WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

ELECTRIC NATION (CarConnect)

WPD_NIA_013

NIA MAJOR PROJECT PROGRESS REPORT

REPORTING PERIOD: OCT 2017 – MAR 2018

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Contents

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Glossary

Term	Definition
BaU	Business as Usual
BEV	Battery Electric Vehicle
CRM	Customer Relationship Management
DE	Drive Electric
DECC	(the former) Department for Energy and Climate Change
DG	Distributed Generation
DNO	Distribution Network Operator
EATL	EA Technology Ltd
EN	Electric Nation
EV	Electric Vehicle
EVRT	European EV Road Tour
GB	Great Britain
HV	High Voltage
IPR	Intellectual Property Register
LCT	Low Carbon Technologies
LowCVP	Low Carbon Vehicle Partnership
LEGK	Lucy Electric GridKey
LCNI	Low Carbon Networks and Innovation
LCV	Low Carbon Vehicles event (2017 event held 6th to 7th September at Millbrook)
LV	Low Voltage
MEA	My Electric Avenue project
MPAN	Meter Point Administration Number
NAT	Network Assessment Tool
NIA	Network Innovation Allowance
OHL	Over-Head Line
PHEV	Plug in Hybrid Electric Vehicle
PIV	Plug in Vehicle
PIVDCS	PIV Demand Control Services (or Demand Management Services)
PR	Public Relations (activities)
REX / REX-EV	Range Extended Electric Vehicle
ULEV	Ultra-Low Emission Vehicle
V2G	Vehicle to Grid
WPD	Western Power Distribution

1 Executive Summary

Electric Nation (the customer facing brand of CarConnect) is funded through Ofgem's Network Innovation Allowance (NIA). Electric Nation was registered in April 2016 and is expected to be complete by October 2019.

Electric Nation aims to enable DNOs to identify which parts of their networks are likely to be affected by Plug-in Vehicle (PIV) uptake and domestic charging, and whether PIV domestic charging demand management services are a cost effective solution to avoiding or deferring reinforcement on vulnerable parts of their networks, using three methods.

Method 1: Modelling

This project will provide DNOs with an assessment tool to predict where PIV market penetration may cause network problems through increased demand for domestic PIV charging. This tool will, firstly, enable assessment of all (non-meshed) LV networks in a DNO's licence areas to identify those most likely to be affected by increased penetration of domestic PIV charging. Secondly, the tool will enable more detailed assessment of those LV networks to identify the level of domestic PIV charging penetration that would present a problem and trigger reinforcement and enable assessment of domestic PIV charging demand control, and potentially Vehicle to Grid (V2G), as solutions to avoid or defer reinforcement.

Method 2: Monitoring

This project will develop an algorithm deployable on an existing substation monitoring facility that will enable the effect of charging PIVs on a LV network to be retrospectively analysed and allow the measurable impact to be compared against the modelling tool output.

Method 3: Mitigation

This project will adapt existing smart charger technology, potentially including V2G chargers, if state of technology development is sufficiently advanced during the project timeframe, and existing commercial charger management services to deploy these in a mass-market customer trial. The aim of the trial is to prove the technical/economic viability of domestic PIV charging demand control and V2G services, to avoid or defer network reinforcement and to prove that such systems are acceptable to customers. The customer trial will include a wide range of PIVs, with a range of battery sizes and charging rates to assess to what extent such systems can be deployed in a future with a diverse PIV market.

This report details progress of the project, focusing on the period October 2017 to March 2018.

1.1 Business Case

As groups of neighbours acquire PIVs, localised clustering of demand is likely to cause problems for electricity networks, as demonstrated through the (Low Carbon Networks Fund) My Electric Avenue (MEA) project. MEA showed that approximately 30% of GB low voltage networks will need reinforcement by 2050, if adoption of PIVs (and domestic charging) is widespread (i.e. meeting DECC's High EV Market Growth Forecast). This represents a present day cost of £2.2bn to UK customers – Transform Model® analysis, based on UK Government forecasts of nearly 40 million PIVs on UK roads by that time. The UK Government is committed to the electrification of transport – as illustrated by its recent investment into ultra-low emission vehicles (ULEV) such as its extension of grants for PIV chargers, PIV car subsidies and the Go Ultra Low Cities Scheme.

Which parts of distribution networks will be affected by PIV market growth is not understood – the MEA analysis used idealised network types. There is no tool available for assessing real LV networks to identify those at risk from high penetration of domestic PIV charging, and to identify the technical efficacy and economic viability of smart solutions (domestic charging demand control and V2G) against traditional network reinforcement. Through this project, a tool will be developed that will allow the assessment of real LV networks for the susceptibility to excessive demand from domestic PIV charging.

In recent years, "smart" chargers have been developed for domestic and public charging use, which are controllable for access and billing purposes. Alongside these smart chargers, control services have been developed and deployed to carry out this access control and billing services. These smart chargers also give the option to modulate the power taken by PIVs, giving a more refined set of demand control options than trialled in MEA. It is thought that these technologies could be adapted for domestic charger control to provide demand control services to DNOs across LV areas (rather than just single feeders). However, it is not known whether the application of these technologies, for charging PIVs at home, is technically viable and acceptable to customers. The technical challenges include: ensuring secure and reliable communications between the charger and control services; providing customers with information about the charging of their PIV; allowing the customer to state preference as to when they are charged (ensuring the control is as "fair" as possible to all); and investigating what, if any, compensation or incentives customers require to participate in PIV demand control. Also, the PIV market has and will continue to diversify with a range of battery sizes fitted to PIVs and nominal charge rates growing (from 3kW to 7kW+), making possible peak loads higher and adding complexity to the challenge of PIV demand control. Therefore, this project will investigate to what extent it might be possible to utilise domestic PIV charging demand control to defer or avoid some of the £2.2bn cost to UK customers, calculated in the MEA project.

In addition, vehicle to grid (V2G) services and associated technologies are being developed in the UK and abroad. The impact of mass V2G services on LV networks needs to be understood, especially as some V2G services (such as transmission frequency services) may adversely affect distribution network operations, in a similar way to solar PV generation. V2G could be a solution as much as a problem for LV network congestion, in that export mode could be used to address peak PIV demands - but as V2G has not been developed sufficiently at this time this is a poorly understood option. Furthermore, adapting the domestic PIV charging demand control services to utilise V2G export mode to address PIV charging induced peak loads has not been proven. This project aims to explore the technical readiness of V2G technology for domestic use and assess its potential economic feasibility.

1.2 Project Progress

This report covers project progress for the period October 2017 to March 2018.

Project activities in this period have focussed on recruitment of customers into the trial, demand management events on customer charger points with a winter profile, resolving further charger communication issues, and the delivery of the V2G charger for the V2G trial. This 6 monthly period included a 6 monthly PRG meeting in January 2018.

EA Technology:

- Attendance and presentation at a number of relevant industry events to raise the profile of the Electric Nation project and to share early learning arising from the customer trial;
- Activity on development of the Network Assessment Tool (NAT) focussed on improving the network mapping heuristics, implementing Debut load flow analysis on the resulting network models, to produce voltage drops and to identify thermal constraints across each feeder model and then analysing failure modes;
- Customer research through questionnaires at: baseline, post installation, and during the trial;
- Readying the Capenhurst test system for V2G charger installation;
- Testing the GreenFlux and CrowdCharge Apps in preparation for the next phase of the project;
- Assisting DriveElectric in resolving charge point communication and back-office integration issues and faults, and tracking the communications performance over time;
- Moving customers into demand management, scheduling demand management events and monitoring the impact on customers; and
- Coordinating the work of NCS (Cyber Security sub-contractor).

Drive Electric:

- Drive Electric has achieved the target of recruiting 700 participants. Currently 658 surveys have been approved by installers with 608 chargers installed;
- Continued development of qualification and installer processes;
- Continued monitoring and analysis of the engagement teams marketing activities; notably social media, referrals from dealers and installers. Marketing activity has been reduced since reaching 700 recruited participants in January 2018;
- Because of issues with delays to delivery of new electric vehicles, it has been agreed with WPD that the final figure for chargers installed may be below 700; and
- Fixes for chargepoint communication issues continued to be monitored, analysed and developed.

Lucy Electric GridKey

- Completion of EV detection algorithm;
- Production of "Electric Nation Algorithm FRD" report.

TRL

- Continued monitoring of project against Key Outputs, Milestones, Actions, Risks and Issues;
- Provision of regular (monthly, quarterly and six-monthly) reports to WPD describing project progress; and
- Providing technical and project management oversight of project delivery and work being carried out by the delivery team.

TRL's staff on the project have now changed. TRL's Project Management lead is now David Blythin and TRL's Technical Lead is now Peter Vermaat. These changes were needed to accommodate the departure from TRL of Denis Naberezhnykh in February 2018 and Andy Wells in April 2018.

1.3 Project Delivery Structure

1.3.1 Project Review Group

The Electric Nation Project Review Group meets on a bi-annual basis. The role of the Project Review Group is to:

- Ensure the project is aligned with organisational strategy;
- Ensure the project makes good use of assets;
- Assist with resolving strategic level issues and risks;
- Approve or reject changes to the project with a high impact on timelines and budget;
- Assess project progress and report on project to senior management and higher authorities;
- Provide advice and guidance on business issues facing the project;
- Use influence and authority to assist the project in achieving its outcomes;
- Review and approve final project deliverables; and
- Perform reviews at agreed stage boundaries.

The last Project Review Group meeting was held on 17th January 2018 and the next is expected to be held around June 2018.

1.3.2 Project Resource

Western Power Distribution (WPD)

Project Manager: Mark Dale

Project Support: Emily Green

Marketing and Data Provision support as required.

EA Technology (EATL)

EA Technology's primary roles in the project are:

- Project management – delivery of project;
- Management of project supporting activities, such as marketing and, PR for customer recruitment, and customer research;
- Development of the Network Assessment Tool;
- Development of the customer trial programme;
- Management of the PIVDCS suppliers and their input to the trial;
- Development of the PIVDCS algorithm(s);
- Management of V2G trial; and

- Production and dissemination of the project deliverables, reports and learning outcomes.

DriveElectric (DE)

Drive Electric's primary roles in the project are:

- Recruitment of customer trial volunteers;
- All practical aspects of operating the customer trial;
- Customer relationship management (including data protection);
- Supply of PIVs to some of the customers volunteering for the trial (not funded by this project);
- Supply and installation of "smart" chargers, through sub-contractor organisations;
- Customer communications and retention in the trial;
- Supply of vehicle related trial data; and
- Supply of V2G chargers.

TRL

TRL's primary roles in the project are:

- Overarching project overseeing role for all three methods, providing WPD deeper insight into how the project is performing from both a Project Management and Technical perspective;
- Provision of feedback, expert advice, technical review and reporting of project approach and milestones;
- Maintaining the project RAID log, Action Log and Key Outputs and Milestones log, alongside EATL and DE;
- Monthly meeting coordination and reporting;
- Monthly and 6 monthly reporting to WPD;
- Escalation of significant issues to WPD; and
- Independent validation of milestones.

Lucy Electric Gridkey (LEGK)

Lucy Electric Gridkey's primary roles in the project are:

- Supply of monitoring equipment;
- Development of a detection algorithm (TTP supporting LEGK); and
- Production of a functional specification for a detection algorithm to detect EV charging.

1.4 Procurement

Table 1-1 details the current status of procurement for this project.

Table 1-1: Procurement Details

Provider	Services/goods	Area of project applicable to	Anticipated Delivery Dates
CrowdCharge	PIVDCS services	Test System Pilot Installations Customer Trial	August 2016-December 2018
Greenflux	PIVDCS services	Test System Pilot Installations Customer Trial	August 2016-December 2018
ICU Charging Solutions	Smart Chargers	Test System Pilot Installations Customer Trial	August 2016-December 2018
APT	Smart Chargers	Test System Pilot Installations Customer Trial	August 2016-December 2018
The Tech Factory	Systems Integration (smart charger communications) equipment, services and support	Test System Pilot Installations Customer Trial	August 2016-December 2018
NCC	Cyber Security Assessment of PIVDCS systems	Customer Trial & Functional Specification	Summer 2019
EV Charging	Smart Charger	Pilot Installations	November 2016-

Solutions Stratford Energy Solutions Actemium UK The Phoenix Works	Installation services	and Customer Trial	Spring 2018
Impact Utilities	Customer research services	Customer Trial	December 2016 – January 2019
AutomotiveComms	Marketing & PR services	Project	July 2016-October 2019
TTP	Algorithm development for LEGK	Monitoring	End of project
GEOTAB	Vehicle Telematics	Telematics	July 2017 – September 2018

1.5 Project Risks

A proactive approach is taken to ensure effective risk management for the CarConnect | Electric Nation project. A RAID (Risks, Assumptions, Issues, and Dependencies) log is maintained, examined and updated by TRL, EATL, DE, and LEGK. This activity ensures that risks are frequently reviewed, examining: whether risks still exist, whether new risks have arisen, whether the likelihood and impact of risks have changed, for reporting of significant changes that will affect risk priorities, and to deliver assurance of the effectiveness of control.

