

EV Charging and Electricity Networks

University of Salford EV Workshop

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15th September 2021

Agenda

- Introduction
- Electrification of Transport – what does this mean for electricity networks?
- How are network operators getting ready for EV charging?
- Domestic EV charging – could smart charging manage the additional load?
- Supporting EV connections through online tools – two examples

What we do

The power to convert Monitoring into Insights

Our products and services are **designed for owners and operators of power networks** to:

- Help keep the power safely on
- Allow networks and equipment to be managed in a cost-effective way
- Prevent catastrophic failures and the subsequent financial losses
- Create clarity with asset investment decisions
- Ensure our customers benefit from leading edge technological advances.

Promoting the development of resilient, accessible, low-cost energy networks, accelerating the transition to energy decarbonisation



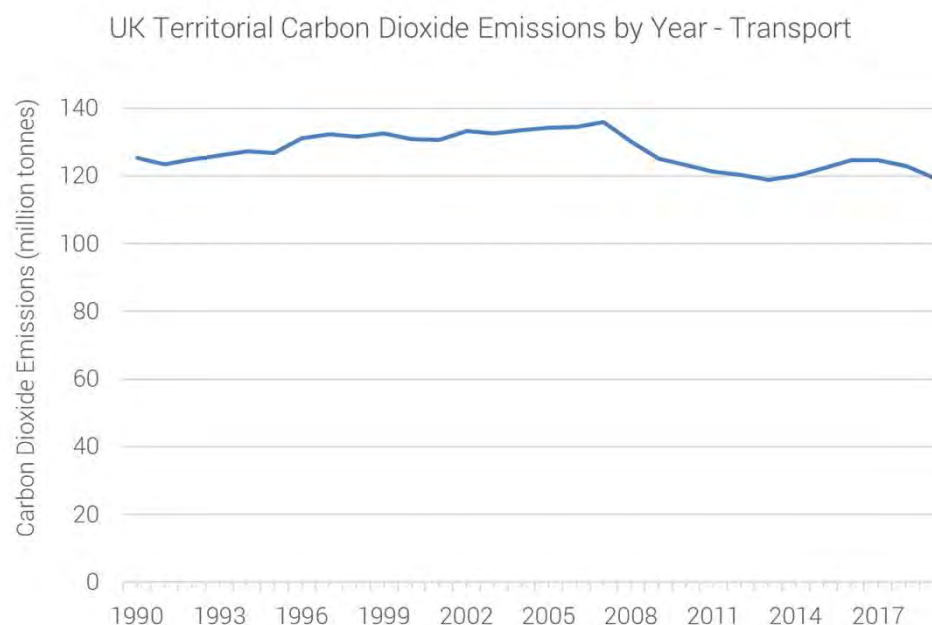
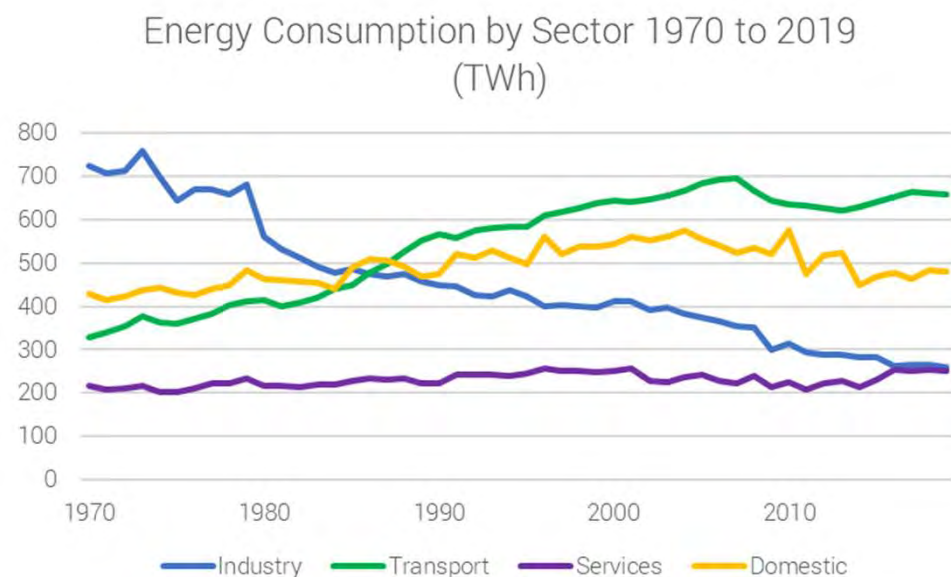
Introduction – Electric Vehicle Infrastructure Team

- Supporting the transition to electric vehicles
 - by making and selling software for grid operators, planners, developers and chargepoint providers
- Making it easier to get connected to the electricity grid
 - by making our software widely available
- Enabling the decarbonisation of our energy system
 - by championing open data and modelling techniques
- Team of 14 professionals – mix of engineering consultants and software developers

Electrification of Transport – what does this mean for electricity networks?

Electrification of Transport – What's Happening?

