EVALUESERVE

Industry Insight – Future Mobility Radar

Disruptive Charging Technologies and Trends Transforming the EV Industry

September, 2022

As demand for electric vehicles (EVs) is on the rise, there is a significant increase in innovation in the field of EV charging. Researchers across academic institutes are working to develop new technologies for 'on-board chargers' that enable quick charging and provide convenience to EV owners. Technologies such as **FAST CHARGING** and **ULTRA-FAST CHARGING**, and trends such as convenience charging and safe charging are expected to transform the EV ecosystem in the near future.

Disruptive Technologies

1. Fast Charging

Commercially viable EV batteries which are available today take about 10 hours to fully recharge at home. Even the fastest superchargers available in the market need 20–40 minutes to fully recharge them. Upcoming technologies, such as 800V charging and quantum charging, which charge batteries at a faster rate, are expected to change the EV charging scenario.

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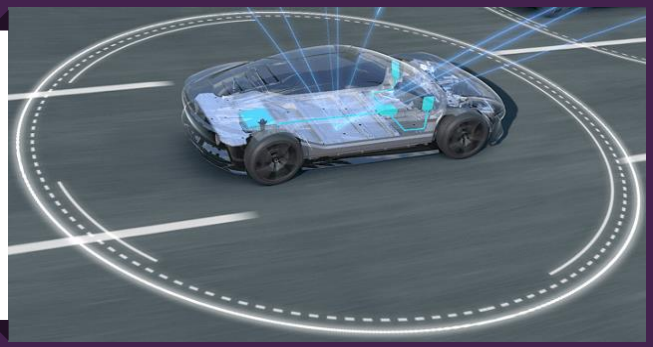
a. 800V Charging

The vast majority of EVs, barring a few exceptions, use 400V batteries. However, experts believe that new EV models from 2025 onwards will be built on an 800V architecture. The transformation will be fueled by higher voltage technologies that enable manufacturers to use fast charging batteries in their models (higher voltage for the same resistance results in more current being channelled into cells). Paired with fast-charging batteries, 800V charging technologies can theoretically deliver 10–80% charge in 10 minutes or less.

Several original equipment manufacturers (OEMs), including the following, have announced the launch of upgraded batteries as well as EV models based on 800V architecture.

BYD

BYD has introduced the **Blade Battery** in Shanghai, as part of its 3.0 e-platform. Compatible with 800V chargers, it will allow drivers to charge a 90-mile range in 5 minutes.



Audi has launched the **eTron GT** which is configured with an 800V battery that can hold 270kW. eTron GT will give drivers a better range and an incredibly fast charging time.

Audi

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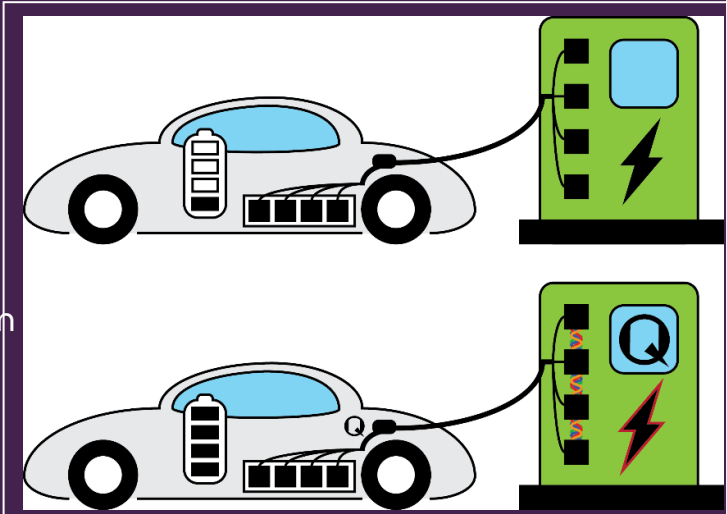
Hyundai

Hyundai has released the **Kia EV6**, which is configured with 800V battery and boasts a charging speed of 80% in 10 minutes. Kia has also launched an upgraded 800V version of its INOIQ 5 model, giving consumers more options, as they shop for fast-charging EVs.

b. Quantum Charging

Classical batteries, in which the cells are charged in parallel and independently of one another, do not support collective charging. However, entanglement (by means of quantum resources) can be utilized to vastly speed up the charging process by simultaneously charging all cells within a battery.

A research team at the Institute for Basic Science, South Korea has developed a quantum charging technology. The team claims that the new technology will reduce EV charging time from 10 hours to just 3 minutes. However, some experts believe that quantum technologies still need years of research before they can be commercially introduced to revolutionize energy use and bring about widespread adoption of green technologies.



