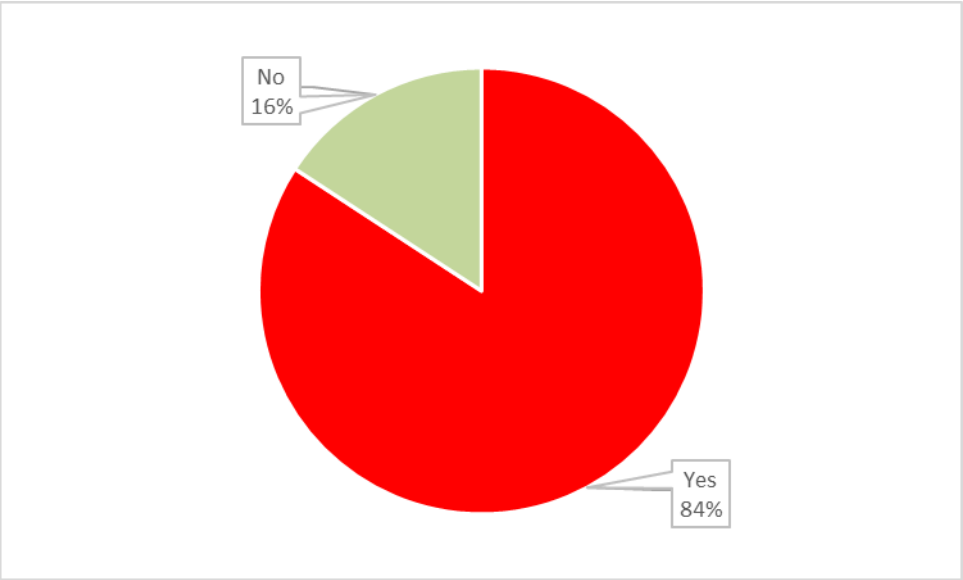
Participants have split into a 'charge at will' and 'straight into demand management' group (see Section 5.2.2 for further details). The baseline survey results of these populations can be compared to show any difference in initial satisfaction between those who are allowed a period of unrestricted charging, vs. those who are very quickly under demand management. Comparison of participants who have experienced these two pathways at the analysis stage will help to reduce the effect of anomalies such as experience or knowledge levels and reduce the impact of Hawthorne effects.

This section of the report is designed to provide an insight into the interim survey results at the point of writing. A full analysis, including levels of statistical confidence of the survey results will be provided later in the trial.

4.1 Do you have access to another vehicle?

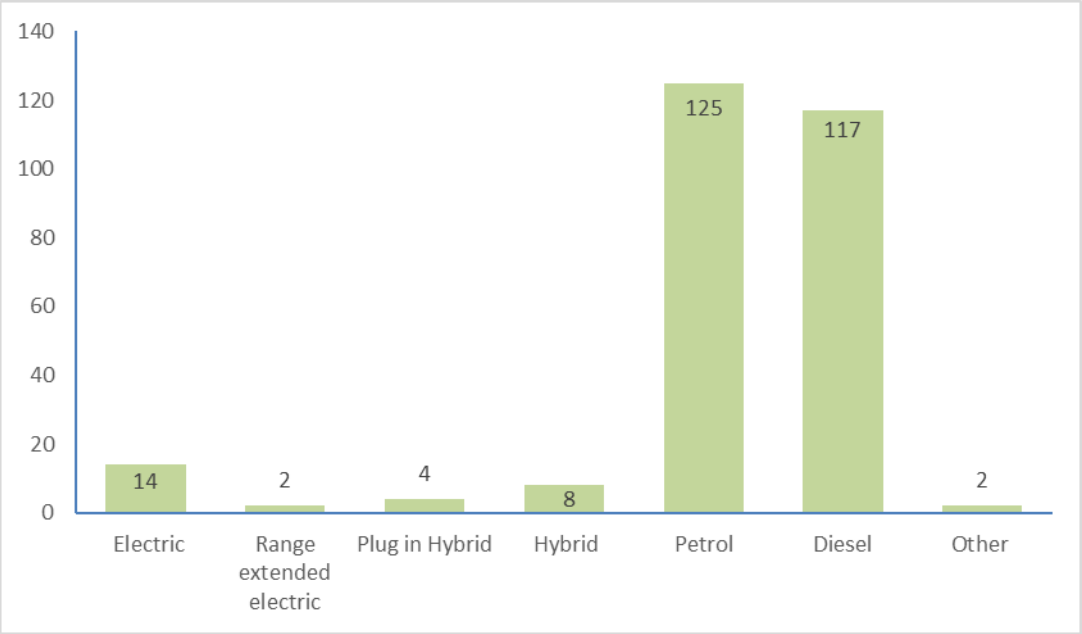
Participants were asked if their household has access to another vehicle(s).

Figure 9: Do you have access to another vehicle? (266 responses)



The participants with access to another vehicle were then asked how the other vehicles(s) were powered (please note that some households have access to multiple other vehicles).

Figure 10: What type of alternative car does your household have access to (266 participants asked, 224 of whom have access to another vehicle, total of 260 vehicles)

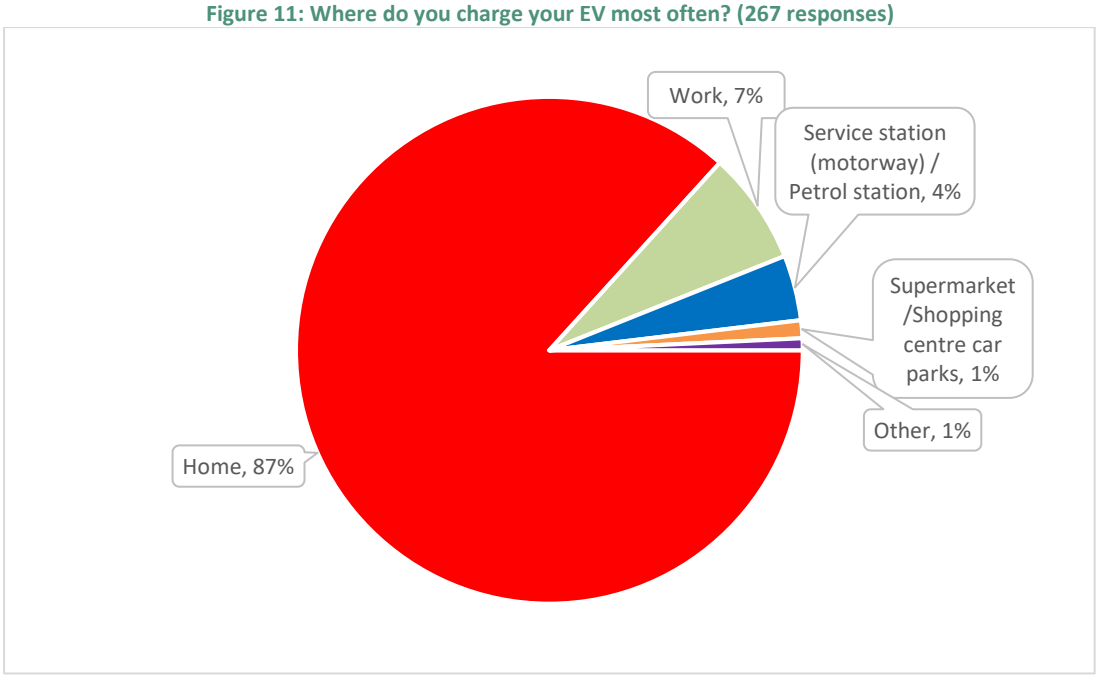


Seven percent of household have access to two plug-in vehicles. Some of these households have two BEVs.

4.2 Where do participants usually charge their EV?

Participants were asked where they charge their EV. They are able to provide multiple answers to this question. Most participants charge their EV at home.

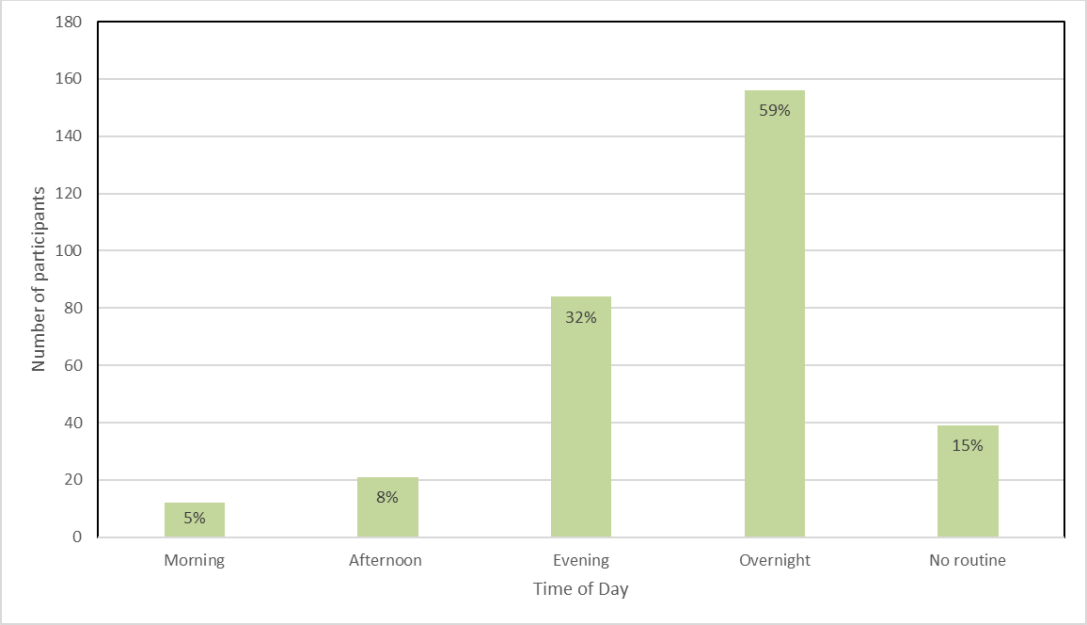
Figure 11: Where do you charge your EV most often? (267 responses)



4.3 When do you usually charge your EV?

Participants were asked what time of day they usually charged their EV. Participants were given the option to choose more than one answer.

