News & Highlights

# Charger Collaborations Power Global Electric Vehicle Expansion

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Kansas City, Missouri, is not a place most Americans would consider a trend setter. But amid surging global enthusiasm for electric vehicles (EVs), this midsize city located in the middle of the continental United States is helping lead the charge. It owes its new reputation as the "EV Mecca of the Midwest" to its electrical utility Evergy (formerly Kansas City Power and Light Company), which joined forces in 2015 with EV charging station manufacturer ChargePoint to install 1000 publicly accessible chargers throughout the Kansas City area [1,2] (Fig. 1).

With this joint venture, the utility jumped aboard a recently accelerating, worldwide movement towards collaboration among governments, power companies, EV and charger manufacturers, and others to boost the number of publicly available EV chargers and to improve their interoperability, both considered keys to large-scale global adoption of EVs [3]. Of the 50 most populous US metropolitan areas, Kansas City stood out in a January 2019 EV industry analysis as the only one at the end of 2017 to already have enough chargers for its projected number of EVs in 2025 [4]. About 75% of the other 49 metro areas lacked even half the chargers they are expected to need by then.

Driving and charging EVs must become as easy as using and fueling internal combustion engine vehicles for most consumers "to be willing to make the change to a next generation technology versus staying comfortable with the existing technology," said Robert Graham, a retired marketing and communications executive who headed the US Department of Energy's EV Everywhere initiative in 2015 and 2016.

An early lack of hardware standardization among EVs and chargers led to equipment incompatibilities, most notably between the so-called Charge de Move (CHAdeMO) charging standard from Japan and the combined charging system (CCS; also known as the "J1772 combo") standard originated in Europe [5,6]. The creation by high-profile EV maker Tesla of a proprietary "Supercharger" network has also hindered interoperability [7]. But today the EV industry routinely bridges the CHAdeMO-CCS hardware divide by outfitting charging stations with both systems; it also offers adapters for mating incompatible plugs and sockets [5].

Such accommodations have made hardware interoperability work well within the world's largest EV markets, said Peter Van den Bossche of Vrije Universiteit Brussel in Belgium, an EV standardization expert and the guest editor of a special issue on charging infrastructure for the *World Electric Vehicle Journal* [8]. Among those top markets, China ranks by far as the biggest,



**Fig. 1.** A direct-current (DC) fast charger in Kansas City, Missouri, in the middle of the United States, recharges an EV's battery. DC fast chargers deliver electricity at higher power and therefore charge vehicles more quickly than most other stations in charging networks. Of the 50 most populous US metropolitan areas, Kansas City stood out in a January 2019 EV industry analysis as the only one at the end of 2017 to already have enough chargers for its projected number of EVs in 2025. Credit: Evergy, with permission.

followed by Europe, and then the United States. Because China has its own national charging standard, known as GB/T, the EV and charger market there benefits from a high level of hardware interoperability, said Beijing-based EV expert Yali Zheng, deputy director of the Automotive Industry Research Department at the China Society of Automotive Engineers. China is currently working with Japan to create a new CHAdeMO 3.0 standard intended to be compatible with current CHAdeMO equipment, GB/T, and possibly CCS, as well as with anticipated, faster, higher-power chargers of the future [9].

Nonetheless, across the EV industry, hindrances to hassle-free charging remain, due to nonuniformities and insufficient cooperation among communications and control systems that govern charger operation; payments; tracking of electricity usage; and online, real-time reporting of operational readiness and other charger information [3].

"Now the problem is access," Van den Bossche said. For longer trips, especially across national borders in Europe, "you have to take half a dozen charging cards and charging passes." Charging-related apps generally are incomplete, he said, and chargers often lack transparency about the rate being paid, typically just a few tens of US cents per kilowatt-hour.

To overcome such barriers, alliances of charger makers and sometimes other EV infrastructure players around the world are devising and implementing standards and agreements as well as enhancing communications and data-sharing systems. The payoff could ultimately be sufficient interoperability (also known as "e-roaming") for an EV driver anywhere to readily locate a nearby charger online, verify remotely that it works, charge their car with it, and pay, regardless of charger brand.

Yali Zheng said that China has several apps for locating chargers and EVs can use most stations with equal ease thanks to the GB/T standard and improving networking among charger operators. As for payments, "that's easy for us, because we don't use cash or credit cards here very much," she said. Instead, many Chinese rely on mobile payment platforms, such as "WeChat or Alipay to swipe the phone and pay for everything." she said.

As the EV industry upgrades interoperability, other researchers and entrepreneurs are looking into additional ways to improve charging. Potential or recent advances range from wireless charging systems, portable chargers, and faster chargers of unprecedented power (like those envisioned at the 900 kW high end of the upcoming CHAdeMO 3.0 standard) to robotic chargers and experimental flow batteries that are reenergized by merely replacing used electrolyte fluid with a fresh supply [10–14].

In 2019, movement toward greater interoperability among EVs and charging stations picked up speed. Since its founding by a Germany-based consortium of automakers and technology and energy companies in 2012, the firm Hubject has been building a global, e-roaming network that by mid-2019 had 300 partner businesses in 26 countries, according to the company's website. Hubject has announced that it is working with charger manufacturer Electrify America to install thousands of new US chargers equipped to communicate with an EV, charge it, and collect payment automatically just from being plugged into the car [15]. In May 2019, Hubject also announced that it had signed cooperation agreements with four Chinese charger network operators to add 35 000 chargers to its already 100 000-charger plus network [16]. In June and August 2019 Electrify America and fellow charger manufacturers ChargePoint and EVgo, respectively, publicized agreements to provide mutual access to customers [17,18]. Even Tesla has recently begun to participate in charger interoperability, confirming late in 2018 that new Model 3 cars destined for Europe would accept the CCS charging plug [19].

In the past decade, electric car numbers worldwide have swelled more than 300-fold, from less than 15 000 in 2009 to well over 5 million in 2018, and "light-duty EVs," which include cars and small delivery trucks, are expected to further soar to 50–100 million vehicles by 2025 [20]. The global number of publicly available chargers has increased even faster, from just over 400 in 2009 to about 540 000 in 2018.

In the 2 million-population Kansas City metro area, with less than 500 EVs in 2015, the region's power company launched its clean charge network primarily to add ratepayers who would consume electricity during off-peak hours when EV owners typically charge their cars, said Jeffrey Beeson, Evergy's manager of product marketing.

Diminishing power usage from rising energy efficiency and other factors had been sapping the utility's revenue as the company still bore the growing costs of meeting peak energy demands [21]. "What we love about EVs," said Beeson, is that "they help disrupt that cycle by using more electricity when the grid is underused." Interoperability shortcomings have caused little concern locally, he said, because the utility intentionally installed only chargers made by ChargePoint or running their software.

The utility's "build it and they will come" strategy appears to be working. The number of EVs in the metropolitan region exceeded 5700 as of June 2019 according to the Electric Power Research Institute, Beeson said, an increase of more than 1000% since the charger network was launched.

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