Context:



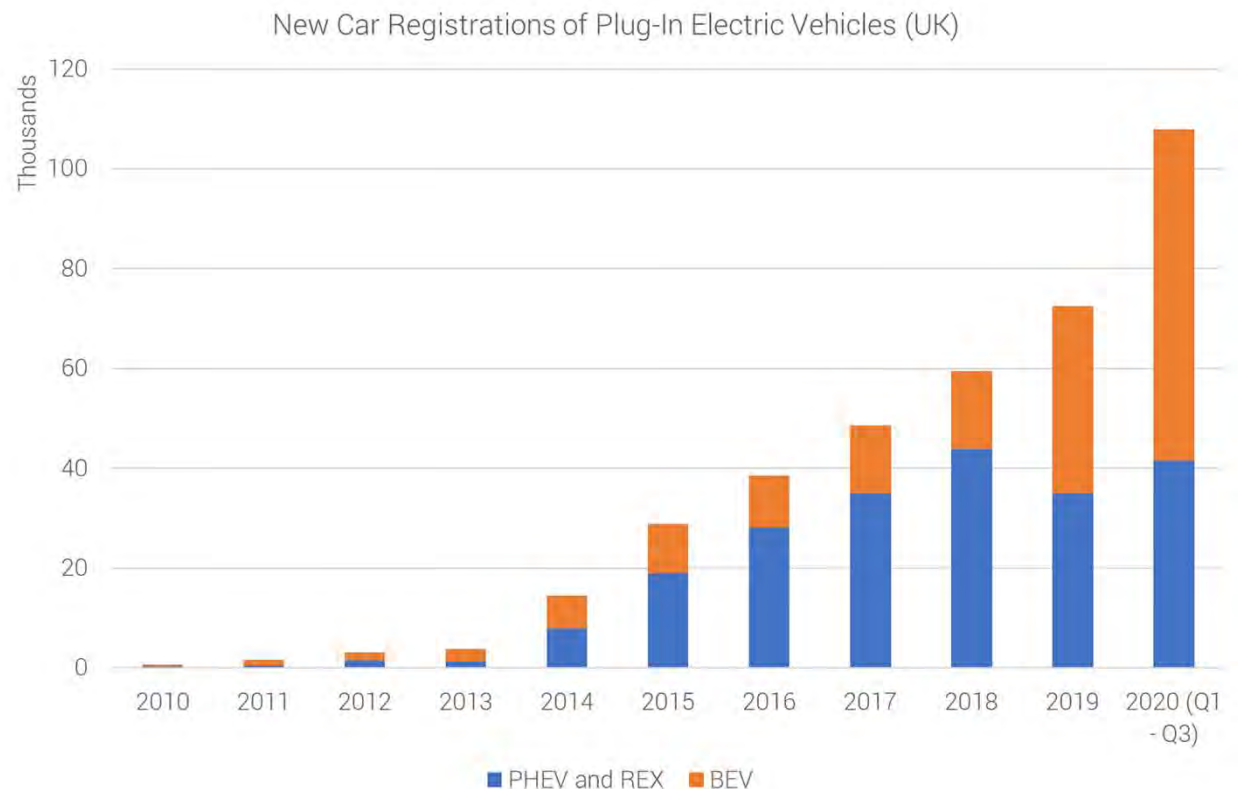
- The transport sector now accounts for the largest share of UK energy consumption by sector
- No significant reduction in emissions from transport since 1990

Electrification of Transport – What's Happening?

- Significant policy support for electric vehicles – switching cars and vans from petrol/diesel to battery electric vehicles:

- EU level binding emission targets for new vehicles – applying to manufacturers
- Ban on the sale of new internal combustion engine powered vehicles in 2030 (previously 2035)
- Purchase subsidies for battery electric vehicles
- Grants available for individuals and businesses installing charging points
- Attractive benefit in kind tax rates for EVs (compared to petrol/diesel cars)

- Increasing sales of battery electric and plug-in hybrid vehicles in the UK



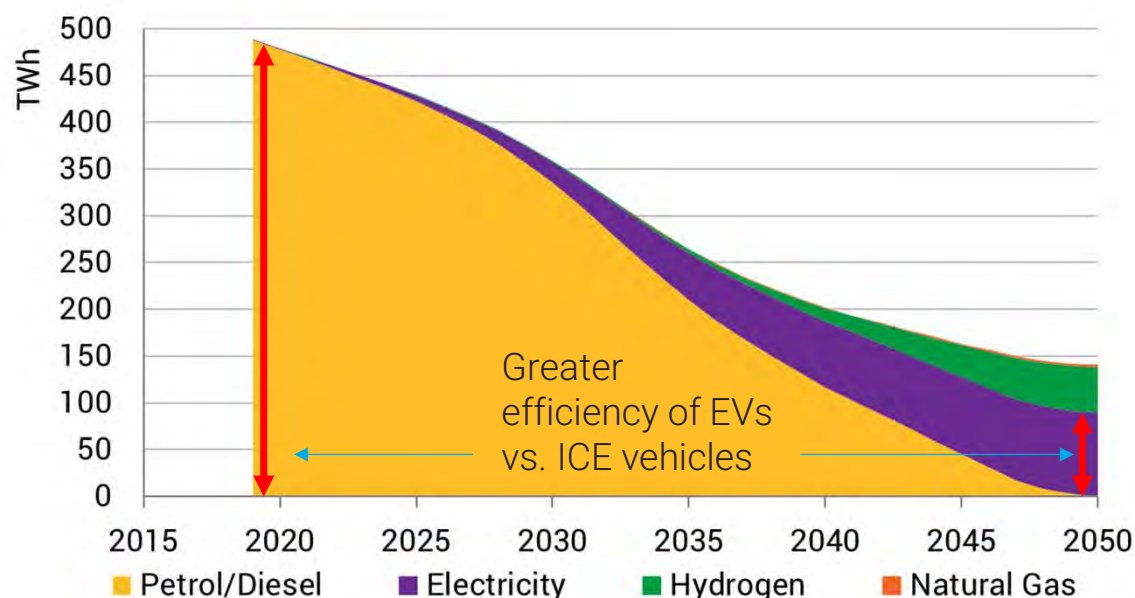
Data Source:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/942102/veh0253.ods

Electrification of Transport – What's Happening?

