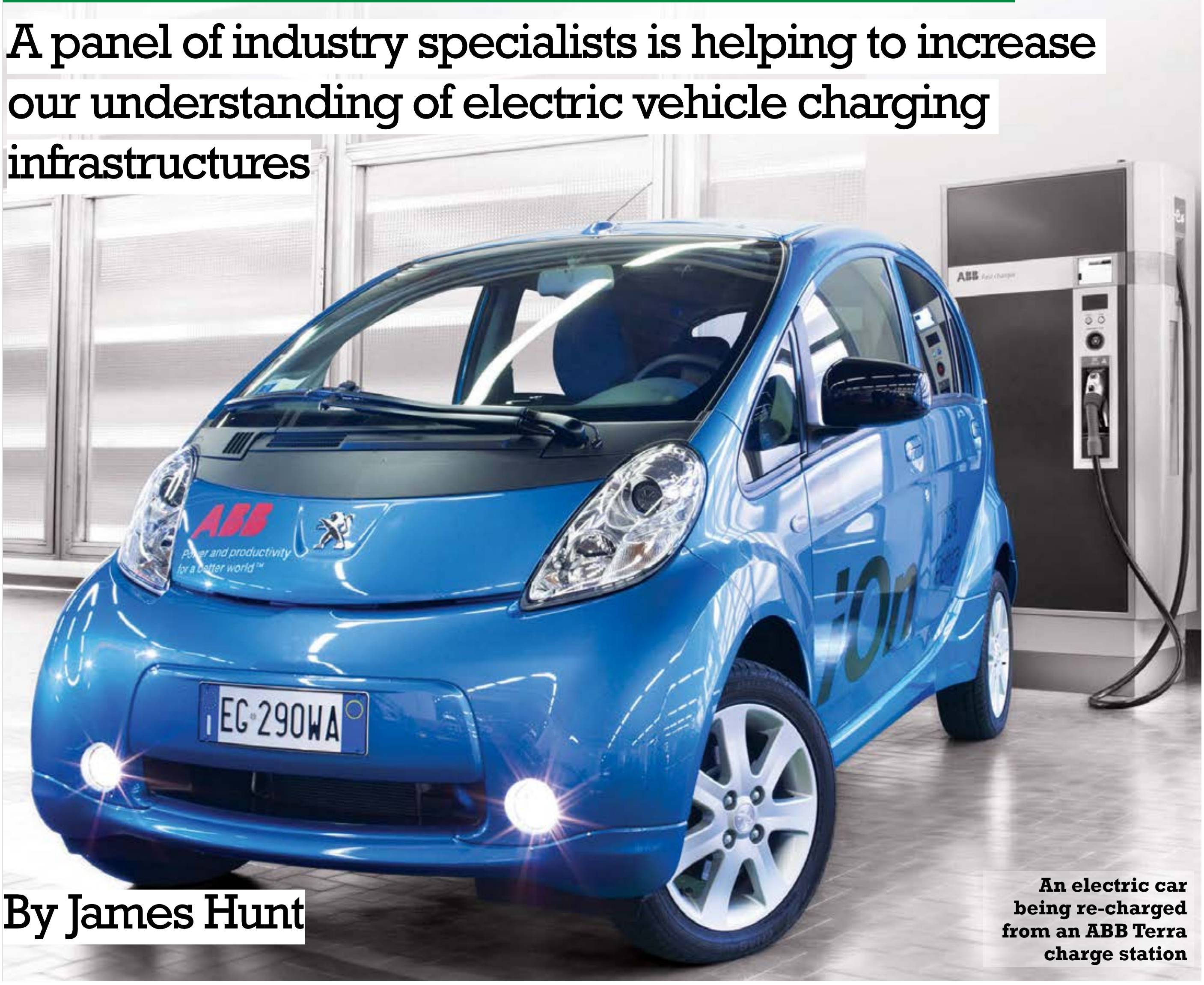
EXPERTS HIGHLIGHT EV CHARGING ROADMAP

A panel of industry specialists is helping to increase our understanding of electric vehicle charging infrastructures



By James Hunt

An electric car being re-charged from an ABB Terra charge station

COME 2015, EU regulations require passenger vehicles to meet a CO_2 emissions target of 130g/km – averaged over all new vehicles. With a fine of €95/vehicle/gm CO_2 for breaches of the limit, there is a clear incentive to reduce average emissions. One important way of achieving this is through the gradual replacement of IC-engined vehicles with electric vehicles (EVs). When this new sector reaches a certain critical mass in terms of EV sales, a substantial and fast-growing residential, commercial and public infrastructure will be required – together with the adoption of smart grids, grid control, charging equipment maintenance, remote diagnostics and status visibility for users.