Risks are reported to WPD within each monthly report. At each monthly meeting, the RAID log is reviewed and updated by the project delivery team, TRL and WPD. TRL provides a critical overseeing role within the meeting to ensure that all risks are being effectively captured and managed.

Contained within Section 7.1 of this report are the current top risks associated with successfully delivering Electric Nation as captured in the RAID log. Section 0 provides an update on the most prominent risks identified at the project bid phase.

1.6 Project Learning and Dissemination

A Project Learning Log is maintained. Project lessons learned and what worked well are captured throughout the project lifecycle. These are captured through a series of on-going reviews with stakeholders and project team members, and will be shared in lessons learned workshops at the end of the project. These are reported in Section 5 of this report.

Project Dissemination Activities during this period

The team has attended a number of relevant industry events to raise the profile of the Electric Nation project and to share early learning arising from the customer trial:

- Little Wenlock, Telford Community Event day (30th September 2017) – DriveElectric attended along with WPD to promote the Electric Nation project.

- Electric Nation was presented at WPD's Balancing Act event on 5 October, introducing the Network Assessment Tool. The write-up of the event can be found here: http://www.electricnation.org.uk/2017/10/11/electric-nation-at-wpds-balancing-act-conference/.

- WPD presented on Electric Nation at the Electric Vehicle Charging Point Infrastructure Conference, Nottingham on 4 October.

- Representatives from WPD and EA Technology represented Electric Nation at the UN Climate Change Conference in Bonn, 9-10 November. The Electric Nation model was used to demonstrate the project to a wide range of COP23 delegates from across the world. There was lots of interest in how uptake of EVs is occurring in the UK, and how smart charging could help, either for solving network issues (as is being investigating in Electric Nation) or for maximising the use of renewable energy. The Electric Nation presentations, part of the UK's Smart Systems and Flexibility slot, and arranged in partnership with the Department for International Trade, enjoyed an audience which filled the room in the UK Pavilion.

- EA Technology was interviewed on BBC Radio 5 Live, about electric vehicles and Electric Nation. WPD was interviewed on the same day for Radio Wales, on the topic of smart charging and Electric Nation, with customers being at the forefront of the discussion.

- Representatives from WPD and EA Technology represented Electric Nation at the Low Carbon Network Innovation (LCNI) Conference in Telford, 6-7 December 2017, on WPD's stand. Electric Nation launched a Smart Charging Guide Summary at the event, by a speaking slot on Day 2 of the Conference. The Smart Charging Guide Summary is a four-page version of the full Smart Charging Guide (under development), aimed at those who are involved in the decision-making process about how EV drivers charge their electric vehicles – in Government, the energy industry, the automotive industry, the EV charging sector, planning and other stakeholders – which will be available in due course.

  Electric Nation's Smart Charging Guide provides essential background information for the eventuality of smart charging being rolled out nationally. Smart charging is included in the Government's 'Automated and Electric Vehicles Bill' and is expected to be mandated.

  The Electric Nation model was used to demonstrate the project to the delegates. WPD filmed the model in action, to be used to explain the concept of smart charging and vehicle to grid technology, and benefit for customers.

- New Energy Forum 9 January 2018 - WPD and EA Technology took part in an industry roundtable on 'EVs: Paving the way for transport electrification and the evolving business models for charging infrastructure'.

- Cenex LEVEL V2G event 31 January 2018 – EA technology presented to an industry and academic audience on latest charging data findings and V2G progress.

- News: On the project news page this month we promote Mark Dale from WPD's presence at Ecobuild Live at the ExCel, London, on 7 March http://www.electricnation.org.uk/2018/02/07/electric-nation-at-ecobuild-2018/

- WPD presented Electric Nation at Ecobuild on 7th March, alongside OLEV and Cenex. This represented a good opportunity to raise awareness of the LV network issues.

- WPD also presented Electric Nation an All Party Parliamentary Group at the House of Commons in this reporting period.

2 Project Manager's Report

2.1 Project Background

Electric Nation aims to enable DNOs to identify which parts of their network are likely to be affected by Plug-in Vehicle (PIV) uptake and domestic charging, and whether PIV domestic charging demand management services are a cost effective solution to avoiding or deferring reinforcement on vulnerable parts of their networks, using three methods.

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2.2 Project Progress

2.2.1 Method 1: Modelling

Activity on development of the Network Assessment Tool (NAT) in this period has focussed on improving the network mapping heuristics, implementing Debut load flow analysis on the resulting network models, to produce voltage drops and to identify thermal constraints across each feeder model and then analysing failure modes (i.e. failed mapping, failed Debut analysis or both). Common failure modes were then used to iteratively improve mapping, network modelling and so Debut load flow analysis. Initially this work was undertaken on sample data from the Plymouth area, latterly on 3 other sample areas representing each of WPD's license areas.

Network modelling heuristic techniques

These algorithms build a model of the LV networks associated with each LV substation and associated customer groups with a particular feeder made up from cable/Over Head Line (OHL) segments.

Simplistically, for each transformer (using the number of *dumb* feeders associated with the substation) the cables/OHLs closest to the transformer are identified. For each nearest cable/OHL, following cable/OHL segments (based on nearest start co-ordinates matching end co-ordinates) are identified to make up a feeder string, sometimes with branches. Where feeder strings lead to another transformer location a note is made that a normally open point will be located somewhere on that feeder for later analysis.

This part of the heuristic builds a map of all LV feeders.

The next part of the heuristic takes customer locations associated with a *dumb* feeder and using Hall-Curve analysis identifies the best match for a dumb feeder with a stitched-together feeder (made up of cable/OHL segments).

Further cleaning is sometimes required to identify miss matched data (customers who are a long distance away from a substation/feeder that must have been miss-assigned to a particular transformer, for example)

Associations of customers to feeders helps to then identify boundaries between LV areas (transformer supply boundaries) that can be used to approximately identify normally open point locations, sometimes validated by cable/OHL specification changes along the feeder string.

This results in a map of transformers, with associated feeders and customers to each feeder which provides the model for load analysis to be used in the NAT. An example is provided in

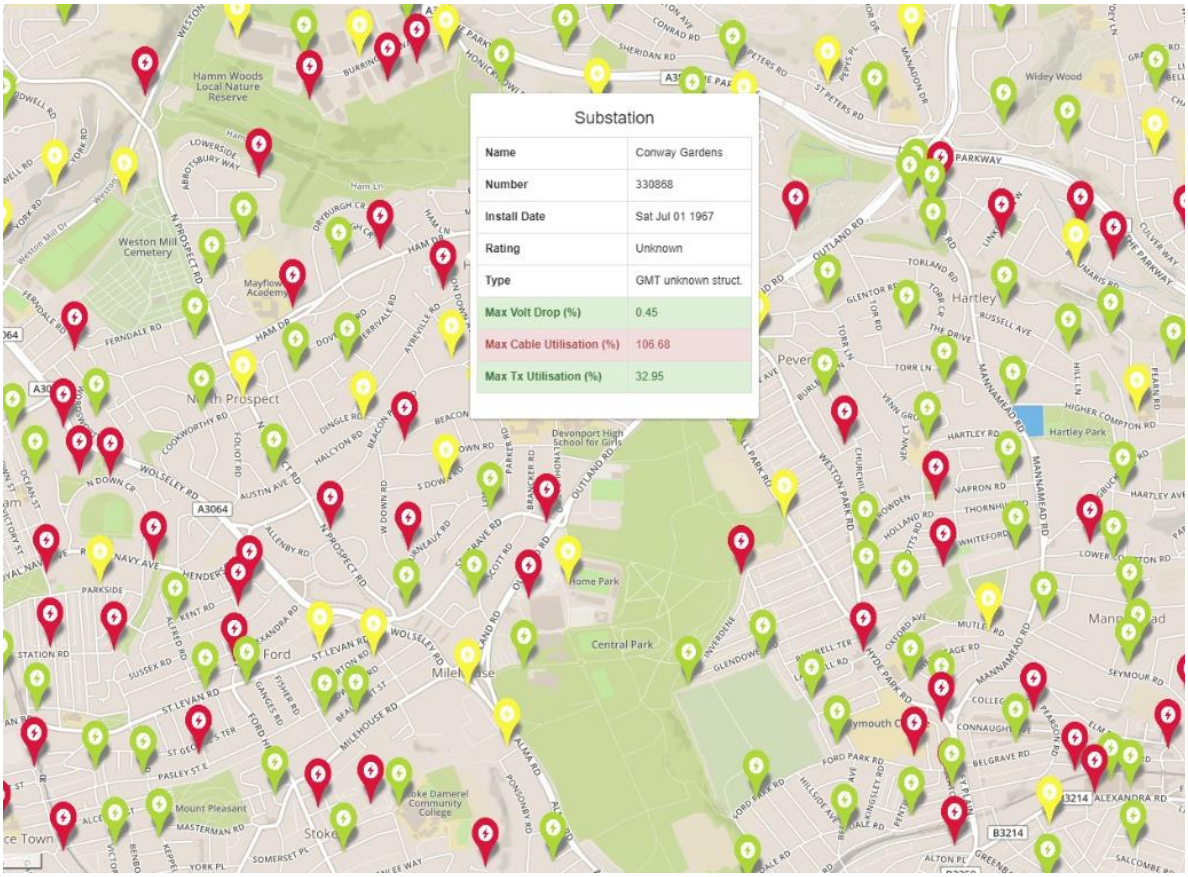


Figure 2-1.

Figure 2-1 – Example transformer location map from the NAT (mocked up data showing transformer grading by an "EV Impact" rating for illustration purposes)

Validation of network assessment methodology, using the available data

The quality of the data provided by WPD is variable and not ideal, in particular cable routing raw data is not available, so straight line distance between cable section start/end xy co-ordinates can be less than the recorded cable section length. In some cases the actual cable is not available in the records, usually for older records, so the straight line distance is the only available measure. It should be noted that the asset locational data in respect to the mapping background is available

The specified feeder assessment methodology for the NAT is the Debut engine, as used in WinDebut. To test whether the Debut engine would work with the available data a simpler diversified demand algorithm was applied to a sample of feeders produced by the network

modelling heuristics, to produce voltage drop assessments at nodes along the feeders. This testing showed that a high proportion of the sample feeder models could be successfully assessed. Further testing is underway to confirm these results, applying the Debut engine manually to the sample feeder models.

Feeder models that cannot be assessed by the Debut engine, owing to nonsensical feeder models or that produce nonsensical results would be flagged within the NAT as having a low confidence level or requiring attention.

General NAT Development activity

Following a review meeting with WPD in September, EA Technology has been working on following up the actions, including:

- Obtaining WPD's design guidelines to ensure these are incorporated into the NAT;
- Verifying that WPD does not have licenses for satellite views of the license areas – this feature will not be included as an overlay in the NAT owing to the costs of such licenses;
- Obtaining WPD licence area and energy supply area boundary files for incorporation into the NAT;
- Obtaining additional sample data from Crown database, for testing the data input routines and network mapping heuristics further, including additional data such as known EV charger installations and estimated energy consumption data for meters;
- Obtaining a complete set of Crown data covering all four of WPD's license areas.

Validation of network assessment methodology, using the available data

Earlier in this period work on the refinement of the network mapping heuristics, resulting in a hybrid heuristic using Hall Curve and meter to cable distance methods was suspended, while EA Technology moved on to incorporating Debut feeder assessment into the NAT.

This work resulted in the NAT being able to produce Debut input files based on "Good" network maps, i.e. those network models where the mapping heuristic did not fail, for reasons such as orphaned cable sections not connected to a substation, missing cable segments and no customers associated with a substation/feeder.

These Debut input files are then processed by an instance of the Debut engine, which in turn produces output files or errors.

EA Technology then focussed on improving data processing and network assessment via a Failure Mode Effect Analysis approach, initially on a Plymouth area sample and then across three other sample areas, one for each of WPD's license areas, in an attempt to address the

likely differences in data quality in each license area (owing to differences in engineering practices in each area's predecessor organisations).

The earlier iterations of the mapping heuristics and network assessment only considered 200 distribution substations in the Plymouth area, which was thought to of been of a high data quality standard. Successive iterations have now expanded into each licence area by considering 600 more distribution substations in Lincoln, Worcester and Cardiff. There are notable differences in the data quality and a noticeable reduction in mapping/analysis success was found, particularly in the Cardiff area. A further three review cycles has allowed for new algorithmic steps to be devised enhancing the success rates of the network translations in the newly processed areas.

Table 2-1 below expresses success rates of correct network translations across the separate sample areas. This is split into success for distribution substations with all downstream feeders successfully mapped and assessed (so, for example, 1 out of 4 feeders associated with a substation failing to map or assess would result in a "fail") and success for each individual feeder (which allows for the counting of successful mapped and assessed where (say) 1 feeder may have an error but others on the same substation have processed correctly).