Figure 12: When do you usually charge your EV? (267 participants)

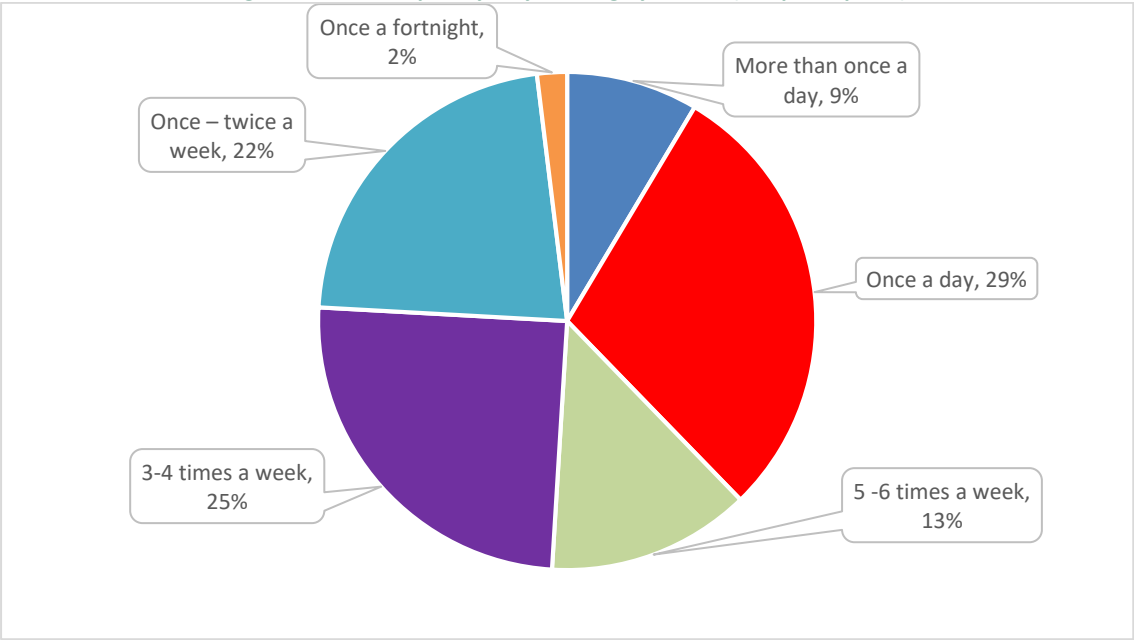


Most participants state that they charge their EV either in the evening or overnight.

4.4 How frequently do you charge your EV?

Participants were asked to indicate how frequently they charged their EV.

Figure 13: How frequently do you charge your EV? (262 participants)

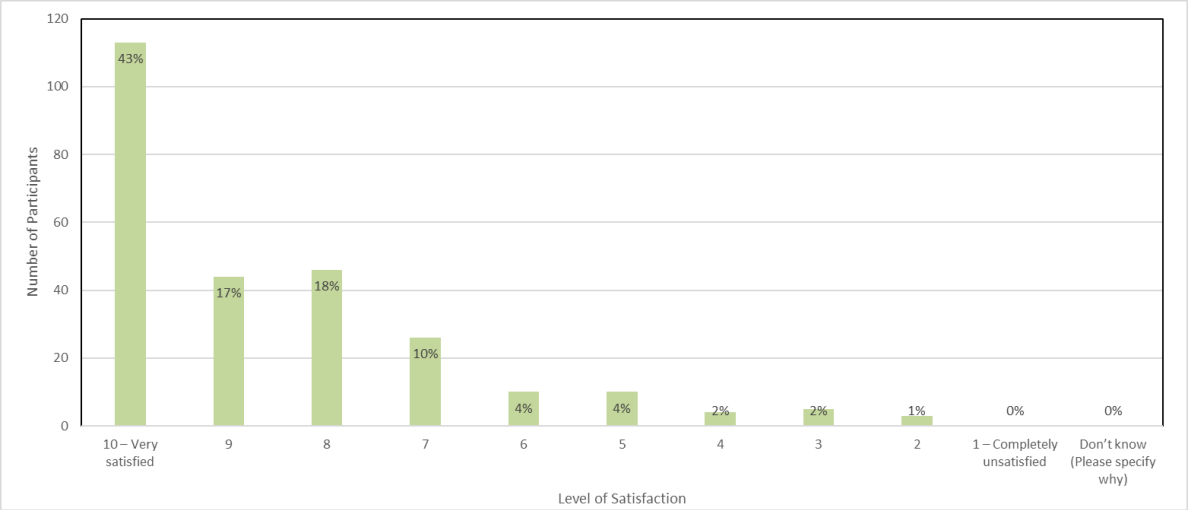


Over a third of participants charge their EV at least every day.

4.5 How satisfied are you with the current arrangements?

Participants were requested to indicate how satisfied they were with the current charging arrangements. Nearly half were very satisfied.

Figure 14: Participant satisfaction with current charging arrangements (based on 261 responses)



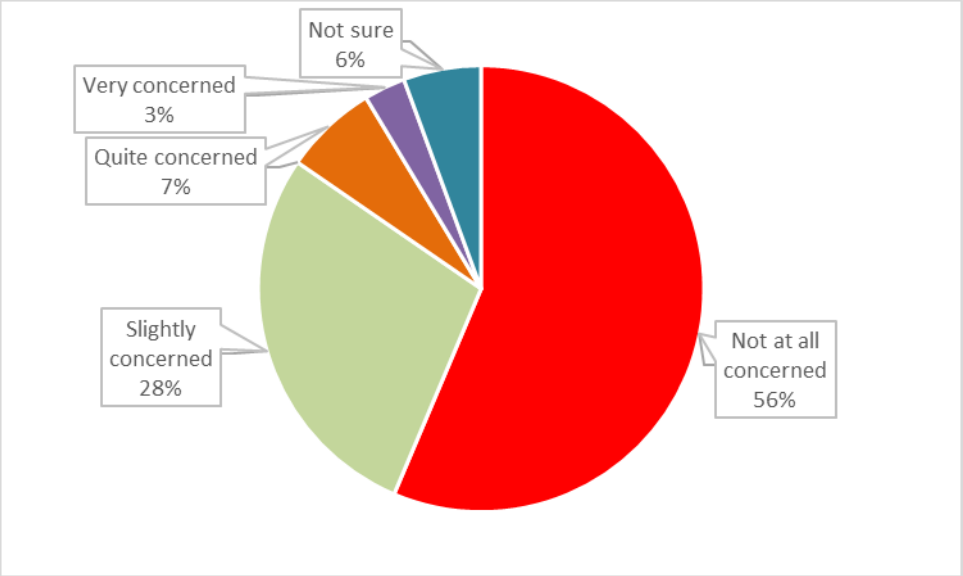
78% of survey respondents were satisfied (Satisfaction rating of 8-10) with the current arrangements, 19% were neutral (rating 7-4) and 3% were dissatisfied (rating 3 or below). 43% of respondents gave a 10/10 satisfaction rating indicating that they are very satisfied.

The publicly available charging infrastructure were cited as reasons for frustration in some cases rather than dissatisfaction with the facility to charge their EV at home.

4.6 Are you concerned about having your charging managed?

Respondents were asked about their level of concern about the upcoming charge management trials. All trial participants are made aware that the Electric Nation project will be trialling managed charging and that as trial participants' their EV charging will be subject to demand management in a broad sense, however they have not been given precise information about the nature of the trial.

Figure 15: Are you concerned about having your vehicle charging managed? (267 respondents)



Over eight in ten respondents were not at all or only slightly concerned about the upcoming trial. These results were then analysed according to the type of vehicle (BEV or PHEV) that the respondent owned to see if either category of participant were more concerned. Figure 16 below shows the level of concerned of the BEV drivers.

Figure 16: Are you concerned about having your vehicles charging managed (131 BEV respondents)

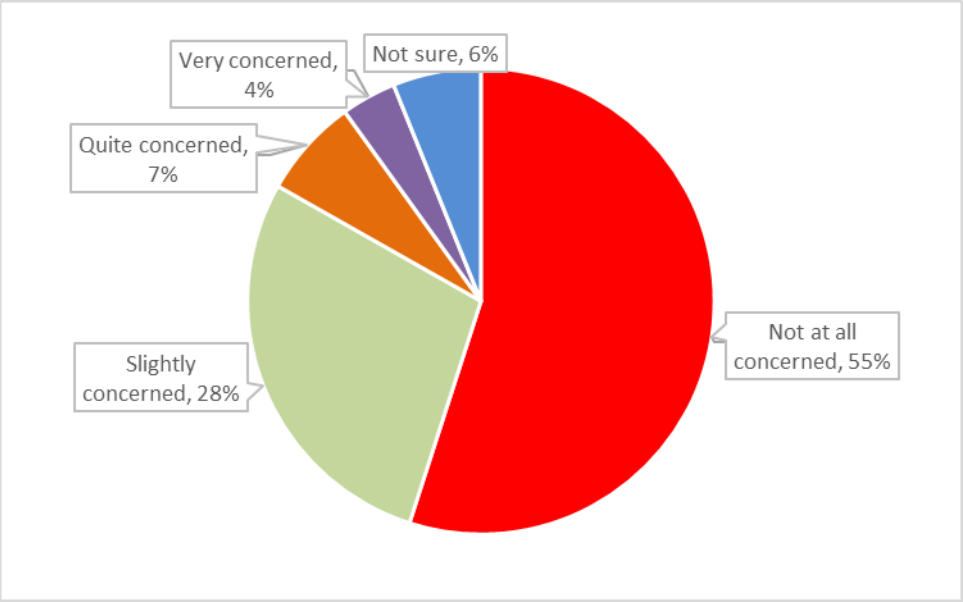
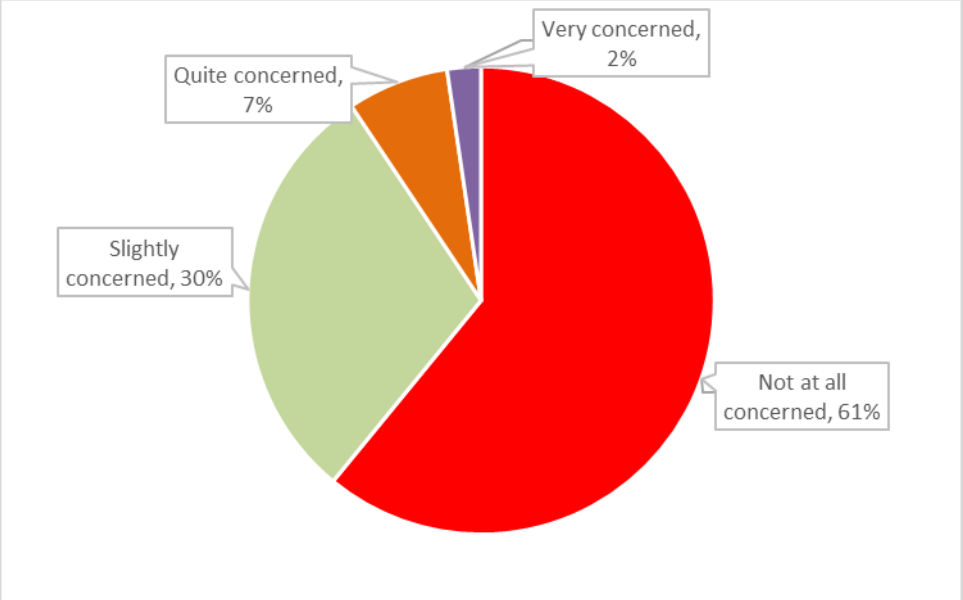


Figure 17 shows the level of concern of the PHEV drivers.