In response to the fast-growing importance of EVs, the Web portal Voltimum (see p11 for details) has formed an EV Infrastructure expert panel made up of industry specialists. The panel publishes the latest regulatory and technical information, and answers queries. Members of the panel comprise representatives from Siemens, ABB, BEAMA, Schneider Electric, ECA, Legrand, Eaton and the IET. This article is based on content provided for *VoltiTECH*, Voltimum's e-newsletter, by the EV Infrastructure panel. The Siemens white paper 'Demand Response' illustrates the calibre of article contributed to the *VoltiTECH* EV issue entitled: 'Electric vehicle (EV) infrastructures – how to understand them'.

The white paper argues that in 'smart' cities of the future all grids will be monitored and controlled by one integrated system, minimising overall energy requirements and incorporating renewables efficiently. EV battery storage capacity will be integrated into the power grid, which will allow >

Plugging in to a charge - Schneider Electric recommends using the Type 3 socket, because it is the only one with safety shutters

< surplus wind-generated electrical energy to be transmitted to EV batteries when the grid load is low. The batteries will then feed and stabilise the grid during peak-load periods.

The charging infrastructure

Important variables include EV type, charging speed, long-term interoperability, UK wiring regulations, and charging modes, which are:

Mode 1 – Using a non-dedicated circuit and standard socket-outlet. This charges without cable-incorporated RCD protection over 10-12 hours. This mode is not advised since RCD protection cannot be guaranteed at all outlets.

Mode 2 – The EV is grid connected via household socket-outlets. Recharging is carried out via a single- or three-phase network and an earthing cable. Mode 2 is suitable for places having no dedicated charging installation, and for use by legacy vehicles. Cables have an integral control box with RCD set to a specific charging power and to guarantee protection. The household's existing electrical installation must be checked by a competent person and should be compliant with current industry regulations. EV manufacturers' guidelines must be followed.

Mode 3 – Suitable for domestic and public installations, this is preferred long-term. Chargers come either with a tethered cable or a dedicated socket-outlet, and they allow load-shedding so that electrical appliances can be run during EV charging (or to optimise charging times). Communications functions will be essential because of the smart meter roll-out. Off-peak charging and energy management is built into Mode 3 chargers, future-proofing them.

Mode 4 – This dedicated d.c. supply operates at 500V, 125A for rapid and service station charging, but the high current means it's unsuitable for domestic use. Integral control and protection functions are incorporated, and smart metering supports billing/ pay-as-you-go transactions based on energy consumption.

Siemens points out that smart grid real-time monitoring and control will use an energy automation communication infrastructure to collect dynamic status data about the grid and energy flows. Vast grid sizes mean distributed data aggregation to reduce the data volume to be processed by control centres. EV charging and billing will be a part of this; to avoid a still bigger grid load, coordination will be necessary to avoid peak-load increases – especially with fast charging, which will necessitate a decentralised energy buffer with careful demand response management.

Domestic charging

Most EV charging will probably be at home, and BEAMA's new guide 'BEAMA Electric Vehicle Infrastructure Project – Guide to Electric Vehicle Infrastructure' states that it will be crucial for consumers to charge their EVs responsibly, limiting the effect on the local electricity networks while maximising the potential for carbon reduction and energy management. Off-peak charging minimises local network demand, while consumers will use less energy and benefit from cheaper tariffs.

From a safety perspective, BEAMA points out that as domestic appliances rarely exceed 2kW, householders may be unaware of the dangers involved in handling electrical equipment – such as chargers – that could pose just such a risk, so each installation must meet BS 7671 requirements.

As the IET's new 'Code of Practice for EV Charging Equipment Installation' shows, BS 7671:2008(2011) does not specifically cover installing EV charging equipment, but it does allow full compliance with the Wiring Regulations. It provides recommendations on charge-point physical layouts, such as avoiding trip hazards, and providing labelling of BS 1363 sockets, which must be on dedicated circuits.

Domestic installations should be risk-assessed, noting that separate earthing system conductive parts should not be simultaneously accessible. Moreover, if an EV cannot be charged inside the building, then the building's PME earth should not be used; the charging equipment should be on an external TT earth. Alternatively, use equipment to disconnect the supply, or provide electrical separation via an isolating transformer.

The Code of Practice says that roadside and commercial chargers must not be connected to an unmetered supply, nor to a PME earth, nor loop wired. For purely commercial installations, charge points can be connected to the building earth externally (if part of a guaranteed TN-S system), or if the building has a steel structure, or has reinforced foundations.