Table 2-1: Success rates of correct network translations across the separate sample areas

	Plymouth	Lincoln	Worcester	Cardiff
All Distribution Substation (all feeders) Processing	59.4%	42.9%	50.2%	34.7%
All Feeders (in isolation to the distribution site)	80.6%	67.7%	78.6%	56.5%

Although this reduction in success outside of Plymouth was anticipated, the extent of the impacts is now understood and there is much greater confidence in the derived success rates.

EA Technology has also learnt that the success metric by feeders rather than substations is more useful. Although the NAT Debut assessment reports will relate to a whole distribution substation site, i.e. "good" having high EV capacity, "bad" being susceptible to EV loads (owing to high/unacceptable voltage drops or thermal constraints on one or more feeders). Where a substation might be labelled as "failed to assess" owing to mapping or load flow assessment failing on a proportion of feeders, EA Technology will now, where possible, produce a qualified assessment ("qualified-good"/"qualified-bad") using the available

"good" mapped/assessed feeders – with reasons for the qualification and some form of confidence measure associated with this qualification (say, % of feeders "good" vs "bad").

Feeder mapping/assessment failures occur for a variety of reasons, including:

- No customers associated with feeder: many of these are suspected commercial industrial sites, EA Technology is working with WPD to improve identification of C&I meter points, obsolete substations or new developments where customers are not in place as yet;
- No feeders associated with substation, with or without customers: for similar reasons as above;
- Cable topology cannot be mapped to customer topology – mapping fails: These can be:
    - Rural locations where customers are widely distributed from linear feeders (OHLs) and customer connection cables are not included in the data set;
    - Complex situations, each being a unique challenge to the heuristics, altering the heuristics to match one situation then leads to mapping errors on the wider data set.

A fall-back method for developing "ideal" network maps, where the mapping heuristics fail, has been developed – this method would create a network map that would act as a proxy for networks where available data is insufficient to enable a good network map to be produced or the available data is too complex for the existing algorithms to produce a good map. These ideal maps will produce a network model that DEBUT can use to produce results, albeit built on an idealised network topology. These will, obviously, be flagged as such in the NAT results.

In parallel activities, EA Technology has continued the preparation for the next stage of focussed development: the assessment of EV load penetration onto the mapped and assessed networks. Algorithms for EV loads have been conceptualised to allow for a clustering method, which will cluster EV uptakes into geographical areas based on customer demographics. The obstacle for this at present is the lack of available data to support this at the granularity required to focus clusters on individual substations/feeders. The mechanism can be implemented when more granular demographic data does become available. In the meantime, EV clustering will be applied across Energy Supply Areas within each of WPD's license areas using available forecasts from Regen's EV forecasting reports.

Next steps

- Testing and improving bulk data processing algorithms – that is processing available data covering the whole of WPD's license area. In particular focussing on process speed (target is to reduce processing time for the full data set to 2-3 tens of hours)

and error handling (preventing stalls, e.g. in cases of bad data, the algorithm should skip over bad data rather than stop)

- Incorporation of EV growth models into the NAT.

2.2.2 Method 2: Monitoring

Progress within this reporting period

The development of the EV detection algorithm by TTP and Lucy Electric GridKey has been completed. Results were presented to the PRG meeting in January 2018 but formal reporting was unexpectedly delayed. At WPD's request, TRL has reviewed the "Electric Nation Algorithm FRD" report provided by Lucy Electric GridKey and has provided comments on the report to WPD.

Next steps

Comments provided on the "Electric Nation Algorithm FRD" report to be taken on-board and the report updated by Lucy Electric GridKey and TTP, to meet WPD requirements. The project closedown report will then need to be produced.

2.2.3 Method 3: Mitigation

Progress within this reporting period

Marketing and PR

EA Technology has continued to lead project marketing and dissemination activities in this period.

EA Technology has developed a positive relationship with the Office for Low Emission Vehicles, which is supportive of Electric Nation, with smart charging being on the UK Government policy's agenda under the Automated and Electric Vehicle Bill[1]

- EA Technology met with the Head of Energy for OLEV on 4 January 2018 to provide an in-depth update on Electric Nation. As a result of this engagement, the project has been offered OLEV's Electric Vehicle Home Charge Scheme charging data, under an MOU to be signed by WPD. This data will support project analysis and in particular the development of the Network Assessment Tool.
- As a result of EA Technology's engagement with OLEV, the project has been invited to submit Electric Nation as a case study to OLEV's forthcoming 'Road to Zero' EV strategy. The case study has been submitted and EA Technology await news as to whether it has been accepted.

[1] The Automated and Electric Vehicle Bill is expected to complete progress through the Parliamentary process this year and includes provisions for managed EV charging.

Social media

Twitter

To date, the Electric Nation Twitter account has more than 1,500 followers; the account has delivered 800+ tweets, and achieves a good level of retweet activity, including regular retweets by WPD, the Office for Low Emission Vehicles, and project partners and suppliers.

LinkedIn

Managed by EA Technology, Electric Nation has a LinkedIn Group that currently has 43 members from across automotive / energy / DNO stakeholder groups. It is used on a relatively infrequent basis to deliver news items and event details at which the project and its partners will be appearing. The Group will become more active once the project starts to deliver trial results and learning.

Facebook

Electric Nation has a Facebook page that is customer-facing and is therefore managed by DriveElectric, albeit its set up was supported by AutomotiveComms to ensure branding and message were in line with strategy.

Project Website

In this reporting period EA Technology has ensured the website is kept up to date, with revised and new FAQs and produced 20 News items for the project website, covering project and EV industry news, including:

- 11/10/2017 – Electric Nation at WPD's Balancing Act Conference;
- 19/10/2017 – Electric Nation presents at the LowCVP seminars at Energy 2017;
- 24/10/2017 – Automated and Electric Vehicles Bill;
- 01/11/2017 – Electric Nation featured in Energy World;
- 02/11/2017 – Electric Nation to present at the 2017 UN Climate Change Conference;
- 06/11/2017 – Electric Nation on BBC Radio 5 Live;
- 14/11/2017 – Electric Nation Presentation at the 2017 UN Climate Change Conference;
- 15/11/2017 – Electric Nation in Autocar;
- 29/11/2017 – Electric Nation presents at COP23, LowCVP and WPD conferences;
- 29/11/2017 – Electric Nation in the news;
- 29/11/2017 – Electric Nation to launch Smart Charging Guide at LCNI 2017;

- 29/11/2017 – Electric Nation is on track to achieve its target of 700 trial participants;
- 06/12/2017 – Electric Nation launches Smart Charging Guide at LCNI 2017 as 500 Smart Chargers are installed;
- 09/01/2018 – Record growth in UK Electric Vehicles sales in 2017;
- 07/02/2018 – Electric Nation at Ecobuild 2018;
- 01/03/2018 - New Video Explains how the Electric Nation Smart Charging System works;
- 12/03/2018 – Top 10 electric cars at the 2018 Geneva Motor Show; and
- 29/03/2018 – SSEN Seeks Views on Managed Charging Solutions to aid smooth EV transition.

The Electric Nation film featuring Mark Dale from WPD has been edited and is now available as a download for the project website. An accompanying news item on the website has received excellent traction on social media; Robert Llewellyn has re-tweeted it to his 146.2k followers.

Project newsletter

Produced by EA Technology and circulated via Hubspot to the project contacts' list (comprising 400 stakeholders across automotive, utilities, academia and Government). Newsletters were circulated in June and in August (in co-ordination with the LCV event).

Recruitment of Trial Participants

The Drive Electric engagement team has completed the target of recruiting 700 participants. A reserve list to hold extra participants, in case participants cancel, has been activated. 23 customers are currently on this list awaiting a qualification call should a space become available. The extending lead-time for new vehicle delivery will make it likely that some participants on the reserve list will be needed to maintain the 700 participant total; and WPD has indicated that it will accept a total figure between 670 and 700 participants, so that the project can continue to the next stage.

Social media pages such as Facebook have been instrumental in recruiting participants. Google has also been heavily relied upon to produce the required leads. Friends recommending the project have also created a high number of leads but also a strong conversion rate. The number of approved installations compared with leads in each of the top 10 categories for recruitment is shown in

Table 3-2.

Table 3-2: Recruitment conversions and leads- highest 10 sources

Row Labels	Approved by installer	Leads
Google	185	897
EN Web lead	49	318
Friend's Recommendation	58	196
Fully Charged	29	138
Facebook	19	124
SpeakEV	23	92
Facebook Tesla Owners Club	18	73
WPD	11	66
Twitter	15	57
Tesla	16	52

Chargepoint Installations

EV Charging Solutions, Stratford Energy, The Phoenix Works and DRSFM have continued to provide a good service providing chargepoint installation to Electric Nation customers, with very few complaints.

Positive feedback has been reported via DriveElectric's CRM; to date 25 individual example of good/excellent customer service have been received.

Quality checks of chargepoint hardware have been increased from every other APT charger to every APT charger, to reduce configuration/communications faults.

Customer Relationship Management (CRM) System

DriveElectric's CRM system is kept continuously updated to reflective lessons learned and to streamline work for all members of the team. As the recruitment stage of the project has come closer to the end, the amount of learning has reduced compared to the initial start-up and growth phase.

A bi-weekly team meeting with all members of the EN team is undertaken, to update the team on recruitment and in-trial figures, ongoing issues, lessons learnt, qualification process development, and methods to improve customer satisfaction/manage customer expectation.

Customer Support System

The Customer Support System tracks reported faults and enquiries and tracks these by customer and category to help in resolving faults and generate learning for any similar problems which may arise. The current number of faults in each category is presented in Table 2-3.

Table 2-3: Current categorised faults and percentage of total

Row Labels	Count of EN fault group	Percentage of total faults (%)
Communications	520	51.69
Hardware	134	13.32
Configuration	117	11.63
Behavioural	88	8.75
Electrical	55	5.47
Enquiries	42	4.17
Admin	24	2.39
App	11	1.09
Charger Lead	1	0.94
Communication system	5	0.50
ICU Charger	3	0.30
Other	2	0.20
Vehicle	2	0.20
APT Charger	1	0.10
(blank)	1	0.01
Grand Total	**1006**	

Vehicle Telematics

Obtaining customer permission to use vehicle telematics information has proved to be challenging over the past 6 months and, as a result, the uptake of vehicle telematics by customers is considerably behind that what was anticipated at the beginning of the project. This is likely to have an effect on future versions of the demand management algorithm; the algorithm will need to be less reliant on telematics input rather than other sources.

Telematics from Tesla vehicles is obtained direct using an API supplied by Tesla through agreement with Drive Electric. For other vehicles, a third party OBD-II port dongle - supplied by GeoTab - is used. Table 2-4 shows the vehicle types for whom customers have been contacted about telematics and whether the vehicles are pure electric, plug-in hybrid, or range extender. The final column indicates the number of customers who have accepted telematics, along with a percentage of those contacted.

Table 2-4: customers contacted about telematics, split by manufacturer and whether pure electric or plug-in hybrid

Vehicle Manufacturer	Electric only (BEV)	Plug-in Hybrid (PHEV)	Range Extender (REX)	Grand Total	Accepted Telematics num (%)
Audi	0	2	0	2	0 (%)
BMW	16	20	30	66	8 (12%)
Citroen	1	0	0	1	0 (%)
Kia	9	0	0	9	4 (44%)
Mercedes	0	15	0	15	0 (%)
Mitsubishi	0	23	0	23	11 (48%)
Nissan	11	0	0	11	5 (45%)
Peugeot	1	0	0	1	1 (100%)
Renault	4	0	0	4	1 (25%)
Tesla	23	0	0	23	14 (61%)
Vauxhall	0	1	2	3	1 (33%)
Volkswagen	6	30	0	36	7 (19%)
Grand Total	**71**	**91**	**32**	**194**	**52 (27%)**

Customer Communication

Drive Electric is the primary point of contact with customers. Customers are updated on their application to Electric Nation via bi-weekly charger order updates. These have proved useful in keeping an application active and the customer informed. Customers also receive periodic updates on project progress. As the project trial has moved into the demand management phase with customers, management of trial participants' expectations has been critical.

Out of 990 customers which installers have contacted, only 1.1% have made any form of complaint; this is an exceptionally low figure for a complex order/installation process.

EA Technology has supported Drive Electric's engagement with trial participants through provision of timely and appropriate letters and email communications. In this reporting period, this has included:

- Updated Website FAQs; and
- Produced Customer Newsletter for circulation to trial participants by DriveElectric.

Dissemination

EA Technology, WPD and other project delivery partners have attended relevant industry events to raise the profile of the Electric Nation project and to share early learning arising from Algorithm Development and Testing Report.