Figure 17: Are you concerned about having your vehicle charging managed? (128 PHEV respondents)



The PHEV drivers were slightly more likely to be not at all concerned about having their charging managed while the BEV drivers were slightly more likely to be unsure about the upcoming trial.

To conclude, the Baseline survey suggests that most trial participants who have completed this survey usually charge their EV at home, either in the evening or overnight. More than half of participants do not use their charger every day. Most are satisfied with the current, uncontrolled charging experience. This is significant because all future measurements of satisfaction will be compared to this level of acceptability. Most are not concerned about the upcoming charge management trial. Many have access to another vehicle other than their EV. These are preliminary results based on data that is subject to change as more participants complete the Baseline survey. Further analysis and statistical testing of this data will be carried out as the Electric Nation trial progresses.

5 Trial Design

5.1 Introduction

A core part of the Electric Nation project is a large trial of smart charging (demand management) which will encompass all project participants (approximately 700). The aim of this trial is to evaluate the reliability and acceptability to EV owners of a smart charging system and the influence this has on charging behaviour.

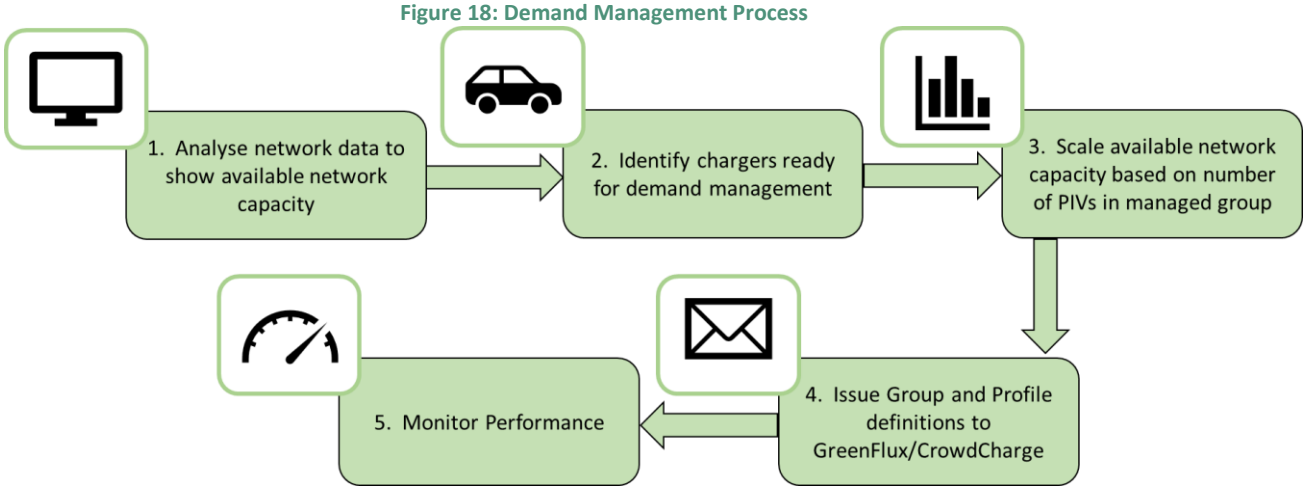
This section describes the trial design in more detail, building on the information included in the Algorithm Development and Testing Report.

5.2 Smart Charging Systems in Electric Nation

Two demand management providers are being used with Electric Nation, GreenFlux[4] and CrowdCharge[5]. Trial participants are allocated to each group during the recruitment process. Each company uses different algorithms to allocate current to individual chargers and the testing of these algorithms was reported in the 'Algorithm Development and Testing' Report[6]. The amount of data they have available (e.g. car state of charge) and the way the participant interacts with their system will also differ between the two providers in later stages of the trial, and in some cases between participant groups for the same provider (e.g. telematics data for CrowdCharge). The two cohorts are being managed to ensure a consistent mix of vehicle type and battery sizes.

From July 2017 onwards, participants are being moved into demand management through a series of group expansions, following the process illustrated below.

Figure 18: Demand Management Process



[4] https://www.greenflux.nl/en/
[5] http://crowd-charge.com/
[6] https://www.westernpower.co.uk/docs/Innovation/Current-projects/CarConnect/CarConnect-Algorithm-Development-and-Testing.aspx

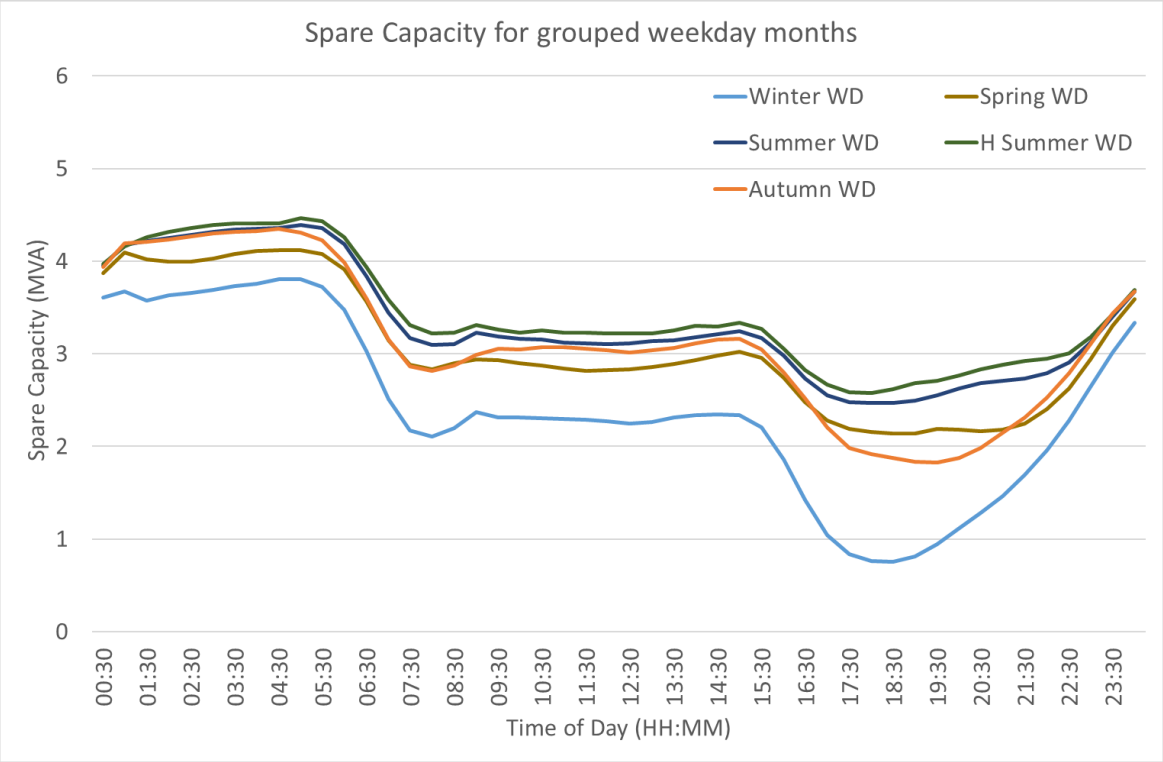
The sub-sections below detail the process undertaken in each of the steps shown in Figure 18.

5.2.1 Analysis of Network Data to Show Available Network Capacity

Electric Nation is trialling the use of demand management (smart charging) to avoid or defer network reinforcement. To achieve this the additional load from EV charging must be accommodated within 'spare' network capacity. This available spare capacity will vary depending on the network in question and by time of year, weekend/weekday and time of day.

In the first year of the Electric Nation trial 'spare capacity' profiles have been generated for a high voltage (HV) feeder in the East Midlands, for five seasons, for weekdays and weekends. The resulting profile is shown below.

Figure 19: Spare Capacity Profile



In the later stages of the trial alternative profiles may be investigated – e.g. managing based on Low Voltage (LV) network capacity, or for different networks.

This spare network capacity is equivalent to the amount of power which could be drawn by EV charging (or other load growth) on the network without exceeding the networks design limits. However, it requires scaling to be used within the trials – for example, the winter profile above has a minimum spare capacity of 0.75MW in winter at 18:30. This is equivalent to 107 chargers drawing 7kW (or slightly less than a third of each cohort when all participants are under demand management). The project is therefore scaling the capacity profiles so that participants experience a similar amount of demand management as the number of participants under management grows.

5.2.2 Identify Chargers Ready for Demand Management

As set out above, there are two routes in demand management:

- Charge at Will: Approximately 100 participants in each cohort (GreenFlux and CrowdCharge) who will be allowed unrestricted charging for approximately 90 days before demand management is imposed.
- Straight into Management: once the charger is in use approximately two weeks is permitted to prove the reliability of the communications from the charger, then the charger enters the managed group.