Projections for transport energy demand show move away from petrol/diesel to electricity

Annual Road Transport Energy Demand by Fuel Type (Two Degrees Scenario)



The Road to Zero could potentially increase today's electricity consumption by about 30% by 2050

Source: <https://www.lowcvp.org.uk/projects/electric-vehicle-energy-taskforce.htm>

Source: Table 4.18 <http://fes.nationalgrid.com/media/1432/fes-data-workbook-v30.xlsx>

Won't Somebody, Please, Think of the Electricity Networks!

Plenty of scare stories about the ability of the electricity networks to cope:

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Electric cars could collapse the national grid 'unless energy giants can decide when and how they are charged'

- Sales of plug-in cars have increased by 716% over the past two years
- New power supply cables needed in much of Britain to ensure the lights stay on
- Energy UK: Power companies would prefer to have right to turn off car charging systems at times the network is under pressure

By SEAN POULTER, CONSUMER AFFAIRS EDITOR FOR THE DAILY MAIL
PUBLISHED: 11:46, 14 September 2017 | UPDATED: 01:46, 14 September 2017

FINANCIAL TIMES

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Electric vehicles + Add to myFT

Charge electric car but don't boil kettle, says National Grid


Homes likely to blow main fuse as system struggles to cope with electricity demand

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Electric cars will mean huge strain on power network

Graeme Paton, Transport Correspondent
Saturday February 11 2017, 12:01pm
The Times



Switching all cars to ultra-low emissions may place a massive strain on the power network
GETTY IMAGES

They are seen as an antidote to the wave of pollution clouding Britain's biggest cities. Within the next few years, it is hoped that a fleet of electric cars will clear

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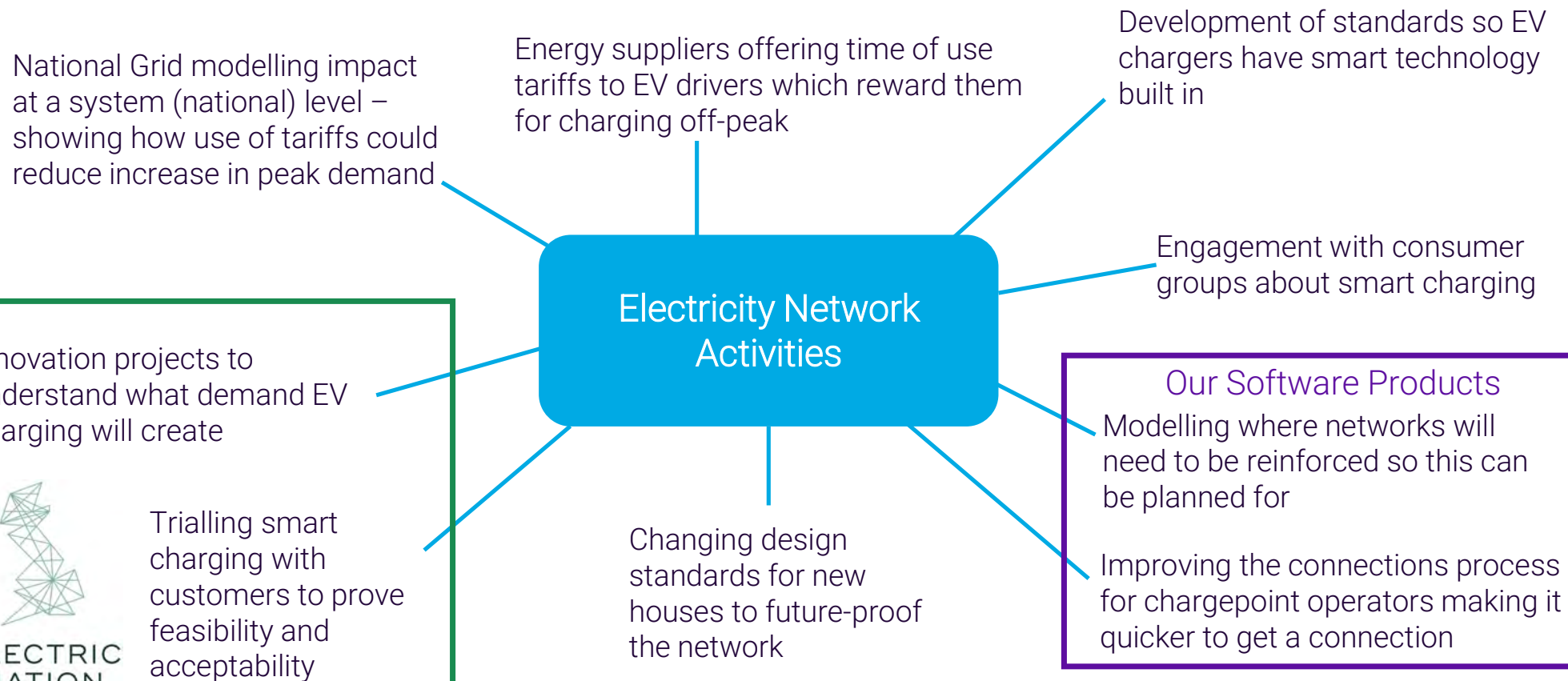
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UK could need 20 more nuclear power stations if electric cars take over our roads and cause 'massive strain' on power network

- Expansion in electric cars could mean UK needs '20 more nuclear power plants'
- Research said low emission vehicles could cause 'massive strain' on power grid
- Transport for London research said London would need two power plants alone
- Comes as Department for Transport wants to boost vehicles use across Britain

By JOSEPH CURTIS FOR MAILONLINE
PUBLISHED: 21:19, 11 February 2017 | UPDATED: 23:12, 11 February 2017

So how do we prepare the electricity networks for this?