- Electric Nation presented at WPD's Balancing Act event on 5 October, introducing the Network Assessment Tool. The write-up of the event can be found here: http://www.electricnation.org.uk/2017/10/11/electric-nation-at-wpds-balancing-act-conference/.
- WPD presented on Electric Nation at the Electric Vehicle Charging Point Infrastructure Conference, Nottingham on 4 October.
- EA Technology participated in a London Business School/EPSRC workshop "System Transition to Digital Energy" on 17 October – sitting on a discussion panel representing "real world" experience of digital technology interfacing with the energy system.
- Representatives from WPD and EA Technology represented Electric Nation at the UN Climate Change Conference in Bonn, 9-10 November. The Electric Nation model was used to demonstrate the project to a wide range of COP23 delegates from across the world. There was lots of interest in how uptake of EVs is occurring in the UK, and how smart charging could help, either for solving network issues (as is being investigating in Electric Nation) or for maximising the use of renewable energy. The Electric Nation presentations, part of the UK's Smart Systems and Flexibility slot, and

arranged in partnership with the Department for International Trade, enjoyed an audience which filled the room in the UK Pavilion.

- EA Technology was interviewed on BBC Radio 5 Live, about electric vehicles and Electric Nation. WPD was interviewed on the same day for Radio Wales, on the topic of smart charging and Electric Nation, with customers being at the forefront of the discussion.
- Representatives from WPD and EA Technology represented Electric Nation at the Low Carbon Network Innovation (LCNI) Conference in Telford, 6-7 December 2017, on WPD's stand. Electric Nation launched a Smart Charging Guide Summary at the event, by virtue of a speaking slot on Day 2 of the Conference. The Smart Charging Guide Summary is a four-page version of the full Smart Charging Guide (under development), aimed at those who are involved in the decision-making process about how EV drivers charge their electric vehicles – in Government, the energy industry, the automotive industry, the EV charging sector, planning and other stakeholders – which will be available in due course.

  Electric Nation's Smart Charging Guide provides essential background information for the eventuality of smart charging being rolled out nationally. Smart charging is included in the Government's 'Automated and Electric Vehicles Bill' and is expected to be mandated.

  The Electric Nation model was used to demonstrate the project to the delegates. WPD filmed the model in action, to be used to explain the concept of smart charging and vehicle to grid technology, and benefit for customers.

- New Energy Forum 9 January 2018 - WPD and EA Technology took part in an industry roundtable on 'EVs: Paving the way for transport electrification and the evolving business models for charging infrastructure'.

- Cenex LEVEL V2G event 31 January 2018 – EA technology presented to an industry and academic audience on latest charging data findings and V2G progress.

- WPD presented Electric Nation at Ecobuild on 7th March, alongside OLEV and Cenex. This represented a good opportunity to raise awareness of the LV network issues.

- WPD also presented Electric Nation an All Party Parliamentary Group at the House of Commons in this reporting period.

The project is in the process of drafting a smart charging guide that will be aimed at those who are involved in the decision-making process about how we charge electric vehicles - in Government, the energy industry, the automotive industry, the EV charging sector, planning and other stakeholders. The document will look at how managed EV charging can facilitate the maximum number of EVs to charge on our networks, while, at the same time, helping to

ensure that electricity is provided reliably to consumers. It provides background information about local electricity networks and the impact of EV charging so that informed decisions about charging can be made. A summary document was produced for LCNI in December 2017, the smart charging guide is planned to be published in April 2018.

Customer research

The customer research activities of the project aim to provide qualitative evidence of customer driving and PIV charging behaviours and acceptance of PIV charging demand management during the customer trial. This will be measured through a series of questionnaires that customers involved in the trial will be asked to complete (electronically, over the phone and in some cases, face to face).

The following types of questionnaires are included:

- Baseline questionnaire – post-recruitment, pre-installation of smart charger – developed and deployed to customers as they are recruited into the trail. This is aimed at gathering recruit socio-economic data and vehicle usage data.
- Post installation questionnaire. This is aimed at gathering data on attitudes to charging their PIV after a few months, in most cases before they experience demand management, but in some cases where demand management is imposed on their charger shortly after they join the trial. Whether trial participants experience demand management before receiving this questionnaire depends on whether they have a PIV already; if the trial participant has to wait for delivery of a new PIV this can be several months after they have had their charger installed. In addition, whether the trial participant has experienced demand management before they receive this questionnaire proved to be highly dependent on charger communications – where reliable charger communications have been difficult to establish participants' experience an extended period of being able to charge at will before demand management is imposed. This is all useful data.
- Trial questionnaire. This is aimed at gathering data on attitudes to charging their PIV during the trial, having had their charger under demand management for at least four weeks.

Both the recruitment and post installation questionnaires have been used to survey trial participants as recruitment into the trial has progressed in this period. Customer response rates to surveys to date are set out below.

Recruitment		Baseline	
N sent	N returns & % complete	N sent	% complete
561	522 / 93%	528	480 / 91%

The Trial questionnaire follows up the post installation questionnaire to investigate whether customers in the trial have changed their charging behaviours and attitudes to charging, driving and journeys, having experienced charging demand management. The questionnaire was launched in mid-January 2018 and will be completed for the first phase of the customer trial in the last week of March. To date response rates to this questionnaire are:

Trial	
N sent	N returns & % complete
306	257 / 84%

Thorough analysis and comparison with the Recruitment survey responses will be undertaken in early April, addressing questions, such as:

- Have a significant number of trial participants changed their charging behaviours or attitudes to charging, satisfaction with the charging arrangements while being subjected to charger demand management?
- Is there any significant difference in charging behaviours, attitudes, satisfaction between PHEV, BEV and REX-EV drivers?
- Is there any significant difference in charging behaviours, attitudes, satisfaction between drivers with vehicles with different battery sizes? – PHEVs tend to have smaller ~10kWh batteries, BEV battery sizes range from 25 kWh up to 90/100kWh.
- Is there any significant difference in charging behaviours, attitudes, satisfaction between PIV drivers subjected to the different demand management systems: GreenFlux and CrowdCharge? Although the two systems achieve the same result, capping of total PIV charging power to a defined limit by time of day, the impact on PIV charging and so drivers is different.

These analyses will then be compared with the amount of charger demand management customers have experienced (number of events their PIV had been involved in and the quality of charging interruption they have experienced, based on a derived value of charge-delay).

This will then inform the structuring of the trial cohorts for the next phase of the customer trial, where Apps are to be tested, giving the customers some form of interaction with the charging demand management systems

Test System

The test System has been used throughout this period to:

- Troubleshoot communications issues identified in customer trial installations, testing improvements to systems and software/firmware updates before they are issued to customer trial systems; and
- Test the GreenFlux and CrowdCharge Apps in preparation for the next phase of the project.

The test system will shortly be used to evaluate the available V2G charging system(s).

PIVDCS Configuration Testing and Improvement (Algorithm Development)

Systems integration

The project utilises two different providers of back-office systems and chargepoint manufacturer:

- GreenFlux / ICU (Alfen);
- CrowdCharge / eVolt (APT)

The communications performance of chargepoints on both GreenFlux and CrowdCharge systems is tracked. This information is used as part of the process to judge whether a participant can move into demand management and also to identify where action is needed to rectify communication systems issues, such as where Wi-Fi bridge replacements are required or customer visits are required by The Tech Factory.

<u>GreenFlux / ICU (Alfen)</u>

EA Technology continues to track the 'overall communications reliability'. Figure 2-2 below shows the performance from Week 20 2017 (15 May 2017) onwards, thus spanning this 6 monthly reporting period and that which proceeded it. This indicates that overall communications reliability on GreenFlux has not been as good during the most recent 6 monthly period, that preceded it. However, the period since Christmas has seen a gradual increase in the overall communications reliability of GreenFlux chargers. The number offline all week continues to decline in each week.

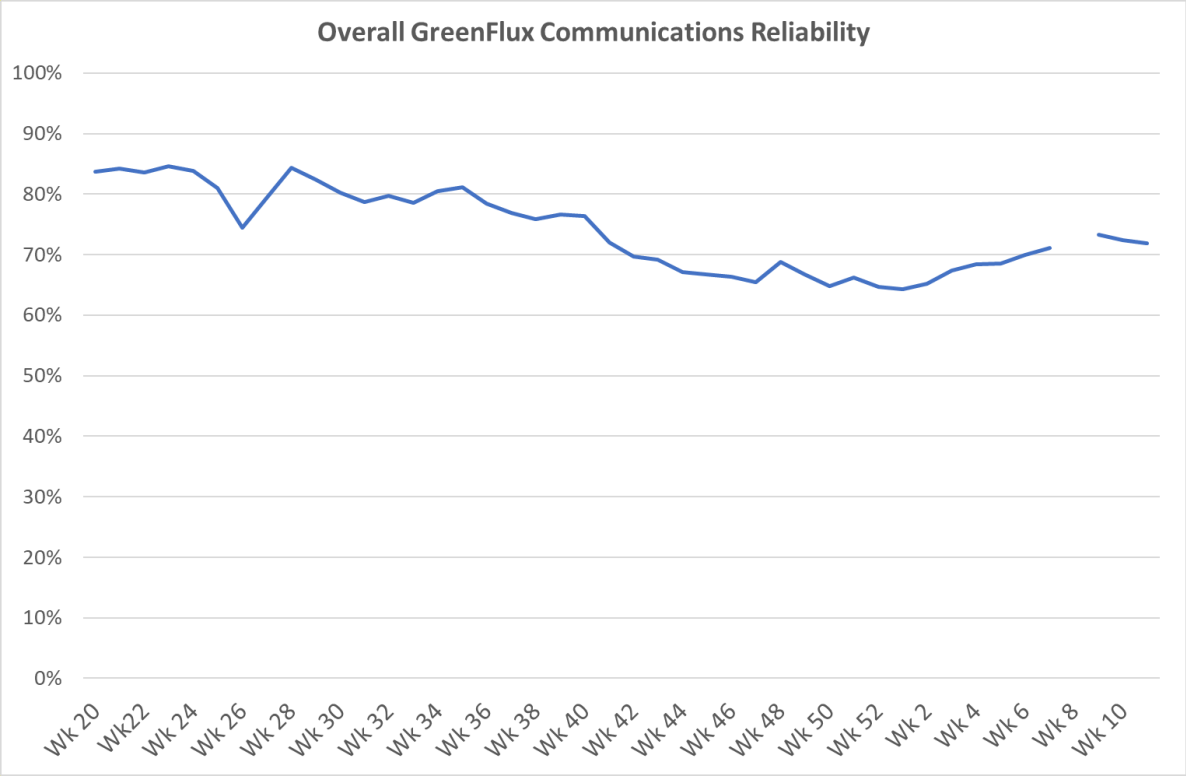


Figure 2-2 – Overall Communications Reliability - GreenFlux

Figure 2-3 shows percentage uptime since installation across all FreenFlux / ICU (Alfen) units. This shows the effect of a manufacturing error at ICU (Alfen), where 101 chargers were released from their factory (serial numbers 216 – 317) with the wrong firmware version, owing to a quality assurance error. The effect of not having the correct firmware in these chargers was that communications 'auto-detect' was disabled, meaning that where Ethernet communications failed the charger would not automatically fail-over to mobile phone data (SIM) communications. This issue was identified on chargers installed during the last quarter of 2017 as communications on newly installed chargers fell from the historical 70+% online after installation figures. The communication reliability of these chargers is considerably worse than the rest of the GreenFlux/ICU (Alfen) units. Chargers installed from December onwards could be rectified remotely by ICU (Alfen) as part of the installation process, and units with serial numbers of greater than 317 are unaffected, and these are being installed in 2018. The decline in performance of units installed in February 2018 is also of concern and is being investigated further.

The ICU (Alfen) firmware version issue is exacerbated by a second firmware issue, with the Wi-Fi bridges used to connect the charger Ethernet port to the participant's home broadband router. Here, a manufacturer's firmware fault can lead to the Wi-Fi bridge not connecting and so disabling Ethernet communications. This fault can only be rectified by

installing a replacement Wi-Fi bridge. The Tech Factory has an ongoing campaign to replace Wi-Fi bridges for affected unit.