By using these routes, it should be possible to show whether there is any difference in the acceptability of demand management depending on whether participants have prior experience of unrestricted charging. The results of the 'baseline' surveys between the two populations can also be compared to show whether participants have different satisfaction levels with their charging at this stage, or whether their charging behaviour changes once they enter routine management (if they are aware of this), or once they have experienced some curtailment. This analysis will be completed later in the trial and the results shown above include participants from both populations.

Regardless of the route to management, chargers must satisfy a number of conditions before they entered the 'managed' group. Prior to this they provide data to the trial which will inform the project's understanding of charging behaviour for different types of PIVs. These criteria are set out below:

- Confirm the charger is in use: the date on which the first significant transaction occurs is recorded for each charger (i.e. excluding small transactions which occur during testing when the charger is installed). There can be delay between charger installation and the first use of the charger, for example if there is a delay in the delivery of the vehicle. For the charge at will group approximately 90 days is required between the date of first transaction and their entry into demand management. This measure is purely based on the time since they start charging, and does not include the number of transactions. However, it is a sufficient period of time for drivers to develop a charging routine.
- Charger configuration is ready for demand management: this is undertaken in conjunction with GreenFlux/CrowdCharge as appropriate and any issues are remedied as necessary.
- Ensure reliable communications: poor communications between the charger and demand control provider could negatively affect the participant's experience of smart charging, or make smart charging impossible (in the case of no communications). If a participant is more harshly affected by demand management due to a communications failure this could be reflected in their acceptability of the concept of smart charging, when it does not represent a realistic scenario. For this reason, participants are only being transferred into demand management after two to three weeks of good (85%+ reliability) performance.

- Test of controllability: this stage confirms that each individual charger is controllable before it is placed in a group. For CrowdCharge participants this is routinely carried out during each transaction and involves a very short reduction in the current available (no participant impact). GreenFlux participants pass through a 'test card' phase in which the charger behaves as it will during management, but full capacity is available at all times. Performance in the test card phase is then evaluated and recorded before the charger passes to routine management.

Batches of chargers which are ready to enter demand management are being identified approximately fortnightly, made up of a mix of participants who have been through the 'charge at will' and 'straight to management' routes. The output from this stage is a list of charger IDs which will form the managed group and the total number of chargers involved. An update on the number of participants which have passed this stage is provided in Section 6.1 below.

5.2.3 Scale Available Network Capacity Based on Number of PIVs in the Managed Group

The profiles of spare capacity (current limit) set out in Section 5.2.1 are scaled based on the number of EVs in the managed group. This scaling factor is applied so that the participants experience a similar level of demand management to that which would apply when 30% of vehicles in the area are electric. This 30% figure was selected based on the findings of My Electric Avenue, and to be representative of a "2030 scenario". The proportion chosen could be altered in one of the later stages of the trial. The level of management that participants experience should stay consistent as the group is expanded (within the same season) as the current limit profile (demand limit) is re-scaled with each expansion.

5.2.4 Issue Group and Profile Definitions to GreenFlux/CrowdCharge

A data format has been agreed between EA Technology and both DCS providers to show the participants who make up a managed group and the weekday/weekend profile they should be managed to. This is issued by EA Technology and then implemented. Participants are not informed when the switch is made into demand management, to avoid prejudicing their survey responses. Impact Utilities are also notified of the date when each participant enters demand management to allow their survey to be issued at the appropriate time.

5.2.5 Monitor Performance

Throughout the trial (both before and after the implementation of demand management) all chargers should supply transaction records and meter values (current drawn and current allocated). These are being supplied to EA Technology by both demand management providers. Analysis of the effect of the demand management applied to date is given in Section 6.2.

6 Trial Update

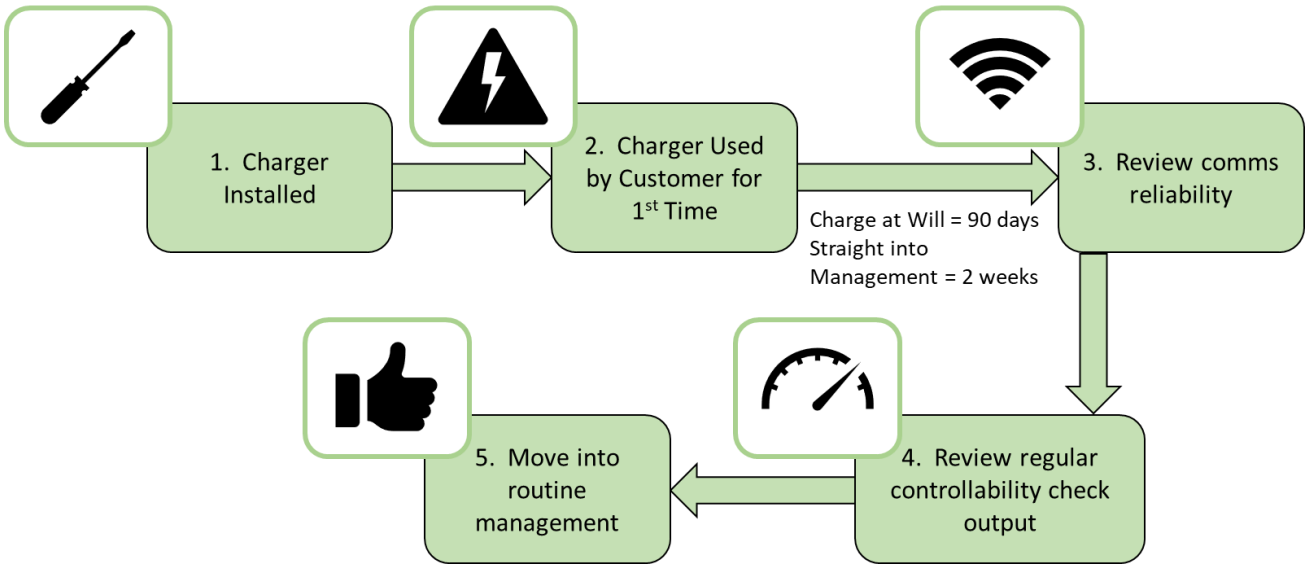
6.1 Customers in Demand Management

In order for participants to enter routine management they must pass a number of tests, as set out in Section 5.2.2 above. At any of these stages it is possible for an issue to occur which could delay a charger entering management. This section outlines the detailed process by which chargers pass through these stages for both GreenFlux and CrowdCharge and the progress made to date with moving participants into routine management.

6.1.1 CrowdCharge

The diagram below shows the stages by which CrowdCharge participants enter demand management:

Figure 20: CrowdCharge Process for Entry into Demand Management



The number of chargers at each stage is shown in the following table.

Stage	Number Passed Stage	Notes
1. Charger installed	174 (based on information until end w/c 25th September)	The decision regarding whether a charger is 'straight into management' or 'charge at will' is made based on the installation date. 98 chargers, installed before the end of June are 'charge at will' and all installations after this point will be 'straight into management' (currently 76 units).
2. Charger used by participant for 1st time	103 of 174 (last reviewed 2nd October) = 84 Charge at Will + 19 Straight into Management	A transaction record is not currently available for the remaining 71 chargers. There are a variety of potential possible causes for this: • Configuration issue – this is believed to affect approximately 30 units and is being resolved at the time of writing. These transaction records are available from an alternative source and therefore

		the 'date of 1st transaction' will be populated by early November, allowing these chargers to progress to the next stages of demand management initialisation. • Communications reliability – if chargers are not communicating with the back office then no transaction records will be available. • Charger not yet in use – e.g. car not yet delivered.
3. Review communications reliability – Charge at Will	42 (of 98 Charge at Will in total, and 84 which have reached this review stage)	In total 84 'Charge at Will' chargers have reached this stage (i.e. they are installed and known to be in use). 42 of these have passed an assessment of their communications reliability. The remaining 42 have not yet passed this assessment. This may either be due to poor performance or where the charger has not been in use for 90 days (8 units).
3. Review communications reliability– Straight into Management	14 (of 76 Straight into Management)	In total 19 'Straight into Management' chargers have reached this stage. 14 of these have passed an assessment of their communications reliability – this indicates an improvement in reliability for installations which occurred more recently.
4. Review regular controllability check output	56 = 42 (Charge at Will) + 14 (Straight into Management)	A short controllability check should take place during each charging event. If the previous two stages (transaction record and reliable communications) have been passed, then the controllability check is also passed.
5. Move into routine management	56	56 chargers have moved into routine management, and this will continue to expand as other charge points moved through the preceding stages. 42 are 'charge at will' and 14 'straight into management. Section 6.2 provides more detail on the results of this demand management.

As shown above there are two main reasons preventing chargers progressing into demand management:

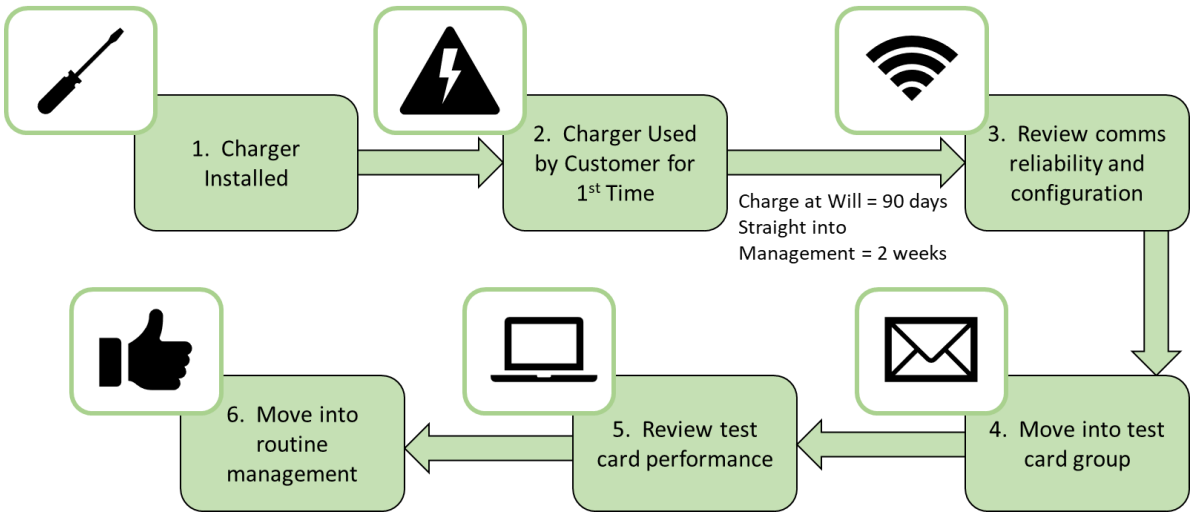
- No transaction records: potential causes for this issue include poor communications, a delay in the start of charging (e.g. delay in vehicle delivery) or a configuration error. Where a configuration error is the cause then transaction records are available from an alternative source, but are not currently being supplied to the project database. In total, 71 chargers do not currently have an associated transaction in the project database to indicate the start of charging. The alternative data source provides at least one transaction record for 59 of these units. This will allow the date of 1st transaction to be populated and the chargers to move to the next stage of demand management initialisation.
- Communications reliability: this has been an area of continual focus by the CrowdCharge team during recent months. The following actions are being taken:
    - Ongoing monitoring of communications performance by CrowdCharge and EA Technology, issues raised with the Tech Factory (responsible for systems integration) as they arise.