Domestic EV Charging and Demand Management – the Electric Nation project



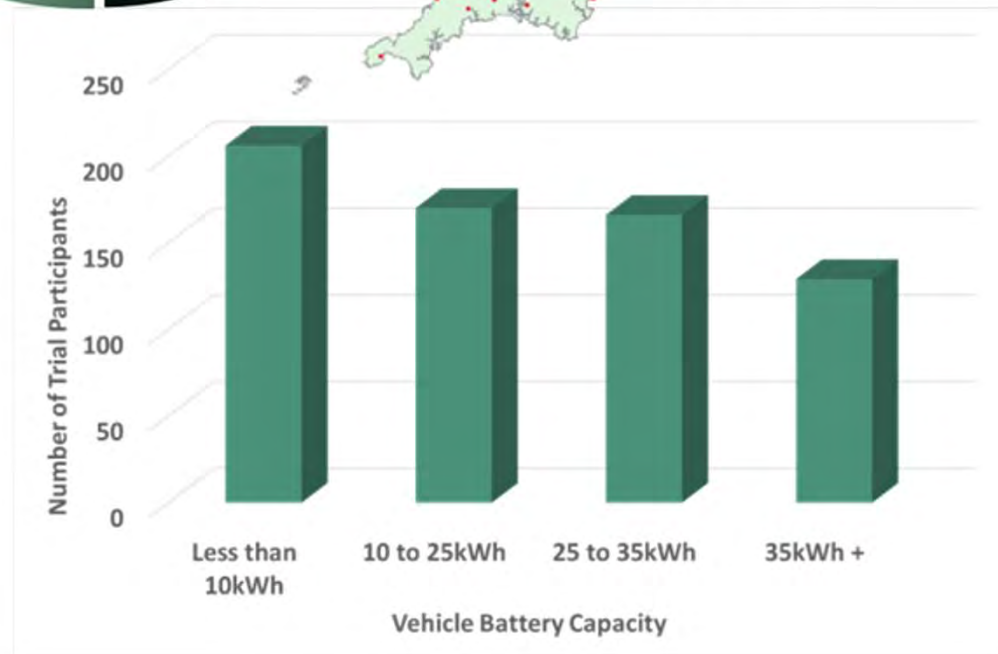
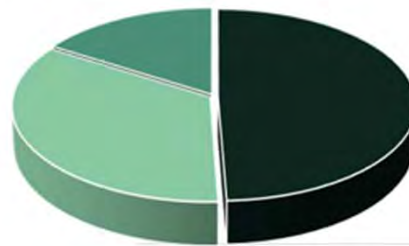
What was Electric Nation?

- Developed to address the challenge of increasing demand on distribution networks from the electrification of transport
- Aims:
 - Expand understanding of the impact of domestic EV charging on distribution networks (range of vehicles, up to 7kW charge rate)
 - Increase understanding of charging behaviour for different vehicle types
 - Evaluate technical feasibility and customer acceptance of smart charging solutions to manage additional demand
- Western Power Distribution (DNO) Network Innovation Project
- 2016 – 2019
- Project Partners: EA Technology, Drive Electric, TRL, Lucy GridKey

What Did We Do?

