Smart Electric Urban Logistics

Smart Charging Technology

Smart Electric Urban Logistics (SEUL) is a two-year project which commenced in April 2017, designed to support the wider transition to Electric Vehicles (EVs) for larger commercial fleets. Smart charging technology integrating energy storage as well as an innovative tool to assess existing grid capacity will provide scalable learnings from real-world operation and testing.

The SEUL project is led by UPS with project partners Cross River Partnership and UK Power Networks and is part of the Low Emission Freight and Logistics Trial funded by the Office for Low Emission Vehicles (OLEV) in partnership with Innovate UK.

For further information on the project background, please see SEUL Factsheet 1.

What is Smart Charging?

The integration of EVs is expected to increase peak demand on power distribution networks. This could require reinforcement of the local electricity grid which can be costly and time consuming. Previous work on controlling electrical loads demonstrated that mechanisms to control EV charging can be used to alleviate local constraints and reduce the need to reinforce the grid. The controllability of the EV demand during a charging session is referred to as 'smart charging'.

While smart charging is based on a communication standard between the EV and the charge post, the complexity of a smart charging system lies with the implementation of sophisticated algorithms which send curtailment commands to the charge posts. The approach of using software systems and algorithms to manage a network constraint is quite novel for power system applications. Traditionally all electricity networks were built with a 'fit-and-forget' mentality and used predominantly passive assets such as transformers and cables.

Smart Charging Technology deployed as part of the SEUL Project

Following an initial grid reinforcement exercise in 2013/14, the central London depot of global logistics firm UPS has a 1,250kVA connection agreement with the local Distribution Network Operator (DNO). However, full fleet electrification with uncoordinated EV charging in addition to existing on-site demand would require a connection of 2,200kVA. The deployment of smart charging technology will bridge this connection gap without the need for further physical grid reinforcement. The operational profile of the company provides a 12-hour time window to charge the EVs, which means that vehicle demand could in fact be spread throughout this time-window to lower peak demand. Upon evaluating different technologies and assessing several smart charging options, it was decided that the optimal set of technologies for the site would be a combination of an Active Network Management (ANM) and Energy Storage Systems (ESS).

The **Smart Grid system** that has been developed, installed and commissioned at the UPS site by UK Power Networks Services comprises four core sub-systems: a high-speed power meter, an Active Network Management system (ANM), an Energy Storage System (ESS) and smart charge posts. The following diagram highlights the four elements of the smart grid system.

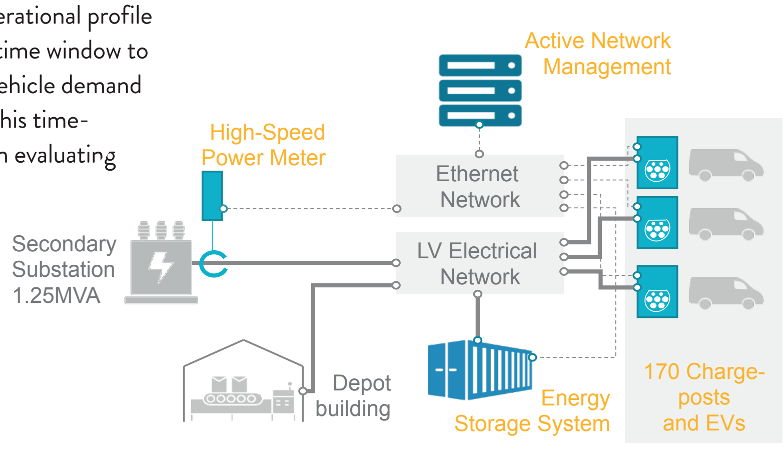

Figure 1: SEUL Smart Charging System

FACT SHEET 2

The **Active Network Management system** is a sophisticated software solution which is connected to all systems' interfaces and is responsible to dispatch the ESS and/or curtail the EVs when the site demand gets close to the capacity limit. The system collects information related to the site demand, the energy that has been supplied to each of the vehicles and the State of Charge of the ESS in order to prioritise the curtailment of the EVs.

