A Smart Flexible Energy System: Call for Evidence

Ultra Low Emission Vehicles

Response submitted on behalf of Cenex

Consultation Questions Addressed and Responses

Q33: ***How might Government and industry best engage electric vehicle users to promote smart charging for system benefit?***

33.1 In the context of this Q&A, smart charging is the intelligent charging of electric vehicles (EVs), where charging can be time-shifted based on grid loads and in accordance to the vehicle owner's needs. The total system boundaries extend from the EV user to power generation and distribution assets, with the scope of benefits including economic, environmental, diversity and security of supply benefits. Within the system scope there is an 'inner' system of localised assets including the vehicle charger, the low voltage and local high voltage (11 kVA) assets, including substations, as owned and operated by Distribution Network Operators (DNOs).

33.2 Within the wider system, the expectation of smart charging, is that electricity providers will offer EV owners monetary and/or non-monetary benefits in exchange for enrolment in a program that permits managed 'smart' charging at the times when curtailment capacity is needed for the grid.

33.3 For domestic EV users, as well as commercial\businesses operating fleets of EVs, the expectation is that shifting electricity consumption between different Time of Use (TOU) tariffs that reflect peak (expensive energy supply) and off peak (cheaper energy supply) will deliver energy cost savings. For an operator of a large fleet of EVs these savings could be attractive but may not make for a compelling business case. However, for a private motorist using domestic supply for charging, analysis (by Cenex and others) shows that the value of savings to the user are insufficient to create a business case for consumers to invest themselves is smarter charge points, or to be easily recruited to, or actively engage with smart charging schemes.

33.4 The main beneficiary of smart charging is likely to be the DNO, where smart load management can help defer investment in areas of a local distribution network that might otherwise become overloaded. There is however a challenge in the value-chain, in that there is generally no 'supplier/customer relationship' between the EV user and the DNO. In order that the EV user opting in to smart charging can be suitably rewarded, a series of contractual arrangements between the energy system participants will be necessary to allow some of the (deferred investment) cost savings to be passed back to the EV user. There needs to be a transparency to these arrangements and effective marketing of the shared nature of the benefits.

33.5 The business model for large EV fleet operators could be aided by a more flexible approach to TOU tariffs and DNO initiated incentives. Similarly, public charging network operators represent a category of electricity consumer\supplier that could be engaged through smart charging incentives.

33.6 At the moment, EV users get tax breaks for EV ownership and use. These incentives are not sustainable for Government in the long term. As with this consultation, Government is wise to explore the policy options available to work with electricity sector participants to financially incentivise smart charging as a means of ensuring growth in EV ownership.

33.7 Studies, such as that of the Royal Academy of Engineering (Ref: www.raeng.org.uk/publications/reports/counting-the-cost) have looked at the economic and social costs of disruptions in electricity supply. The switch from petrol and diesel to electricity as a road fuel adds scale and scope to the cost of disruptions and increases the importance of incentivising measures that facilitate demand side management as well as those that increase energy security.

Making smart charging a system priority going forward, and initiating variable rate tariffs at non-smart charging stations, will allow system participants in the value chain (notably the DNO, the electricity retailer and the EV user) to become accustomed to the way smart charging operates. This is a wider priority system not limited to charging. Already demand side management measures are being effectively deployed using industrial process assets and an active market exists for the demand side management services based on aggregating assets. The opportunity lies in incentivising the home owner to change their behaviour in terms of when they consume electricity for a range of activities not limited to EV charging. In this regard, consideration needs to be given to ensuring that the smart meters to be rolled out to homes in the UK are not limited in the functionality they offer as an interface and don't become a barrier to facilitating smart charging of EVs.

The behaviour change required for smart charging needs a total systems approach with key stakeholder alignment that can only be achieved through policy intervention ranging for measures that either regulate for, or incentivise smart charging, and are supported by accompanying public information campaigns. In this regard, consideration needs to be given to ensuring that the smart meters to be rolled out to homes in the UK are not limited in the functionality they offer as an interface and don't become a barrier to facilitating smart charging of EVs.

33.8 There is a concern within the UK EV ecosystem that the imposition of managed charging could inhibit the attractiveness of the ownership and use proposition for EVs. The EV proposition currently requires early adopters to perceive that they have the required vehicle utility (range and performance) of a petrol or diesel, or at least a level of utility that isn't prohibitive to their normal vehicle usage requirements. A freedom of movement restricted by system constraints at an unseen DNO level would be poor received politically and could slow the rate of growth of EVs and the related EV equipment and services market. A slower growth would in itself defer the need for DNOs to get involved in demand side management of charging as a low penetration of EVs would lessen the priority to respond. However, from a system perspective, it is a better option to plan for and implement smart charging measures whilst EVs are still a small percentage of the vehicle parc rather than wait until a large number of vehicles are EV and user behaviour has been established and will be harder to modify.