- Contact with participants: this is the first stage diagnosis, co-ordinated by CrowdCharge/Drive Electric and resolves issues such as equipment being switched off.
- Site visits: The Tech Factory are carrying out site visits where necessary to restore communications and recording the findings of these visits in order to identify the root cause of the issues experienced and modify procedures to address these.
- Ongoing communications system development: this is focused on identifying additional measures that can be taken in relation to the system hardware or software which could improve communications reliability. A process is in place to ensure these changes are tested prior to deployment in the trial group.

6.1.2 GreenFlux

The diagram below shows the stages by which GreenFlux participants enter demand management.

Figure 21: GreenFlux Process for Entry into Demand Management



The number of chargers at each stage is shown in the following table.

Stage	Number Passed Stage	Notes
1. Charger installed	234 (based on information until end w/c 2nd October)	The decision regarding whether a charger is 'straight into management' or 'charge at will' is made based on the installation date. 136 chargers, installed before early July are 'charge at will' and all installations after this point will be 'straight into management' (currently 98 chargers).
2. Charger used by participant for 1st time	207 of 234 (last reviewed 10th October)	The remaining 27 chargers may not have been used yet, or there may be no communications between the charger and back office, resulting in no transaction records being available. Once communications are restored these records will be sent to the back office.

3. Review communications reliability and configuration – Charge at Will	111 (of 136 Charge at Will)	111 chargers have been transferred into the test card phase following a review of their configuration and communications reliability. Difficulties in establishing reliable communications accounts for the majority of 25 remaining units (136 in charge at will minus 111 which have passed to the test card phase). A small number of chargers have not yet reached the 90 days threshold since they were first used.
3. Review communications reliability and configuration – Straight into Management	44 (of 98 Straight into Management)	44 have been transferred into the test card phase. Of the remaining 54 units, 21 have not yet been used (or have no communications so transaction records have not yet been supplied). Communications reliability, rather than mis-configuration is the main reason preventing other chargers progressing into demand management.
4. Move into test card	155 (both routes)	155 chargers will have entered the test card phase since early July.
5. Review test card performance	Charge at Will: 100 reviewed, 74 passed Straight into Management: 27 reviewed, 18 passed.	28 chargers entered the test card phase in w/c 16th October and have therefore not yet been reviewed. There are three main causes for a failure at the test card phase: • Use of a timer (affecting 19 chargers): this currently results in a more restrictive demand management regime, and this is being addressed by an adaption to the GreenFlux algorithm, which will be tested and deployed in the second half of October 2017. Once deployed the test card performance of these 19 units will be reviewed again, before moving these participants into routine management. • Lack of transactions in test card phase: three successful transactions are required to pass this phase. Where a participant uses their charger infrequently the test card phase may last longer. • Charger offline: this prevents meter values being sent to the online portal, therefore the test card performance cannot be evaluated.
6. Move into routine management	92 chargers	92 chargers (74 charge at will, 18 straight into management) have moved into routine management, and this will continue to expand as other charge points moved through the preceding stages. Section 6.2 provides more detail on the results of this demand management.

As summarised in the table above the main reason preventing chargers moving through all stages of the demand management initialisation process is a lack of reliable communications. The following actions are being taken to address this:

- Week by week monitoring of reliability: this is reported as part of monthly project management reports. It also provides an 'early warning' of declining reliability allowing further action to be taken.
- Contact with participants: chargers with poor communications are identified by EA Technology, who liaise with DriveElectric so the participant can be contacted to a) ensure that all equipment is switched on and b) ask the customer to reset their system.
- Refinements to communications system used: a series of video instructions will be issued to participants in the next month to identify potential hardware issues with communications equipment. This will enable remote diagnosis of issues so that replacement/additional equipment can be issued to participants.

6.2 Results of Demand Management to Date

The first 'routinely managed' groups were established in July, and these have been expanded multiple times over the summer and early Autumn, as shown below.

	CrowdCharge		GreenFlux	
Group Number	Total Number of Participants in Group	Date Enacted	Total Number of Participants in Group	Date Enacted
0001 (Summer profile)	10 (10 (CAW)/0 (SIM))*	04/07/2017	16 (16/0)	11/07/2017
0002 (Summer profile)	21 (15/6)	15/08/2017	31 (31/0)	10/08/2017
0003 (Summer profile)	33 (25/8)	11/09/2017	44 (44/0)	31/08/2017
0004 (Autumn profile)	45 (24/11)	17/09/2017	64 (56/8)	18/09/2017
0005 (Autumn profile)	56 (42/14)	09/10/2017	92 (74/18)	11/10/2017

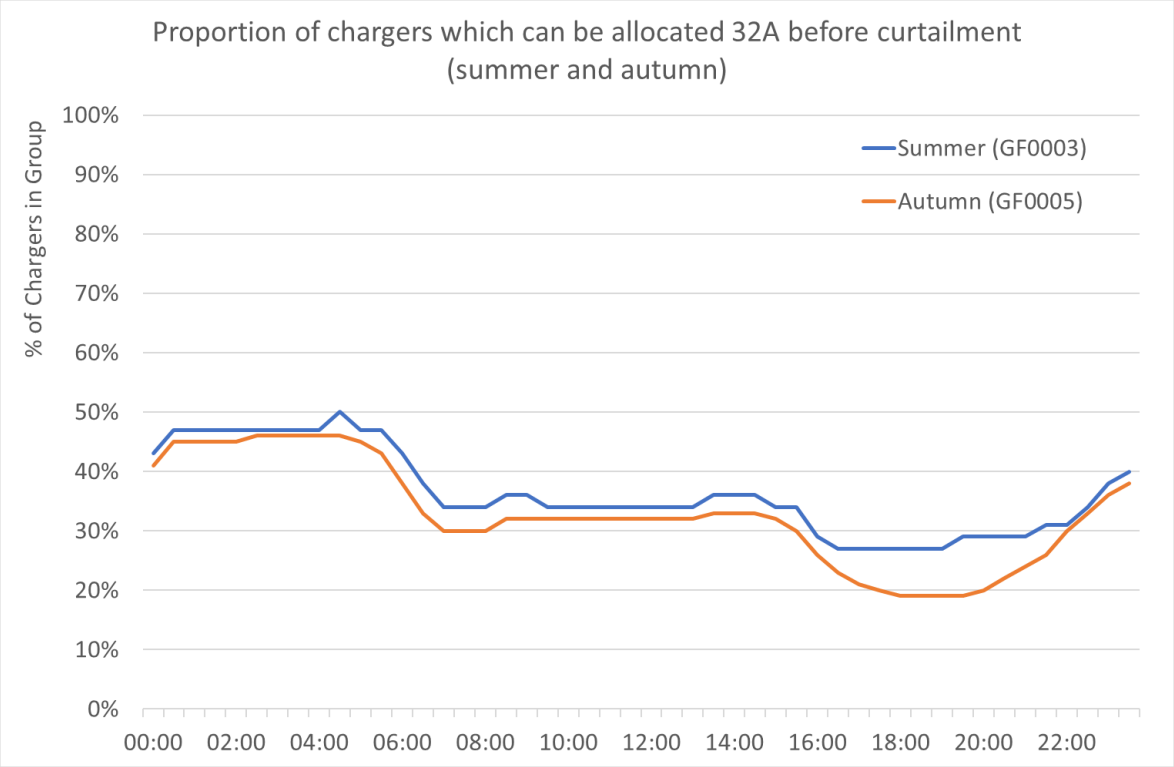
* Split between Charge at Will (CAW) and Straight into Management (SIM)

As described above a new 'demand limit' is provided to CrowdCharge/GreenFlux each time the routinely managed group expands. The profile will also be adjusted throughout the year to reflect varying levels of 'spare' network capacity across seasons. Summer profiles were used until mid-September, before all participants were transferred into Autumn from mid-September onwards.

The level of demand management which occurs is a function of the demand limit profile and the charging diversity of the managed group. As increasing numbers of participants in the group plug-in at the same time then it becomes more likely that demand management will occur. Management (curtailment of available current from chargers) also becomes increasingly likely as the seasons change, as the 'spare' network capacity available for EV charging decreases due to increases in other loads.

An indication of the likely level of demand management can be obtained by comparing the available capacity in each half hour with the proportion of chargers which would need to be active before the limit was breached. For example, a group containing 10 chargers with a current limit of 160A could allocate 32A to five (50% of the group) before some curtailment was required. This is illustrated below using the summer and autumn weekday profiles applied to GF0003 and GF005. In each case it is assumed that all chargers are allocated 32A. If any 16A cars are active, then a slightly larger number of chargers can be supplied before curtailment is required.

Figure 22: Differences in Summer and Autumn Profiles



In the autumn example above, on each weekday 19% of the 92 stations in the group can charge at 32A at 19:00. Therefore, if on a given weekday only 15 chargers were being used at this time then no management would occur. Graphs such as the above provide an indication of how restrictive a given profile is, but cannot predict whether management will occur on any given day, as this depends on the charging behaviour of each participant.