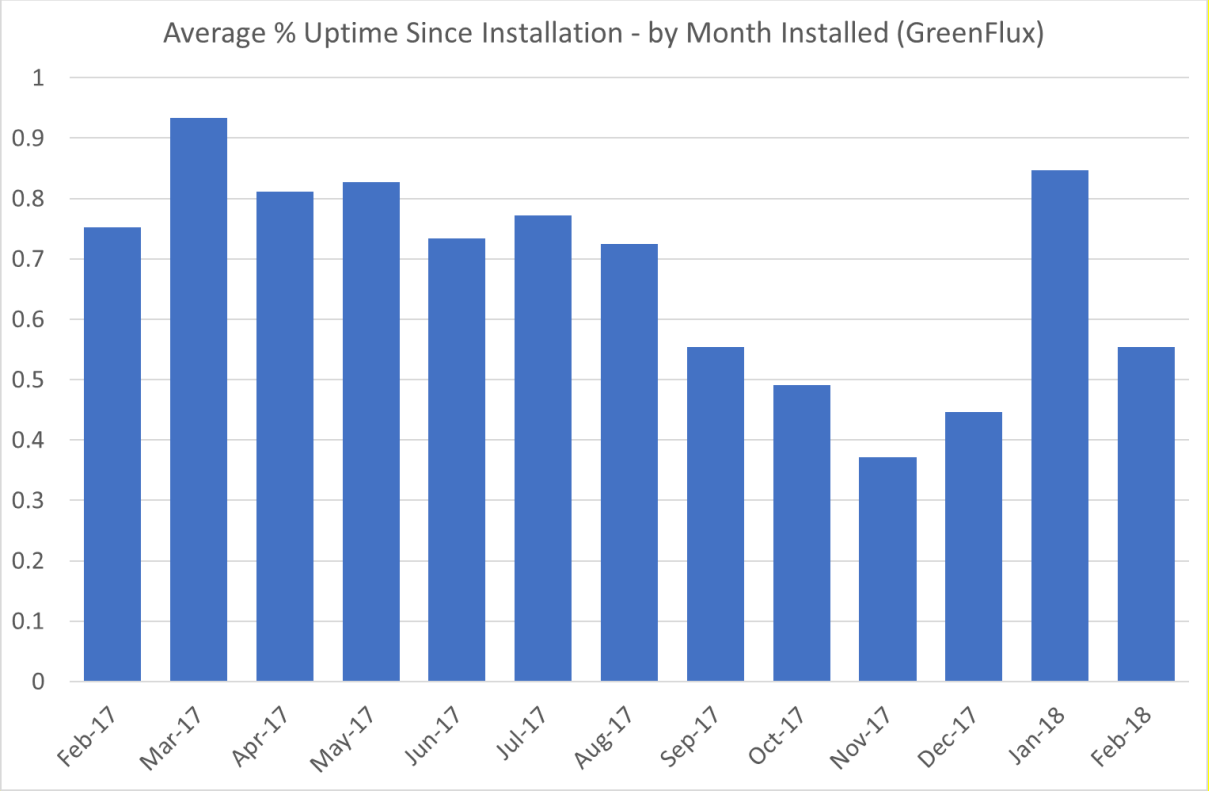


Figure 2-3 – Average % uptime since installation - GreenFlux

An action plan has been agreed between Alfen, GreenFlux, DriveElectric, EA Technology and the Tech Factory to get the remaining offline units online, via a combination of issuing new Wi-Fi units, remote diagnostics/troubleshooting (via text messages) and site visits.

In addition to the actions described above, the following is also in progress:

- Visits by Siemens engineers on behalf of ICU (Alfen). The start of this process is currently on hold whilst a data protection/non-disclosure agreement between Alfen/Siemens and DriveElectric is put in place to protect trail participants personal data.
- Contacting customers who are not yet under management due to unreliable communications with troubleshooting information. This information has been prepared and is on the Electric Nation website (http://www.electricnation.org.uk/greenflux-help/) . The information is on an 'orphaned page' and is therefore only accessible to participants who have been provided with the above link. Customers will be informed that the app is being

launched, but they are currently ineligible due to the communications performance of their charger. It is hoped that this provides an incentive for customers to either resolve the issue themselves (e.g. where equipment has been switched off) or co-operate with site visits by the Tech Factory/Siemens.

CrowdCharge/eVolt

Communications performance since the end of July 2017 for CrowdCharge/eVolt system is shown in Figure 2-4 below. Compared with the previous 6 monthly performance, the overall communications performance of the CrowdCharge/eVolt system has been better in the most recent 6 months (since October 2017).

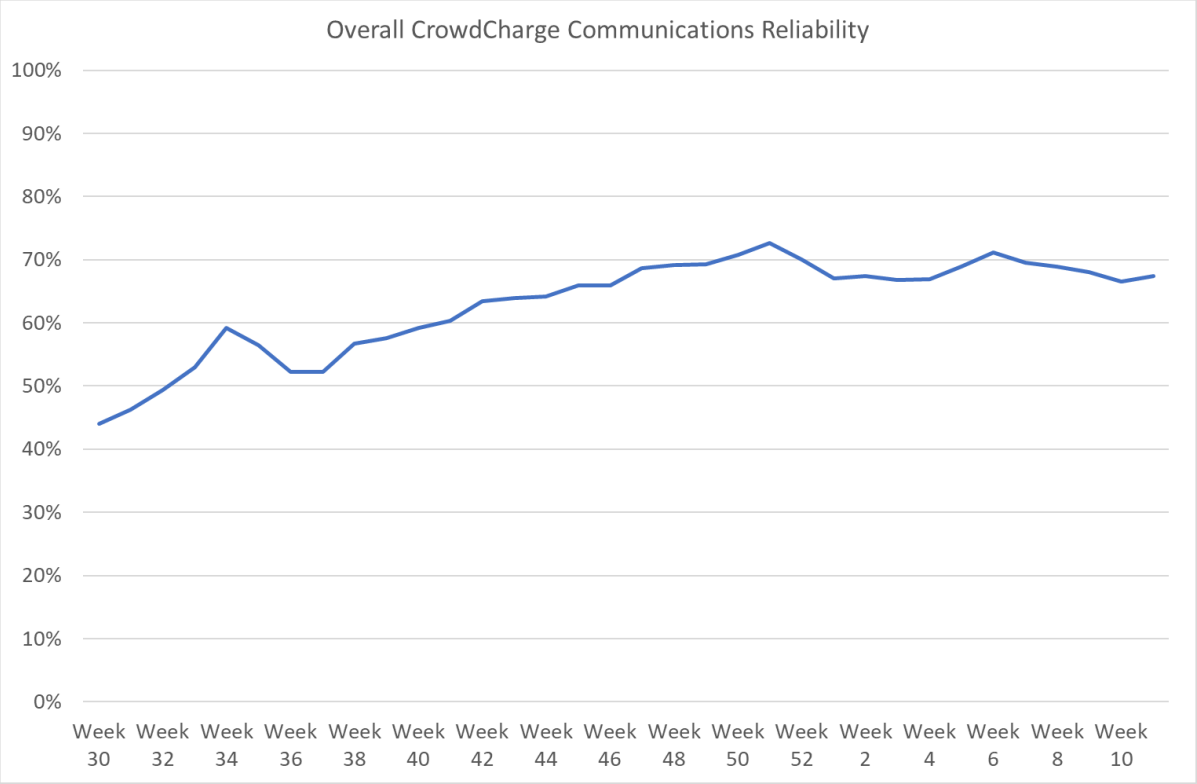


Figure 2-4 – Overall Communications Reliability - CrowdCharge

Performance has declined slightly in the last four weeks. This has conincided with a period of lower customer interaction owing to staff illness at DriveElectric/CrowdCharge (e.g. prompt requests for resetting of equipment when it falls offline). This demonstrates the effect that a more a passive approach could have on the overall reliability of the system. Reliability increased slightly in Week 11 as a greater degree of customer interaction began again.

Figure 2-5 shows the percentage uptime since installation across all CrowdCharge/eVolt units. The reliability of the March installations has been raised with the CrowdCharge team.

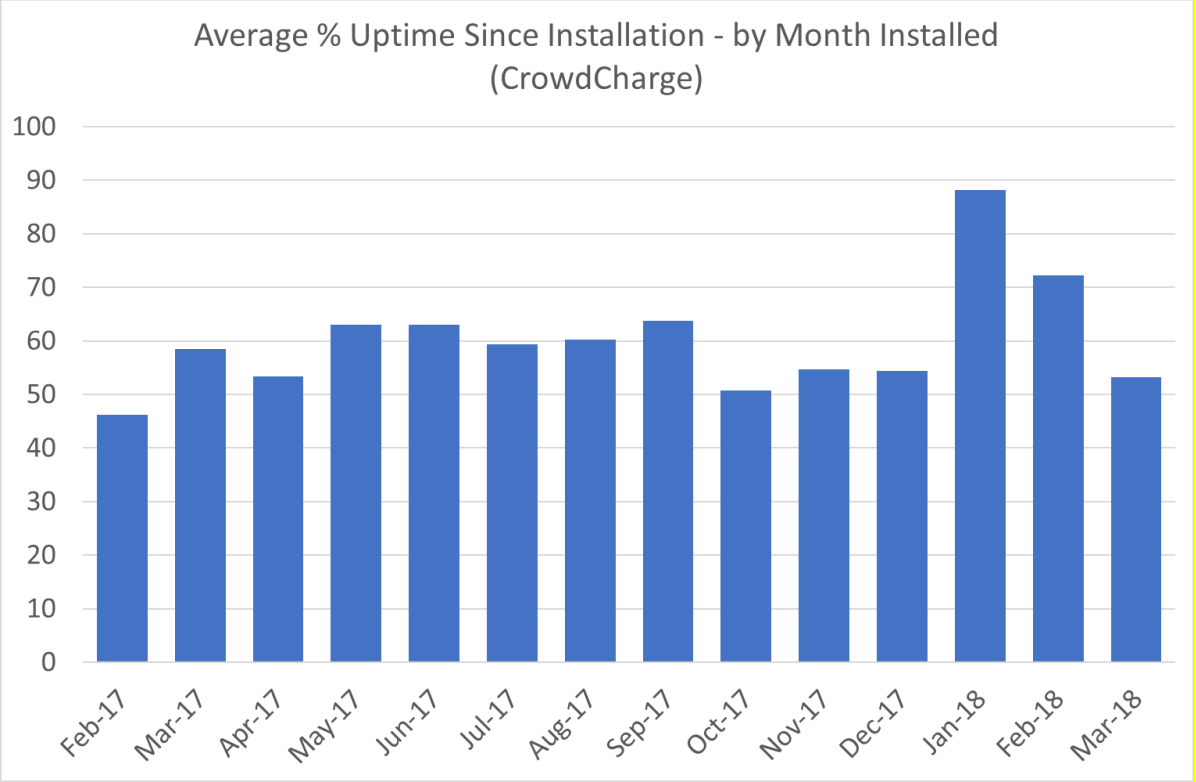


Figure 2-5 – Average % uptime since installation - CrowdCharge

CrowdCharge and the Tech Factory are responsible for identifying and resolving communications issues in this group. The actions taken have been a mixture of customer actions (charger resets, swapping Wi-Fi units) and visits by the Tech Factory to rectify CrowdCharge controller issues that cannot be rectified remotely owing to the secure communications processes built into the CrowdCharge system.

CrowdCharge produces a weekly summary showing which chargers require different actions alongside monitoring the total number of communications faults, recurring issues and new offline units.

Customer Trial

There are two 'routes' by which customers can enter demand management:

- Charge at will – customer has approximately 3 months of unrestricted charging from when they start using their charger.
- Straight into demand management – as soon as the customer has started charging and reliable communications are proved the customer enters demand management.

Installations which took place before mid-July 2017 took the first route. Installations occurring after this point should go straight into management. However, some participants have experienced communication issues resulting in a more extended period of time before management can begin.

Customers entering demand management were originally exposed to an autumn demand limit profile and then, from early November to date, were exposed to a winter profile (the most restrictive within the trial). A decision will be made in April 2018 when to transfer participants to a spring profile, and a suitable profile that will ensure management continues to occur on some days.

Figure 2-6 illustrates the frequency with which demand management events have taken place in the CrowdCharge group.

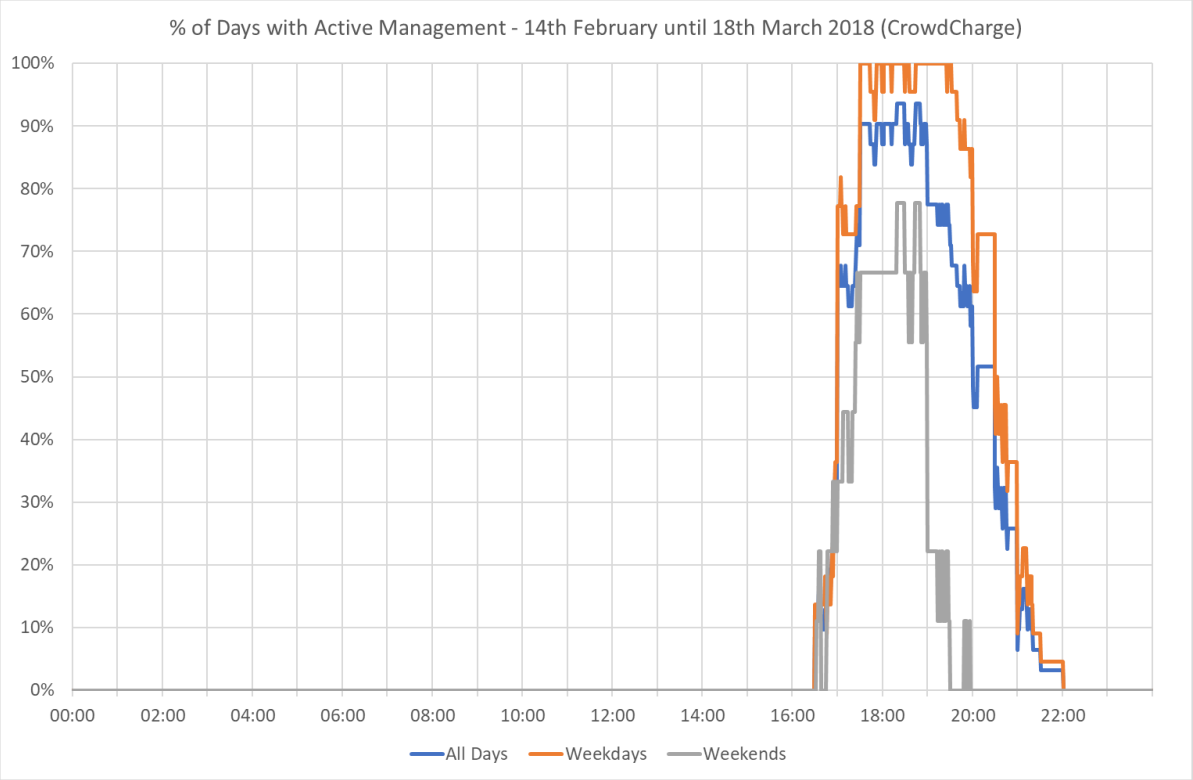


Figure 2-6 – Percentage of days with active demand management (CrowdCharge)

This shows that management continues to be active at some point on all weekdays and most weekend days. Management at the weekend tends to be active for a shorter period of time.