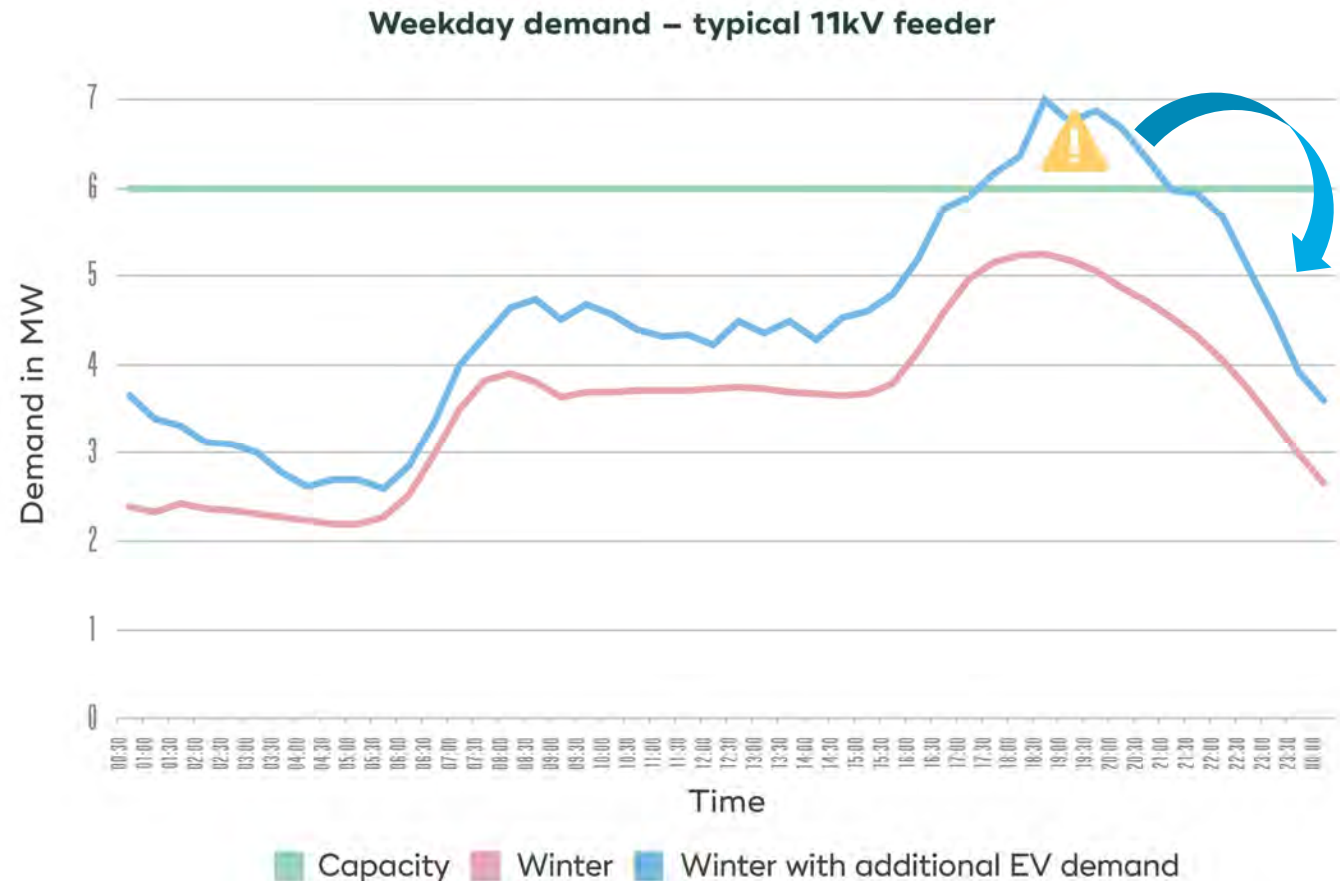
- 673 participants
- 2 year field trial
- Over 130,00 charging events

■ Electric only (BEV)
■ Plug in Hybrid Electric Vehicle (PHEV)
■ Range extender (REX)



Smart Charging Explanation

- Smart charging in Electric Nation involved:
 - Sending signals to slow charging down when necessary; or
 - Use tariffs to encourage drivers to charge outside of peak time



What Did We Find Out?

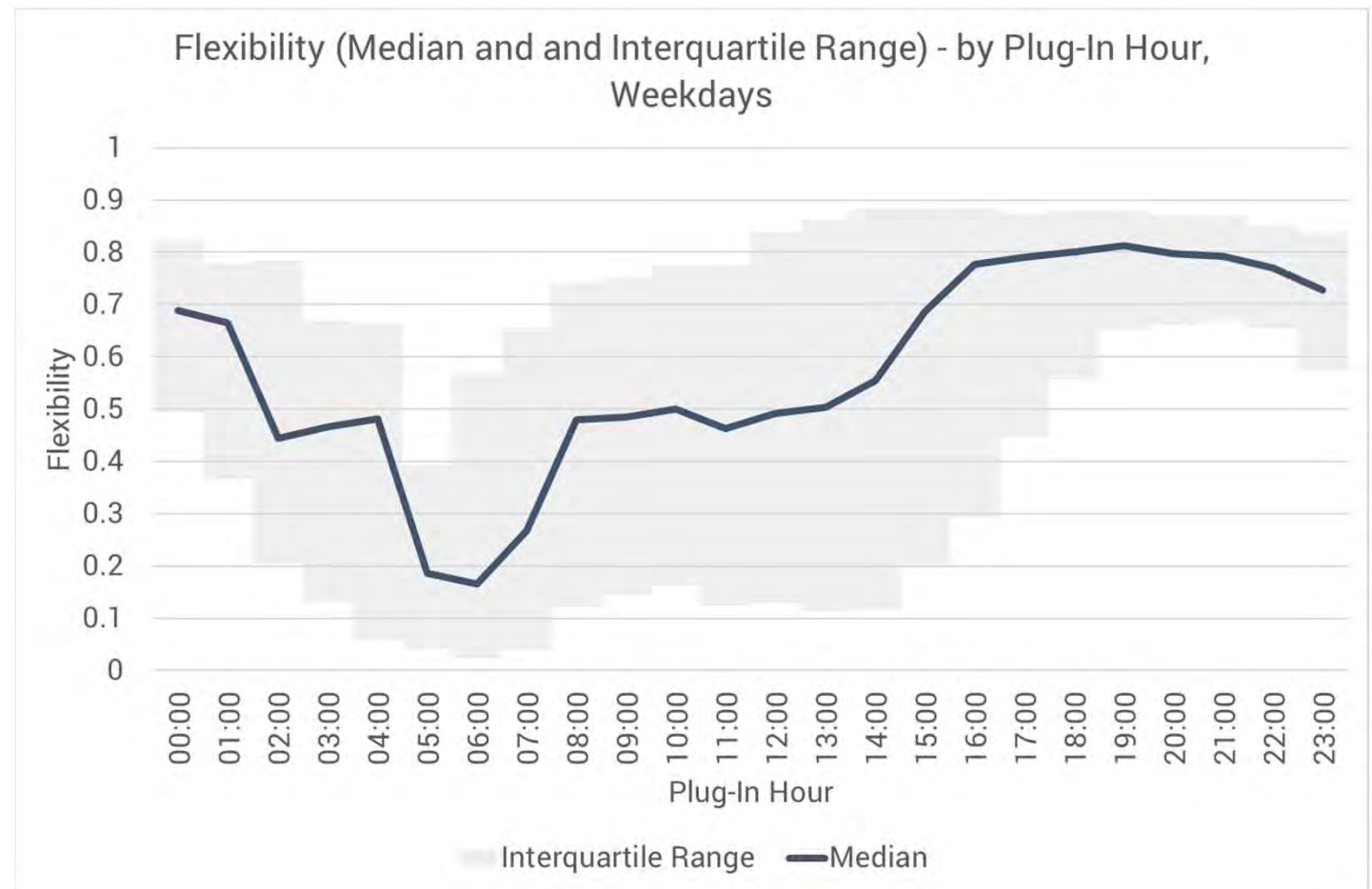
- If charging is slowed down (e.g. in the evening peak) would it inconvenience drivers?