The **Energy Storage System** is a flexible and fast asset that acts as a buffer and is dispatched to smooth the demand profile minimising the curtailment of the EVs. In addition to peak-shaving functionality, the asset can deliver several services including frequency and voltage regulation to further improve its business case.

The 11kW Type 2 **charge posts** that had previously been installed on site were retrofitted with a device to allow communication between the charge-points and the Active Network Management. They communicate with the vehicles as-per the IEC6181 standard.

The **high-speed power meter** is connected at the busbars of the transformer which powers the site and records, in a second-to-second granularity, data related to the total demand of the site, voltage levels and frequency.

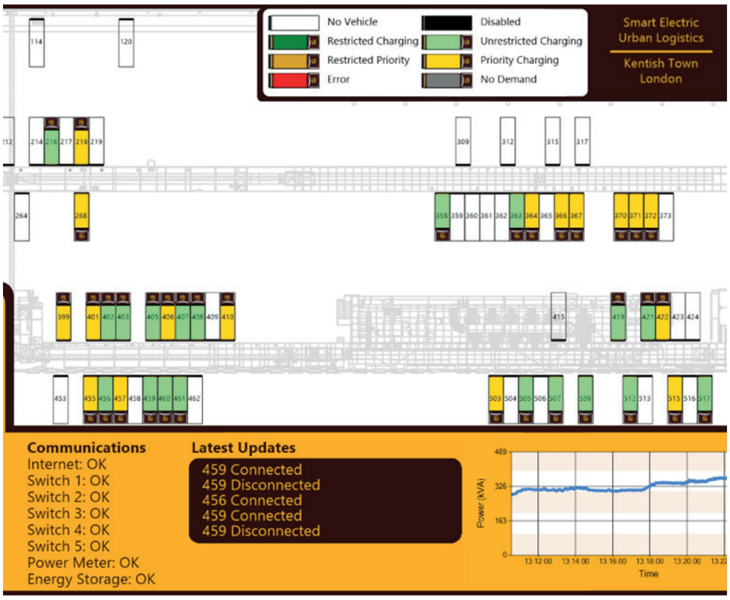

Figure 2: Live System Status

Key Learnings

Smart charging firstly reduces the capital expenditure (CAPEX) required to transition a fleet to EVs by minimising the grid connection capacity required, and making best use of existing assets. The technology can bring further commercial benefits by reducing operational expenditure (OPEX), such as the cost of energy, and could potentially earn revenues in the future. When considered with the reducing costs and improving performance of vehicles, smart charging will play a key role in enabling fleets to transition to EVs over the coming years.

The installation at the UPS site in central London demonstrates that smart-charging can support the optimisation of the use of existing assets. Here the system allows for a full depot of EVs with an uncontrolled peak demand of 2,200kVA to be charged on a 1,250kVA grid connection. It therefore avoids installing additional electrical equipment and reinforcement works on the local grid.

In the near-term, smart-charging can be used to reduce OPEX by capitalising on time-of-use tariffs, offsetting the vehicle charging to periods of low electricity cost.

Additional revenues can be earnt by providing ancillary services to the grid – controlling the rate of charge of vehicles to help the grid System Operator to manage supply and demand across the UK's network.

Both vehicle and smart-charging technology is developing rapidly. Developments will enable further optimisation of existing assets, such as integrating state of charge information of the vehicles into the system, allowing increased optimisation of charging. Additional revenues may be possible by using bi-directional charging and "Vehicle-to-grid" (V2G) technologies. These developments will ultimately lead to reduced CAPEX and OPEX for charging EVs in fleets.

Finally, business continuity must be considered throughout the project. For fleet operators deploying EVs, any unavailability of EV charging can have a substantial financial and reputational impact and thereby hinder future EV deployment. Thus, careful design, implementation and testing of fail-safe mechanisms is critical for the implementation of a successful system that can be adopted as Business as Usual by end-users.

For more information, please see
https://crossriverpartnership.org/projects/smart-electric-urban-logistics/

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