Q34: ***What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, network and system operators) to develop consumer propositions for the;***

34.1 ***Control or shift of electricity consumption during vehicle charging?***

There are several factors that hinder vehicle and electricity system participants from the ability to control electricity consumption during vehicle charging (also known as smart charging or V1G). There are both technical and user acceptance barriers:

34.1.1 Electric Vehicles (EVs) and Electric Vehicle Supply Equipment (EVSE) need to operate to common communication standards and protocols, and pass consistent data, so that managed charging can be flexibly implemented. This will best be facilitated by an agreed protocol of standardised identifiers for the user, the vehicle and the charging equipment, so that the control capability of the vehicles and charging equipment can be determined, and the opt-in status and local data relating to the user accurately considered as the control strategy is implemented in real-time. Across Europe (and with representation from the UK by Cenex), the eMI3 Group (eMobility ICT Interoperability Innovation Group; www.emi3group.com) is already developing suitable standards for identifiers, and has the support of leading vehicle manufacturers BMW and Renault and several significant charging system participants such as e-laad, Bosch, Gireve, Schneider, EDF and E.ON. Initially set up to progress interoperability for EV roaming and reconciliation of electricity costs, the scope of the eMI3 approach is now recognised as a means of facilitating smart charging.

34.1.2 Without an approach like that of eMI3, a potential 'deadlock' situation could arise if several stakeholders in the recharging chain attempt to implement charging control in the absence of communication between themselves and agreement on extent of authority and control priorities. This could result in a market failure for smart charging.

34.1.3 It is highly likely that both users and infrastructure providers will object to external controls, and suitable compensation and rewards need to be devised.

34.1.4 As noted above, EV users will question why managed charging is necessary, and in certain situations (which relate to the user, and not any measurable or predictable condition) it will be necessary to circumvent managed charging and any system proposed will have to offer this capability. This further complicates 'the offer', as it will therefore be necessary to find a fair and equitable mechanism to offer the capability, whilst at the same time discouraging it's use when not required to prevent users simply overriding the control.

34.2 ***Utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network?***

<u>In addition to the barriers that exist with smart charging</u>, several additional barriers exist with vehicle-to-grid:

34.2.1 The usual safety considerations associated with embedded generation (anti-islanding and electrical isolation) need to be considered. In the UK, connection will have to be through a

G83 or G59 relay, and G59 requires the consent of the DNO. Such consent is becoming increasingly difficult to receive as DNOs need to maintain grid stability and embedded generation is inherently difficult to accommodate.

34.2.2 The impact of multiple vehicles operating in either a charge or discharge cycle could represent significant issues to the Low Voltage network, such as harmonic alignment and voltage increase. This could significantly impact on the network if not properly managed.

34.2.3 User acceptance will require confirmation that operation does not degrade the battery at an unacceptable rate. EV battery degradation requires further research.

34.2.4 EVSE hardware costs are likely to increase as a V2G unit needs to provide bidirectional charging and discharging, and the control and communications elements of the unit are also likely to be more complex.

34.2.5 As noted, the business case for smart charging requires additional support over and above energy (tariff shifting) cost reduction. DNO-delivered financial incentives also need to be built into tariff arrangements.

34.2.6 Identification of suitable markets for energy trading is necessary to make V2G a viable option for the UK. Whilst smart charging provides economic benefits to the network operators, V2G puts the economic potential back into the hands of the EV owner. Creating convincing business cases is crucial to timely uptake of technology. This will require engagement of aggregators or Virtual Power Point (VPP) operators in order for market operation to become a reality.

Q35: ***What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium?***

35.1 There are currently a number of barriers to the use of electrolysis as a renewable energy storage medium. Study work undertaken by Cenex via the HyUnder project, investigating salt cavern storage of hydrogen and modelling associated energy storage costs, supported the widely-reported view that the high capital costs associated with current electrolyser technology represents one of the main barriers to electrolyser deployment as a means to generate hydrogen as a renewable energy storage medium.

35.2 A cost-effective electrolyser could be used to convert electricity generation at off-peak times into hydrogen to be stored and used as an energy source, thereby enabling the business case for leveraging storage as a means of levelling out peaks and troughs in the electricity generation that renewables deliver based on their intermittent operation. In practice the high CAPEX and related OPEX for electrolysers currently means that electrolysers are expected to operate continually, not intermittently, and then be incentivised to switch off times when demand. Electrolysers represent attractive demand-side assets as they are almost always generating for storage as opposed to generating hydrogen for immediate and variable consumption.

35.3 The scope for cost effective electrolysers depends on technology improvements for cost reduction with research projects ongoing looking at both proton exchange membrane electrolysers, which accommodate intermittent operation, as well as alkaline electrolysers, which are typically operated in a steady state mode.

35.4 For scope of electrolysers to deliver value-added services to smart network operation could extend to include reactive power, frequency response, inertia, short-term operating reserve, peak lopping, local backup power. Research and demonstration activities to assess these operational capabilities in practice would provide valuable learning for those companies interested to invest in energy storage and demand side management assets.

35.5 A second key barrier to the business case for electrolyser investment lies in the outlook for future markets for hydrogen generated, whether for road transport, via fuel cell vehicles, or for distributed or centralised power generation with hydrogen consumed via fuel cells or combined cycle gas turbines for combined power and heat. With hydrogen fuel cell vehicles only in the earliest stages of market introduction, the investment case for electrolysers as fuel storage and fuel stations is not yet proven.

35.6 Energy scenarios, such as those modelled by the Energy Technologies Institute ESME model, include scenarios where electrolysers generate hydrogen for storage and subsequent reuse in fast-response and load following generation assets designed to meet peaks in demand.

35.7 The other market opportunity for renewable hydrogen lies in its potential role as a means of decarbonising heat, whether as pure hydrogen or as hydrogen blended into natural gas or biogas. The policy priority to decarbonise heat is now recognised but a consensus as to the business case for different options has yet to be established. Further research and demonstration activities would be helpful to help assess the business case for renewable hydrogen for heat networks to developed.