$$\text{Flexibility} = 1 - \frac{\text{Charging Duration}}{\text{Plug in Duration}}$$

- Flexibility is **high** when the charging duration is much shorter than the plug-in – there's time to make up for the reduced charging speed

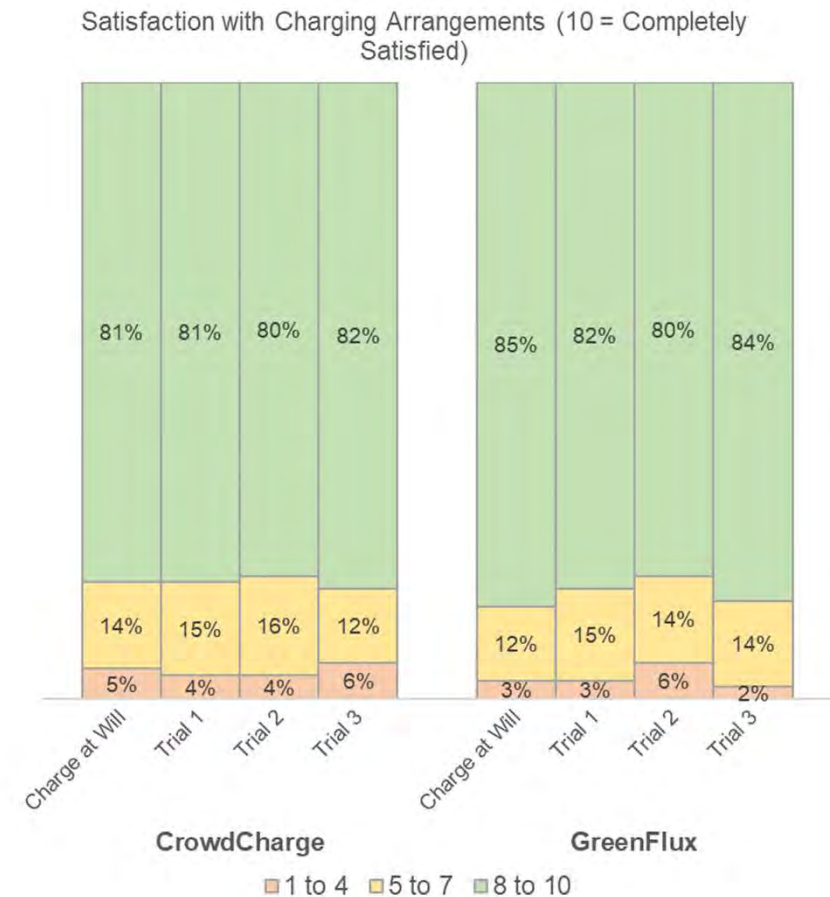
What Did We Find Out?

1. Data from the trial shows flexibility in charging – but without an incentive the demand in the evening peak requires management



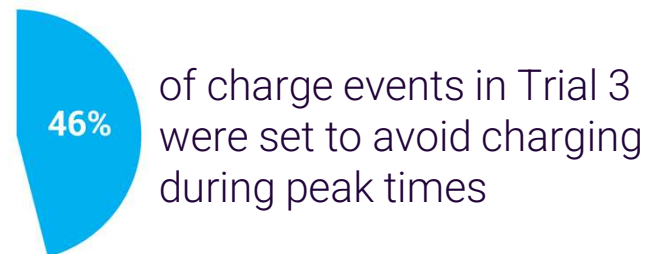
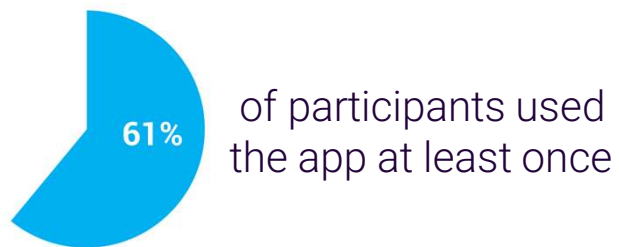
What Did We Find Out?

