Consumers, Vehicles and Energy Integration (CVEI) Project: Achieving the benefits of integrating vehicles into the energy supply system

Low Carbon Vehicle Partnership Annual Conference, 30th June 2016

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Challenges for low carbon vehicles

• Meeting user energy supply requirements, whilst managing energy capacity constraints

• Implementing intelligent vehicle charging without compromising vehicle / battery utility

• Developing greater understanding as to where and to what extent to invest in network reinforcement

• Integrating liquid and electric “fuel” supply systems for vehicles, and utilising the capability of the liquid fuel system
Plugging vehicles in and charging them

Journey arrival times (2007-2010) and Electricity demand profile (7th December 2010)

- Proportion of all journeys (2007-2010)
- Electricity demand (GW)

Time of day

Education (But Excl. Escorting Others)
Holiday Base / Day trip
In course of work
Personal Business (Medical, Eat/drink, Other)
Visiting Friends / Socialising / Entertainment / Sports
Escorting Others
Shopping (Food and Other)
Travel to Work
Return Home
Electricity demand

Compiled using NTS and UKERC data

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Plugging vehicles in and charging them

Journey arrival times (2007-2010) and Electricity demand profile (7th December 2010)

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Consumers, Vehicles and Energy Integration Project

Project aim:
- to address the challenges involved in transitioning to a secure and sustainable low carbon vehicle fleet
- to examine how tighter integration of vehicles with the energy supply system can benefit:
  - vehicle users
  - vehicle manufacturers
  - organisations throughout the energy supply chain

The outputs will:
- help inform UK government (and European?) policy
- help shape energy and automotive industry products
Project overview

- ETI investment of £5 million over two years

  - Stage 1: detailed design & analysis to characterise:
    - market, policy and regulatory frameworks
    - business models and customer offerings
    - integrated vehicle and infrastructure systems and technologies for electricity and liquid fuel / hydrogen
    - consumer and fleet attitudes to adoption and usage behaviours

  - Stage 2: trial with mass-market consumers, and a corresponding fleet study:
    - to test and validate solutions and assess responses
The project team
Modelling framework (overview)
Development of narratives

- Various “narratives” (scenarios) defined to describe aspects of possible future environments for ULEV deployment and use.

- These are used to “stress test” the effectiveness and robustness of solutions in different futures.

- Each narrative comprises many “building blocks” characterising key aspects of:
  - customer proposition,
  - market & policy framework,
  - physical value chain, and
  - commercial value chain.

- Example factors addressed by the range of narratives are shown here …
Each narrative comprises many “building blocks” characterising key aspects of:
- customer proposition,
- market & policy framework,
- physical value chain, and
- commercial value chain.

“Transport on Demand” narrative

“Hydrogen Push” narrative
Purpose of Stage 2

- Trial with mass-market users …
- to deliver learning, testing and, so far as possible, validation of …
- the expected impacts of the system solutions and offerings identified in Stage 1 …
- on vehicle users, fleet operators, emissions, market behaviour, system resilience and cost.
**Early stages of adoption**

- Users with access to EVs are still classed as ‘Innovators’ (i.e. very early stage of adoption)
- To date, trials have been conducted using only Innovators
- Low numbers of consumers
- Attitudes and behaviours are not representative of the majority of users

**Future majority ‘Mass-market’ consumers**

- Much larger numbers of users
- These will significantly influence the energy system
- Very different motivations, attitudes and behaviours to those of Innovators
- Unlikely currently to use or own a plug-in vehicle
- Do not generally have specific motivations for early adoption of plug-in vehicles
- Less likely to adapt behaviour (e.g. to accept managed charging) to meet needs of the vehicle or energy system
Unique value of this trial

• Trial with mass-market users
  – i.e. people from the majority of the vehicle user and fleet operator market

• Addressing widely-applicable plug-in vehicles (BEVs and PHEVs)
  – suitable for wide range of users

• Holistic system design
### Key components of Stage 2*

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<thead>
<tr>
<th>Consumer – Vehicle Uptake Trial</th>
<th>Fleet – Uptake and Managed Energy Supply Study</th>
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<tbody>
<tr>
<td>➢ to enhance understanding of adoption of EVs</td>
<td>➢ to assess informed response to modelled fleet-wide roll-out</td>
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<td>• 200 consumers, given 2 days with each of 3 vehicles in turn (BEV, PHEV, ICE)</td>
<td>• case studies with selected fleets based on analysis in Stage 1</td>
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<td>• additional questionnaires and choice experiments (with reduced ‘psychological distance’)</td>
<td>• some vehicles replaced by ULEVs to provide real experience</td>
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<td>• findings inform analysis on uptake by mainstream consumers under different market and policy frameworks</td>
<td>• wider fleet roll-out modelled and assessed with operators</td>
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<tr>
<th>Consumer – Charging Behaviour Trial</th>
<th>Update of Results, Reporting and Dissemination</th>
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<td>➢ to assess response to market frameworks and policy incentives for demand management</td>
<td>➢ to complete analysis and communicate results</td>
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<td>• 240 consumers, given 2 months with a vehicle</td>
<td>• capture learning, update frameworks, assumptions, uncertainties and analysis</td>
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<td>• parallel BEV and PHEV trials</td>
<td>• derive conclusions re uptake and integration of vehicles into system</td>
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<tr>
<td>• data on use and charging / fuelling, with additional questionnaires and choice experiments</td>
<td>• reporting and dissemination</td>
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<tr>
<td>• findings inform analysis of effectiveness of charging solutions and vehicle-energy integration and of system level impacts</td>
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* All details are provisional, subject to detailed trial design to be completed during Stage 1
Key take-home messages today

• There are substantial **challenges** associated with widespread roll-out of low carbon vehicles, but a paradigm shift from a “**problem for the network**” to an “**opportunity through integration of vehicles as part of a wider system**” can yield **benefits for all actors in the system**:
  – including increased uptake of low-emission vehicles, managing charging and refuelling, and optimising the system design.

• Analysis and solutions must be **holistic** (considering all parts of the system together, including users).

• CVEI Project will determine and characterise **good system solutions**.

• Robust trial in Stage 2 will generate additional data to test solutions and inform analysis, and will add **unique value** (though use of PHEVs and mass-market consumers in particular).

• Expect to communicate **initial results soon**:
  – Stage 1 in Sept (at Cenex LCV2016, SMMT, other stakeholder groups, publication of reports, etc)
  – Stage 2 next year.