If management is never active then the average (and minimum and maximum) current will be 32A. If management is occasionally active but not particularly restrictive, then the average will be close to 32A. This is shown for all days, weekdays and weekends in Figure 2-7.

This shows the inverse trend to Figure 2-6 above, showing much more restrictive management during the week compared to weekends. The next development is to use the current allocated to chargers during a management event to show whether an individual vehicle has been affected.

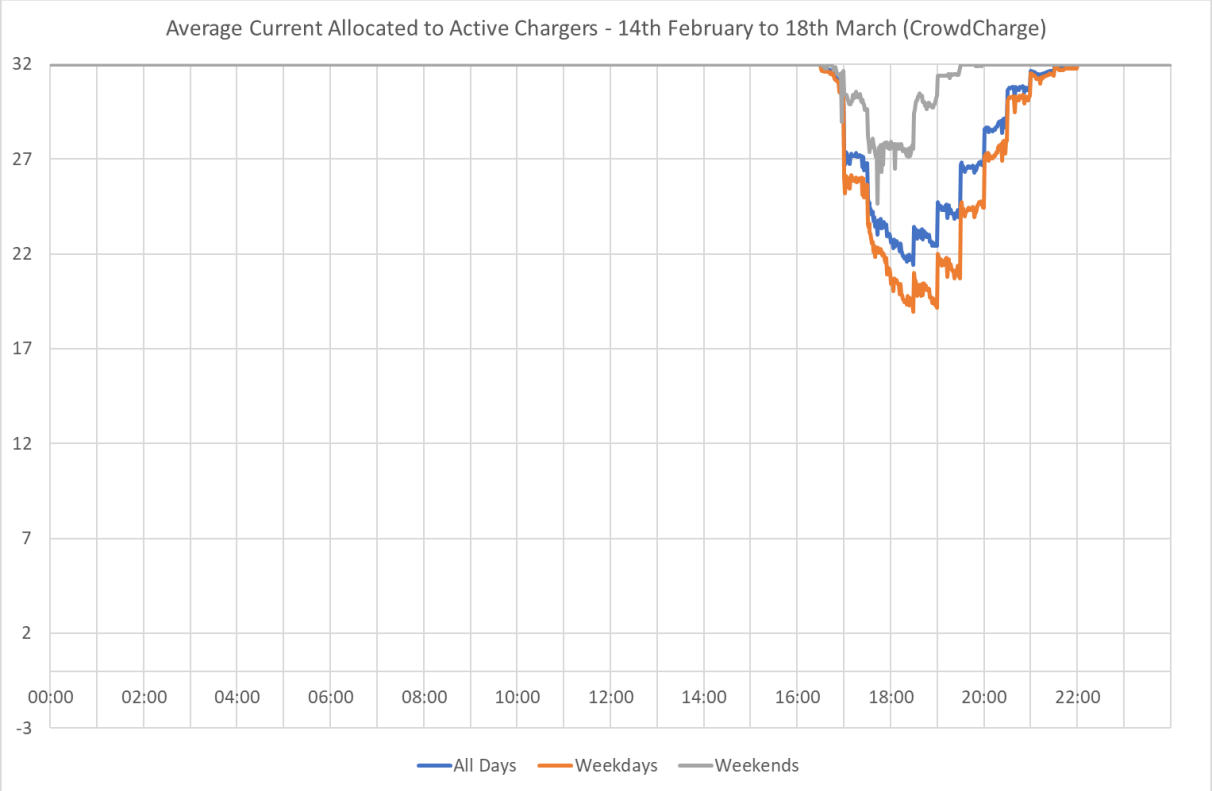


Figure 2-7 – Average current during allocated to chargers (CrowdCharge)

For GreenFlux, Figure 2-8 shows a lower occurrence of demand management relative to the CrowdCharge group, and a higher probability of management occurring at a weekend compared to a weekday. Management will occur less in the GreenFlux group due to the method used to allocate charge. Within the GreenFlux system a nominally 16A vehicle is only allocated 16A, rather than 32A. This allows the same total limit to be spread over a greater number of chargers before curtailment is required (assuming some nominally 16A vehicles are active).

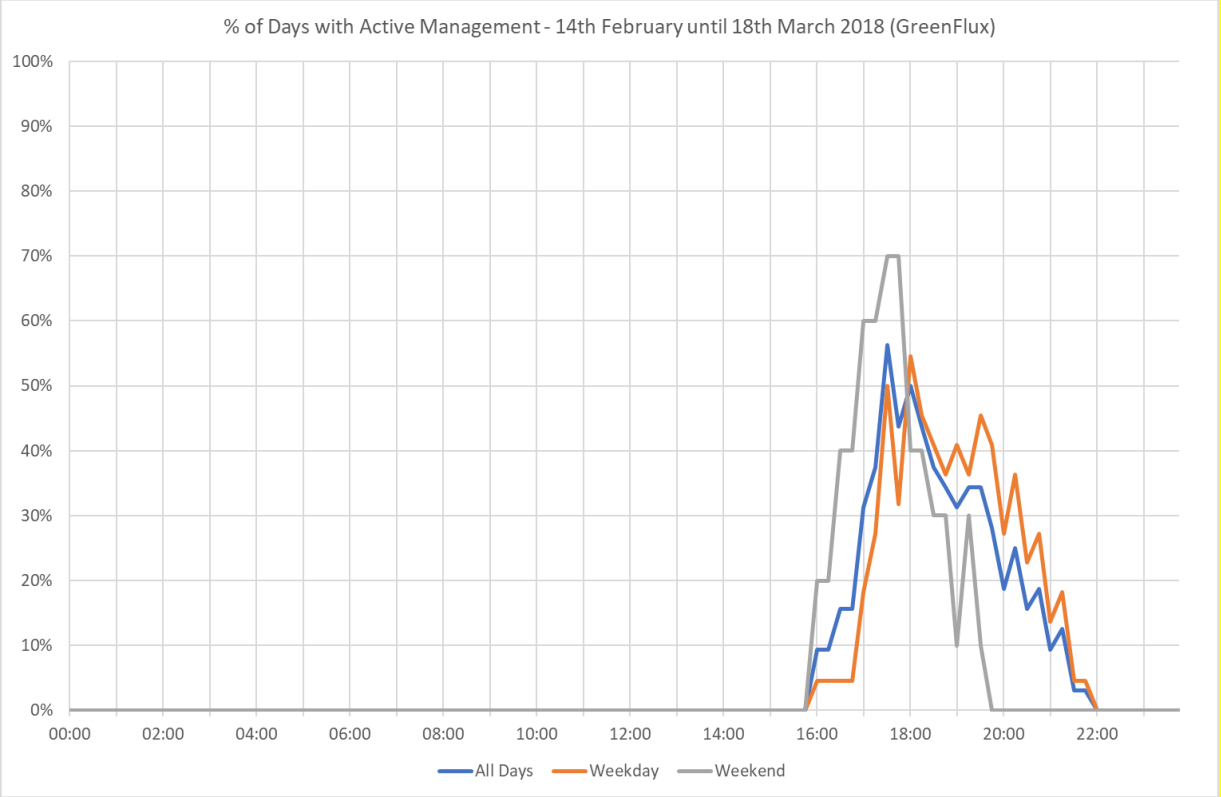


Figure 2-8 – Percentage of days with active demand management (GreenFlux)

Implementation of Demand Management: GreenFlux

The roll out of demand management continues. 114 participants who entered the trial via the "Charge at Will" route have now entered demand management, along with 95 participants who were straight into demand management. Additionally, 32 customers are currently in a 'test card' phase before being moved into demand management.

A small number of customers have had to be removed from demand management. The majority of these are owners of the BMW 330e, which has a known issue with smart charging where a pause in charging is employed. In this situation the car does not start charging again after the pause and so the only acceptable solution for these participants is removal from the smart charging group.

GreenFlux has developed an app which allows participants to request 'high priority' for their current charge session, decreasing the participant's chances of experiencing curtailment as a result of demand management. Testing of this app has been undertaken in the most recent 6 monthly period, focussing on:

- All vehicles request high priority during charge cycle – effectively removing the effect of high priority;
- Confirming that high priority is lost when a vehicle is unplugged, regardless of the length of time for which it is unplugged;
- Effect of communications outages during charge events, where these outages affect chargers both in normal and high priority;
- Vehicle on a timer requests high priority when plugging in; and
- Staggered vehicle plug-ins and use of the high priority button.

Implementation of Demand Management: CrowdCharge

The roll out of demand management continues. 82 participants who entered the trial via the "Charge at Will" route have now entered demand management, along with 104 participants who were straight into demand management.

Development and testing of the next CrowdCharge algorithm iteration will form part of the next 6 months' activities. This will include the use of a journey planning app and telematics (for the vehicles for which it is available).

Cyber Security

Effective cyber security in the future deployment of PIVDCS is essential as "internet of things" type devices have already proved to be gateways to subversive internet attacks. Smart chargers are, by the fact that they require internet connectivity, "internet of things" devices. Weaknesses in smart charger communications could provide threats to PIVDCS systems that could be used to disrupt electricity demand (e.g. rapid simultaneous switching of active charger could cause faults or disrupt frequency locally or even wider afield). It is likely, in future, that real time demand control may be required, where connectivity between Distribution Network Operator systems and PIVDCS is required. In which case, PIVDCS systems could even act as a gateway to Distribution Network Operator data/control systems and provide more avenues to electricity distribution, transmission and generation systems.

While it is recognised that the PIVDCS systems deployed in this project are limited in scope for cyber-attack and unlikely to be the final technological solution in this area, replaced by evolving/new technologies; the principles of effective cyber security and learning from this project could and should be used in the procurement of future PIVDCS.

As there is no physical connectivity between WPD systems and the project's PIVDCS and the fact that the number of smart chargers deployed in the customer trial is relatively small (in

terms of maximum electricity load that can be disrupted in comparison to GB wide electricity loads) the consequences of disruption of the project's systems are extremely small. So, cyber security threat analysis of the PIVDCS is not an immediate issue and is not a risk to the project.

This project has procured the services of NCC to undertake cyber security threat modelling of both the GreenFlux/ICU (Alfen) and CrowdCharge/APT (eVolt) PIVDCS systems to identify immediate threats to the customer trial (that the suppliers will be required to address within the lifetime of the project, if the consequences to the success of the project are significant) and less urgent threats that should be considered within the functional specification of PIVDCS that will be produced as an output of the project. This functional specification is being developed for future Distribution Network Operator procurement of PIVDCS into the 2020s.

The tasks completed by NCC in this period, having collected all relevant information they required from CrowdCharge and GreenFlux, for each PIVDCS system, are:

- A Threat Scoping Document (effectively a description of the system architectures); and
- A Threat Model (identifying potential weaknesses in the security of each system).

The initial findings from NCC's work are that NCC does not perceive security threats to the home-based chargers and their communications system, as both GreenFlux and CrowdCharge have utilised cyber security methods that are deemed industry best practice. However, NCC has recommended that both GreenFlux's and CrowdCharge's back-offices should be subjected to penetration testing. Both GreenFlux and CrowdCharge have agreed to such testing and NCC is preparing a scoping document and commercial proposal for undertaking such tests during the summer of 2018.

Vehicle to Grid (V2G) Systems

The project has an aim to bring household scale Vehicle to Grid (V2G) systems into the customer trial, using a single phase, G83/G59 compliant V2G system. This would help to assess whether V2G, alongside smart charging/PIVDCS, can be used to meet the project aims of providing mitigation to PIV charging growth. V2G chargers could be switched to export mode at times of peak electricity demand to support local PIV charging when required, supporting local voltage and reducing LV substation loads.

A considerable amount of work has been undertaken by the project team in investigating currently available V2G technology across the world. Almost all V2G charging systems that the project has identified to date are three phase systems designed for commercial charging

scenarios (e.g. offices/car parks). Furthermore, most of these systems are bespoke or pre-production systems.