2. Demand management is technically feasible, and acceptable to the majority of trial participants:
 - Demand management operated successfully for the majority of participants for throughout the trial
 - Satisfaction scored by participants remained high throughout the trial, and was not linked to the amount of management they experienced

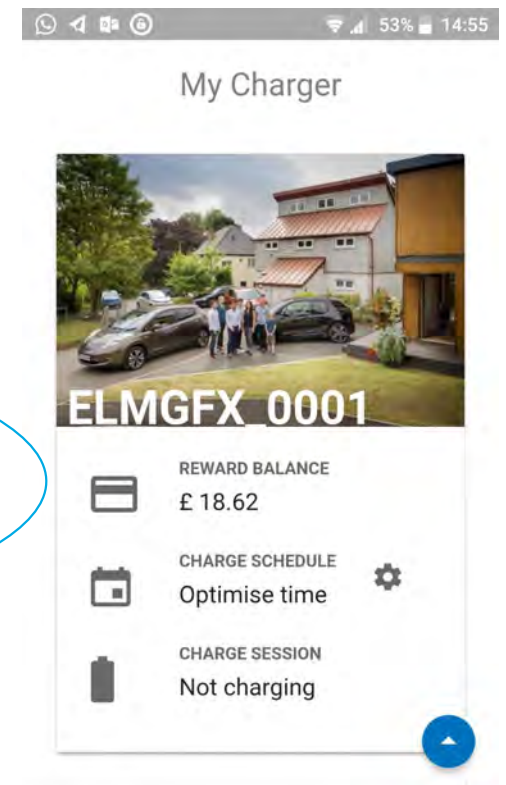


What Did We Find Out?

3. Time of Use incentives are particularly effective when supported by smart charging (with an app) which **makes it simple for the user**

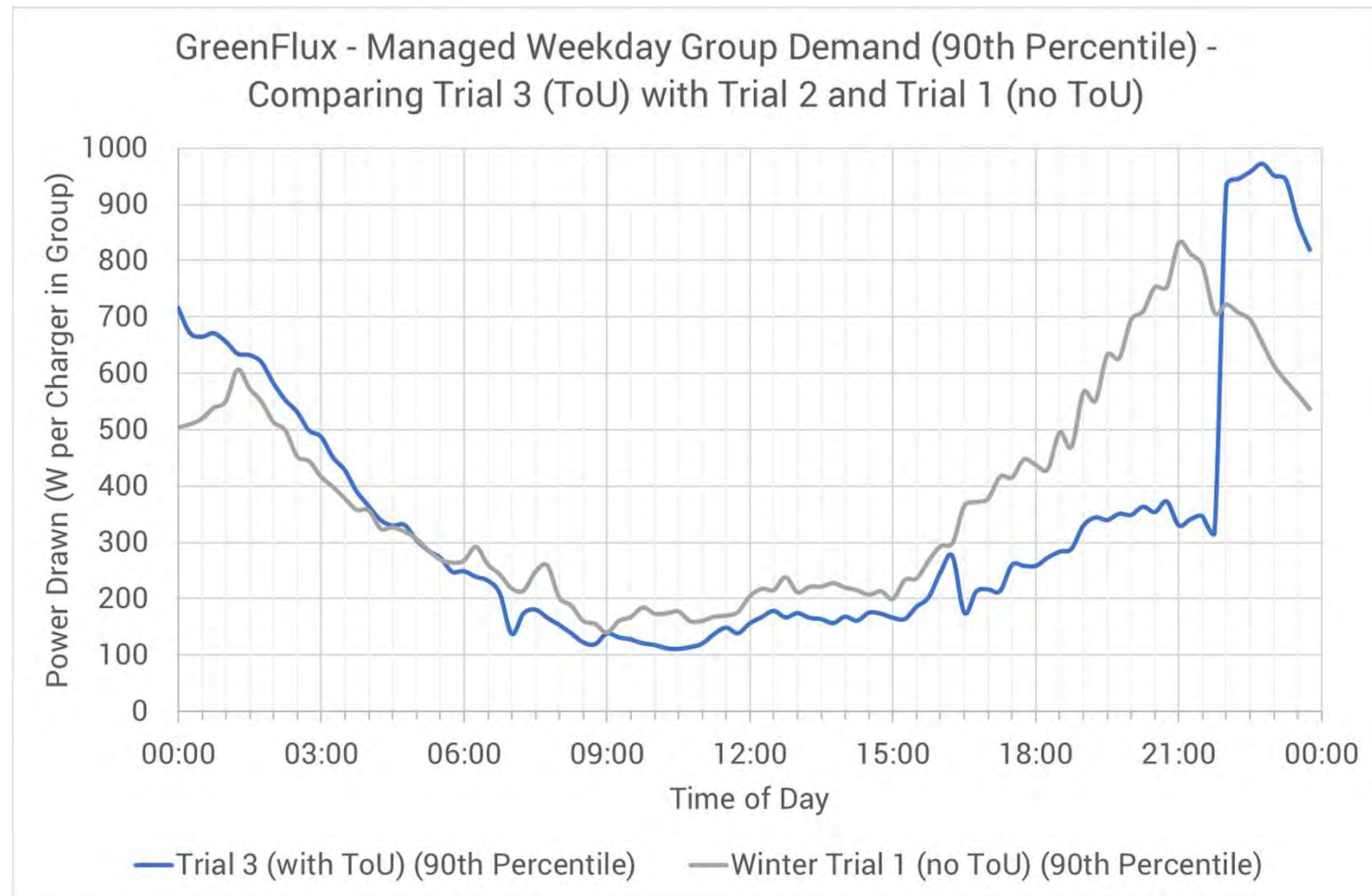


- 86% found the reward structure “very easy” or “easy” to understand
- 86% said they would be either “very likely” or “slightly likely” to use a similar app in the future
- 76% of participants would be highly likely to recommend Trial 3 to a friend



What Did We Find Out?