Each smart charger provides meter values to the demand management providers, and the project database. These show the current drawn by the charger (either each minute, or every three minute) and the current allocated by the back office.

The data provided to EA Technology does not include a direct indication of when a charge transaction has been managed due the capacity limit, as current allocated can be reduced as a vehicle reaches the end of charge cycle. A variety of measures have been investigated to determine the amount of demand management which has occurred, and the impact this

has on each customer. The approach being developed at the time of writing utilises a combination of three metrics:

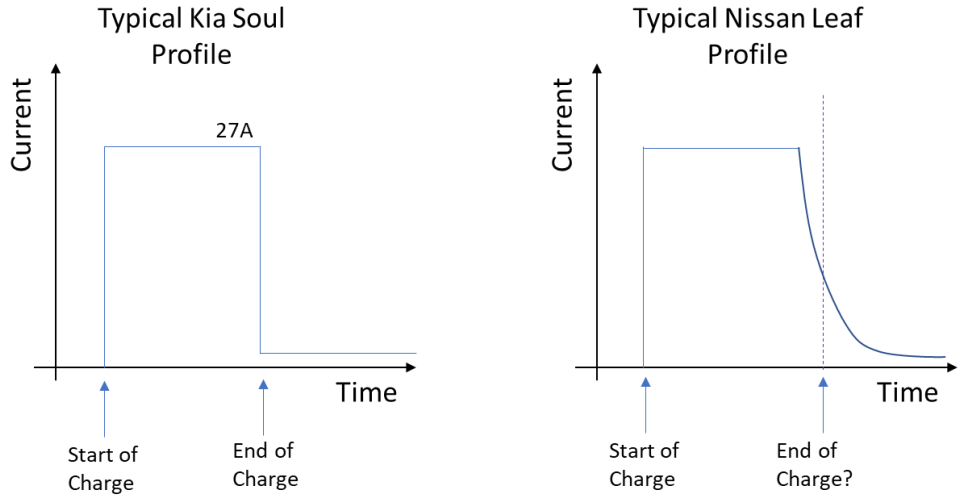
1) Group Current Allocated vs. Profile Limit

The meter values from all active chargers in a group can be combined in fifteen-minute blocks (i.e. adding up current drawn by a group of chargers). This can then be compared to the profile limit for the block. If the total current drawn is lower than the profile limit, then demand management was not active in this fifteen-minute block. If the total current drawn is close to the profile limit, then demand management is likely to be active. In which case, transactions which overlap with these blocks may have been affected by demand management.

2) Restrictiveness

This is calculated by dividing the average current drawn over the course of the transaction by the maximum current drawn. (Due to the nature of the algorithms, it can reliably be assumed that at some point in the charge cycle it would have drawn the maximum possible for that vehicle/charging point, though there are some caveats, for example very short transactions and when vehicle has been plugged-in near full charge).

However, a value of less than 1 does not necessarily infer that demand management occurred. For example, the graphs below illustrate 'typical' charging profiles.



The graph of the left, typical of a Kia Soul, is a more straightforward example – in the absence of management the meter values are all more or less identical until the end of the charge event – therefore restrictiveness will equal 1 (average of very similar values / maximum of the values will be very close to, or equal 1). However, for a Nissan Leaf the situation is more complex, as the 'average current drawn' will include all values until it is assumed that the 'end of charge' has been reached. As more of the 'tail' is included this reduces the average current, and so the restrictiveness is less than 1. The restrictiveness value then becomes a function of the tail shape, and involves a judgement on the time when charging was complete.

It cannot therefore be assumed that a restrictiveness of less than one indicates the presence of demand management, and this must be combined with the group values described above. The restrictiveness can be used to judge the severity of a management event, but it must be compared with a similar, unmanaged transaction. For this reason, the restrictiveness of all transactions will be calculated, in order to build up a library of values for 'managed' (i.e. transactions which overlap a period where the total group values are close to the profile limit) and unmanaged transactions, for all car types.

3) "Hot Unplugs"

A transaction (charge event) is "hot unplugged" if the participant unplugs the vehicle before the battery is full. This does not necessarily mean that the participant hadn't received all the charge they required – they may only need enough energy for a short journey before plugging in again. A 'hot unplug' can be identified using the meter values received immediately before the end of the transaction. A hot unplug when management has occurred is the situation where the likelihood of a true customer impact is highest. However, it may still be possible that the customer had enough charge, even though the battery hadn't reached 100% State of Charge.

The three measures above can be applied to each transaction, with the options shown below.

Transaction Overlaps a Period where Management is Likely to be Active (Point 1)	Vehicle was Hot Unplugged (Point 3)	Restrictiveness (Point 2)	Conclusion
No	No	A number between 0 and 1	Management was not applied, and the vehicle was fully charged before the customer unplugged. The restrictiveness value provides a baseline for an unmanaged charge event (i.e. for this particular make/model) and energy consumed.
No	Yes	A number between 0 and 1 (more likely to be close to 1 due to absence of 'tail')	Management was not applied but the vehicle was unplugged before fully charged. These transactions will provide a measure of how often the customer does this in the absence of management, which can then be compared to the situation once management is applied.
Yes	No	A number between 0 and 1	Management occurred but the battery was still fully charged before the customer unplugged. The restrictiveness value can be compared to a similar unmanaged transaction can be used to show the degree of management applied.

Yes	Yes	A number between 0 and 1	Management occurred and the battery was not fully charged when the customer unplugged. This the situation with the highest potential impact on the customer. The likelihood that this actually impacted the customer (i.e. they didn't have enough energy to complete their journeys before their next planned charge) can be studied further using the proportion of unmanaged transactions for the customer which are hot unplugged, and the restrictiveness.

These measures will be summarised at a participant level and provided to Impact Utilities to allow them to combine this information with the results of customer research surveys.

Studying the data for the trial until the end of October (summer and autumn profiles) does not show any periods where the group current drawn is close enough to the profile limit to suggest management was active. There are variety of possible causes for this:

- Plug-in diversity was high enough that sufficient capacity was available at all times. This is particularly likely in summer and autumn as the background loading is lower, so more capacity is available for EV charging.
- Although chargers are only moved into routine management when the comms performance is good, there is still some downtime in the managed group. This reduces the likelihood that management becomes active as only chargers which are sending meter values contribute to reaching the group limit.

Electric Nation is trialling customer acceptance of demand management (managed charging) to support local electricity networks. If sufficient capacity is available on networks in summer and autumn, with 30% EV uptake (as per the scaling on the profiles described above) then the tests completed to date are realistic. The situation will change in the rest of the trial as follows:

- Winter profiles will be enacted during November 2017 and the available capacity will be lower, increasing the chance that management will occur.
- An adjustment factor will be applied to account for the proportion of chargers in the managed group which are not communicating. This is also realistic in a business as usual deployment, as this would need to account for the availability of chargers.
- Scenarios may be trialled in which profiles are generated for higher EV uptake than the current 30%.

The project will continue to report on the enactment of demand management via monthly reports and further milestone reports.

7 Next Steps

7.1 Customer Research

Impact Utilities have now created the next Baseline survey to be used during each demand management trial that project trial participants experience. This has been approved by the project team. Trial participants will normally experience between three and five different demand management regimes, each regime lasting about four months. This survey is based on the Baseline survey (Appendix 2) to allow comparison of results between the population who are not experiencing managed charging, and each demand management trial population. It will allow Impact Utilities to be able to compare, and calculate with statistical confidence, whether the trial population change their charging or driving habits as a result of experiencing demand management. Although minimal demand management has occurred to date this will increase once 'winter' profiles are enacted. For this reason, participant surveys will take place only after a minimum of four weeks of 'winter'. The profiles used and survey timing will continue to be designed to ensure that participants have experienced a representative amount of demand management. Participant feedback will be analysed by Impact Utilities, who will be provided with data from EA Technology showing the amount and impact of demand management experienced by each participant. It will also allow a judgement to be made about the acceptability of particular demand management solutions to the trial population.

All participants will be requested to complete the next Baseline survey to investigate their attitudes toward controlled charging towards the end of November 2017. This timeframe has been agreed on to maximise survey response rates, which could be disappointingly low if the survey wasn't distributed until December. The project team is considering other ways to help achieve a healthy survey response rate for this survey such as issuing a participant newsletter shortly before the survey is issued reminding participants to complete the survey, and posting reminders via social media.

After the end of the project in December 2018 the trial population will be asked to complete a final survey. This survey will seek to establish if trial participants were happy with the trial experience, if they still drive EVs, and also to establish if being part of the Electric Nation trial altered either their driving or charging habits.

7.2 Smart Charging Trials

As shown above, the project team are in the process of moving all participants into routine demand management. This will continue until all installations are completed (estimated to be in March 2018), and all issues preventing the roll-out of management are resolved. Alongside this activity participants who are under routine management will experience different levels of demand management as the year progresses – with winter profiles due to be enacted during November 2017.

The next major development for the smart charging trial is the development and testing of the 2nd algorithm configuration by both GreenFlux and CrowdCharge. Both demand management providers are currently developing these systems, as follows:

- CrowdCharge: the allocation of current between chargers (i.e. where the group demand would otherwise exceed the available network capacity) will be refined and informed by additional sources of information. CrowdCharge are in the process of developing an app interface to allow drivers to input journey preferences, allowing an estimate to be made of how much energy is required by a user, and how much time is available to deliver this energy. This will work alongside telematics data (where available, although this is not a pre-requisite for migration of an individual customer to algorithm configuration 2) from vehicles which will indicate the state of charge of the battery, and therefore how much energy would be required for a full charge, or to complete the journey entered by the user via the app.
- GreenFlux: the use of customer portals will be expanded, and the online portal will contain an 'override' option. This will allow customers to increase the 'priority' assigned to their charger when necessary, via a web based interface.

In preparation for these algorithm updates EA Technology, Drive Electric and both demand management providers are beginning the roll-out of the relevant apps/portals and telematics (where necessary). Development of the algorithm updates is ongoing and will be tested at on the Electric Nation test rig later this year, before deployment into the trial early in 2018.