To mitigate the risk of being tied to a single supplier for this element of the project, the project aimed to get two V2G chargers installed on the test system with a view to selecting one to supply chargers into the customer trial upon successful testing.

To date, the project has procured one pre-production prototype V2G charger from Nichicon (which has a partnership agreement with CrowdCharge) and continues negotiations with another supplier to possibly bring a second unit into the Electric Nation test system. In the last 6 month period, the Nichicon unit has been shipped from Japan, delivered to the project team and has undergone initial testing by CrowdCharge. EA Technology has also installed the power, communications and physical infrastructure to accommodate V2G charger(s) on the test system at Capenhurst, including and independent G59 relay to protect the EA Technology power supply from errant performance of the V2G chargers.

The two manufacturers are as follows:

Nichicon

Nichicon has manufactured a pre-production prototype, which was delivered into the project in January 2017. This unit is a modified production model of Nichicon's Vehicle to Home charger, with some 7,000 units in operation in Japan.

CrowdCharge has set up this unit at their premises to enable: CrowdCharge to commission the unit in preparation for transfer to the Electric Nation test system; and CrowdCharge to test their controller to back-office interface with the V2G charger's control system.

Commissioning has proved difficult to date, including that the Japanese-English translation of technical documentation and the control interface has proved challenging and time consuming. The unit does not appear to be functioning as expected and there is concern that the unit may have been damaged during transportation from Japan.

Unnamed Supplier (owing to an NDA EA Technology are unable to name this potential supplier at this time)

This supplier has a V2G charger that has been tested in the USA. A pre-production 3-phase prototype was originally offered for testing by Electric Nation with a commitment to produce single phase units in summer of 2018. The supplier remains unwilling to allow CrowdCharge to provide control interface system with their system, owing to their partnership with Nichicon. So, at EA Technology's suggestion, GreenFlux has investigated whether their back office could be adapted to interface with this supplier's charger control interface. GreenFlux responded positively in that technically they could deliver such an interface, However, the cost of developing this interface (at £60,000) was too expensive for

the Electric Nation budget. GreenFlux and the supplier are now in negotiations to develop a more attractive financial offer: The supplier has indicated a willingness to make a financial contribution to the GreenFlux back office development. GreenFlux has suggested incorporating a separate EU V2G related project with which they are involved into co-funding the V2G testing on the Electric Nation test system (via a data sharing agreement). WPD has indicated that this would be an acceptable way forward, subject to establishing a satisfactory data sharing agreement.

The supplier has also indicated that their single phase V2G unit development has been accelerated and that they would prefer to supply this unit for testing in Late May 2018 (to be confirmed), rather than a 3-phase unit, as originally offered.

Next steps

- Complete installations for remaining participants;
- Introduction of user Apps for customers for GreenFlux then CrowdCharge;
- Helping customers to use charging apps and portals;
- Systems Integration supply of equipment for Customer Trial installations – ongoing;
- Work with Systems Integration provider, charger manufacturers and PIVDCS suppliers to support to installers and DriveElectric trial support team to ensure maximum communications uptime of chargers in trial – ongoing;
- Continue development of trial data database, incorporating data returns from GreenFlux/CrowdCharge/Impact Utilities and developing queries and reports for analysis and project reporting purposes – ongoing;
- Use GreenFlux/CrowdCharge data returns to watch out for potential early issues with PIVDCS App implementation in the customer trial– ongoing;
- Continue progressing Cyber Security analysis – ongoing;
- Continue management of Customer Research supplier and liaison with DriveElectric to ensure customer research activities cover expected growth in trial population (demographic of participants and vehicle mix);
- Continue pursuit of V2G options with at least one V2G charger installed on test system by early summer 2018; and
- Continued development of the Network Assessment Tool.

3 Progress against Budget

Spend Area	Budget (£k)	Expected Spend to Date (£k)	Actual Spend to Date (£k)	Variance to expected (£k)	Variance to expected %
WPD PROJECT MANAGEMENT (LOP)	45,000	45,000	45,000	0	0
TRL CONTRACT	226,802	147,422	147,422	0	0
EATL CONTRACT	3,094,359	1,895,177	1,895,177	0	0
FLEETDRIVE CONTRACT	2,129,375	1,472,700	1,472,700	0	0
GRIDKEY CONTRACT	89,680	89,680	89,680	0	0
GRIDKEY CONTRACT	165,800	116,060	99,480	16,580	14
EQUIPMENT REQUIREMENTS	5,000		2,760	2,240	45
DEPOT INSTALLS	10,000		10,000	0	0
DEPOT INSTALLS	90,000		90,623	-623	-1
DEPOT WPD INSTALLS	10,363		10,363	0	0
WPD PROJECT MANAGEMENT 2	51,000	9,800	26,416	16,616	69
TOTAL	**5,917,379**	**3,775,839**	**3,889,621**	**113,782**	**3**

Comments around variance

1. Grid Key payment withheld awaiting milestone report
2. Equipment costs unexpected sub install ancillaries
3. WPD project management weighted heavily at project start

4 Progress towards Success Criteria

1. An LV Network Assessment Tool for DNOs (an add-on to the widely used WinDEBUT LV design tool) that:
   a. Analyses and quantifies PIV related stress issues on LV networks (to LV area scale), including:
      a. Heuristics enabling rapid assessment of PIVs on LV networks through "topological" modelling of LV networks.
      b. Ability to include known PIV charger installations.
      c. Ability to forecast future PIV charger installations based on PIV market growth and forecasts.
      d. Flexibility allowing for future charger rating and PIV battery size developments.
   b. Identifies best economic PIV solution: Demand Control/V2G/Reinforcement.

   Progress on development of the NAT, extensive testing of the mapping heuristics and Debut network assessment on the Plymouth area sample data set, followed by testing and improvement of the resulting heuristics on data sample areas from the other WPD license areas resulted in 70+% of feeder maps being classed as good and load-flow assessment possible. This outcome enables EA Technology to move on to the next stage of the project: bulk data processing for the whole of WPD's license areas.

2. A functional specification for a technique to monitor and understand the effects of electric vehicle charging on LV networks across different levels of penetration (to be delivered by others)

   An "Electric Nation Algorithm FRD" report has been produced by Lucy Electric GridKey with the assistance of TTP. This report has been reviewed by TRL and recommendations for improvement have been fed back to WPD. It is recommended by TRL that these improvements should be made before the document is able to be accepted by WPD in order to meet the success criteria for the project.

3. A functional specification and commercial framework for future procurement and deployment of PIV/V2G Demand/Export Control Services by DNOs to delay or avoid network reinforcement in cases where PIV installation numbers create network stress.

   Progress on recruitment of customers into the trial and getting equipment installed in customer homes has been excellent. DriveElectric achieved the project target of 700 recruited participants in January 2018, 3 months ahead of the project's deadline.

Reaching the target earlier than anticipated allowed for the creation of a reserve list to ensure DriveElectric could ensure 700 participants would be reached despite the inevitable cancelled applications. Installations by all four installers continue to be of a high quality, with positive feedback remarks from participants; there are approximately fifty installations left to reach the target. Communication issues with both the GreenFlux and CrowdCharge systems continue due to various issues such as behavioural or hardware failures, however importantly this has not affected any participant's ability to charge their vehicle.

Nearly 200 customers have now been placed under smart charging control in each of the CrowdCharge and GreenFlux trial cohorts, with many being subjected to smart charging events as the group demand limits were moved from autumn to winter electricity demand limit profiles in November – February. Both the PIVDCS have performed well, managing group demand within the electricity demand profile limits provided. Various issues with communications with the smart chargers installed has delayed entry of chargers into smart charging. However, concerted efforts by project partners and suppliers to remediate these problems has begun to produce results with overall communications performance of installed chargers improving, enabling more chargers to enter smart charging. The first phase of the customer trial is being completed with a customer behaviour/satisfaction survey which will be used to inform design of the cohorts for the second phase of the trial where "apps" developed by CrowdCharge and GreenFlux will enable customers to interact with the smart charging systems (in particular requesting higher priority during smart charging demand management events). These apps have been tested during the latter part of this period on the test system in preparation for introduction to the customer trial.

5 Learning Outcomes

The project maintains a comprehensive learning log. The lessons learned during this period have primarily been in the following areas:

- Knowledge Base;
- Installers;
- Customer Engagement;
- Industry standards;
- Project end terms;
- Pilot Installations;
- Customer Behaviour;
- Qualification process;
- Marketing & PR;

- Project Planning and Dissemination;
- Customer Research;
- Access to DNO data;
- Supplied goods for customer trial;
- Customer participation;
- Recruitment process; and
- Processes

Details of the learning log entries created in the last 6 month period are provided in Table 5-1 below.

Table 5-1 – Learning Log entries created in part 6 month period

Context What activity does the learning point relate to?	Learning Point What has been learned?
Knowledge Base	An online, user friendly knowledge base should be established at the start of any project. This should be accessible by all parties involved to increase learning and efficiency (customers, installer, customer engagement team, market research team, technical team etc). Customer feedback can be feed into this as the project develops in order to enhance overall customer experience and collaboration between parties. This can then be offered to customers on initial contact from project team. This would allow a simple way for all involved to develop learning as the project advances.
Installers	During the early stage of the project regular meetings/training days should take place in order to renew process, raise issues, review installation produces with the aim to share learning from all involved and increase knowledge. This would save time and resources later in the project e.g. fixing communications later instead of establishing quick fixes on installation.
Customer Engagement	At the start of the project, not all process and procedures are confirmed. Remaining flexible and being prepared to amend process/procedures from customer feedback is essential to customer satisfaction and streamlining of qualification/installations. In addition ensuring flexible system are in place are vital to be able to handle a constantly changing environment as a project develops.
Industry standards	Should not assume that the established legislation and codes of practice can cope with new technology e.g. Max demand calculation, ENA form, IET specifications, OLEV guidelines.
Project end terms	Early termination from project needed to be more thoroughly considered by project team and explained to participants on initial contact.
Pilot Installations	Pilot install should have also been used as a test run for the future customer procedures. For example, customer engagement call, installer documentation sign off/commissioning, business procedures for installers and DriveElectric. This would have ensured the procedures were robust and the pilot customer could have given feedback.

Context What activity does the learning point relate to?	Learning Point What has been learned?
Customer Behaviour	A platform/system should be set up in order for peer to peer feedback/collaboration on the project (e.g. Facebook group/Social media outlet). This would allow common communication between interested participants which could be monitored/queries answered. Analysis could also take place to identify unforeseen behaviours/attitudes which in turn could be feed into a knowledge base to increase understanding and learning for all (switching off chargers picked up early). Participants have asked if a group exists to communicate to other participants.
Qualification process	Ensuring the correct, high detailed questions are asked within the qualification process will help to manage customers' expectations as the recruitment phase continues to the following stage. For example, the qualification team ask detailed questions regarding the customer OLEV grant and parking layout at their property. This helps the installer as they would have this conversation at their stage to ensure they do qualify for the OLEV claim anyway. This has example has added extra time onto the qualification call with the majority of calls now taking 20-25 minutes.
Marketing & PR	There is a need to set out clear rules for use of social media to promote projects to customers and stakeholders. This came about when a "political related" tweet issued by one of the project team, completely unrelated to the project (which is believed to have been an accident, where the team member issued the tweet from the wrong account late at night, i.e. the Electric Nation account rather that their personal one, though no-one owned up to this)
Project Planning and Dissemination	Earlier engagement with Government departments and agencies and perhaps other DNOs that are key stakeholders in a project should be engaged at the outset of a project (if not before). This is particularly the case where the innovation project's scope encompasses issues that (i) may have an impact on wider society, (ii) consumer markets (e.g. the uptake of EVs in this case), (iii) government policy, legislation, etc. Engagement with these stakeholders could help form the project and tasks/activities to attempt to address their concerns/issues/questions (where possible/practical) and would avoid potential overlap and duplication of activity.
Customer Research	In spite of thorough internal, project team, review of the customer research questionnaires, it has been found that some trial participants are misinterpreting one theme of the customer survey questions, related to their "satisfaction with their current charging arrangements" and tend to go off on a rant about the lack of wider charging infrastructure. This is not a critical issue and can be resolved by looking at customer responses elsewhere in the questionnaire. The learning is that in future questionnaires should be

Context What activity does the learning point relate to?	Learning Point What has been learned?
	tested on people who are not involved directly in delivery of the project before being used on trial participants
Access to DNO data	In development of the NAT, EA Technology took a sample of WPDs relevant asset and Crown data, to specify, build and test the data import and network modelling algorithms and heuristics. Once this exercise was completed to the point where it was known that the data provided was adequate EA Technology should have requested a complete set of the data. Providing this full data set is time consuming for WPD's staff, as their normal workload is delaying them, and is consequently delaying testing of the NAT on the full data set.
Supplied goods for customer trial	Supplemental to Lesson Learned #10 In spite of addressing ICU's production QA systems previously, ICU subsequently "rationalised" the number of charger configurations in production and deleted the Electric Nation configuration from their systems, neither manufacturing nor their QA team spotted this, resulting in 101 chargers being produced and dispatched with a key configuration setting set wrong (disabling the SIM communications channel), 60% of these units were installed before the error was identified. Lesson learned – continue to scrutinise the processes of suppliers, especially if problems have previously arisen. A problem which appears to be resolved can reoccur if processes are not followed correctly.
Customer participation	20% of trial participants have not participated in the customer surveys (baseline surveys) - there is no penalty for customers not doing this (NB Impact Utilities say that 80% returns is actually very good for this type of project). At the outset of the project it was assumed that receiving their "free" smart charger would be reward enough to gain customer participation at this stage. (NB completion of further trial surveys are rewarded by issuing shopping vouchers for completed surveys). While the project has a £150 clawback from customers who do not participate in the trial or withdraw during the trial, this has not been used to date and is perceived by the project team as a drastic measure and could possibly damage the project's and WPD's reputation is used.