Plugs and sockets

EV charging plug and socket-outlets are Types 1, 2 and 3 IEC 62196-2, BS EN 60309 industrial, and the BS 1363 domestic type. IEC 62196-2 defines a panel of sockets for Mode 3 charging. Schneider Electric recommends using the Type 3 socket, because it is the only one having safety shutters (mandatory in the UK) to minimise electric shock risk.

For fast-charging user safety, plugs and sockets feature extra pins ('pilot wires'), says Schneider Electric in its white paper entitled 'Connection Method for Charging Systems – a Key Element for Electric Vehicles'. The main control wire connects to the equipment earth through the EV's control circuitry and verifies that the EV is present and connected. It also allows supply energisation / de-energisation and transmits the supply equipment current rating to the vehicle while monitoring the earth presence.

For example, Eaton's Pow-R-Station DC Quick charger runs safety checks to verify that there is no chance of injury to users or damage to equipment. Until the EV has confirmed connection, the pins have no DC power – any disruption causes the power flow to stop immediately.

Key advice that Legrand gives to electrical installers regarding fitting an exterior socket, is to find out whether it will be used for EV charging. If so, there should be a dedicated circuit from the distribution board. This future-proofs the installation, should the customer subsequently install a proper charge point. It also reduces unwanted tripping of unrelated household power outlets.

Billing

'Smart' (automated) billing systems will be crucial for success. For example, ABB's Authorisation and Transaction Support allows EV charging infrastructure operators to efficiently manage access to their web-connected charging equipment. Charge session transactional data provides essential user level information, and charging operations are integrated into an existing central back office system using Open Standard Protocol Support (OCPP).

Designed for EV infrastructure and fleet operators, features include user ID white list management, remote authorisation, session start and stop, and session statistics (kWh, time, ID etc). Subscriber management can be via RFiD smartcards, text, smart-phone apps or online payment.

Standards

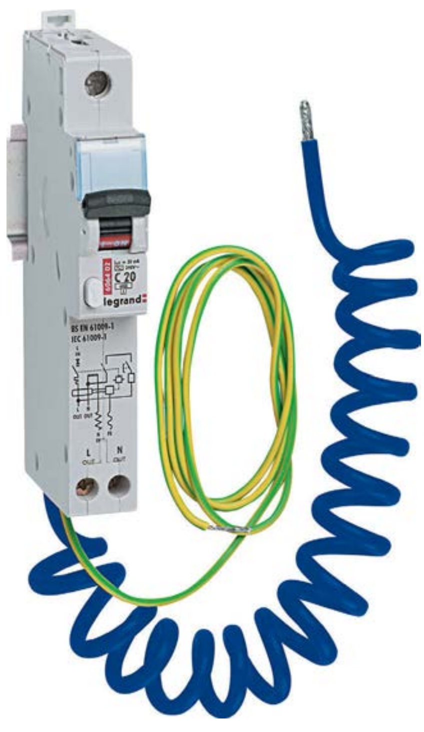
Electro-mobility growth means the development of new standards and a regulatory framework. The EC/EFTA issued mandate M/468 to CEN and CENELEC on European electro-mobility standardisation in 2010 to ensure interoperability and connectivity between the electricity supply point and EV chargers. It also considers EV smart charging issues and looks at safety risks and charger electromagnetic compatibility in terms of Directives 2006/95/EC (LV) and 2004/108/EC (EMC). National, European and international standards committees include the IEC, ISO, ITU-T, CEN, CENELEC, ETSI and BSI.

FACT BOX
VOLTIMUM

Voltimum is an electrical Web portal, which operates in a number of countries worldwide. This is a central source of information for electrical contractors and installers, panel builders, specifiers, consultants, manufacturers, trade associations and industry bodies (including the IET), and wholesale distributors. Voltimum is not a trading portal, but provides round-the-clock access to the latest industry news and events, training courses, technical information, and updates to legislation and regulations. Much rich content is provided by important industry partners, and then woven together by specialist journalists and editors. Search-engine optimisation expertise ensures high visibility in Web searches, while online video news reports present information in an enjoyable way.

Voltimum's award-winning monthly e-newletter, *VoltiTECH*, started publication in June 2003, and has now run to nearly 120 editions, covering a very broad spectrum of topics including regulations and standards, lighting technological advances such as LEDs, BS7671:2008 (2011) first amendment, surge protection, Building Regulations, circuit protection issues, electrical testing, building sustainability, and much more.

James Hunt in the managing editor of the UK arm of the Voltimum electrical Web portal. Further articles, based on key issues from *VoltiTECH* are planned for future issues of *Wiring Matters*.



An RCBO by Legrand - Mode 1 charging is not advised since RCD (or RCBO) protection cannot be guaranteed at all outlets