Appendix 1 – Recruitment Survey

Electric Nation Recruitment Questionnaire

December 2016

568 Electric Nation	ONLINE SCRIPT DRAFT 14/12/16	Susie Smyth, Michael Brainch, Lucy Upshall, Helen Rackstraw

INTRODUCTION TO THE RESEARCH AND ADHERENCE TO MRS CODE OF CONDUCT

CATI ONLY: Hello, may I speak to **NAME FROM SAMPLE** please?

C1. I am calling from Impact Research about the Electric Nation project that you recently agreed to take part in. We recently sent you a survey link by email, can I check whether you received that email?
Yes
No – **CONFIRM EMAIL ADDRESS WITH RESPONDENT MATCHES SAMPLE**

C2. We would be really grateful if you would be able to complete this survey as soon as possible, I can take you through the questions now on the phone, or if you prefer you can complete it online? The survey should take no longer than 10 minutes.
Phone - **CONTINUE**
Online – **CHECK IF NEED LINK RE-SENDING, THANK AND CLOSE.**

Thank you for agreeing to participate in this important project about the future of electric vehicles. This is the first of a number of surveys you will be asked to take part in during the trial and should take no more than 10 minutes to complete, depending on the answers you give us. The purpose of this survey is to check the information we hold about you and gather some background about your household before you start the trials. This information will be used in combination with that from the other trial participants to understand how perceptions might vary by different groups.

This is a genuine market research study and no sales call will result from our contact with you. The interview will be carried out in strict accordance with the Market Research Society's Code of Conduct. Your identity and any information you provide to us will be kept confidential and will not be used for any purposes other than this research. Your details were provided to us

by DriveElectric and only Impact Research and DriveElectric will have access to your personal contact information so that we can keep in touch with you throughout the trials.

SAMPLE CONFIRMATION

We already have some details about you that were passed to us by DriveElectric that we would like to check all are correct before we continue.

S ASK ALL
A1 Can we check your full name is **INSERT FROM SAMPLE** .....
Correct
Wrong – **INSERT NAME HERE**

S ASK ALL
A2 And is this your home address where your charging point is installed? **INSERT FROM SAMPLE** .....
Correct
Wrong – **INSERT CORRECT ADDRESS HERE**

Is your postcode?
INSERT FROM SAMPLE .....
Correct
Wrong – **INSERT CORRECT POST CODE HERE**

QHIDDNO
AUTOCODE DNO FROM POSTCODE LIST:

1) WPD (East Midlands)
2) WPD (South West)
3) WPD (Wales)
4) WPD (West Midlands)
5) Electricity North West
6) Guernsey Electricity
7) Jersey Electricity
8) Manx Electricity Authority
9) Northern Ireland Electricity
10) Northern Powergrid
11) Scottish Hydro
12) Southern Electric
13) SP Distribution
14) SP Manweb
15) UKPN

S ASK ALL

A3 Is this the best telephone number on which we can contact you on for the duration of the trials?

Correct
Wrong – **INSERT CORRECT NUMBER HERE**

S **ASK ALL**

A5 And is this your preferred email address?
Correct
Wrong – **INSERT CORRECT EMAIL ADDRESS HERE**

A6 And can I confirm your vehicle is…
FROM SAMPLE:
FULL EV OR HYBRID
CAR MAKE AND MODEL

(ALLOW EDITING FOR ANY FIELDS THAT ARE WRONG)

S **ASK ALL**
A7 Does your household have regular access to any other vehicles apart from the electric/hybrid vehicle registered for this trial?
Yes **(SPECIFY MAKE AND MODEL)**
No

S **ASK IF YES AT A7**
A8 How many other vehicles does your household have regular access to?
1
2
3+

S **ASK ALL**
A9 Which of these best describes how you personally use the electric/hybrid vehicle registered for this trial?
I am the main driver
I drive the car regularly but am not the main driver
I rarely or never drive the vehicle **CONFIRM WITH RESPONDENT, CLOSE, AND CONTACT IMPACT AS ALL DRIVERS SHOULD BE REGULAR DRIVERS OF THE VEHICLE.**

M **ASK ALL**
A10 Apart from you, who else is likely to drive the electric/hybrid vehicle registered for this trial?
Please select all that apply.

My partner

Another household member
Someone who does not live in the household
Only me EXCLUSIVE

Thank you for confirming that information. We will now ask you some questions about your household.

DEMOGRAPHICS AND HOUSEHOLD INFORMATION

S ASK ALL,
B1 Please record your gender below.

1) Male
2) Female

S ASK ALL
ADD VALIDATION RULE NO YOUNGER THAN 16 AND UP TO 99 YEARS OLD
B2 Please record your age below.
……. Years old

AUTOMATICALLY CODE INTO THE FOLLOWING AGE BREAKS (HIDDEN VARAIBLE]

IF CODE 1 CLOSE

QHIDAGE Please record **age** below

1) Under 18
2) 18-25
3) 26-35
4) 36-45
5) 46-55
6) 56-64
7) 65+

S ASK ALL
B3 Which of the following best describes ***your*** employment?

1) Self employed
2) Employed over 30 hours a week
3) Employed part time, 15-30 hours a week
4) Employed part time, less than 15 hours a week
5) Full time Student
6) Unemployed- seeking work
7) Unemployed- other
8) Looking after the home/children full time

9) Retired
10) Unable to work due to sickness or disability
11) Other (please specify)

S **ASK IF CODE 1, 2, 3, 4 AT B3**
IF CODE 5, 6, 7, 8 SKIP TO B5

B4 Is your work…

1. Mainly daytime work
2. Mainly evening work, from 7pm to 11pm
3. Mainly night work, 11pm to 5am
4. Shifts that change from day to day or week to week

B5 How many people (including children) are there in your household altogether (that is currently living at home with you)?
Please include yourself in the total.
ENTER NUMBER 1-20

IF 2 OR MORE AT B5 ASK B6
B6 How many children live permanently in your household?
ENTER NUMBER 0-20

S ASK ALL
B7 Which ONE of the following categories best describes the employment status of the ***Chief Income Earner*** (CIE) in your household?

1) Semi or unskilled manual *worker (e.g. Caretaker, Park keeper, non-HGV driver, shop assistant etc)*
2) Skilled manual worker *(e.g. Bricklayer, Carpenter, Plumber, Painter, Bus/ Ambulance Driver, HGV driver, pub/bar worker etc)*
3) Supervisory or clerical/ junior managerial/ professional/ administrative *(e.g. Office worker, Student Doctor, Foreman with 25+ employees, salesperson, etc)*
4) Intermediate managerial/ professional/ administrative *(e.g. Newly qualified (under 3 years) doctor, Solicitor, Board director of small organisation, middle manager in large organisation, principle officer in civil service/local government etc)*
5) Higher managerial/ professional/ administrative *(e.g. Doctor, Solicitor, Board Director in a large organisation 200+ employees, top level civil servant/public service employee etc)*
6) Student
7) Casual worker – not in permanent employment
8) Housewife/ Homemaker
9) Retired and living on state pension

10) Retired and not living on state pension
11) Unemployed or not working due to long-term sickness
12) Full-time carer of other household member

S ASK IF CODE 10 AT B7

B8 Which ONE of the following categories best describes the employment status of the Chief Income Earner ***before*** they retired?

SHOW THE SAME LIST AS B7, EXCLUDING CODES 9 AND 10

AUTOMATICALLY CODES OF QUESTIONS B7 AND B8 INTO SOCIAL ECONOMIC GRADE AS FOLLOWS:

CODE 1	**D**
CODE 2	**C2**
CODE 3 OR 6	**C1**
CODE 4	**B**
CODE 5	**A**
CODE 7 OR 8 OR 9 OR 10 OR 11 OR 12	**E**

S GRID ASK ALL

B9 Which of these best represents your **total** household income before tax and other deductions, either per month or per year.

This information will only be used to check that we have surveyed a mixture of different customers.

ONLY ALLOW ONE ANSWER IN ONE COLUMN

	PER MONTH	PER YEAR
1	Up to £539	Up to £6,499
2	£540 - £789	£6,500 - £9,499
3	£790 - £1289	£9,500 - £15,499
4	£1290 - £2079	£15,500 - £24,999
5	£2080 - £3329	£25,000 - £39,999
6	£3330 - £4999	£40,000 - £59,999
7	£5000 - £7499	£60,000 - £89,999
8	£7500 and over	£90,000 and over
98	Don't know	Don't know
99	Prefer not to say	Prefer not to say

S ASK ALL

B10 Which of the following do you have in your main charging address?

Mains electricity only
Mains electricity and mains gas
Mains electricity and another fuel source such as oil

S ASK ALL
B11 Do have solar panels (photovoltaics) at your home address?
Yes
No
Not sure

S GRID ASK ALL
B12 On average, how much is your combined spend, on gas **and** electricity?

ONLY ALLOW ONE ANSWER IN ONE COLUMN

	PER MONTH	PER YEAR
1	Less than £35 per month	Less than £400 per year
2	£35 - £49	£400 - £599
3	£50 - £65	£600 - £799
4	£66 - £85	£800 - £999
5	£86-£100	£1,000 - £1,199
6	£101 - £115	£1,200 - £1,399
7	£116 - £130	£1,400 - £1,599
8	£131-£149	£1,600 - £1,799
9	Over £150 per month	£1,800 or more per year
98	Don't know	Don't know
99	Prefer not to say	Prefer not to say

QHIDFUELPOV:
1 FUEL POOR – IF MORE THAN 10% OF INCOME SPENT ON FUEL BASED ON RESPONSE AT B9 AND B12
2 NON-FUEL POOR – IF LESS THAN 10% OF INCOME SPENT ON FUEL BASED ON RESPONSE AT B9 AND B12

C1 Finally, Have you experienced any technical difficulties while taking the survey?

1. No
2. Yes (Please specify)

Thank you for the information you have provided today. We will be in touch again once you have had your vehicle and been charging it for a few weeks to understand a little more about how you use and charge you vehicle.

If you have any questions in the meantime about the survey you have just done, or future surveys, please contact Impact Research on 01932 226 793 and ask for a member of the Electric Nation team. Our full contact details and those of the Electric Nation project partners such as DriveElectric were provided to you in your welcome pack. Please do not hesitate to get in touch if you have any questions.

Thank you.