A pictorial illustration of today's EVs and future EVs (based on quantum battery technology).

Ultra-fast Charging

In the near future, public charging of EVs is expected to be 'ultra-high-speed.' With the rollout of ultra-fast charging technologies, the industry is aiming to overcome major challenges to EV adoption, such as range and charging anxiety. Manufacturers are coming up with lithium-ion and solid-state batteries that are more stable at faster charging speeds. The recharge rates of these batteries could be around 20 minutes or less.

Several companies, including the following, have announced the roll-out of ultra-fast charging technologies.

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DESTEN

DESTEN™

Hong Kong-based energy sector company DESTEN has unveiled an ultra-fast charging battery pack that can charge up to **80%** of a battery in **4 minutes and 40 seconds.**

The Chinese electric car maker, Nio has unveiled a new 500kW fast-charging station that it will begin installing in China and Europe through the rest of 2022.

Nio

NIO

Storedot

StoreDot

CHARGING THE EV LIFESTYLE

The Israel-based EV battery startup, Storedot claims to be a pioneer in silicon-dominant extreme fast charge (XFC) cell production. Currently, its ultra-fast charging technology can charge the equivalent of 160 kilometers in just 5 minutes. The company aims to reduce the charging time to three minutes by 2028 and just two minutes by 2032.

At ~400V, today's fast charging stations already draw much more power from electric grids than the 120- and 240-V outlets many EV owners use at home. Therefore, even if technological advancements reach a point where EV batteries can be charged in less than 10 minutes, it is not clear whether ultra-fast charging will be a commercial reality in the near future. There are scientific and engineering challenges to overcome before ultra-fast-charging EV batteries become technically feasible and affordable.

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Disruptive Trends

1. Convenience Charging

Convenience charging, in which several players work towards solutions that make it easy and convenient for EV users to charge their vehicles, is expected to be the most disruptive EV charging-related trend in the near future. The following are some of the elements that will play a key role in the development of convenience charging.

a. Modular Scalable Charging

EV charging stations use fixed-power (50kW, 175kW, and 350 kW) chargers and need to buy additional chargers to increase their charging capacity. Modular scalable charging (MSC) platforms give charging stations the flexibility to increase the power level of their chargers. As EV tech advances, MSC platforms are likely to make station upgrades a lot cheaper than replacing existing chargers with powerful ones.

Several research institutes and manufacturing companies, including the following, are engaged in developing MSC-based charging stations.

Tritium

TRITIUM

Tritium, a global leader in DC fast charging technology for EVs, has unveiled the Modular Scalable Charging (MSC) hardware platform that provides customers with the flexibility to increase the power level of their charger as EV charging capabilities advance, and "pay as you grow". Charger power can be increased in 25kW increments, starting at 25kW and increasing to 350kW and beyond.

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Siemens has unveiled the MSC platform-based VersiCharge XL charging unit, which enables the placement of all infrastructural components of a unit above the ground, as long as it is in an enclosed structure. It requires minimal installation work and is designed to be installed in parking lots.

Siemens

SIEMENS

IIT Delhi

The Indian Institute of Technology, Delhi, has developed an environment-friendly, smart, and modular 20kW EV charger that is compatible with a wide range of EVs, including cars, three-wheelers, and two-wheelers; it also has a solar interface. Charger operators can purchase a 2-kW charger, based on their budget, to scale-up their capacity. The charger's output current can be controlled remotely based on grid load.

b. Doorstep Charging

Doorstep charging eliminates the need for EV users to charge their cars manually, as well as saves them from the hassle of installing and maintaining a charging point.

Hopcharge, a startup based in India, offers an on-demand EV charging service at the doorstep. It holds a patent that is valid in India and the USA. The company's rapid charging technology works across modular and mobile charging infrastructure. It can augment local grid capacity, thereby saving EV owners' time and minimizing the need for expensive grid upgrades. A Hopcharge charge will cost INR3–4 per kilometer, i.e.,

Hopcharge

hopcharge

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c. Plug and Charge

Full scope plug and charge streamlines the entire charging experience, and enables users to pay through a mobile app with a registered RFID tag, instead of having to use credit cards. For this type of charging, users need to connect their vehicle to a charging point via a cable or Wi-Fi (for wireless charging). Several players, including the following, have introduced this functionality to make a mark for themselves.

ABB has introduced its 'Plug N Charge' technology to simplify and streamline EV charging and payments. With Plug N Charge, EV owners can drive up to a charging point and plug a connector into their EVs. The payment is authorized automatically after a vehicle is fully charged.