Context What activity does the learning point relate to?	Learning Point What has been learned?
Recruitment process	At the start of the recruitment process, DriveElectric asked prospective participants to pay a £150 upon signing up to the project with the participant agreement to cover the admin costs in case they then decide to leave. Also the idea was for this to act as a deterrent from leaving the project early. This process was utilised for approx. 4 weeks during the autumn of 2016. The vast majority of prospective participants argued that this did then not make the project 'free to join' and subsequently would not progress any further through the qualification process. The caused the qualification of customer to be a struggle. DriveElectric then decided to reverse the process fee and inform customer that if they decided to remove themselves from the project before the closer date of 31/12/18 they would then be required to pay the £150 then. This was positively received by prospective participants as this was perceived as an exit/cancellation fee.
Recruitment process	The installers began to claim the OLEV grant upon their first installations of company car drivers. This caused an issue due to the OLEV claim expiring after 4 months starting when the customer vehicle is delivered. The qualification team and installers were unaware of this therefore the team were allowing participants onto the project who's expiry date had past resulting in rejected claims once the installer had applied for the grant. Clear communication and understanding of other party's process could have picked up this issue. Furthermore consulting with the OLEV department upon creation of the project/initial installation stage could have identified this issue through technical vetting of applications to the project.
Recruitment process	During the qualification call with participants, Electric Nation asked if they would be willing to provide telematics data once they have their unit installed. Out of all approved surveys, 71% of these participants initially agreed to providing telematics data in principle however only 8% of these have given permission to collect data to date or signed to agree to it. Therefore the learning is all participants should agree and sign to provide vehicle telematics as a project requirement before the charger has been installed. This could contribute to an increased number of telematics participants on the project however it is important to note recruitment may not have been as successful if this was a project requirement.
Recruitment process	POSITIVE - A part of the successful recruitment can be attribute to the participant receiving a free charger and installation worth between £1000-£1500 with only 1 real project requirement in that they must return 2 baseline market research surveys. Learnt that 1) participants are keen to join if they receive a free piece of advanced technology and have to do little in return and 2) leading on from this that perhaps the project could of request more from the participant in return from the free charger and installation.

Context What activity does the learning point relate to?	Learning Point What has been learned?
Processes	POSITIVE - Recruitment/installation processes have been successful due to the flexibility of DriveElectric CRM database. This has allowed additional procedures to be entered in with ease as the project has developed/feedback has been received. These procedures are able to be monitored by date thus allowing detailed analysis of each processes success rate. The ability to analyse how successful any part of the recruitment or installation process has proved vital in improving customer satisfaction. Therefore ensuring a project has a robust and flexible CRM database will contribute to the overall success of customer engagement.

6 Intellectual Property Rights

A complete list of all background IPR from all project partners has been compiled. The IP register is reviewed on a quarterly basis.

Additional Foreground IP entries into the IPR register in the last 6 monthly period have been:

Specific Details of IPR	Current Status
PIVDCS performance analysis/reporting methodologies and graphical representations of these	Currently being developed by EA Technology, will be made publicly available during and on completion of project.
Smart Charger communications learning	Learning from project deployment of smart chargers, in particular issues with smart charger communications will be disseminated to charger manufacturing community at end of project as good practices to be adopted.

7 Risk Management

Our risk management objectives are to:

- Ensure that risk management is clearly and consistently integrated into the project management activities and evidenced through the project documentation;
- Comply with WPD's risk management processes and any governance requirements as specified by Ofgem; and
- Anticipate and respond to changing project requirements.

These objectives will be achieved by:

- ✓ Defining the roles, responsibilities and reporting lines within the Project Delivery Team for risk management;
- ✓ Including risk management issues when writing reports and considering decisions;
- ✓ Maintaining a risk register;
- ✓ Communicating risks and ensuring suitable training and supervision is provided;
- ✓ Preparing mitigation action plans;
- ✓ Preparing contingency action plans; and
- ✓ Monitoring and updating of risks and the risk controls.

7.1 Current Risks

The CarConnect | Electric Nation risk register is a live document and is updated regularly. There are currently 22 live project related risks and 6 risks which have been escalated to issue. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible. In Table 7-1, the details of the project's top five current risks, which have not been escalated to issue, by category, are given. For each of these risks, a mitigation action plan has been identified and the progress of these are tracked and reported.

Table 7-1: Top five current risks (by rating)

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
R007: The vehicle data capture systems/technology may not be ready in time for vehicle delivery	Major (48)	Additional post-vehicle delivery communications and installation of telematics system to participants' vehicles will need to be undertaken. Some OEM data is still to be included, Working with GEOTAB to resolve. Drive Electric is working to contact all participants to establish a greater rate of take-up for telematics.	The need for participants to sign and confirm separately that telematics may be installed and collected has resulted in fewer telematics installations than had been anticipated. This has required re-working future iterations of demand management to include a greater proportion of the vehicle fleet without telematics.
R046: Customers will switch off chargers	Moderate (30)	Customers are being instructed to not switch chargers off as part of trial participation instructions Customers have also been given detailed instructions to allow them to reset their charger system after a loss of communications	Communication with participants has reduced the number of occurrences. The amount of current provided to chargepoints is also reduced if communications are offline and this should act as a deterrent for

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
		(or power failure/charger switched off event) Much work has been done in communicating to customers asking them to leave chargers switched on , reality is some will always do this and this will form part of project results, risk reduced in severity Plan for App to reduce switching off occurrences.	chargers being switched off. The introduction of the App to participants in April and May 2018 should encourage participants to leave chargers switched on, as no data will be available to the App for chargepoints which are not communicating with the back office.
R049: Quality issues of ICU charger hardware lead to failures and increased costs form installers	Moderate (27)	Ongoing fault reporting. DE and EATL regularly communicating with ICU to improve manufacturing process, also feedback on faults will ensure warranty process followed. QS checks in factory increased to 100%	Chargepoint communication problems caused by previous quality issues are being resolved. Additional end-to-end communications checks are now being undertaken prior to installation.
R050: Total home load is incorrectly calculated	Moderate (18)	Increasing numbers of "OWL" meters being installed to gather data to provide more informed guidance. Continue to ensure that all installers are aware of the process for calculating demand and the triggers for asking WPD permissions rather	Manufacturers and installers from across the industry have been invited to an event to discuss household load measurement. This should help to ensure that loads are correctly calculated and reported and that DNO processes for “connect

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
		than connect and notify.	& notify" or application are followed correctly.
R052: Results from the project may not be statistically robust	Minor (12)	Continue to monitor statistical validity for groups and ensure that statistical robustness of the samples is considered through direct interaction with EA Technology and Drive electric and at monthly meetings.	With the change in staff at TRL, this risk will now be primarily monitored by Peter Vermaat of TRL.

Table 7-2 provides a snapshot of the risk register, detailed graphically, to provide an on-going understanding of the projects' risks.

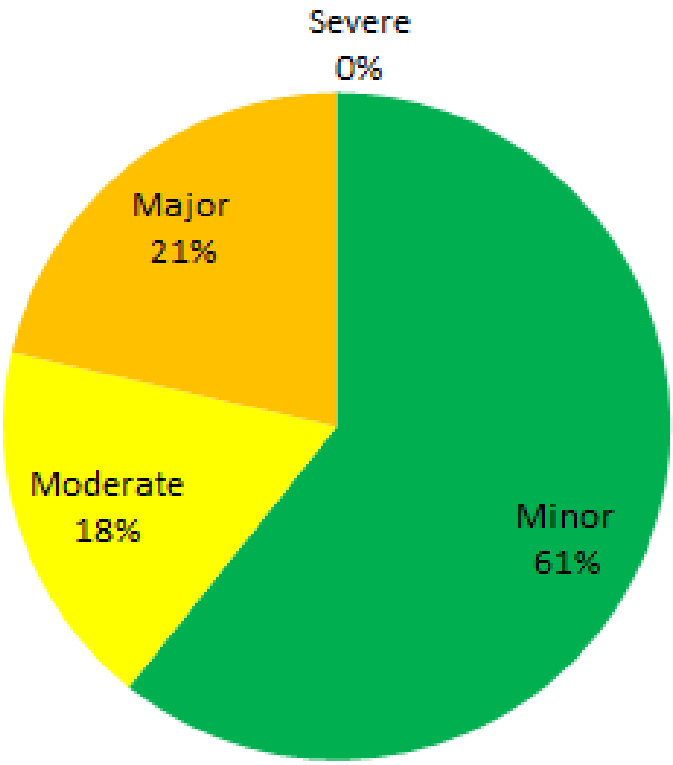
Table 7-2: Graphical view of Risk Register

Likelihood = Probability x Proximity						
	Certain/Imminent	0	0	0	0	0
	More likely	0	0	3	0	0
	50/50 chance	0	1	1	1	0
	Less likely to	0	0	3	1	0
	Very unlikely	3	6	8	1	0
		1. Insignific	2. Small	3. Delay,	4. Substan	5. Inability
		Impact				

	Minor	Moderate	Major	Severe	
Legend	17	5	6	0	**No of instances**
Total	28				No of live risks

Table 7-3 provides an overview of the risks by category, minor, moderate, major and severe. This information is used to understand the complete risk level of the project.

Table 7-3: Percentage of Risk by category



7.2 Update for risks previously identified

Six risks have been closed since 1st September 2017, broadly covering the reporting period to which this report relates. The closed risks are:

- R009: For the Trial, the project may fail to recruit sufficient customer numbers across the range of vehicle types;
- R017: Procurement of Chargers and Installers delayed;
- R027: The Pound may significantly fall in value against the Euro from project development period in late 2015;
- R041: During the engagement process the drop-out rate from customers signing the EOI to completing survey is higher than estimated (10%);
- R042: EV registrations fall; and
- R051: The Tesla requirement for an 'end user' agreement will make collecting telematics data from Tesla vehicles impractical.

Descriptions of the most significant risks identified in the previous six monthly progress report are provided in Table 7-4 with updates on their current risk status.

Table 7-4: Risks identified in the previous progress report

Details of the Risk	Previous Risk Rating	Current Risk Rating	Mitigation Action Plan	Progress
R045: In selection and procurement of project sub-contractors" there may be increases in costs c.f. outline costs quoted during proposal development. ”	Major	Escalated to Issue I008	Resolution Plan for Issue I008: Some cost savings achievable in other areas.	The full costs will be known once all chargepoint installations have been completed, circa May 2018.
R027 / I001: the Pound may significantly fall in value against the Euro from project development period in late 2015	Major	Closed	Risk Closed	Risk Closed
R046: Customers will switch off chargers	Moderate	Moderate	See Table 7-1	See Table 7-1
R012: during Trial there may be	Moderate	Escalated to Issue I009	Resolution Plan for Issue I009: Changes to future specification of	The next algorithm iteration is currently being designed by EA

interface issues with the vehicles (e.g. vehicles do not respond to requests for information) [telematics]			demand management algorithm	Technology and Drive Electric taking into account the number of vehicles with telematics.
R019: possible delay in handover of NAT	Moderate	Low	Ongoing communications with relevant WPD staff about specification, interface and data requirements - application of additional programming staff to catch up on delays	The NAT is progressing well and numerous communications with WPD have taken place.

8 Consistency with Project Registration Document

The scale, cost and timeframe of the project has remained consistent with the registration document, a copy of which can be found here:

https://www.westernpowerinnovation.co.uk/Projects/Current-Projects/CarConnect.aspx#FAQLink142;javascript:void(0);

9 Accuracy Assurance Statement

This report has been written and compiled by the outgoing CarConnect | Electric Nation Project Manager from TRL (Andy Wells) with input from the incoming Project Manager from TRL (David Blythin) and the Project Managers from EA Technology Limited (Nick Storer), DriveElectric (Mike Potter), and Lucy Electric Grid Key (Craig Holahan). This report has been checked by Sikai Huang and Peter Vermaat of TRL. This report has reviewed and approved by the Future Networks Manager (Roger Hey).

All efforts have been made to ensure that the information contained within this report is accurate. WPD confirms that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.