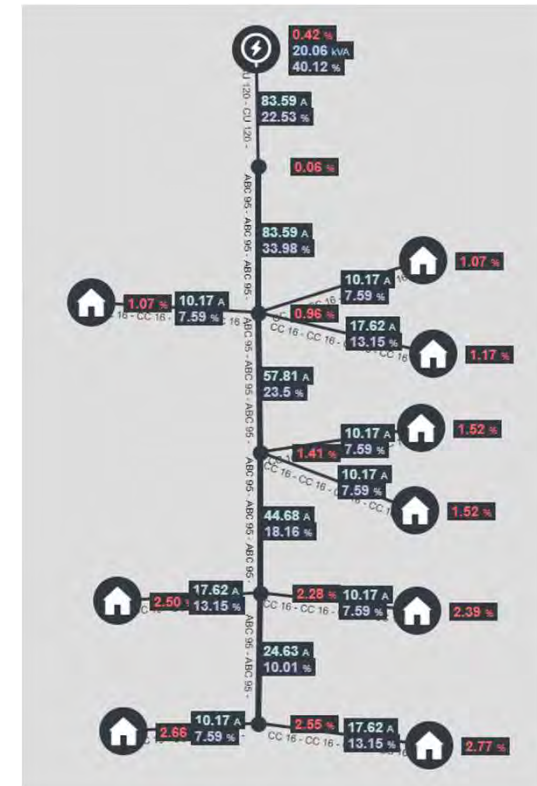
3. (continued) - Time of Use incentives appear to be highly effective at moving demand away from the evening peak



Improving the Connections Process

Network Capacity and Connecting New Loads

- Electricity network assets – transformers, overhead lines and underground cables are rated based on their capacity
- Increasing the load on the network (e.g. by connecting new EV infrastructure) could cause thermal overload or increase the voltage drop on a network beyond statutory limits
- New connections (or increased capacity at existing connections) are assessed by the network operator to determine if there is enough spare network capacity available
- If not, then the customer has the option of paying for the necessary reinforcement work
- Reinforcement work can be expensive and have a long lead time



Challenges with Connections Process

- Customers have very little visibility of the available network capacity so have to get a budget estimate to find out – creating abortive work
- Customers have to gather and provide a lot of information to the network operator for them to complete the assessment – creates a burden on the customer and network operator to process the information
- Connections are becoming more complex (e.g. including generation, new loads, or energy storage) so the costs and time required to process quotations increases
- Manual processes to generate new quotes leads to delays in providing a quotation



EV charging infrastructure will generate a large volume of new connection applications in the coming years – network operators are looking for solutions to streamline this process to benefit customers

AutoDesign – Northern Powergrid

- Available now at <https://www.northernpowergrid.com/auto-design> in the North East and North Yorkshire
- Public-facing online connections tool
- Quick, simple cost estimator – anyone can use it
- Allows users to obtain quotes for a range of connection types – houses, EVs, flats, shops, etc.
- Users have visibility of network capacity – it's easy to understand where they can connect to
- Multiple requests can be done in succession so users can make an informed choice about what they're connecting
- Saves DNO planners time on quotes which don't progress to a physical connection


Stage 1 – Input Connection Location and Type

BD20 6LJ


Address Line 1 *
1 Spring Gardens Mount

Address Line 2


City *
Keighley




House/bungalow



Flat/apartment



Commercial/business



EV Charging

4 **QUANTITY**
Please provide the quantity of premises

Please enter the quantity of houses

4

Stage 2 – Map shows the existing network and where the user can connect



Stage 3 – Draw site plan and connect to network



Stage 4 – Get budget estimate

This budget estimate is based on typical simple connections and is calculated by making assumptions based on similar work we have carried out in the past. The AutoDesign tool will complete an initial technical assessment based on the current network; however, if you apply for a quotation, the quotation price may differ from the budget estimate provided today. The AutoDesign tool assumes the following:

- There is no need to reinforce the local electricity network to provide you with the connection you have requested;
- Our existing network will not need to be moved to accommodate your work;
- You are not installing equipment which could be considered to be a disturbing load, e.g. motors, welders;
- You are not installing any generating equipment or energy storage device, e.g. wind turbines, solar panels, batteries;
- The connection route you have chosen will be direct and economical and there are no abnormal ground conditions along that route; and
- The work will be carried out during our normal working hours of 9am to 5pm, between Monday and Friday.

Your estimated price is: £17,100 +VAT

Your reference number is: 200511-000002

ConnectMore – SP Energy Networks

- Developed as part of the 'Charge' project
- Charge is an SP Energy Networks innovation project
- Preparing Merseyside, North Wales, Shropshire and Cheshire for the drivers of tomorrow
- Ongoing development of electricity networks is key to the future of electric transport and achieving net zero by 2050 – close collaboration between network operators and transport experts is vital if this process is to succeed
- Funded by the Network Innovation Competition
- Timescale: April 2019 – March 2023

ConnectMore

- An online tool which will be made available to the public
- Features:
 - Estimated demand for EV charging – where it is, how much energy is required, what speed of chargers are needed
 - Visibility of available network capacity
 - Ability to generate connection cost estimates to get a connection via an online self-serve tool
 - View smart charging connection options

More information: <https://www.spenergynetworks.co.uk/pages/charge.aspx>

Thank you

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