ABB

GM

General Motors has taken its collaboration with EVgo (America's largest public EV fast charging network) a step further and launched a new plug and charge service as a part of its Ultium Charge 360 ecosystem. Plug and charge was already available to owners of the GMC Hummer EV pickup, Cadillac Lyriq, and Chevrolet Bolt EV / Chevrolet Bolt EUV models. Now, a wider category of GM consumers will have access to the facility.

The company's new ENYAQ iV model is plug and charge compatible. This functionality will be installed over the air for customers of the older ENYAQ iV model, once the company's ME3 software update is installed.

Skoda

ŠKODA

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d. Bi-directional Charging

Bidirectional EVs can receive energy (charge) from an electric vehicle supply equipment (EVSE), as well as provide energy to an external load (discharge) when it is paired with a similarly capable EVSE.

Germany has taken a big leap towards integrating electric cars into the grid. The German parliament has empowered the country's Federal Network Agency to define a framework to connect EVs into the grid and use them as remote batteries. The German government has provided 80 million Euro for research and development of bidirectional charging.

Several companies, including the following, have announced ambitious plans to roll-out bi-directional charging technologies.

PG&E and Ford

PG&E and Ford have announced that they will collaborate and explore how Ford's new F-150 Lightning EV (the first commercially available light-duty truck with bidirectional charging technology) can interact with the electric grid and be a viable option for consumers.

Wallbox

Wallbox has launched Quasar 2, a bidirectional home EV charger that allows users to charge and discharge their EVs, as well as power their homes and the grid through their car batteries. It also enables the use of charged EV batteries to isolate and power homes during blackouts.

There is a limited number of Wallboxes available in the market, and they cost significantly higher than standard EV chargers. For example, a Wallbox Pulsar Plus costs EUR619 (USD699), while the original Quasar1 is priced at EUR3200 (USD3,637).

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2. Safe Charging

Wireless EV charging is a safer alternative to traditional charging, as it enables users to do away with wires, eliminates the need for unsanitary handles to hold, and reduces the possibility of electrocution from broken handles. Moreover, with this technology, EV owners need not worry about getting out on the ice and snow to charge their vehicles in harsh and extreme weather conditions.

With wireless charging, EVs can be charged through a magnetic resonance system on the ground when they are parked over a ground pad. EV owners can park their cars over the ground pad and their vehicles will take in the energy. This technology can be extremely convenient for fleet vehicles, such as taxis, as it minimizes the time spent on charging and increases uptime.

Several companies, including the following, are planning to introduce wireless EV charging.

Siemens AG

SIEMENS

Siemens has invested USD25 million and has a minority stake in a US-based wireless EV charging startup WiTricity. The companies will advance technical developments in the field of wireless charging.

Electreon and Destia

electreon

The companies are collaborating to develop commercial wireless charging projects under which the former's wireless charging systems and operational and maintenance services will be offered alongside the latter's charging-as-a-service solution. Destia offers EV charging solutions for businesses and professional transportation service providers; its customers are primarily bus operators, logistics companies, vehicle manufacturers, and taxi companies.

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Volvo

Volvo has developed a technology that can add 60 miles of range to EVs in just 30 minutes. The company will release the technology through its XC40 Recharge EV models, which will be operated by a taxi company for the next three years. The wireless pads used for charging the XC40 Recharge EVs will be supplied by Momentum Dynamics, a US-based wireless vehicle charging specialist.

The Way Forward

The global EV charging market is expected to reach USD30.4 billion by 2023 and USD35 billion by 2026. The future of EV charging infrastructure is full of opportunities, and we expect to see the development of a range of next-generation vehicles and supporting components in the next few years. We also foresee a wave of collaborations in the near future among charging solution technology providers, OEMs, operators, utilities, and renewable energy players. As new technologies emerge and more companies embrace vehicle electrification, we expect to see key players of the EV revolution courting success. At the same time, consumers stand to benefit from accessible charging infrastructure and open networks and driver roaming agreements, such as GM's Ultium agreement.

At present, the main areas of research across both the industry and academia are EV charging and charging station technologies. Theoretical studies, practical experiences, and deep research in EV charging technologies are required for the establishment of charging stations and sustainable growth of the global EV market.

Government commitment is crucial to accelerating the rollout of charging infrastructure. Overcoming obstacles to the expansion of EV infrastructure to drive the transition from internal combustion engine (ICE) vehicles to EVs will need financial incentives and regulatory support, as well as favouring of the efficiencies offered by shared and autonomous EV vehicles.

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