Appendix 2 – Baseline Survey

Electric Nation Recruitment Questionnaire

February 2017

568 Electric Nation	ONLINE SCRIPT FV 22/02/17	Susie Smyth, Michael Brainch, Lucy Upshall, Helen Rackstraw

INTRODUCTION TO THE RESEARCH AND ADHERENCE TO MRS CODE OF CONDUCT

CATI ONLY: Hello, may I speak to **NAME FROM SAMPLE** please?
C1. I am calling from Impact Research about the Electric Nation project that you recently agreed to take part in. We recently sent you a survey link by email, can I check whether you received that email?
Yes
No – **CONFIRM EMAIL ADDRESS WITH RESPONDENT MATCHES SAMPLE**

CATI ONLY: C2. We would be really grateful if you would be able to complete this survey as soon as possible, I can take you through the questions now on the phone, or if you prefer you can complete it online? The survey should take no longer than 5 minutes.
Phone - **CONTINUE**
Online – **CHECK IF NEED LINK RE-SENDING, THANK AND CLOSE.**

ASK ALL
Thank you for agreeing to participate in this important project about the future of electric vehicles. This is the second survey that you will be asked to take part in during the trial and should take no more than 5 minutes to complete, depending on the answers you give us. The purpose of this survey is to gauge how you are currently charging your electric vehicle. This information will be used in combination with that from the other trial participants to understand how behaviour might vary by different groups.

This is a genuine market research study and no sales call will result from our contact with you. The interview will be carried out in strict accordance with the Market Research Society's Code of Conduct. Your identity and any information you provide to us will be kept confidential and will not be used for any purposes other than this research. Your details were provided to us

by DriveElectric and only Impact Research and DriveElectric will have access to your personal contact information so that we can keep in touch with you throughout the trials.

USE

We have some details about you we would like to check are correct before we continue.

M ASK ALL

A1 Firstly, what do you use your electric vehicle for? Please select all that apply.

1) Social
2) Business
3) Commuting

S ASK ALL

A2 Does your household have regular access to any other vehicles apart from the electric/hybrid vehicle registered for this trial?

1) Yes
2) No

S ASK IF A2=YES

A2a How many other vehicles does your household have regular access to apart from the electric/hybrid vehicle registered for this trial?

1) ……. **(SPECIFY MAKE AND MODEL FOR EACH)**

M ASK IF A2 = YES PLEASE SHOW ON SAME PAGE AS A2

A3 Is your other vehicle(s)… Please select all that apply.

1) Electric
2) Range extended electric
3) Plug in Hybrid
4) Hybrid
5) Petrol
6) Diesel
7) Other (please specify)

Thank you for confirming this information. We will now ask you some questions about your electric vehicle.

CHARGING BEHAVIOUR

M ASK ALL, ROTATE ALL

B1 To what extent do you agree or disagree with the following statement, where 1 is strongly disagree and 5 is strongly agree.

1) My charging behaviour varies considerably from day to day
2) My charging behaviour has a regular routine
3) Whenever I have access to a charger, I plug in, regardless of the level of charge of the vehicle
4) I will only plug in to charge when the battery is too low to complete my current/next journey

M **ASK ALL, MULTICODE**

B2 Where do you charge your electric vehicle? Please select all that apply.

3) Home
4) Service station (motorway) / Petrol station
5) On street charge point
6) Work
7) Supermarket/Shopping centre car parks
8) Other Car parks (please specify)
9) Friend/relative's house
10) Other (please specify)
11) Don't know

S **ASK ALL, SINGLE CODE**

B3 And, where do you charge your electric vehicle most often?

INSERT ALL SELECTED AT B2

S **ASK ALL, SINGLE CODE BY ROW**

B4 How often do you charge your electric vehicle in the following locations?

	1)	2)	3)	4)	5)	6)	7)	8)
Location	More than once a day	Once a day	5 -6 times a week	3-4 times a week	Once – twice a week	Once a fortnight	Less than once a fortnight	I don't have charging routine / Don't know
INSERT ALL SELECTED AT B2								

M **ASK ALL, MULTICODE**

B5 When do you typically charge your electric vehicle at the following locations? Please select all that apply to each location.

	1)	2)	3)	4)	5)
Location	Morning	Afternoon	Evening	Overnight	I don't have a standardised charging routine
INSERT ALL SELECTED AT B2					

S ASK ALL

B6 Thinking about when you charge your electric vehicle in the following locations, how long do you charge your electric vehicle for on each occasion?

	1)	2)
Location	**PROGRAMMER: NUMERIC BOX** _____ hours	I don't have a charging routine / Don't know
INSERT ALL SELECTED AT B2		

S ASK ALL

B7A How do you tend to judge when to charge your electric vehicle?

1) Number of miles left
2) Percentage of battery left
3) Other (please specify)

S ASK IF B7A = 1

B7B At what point would you feel like you need to charge the battery of your electric vehicle?

1) 10 miles or below
2) 20 miles or below
3) 50 miles or below
4) 100 miles or below
5) 150 miles or below
6) More than 150 miles

7) Other (please specify)

S ASK IF B7A = 2

B7C At what point would you feel like you need to charge the battery of your electric vehicle?

1) Below 75% charge
2) Below 50% charge
3) Below 25% charge
4) Other (please specify)

S ASK ALL

B8 On a scale of 1 – 10, where 1 is completely unacceptable and 10 is completely acceptable, how **acceptable** are your current charging arrangements?

1) 1 – Completely unacceptable
2) 2
3) 3
4) 4
5) 5
6) 6
7) 7
8) 8
9) 9
10) 10 – Completely acceptable
11) Don't know (Please specify why)

S ASK ALL

B9 On a scale of 1 – 10, where 10 is very satisfied and 1 is very dissatisfied, how **satisfied** are you with your current charging arrangements?

1) 1 - Very dissatisfied
2) 2
3) 3
4) 4
5) 5
6) 6
7) 7
8) 8
9) 9
10) 10 – Very satisfied
11) Don't know

S ASK ALL

B10 Which statement best describes your attitude to changing your charging behaviour

1) I am very willing to continue with this current charging arrangement indefinitely
2) I am willing to continue with this current charging arrangement for a limited time only
3) I would prefer alternative charging arrangements
4) I cannot continue with these current charging arrangements

OE ASK IF CODES 2 – 4 SELECTED AT B10
B11 Why do you say that?

S ASK ALL
B12 How do you feel about having your charging arrangements managed as part of the trial?

1) Not at all concerned
2) Slightly concerned
3) Quite concerned
4) Very concerned
5) Not sure

OE ASK ALL
B13 Why do you say that?

INSTALLATION QUESTIONS (DE)

Thinking back to when you had your charge point installed….

G ASK ALL
I1 Overall can you tell us what you thought of your experience with DriveElectric in terms of… **ROWS**
a) Contact with DriveElectric
b) Information provided to you about the project
c) Administration of your application for the charger

COLUMNS
1) Very poor
2) Poor
3) Neither poor nor good
4) Good
5) Very good

S ASK ALL
I2 How was your experience of the install itself?

1) Very poor
2) Poor
3) Neither poor nor good
4) Good
5) Very good

S ASK ALL

I3 Did the installer explain how safety would be managed as part of the installation?

1) Yes
2) No
3) Can't remember

OE **ASK ALL**

I4 Is there anything you feel you need more information on regarding the project?

OPEN ENDED

Thank you for providing that information. I would just like to confirm your contact information is up to date.

CONTACT INFORMATION

S **ASK ALL**

C1 Can I confirm that this is still the best number to contact you on?

1) Yes
2) No

S **ASK IF C1 = 2**

C2 Please provide the best number to contact you on in the future?

_____

C3 Finally, have you experienced any technical difficulties while taking the survey?

1. No
2. Yes (Please specify)

Thank you for the information you have provided today. We will be in touch again once the first trial is underway and you have had few weeks to charge your vehicle.

If you have any questions in the meantime about the survey you have just done, or future surveys, please contact Impact Research on 01932 226 793 and ask for a member of the Electric Nation team. Our full contact details and those of the Electric Nation project partners such as DriveElectric were provided to you in your welcome pack. Please do not hesitate to get in touch if you have any questions.

Thank you.

Appendix 3 – Recruitment Survey Invitation

Dear

You are receiving this survey invitation based upon you signing up to the **Electric Nation** research project. Your details were given to us by our project partner **Drive Electric**.

This initial survey will collect some background information about yourself and your electric vehicle, which will be used throughout the duration of the project. All details collected will be kept confidential and only be used for the purpose of this research as outlined in the welcome back. The information you provide for us is important to help us understand how different electric vehicle users' experiences might vary.

To take part in the survey, please read the following and click on the relevant link below:

<SURVEY LINK>

This survey should take approximately 10 minutes to complete. Please aim to complete the survey within the next seven days, after which time we may be in contact with you to remind you to complete the survey as soon as you can.

As part of this research you will be asked to complete up to seven further surveys throughout the next two years as previously explained.

If you have any queries about the Electric Nation surveys we send you please contact us at Impact Research on 01932 226 793 or electricnation@impactmr.com. If you have any other questions about the research then please refer to your welcome pack for relevant contact details. We look forward to receiving your feedback.

Kind regards,

Impact Utilities

Appendix 4 – Baseline Survey Invitation

Email subject: Electric Nation Survey 2

Dear

Thank you for completing the first survey as part of the **Electric Nation** research. **Now you have had your charger for a few weeks** we would like to ask you about your experience so far.

This survey is to understand your initial charging habits before the demand management trial begins. All details collected will be kept confidential and will only be used for the purpose of this research, as outlined in the Welcome Pack. The information you provide for us is important to help us understand how different electric vehicle users' experiences might vary.

To take part in the survey, please read the following and click on the relevant link below:

<SURVEY LINK>

This survey should take approximately 5 minutes to complete. Please aim to complete the survey within the next seven days, after which time we may contact you to remind you to complete the survey as soon as you can.

As part of the Electric Nation project you will be asked to complete up to six further surveys throughout the next two years, as previously explained.

If you have any queries about the Electric Nation surveys we send you, please contact us at Impact Research on 01932 226 793 or electricnation@impactmr.com. If you have any other questions about the Electric nation project then please refer to your Welcome Pack for relevant contact details. We look forward to receiving your feedback.

Kind regards,

Impact Utilities