

DC charging for EV: a decisive outlook for the power electronics industry¹

The total market value of power electronic devices for DC chargers will grow to **US\$347 million by 2026.**

OUTLINE:

- Market forecasts:
The market for plug-in electric vehicle² will reach about 24.5 million vehicles in 2026.
The market value of DC³ chargers will reach almost US\$18.5 billion by 2026 with a CAGR⁴ of 18.5%.
The total market value of power electronic devices for DC chargers will grow with a CAGR₂₀₂₀₋₂₀₂₆ of 21.5%.
- Technology trends:
AC⁵ common bus architecture is gaining interest...
Monolithic vs Modular: modular charger will remain the most common charger approach.
Converter topology: Vienna rectifier (for AC-DC stage) combined with LLC DC converter (for DC-DC stage) will remain the mainstream.
ANPC converter (for AC-DC stage) is also gaining in interest as well.

“While low-power DC chargers, up to 20-30 kW, are commonly based on a monolithic design approach, the modular design is dominant in high-power chargers.” asserts **Milan Rosina, PhD, Principal Analyst, Power Electronics and Batteries at Yole Développement (Yole).**

In the modular approach, a charger is built of several charger modules connected in parallel. The modular approach has advantages of high design flexibility, scalability, and availability.

¹ Extracted from:

DC Charging for Plug-In Electric Vehicles 2021, Yole Développement, 2021

Power Electronics for E-Mobility 2021, Yole Développement, 2021

² EVs that can be charged from an external charger. It includes Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs)

³ DC: Direct Current

⁴ CAGR: Compound Annual Growth Rate

⁵ AC: Alternative Current

In this context, Yole investigates disruptive technologies and related markets in depth, to point out the latest innovations and underline the business opportunities.

Released today, the [DC Charging for Plug-In Electric Vehicles 2021 report](#) provides market metrics and forecasts for DC EV⁶ chargers and analyzes the drivers and challenges for electric vehicles and EV charging infrastructure. Including market trends and forecasts, supply chain, technology trends, technical insights and analysis, take away and outlook, this study also delivers an in-depth understanding of the ecosystem and main players’ strategies.

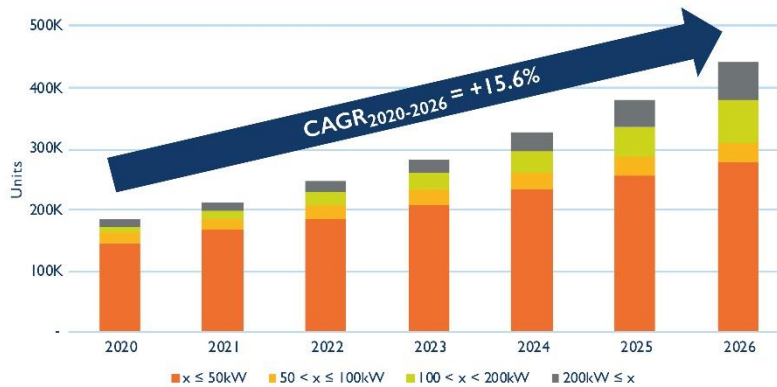
What are the economic and technological challenges of DC charging? How the electric and plug-in hybrid electric vehicles evolve and how is this impacting the DC EV charging market?

What are the key market drivers? How does the business models and supply-chains evolve?

Yole presents today its vision of the DC charging for plug-in-electric vehicles industry.

2020-2026 EV DC charger market in units - Split by power category

(Source: DC Charging for Plug-in Electric Vehicles 2021 report, Yole Développement, 2021)



As analyzed by Yole’s team in the new [DC Charging for Plug-In Electric Vehicles 2021 report](#), as discrete devices are suitable for both low-power monolithic chargers and high-power chargers based on low-power charger modules, discrete devices dominate the DC EV market. However, with increasing charger power, the number of related low-power charger modules is increasing beyond optimal levels. For example, for a 350 kW charger about 12 30 kW charger modules will be needed. Charger module manufacturers are looking to improve their products’ power density, efficiency, and to increase their nominal power to 50 kW and beyond to make them more suitable for high-power chargers.

According to **Milan Rosina from Yole**: “DC charger technology rapidly evolves, and many technology trends were identified and analyzed in this report. Two opposite trends exist regarding charger power. One is a power increase up to 350 kW and beyond in the future to accelerate charging and enable charging in heavy-mobility applications. The other is a power decrease from a historical base level of 50 kW as an alternative to AC charging solutions”.

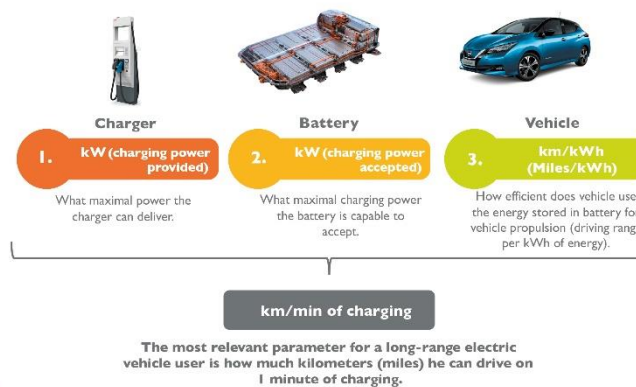
⁶ EV: Electric Vehicle

Charger voltage follows the trends in EV battery packs. As battery voltage increases from 400 V to 800 V levels, driven by Porsche, Hyundai and other car makers, the charger voltage increases from 500 V to 1,000 V. This results in the chargers using power components rated at 1,200 V.

Other trends include increasing use of SiC⁷ MOSFET⁸ devices, growing market share of power modules, bidirectional chargers for V2G⁹ and V2H¹⁰ applications, and battery energy storage to reduce peak loads on the electricity grid.

A new key parameter to compare different charging solutions and different vehicles and vehicle types - km/min

(Source: DC Charging for Plug-in Electric Vehicles 2021 report, Yole Développement, 2021)



Regulations and technologies for EVs, EV batteries and chargers evolve rapidly. This brings new opportunities or threats to the charging infrastructure companies such as ABB, Tritium and Tesla, but also to the companies involved in semiconductor and packaging materials, device packaging, industrial systems, EV/HEV¹¹ and battery manufacturers, and utility companies. Technology or business model differentiation is difficult to identify currently.

For Abdoulaye Ly, Technology & Market Analyst specialized in Electronic Power Systems at Yole: “Yole Développement therefore expects the reshaping of the supply chain and business models to continue in the coming years. Partnerships are crucial to ensure the compatibility between vehicle and charger, and can provide some level of product differentiation”.

One example is the network of 350 kW chargers operated by IONITY, backed by several leading car makers, including Volkswagen, BMW and Hyundai. Both car makers and utility companies have identified the opportunities in providing services to a large and rapidly growing portfolio of PHEV¹² and BEV¹³ customers. An increase of merger and acquisition activities is expected with charging infrastructure providers as main targets. As analyzed in this report,

⁷ SiC: Silicon Carbide

⁸ MOSFET: Metal Oxide Semiconductor Field Effect Transistor

⁹ V2G: Vehicle-to-Grid

¹⁰ V2H: Vehicle-to-Home

¹¹ EV/HEV: Electric Vehicle/Hybrid Electric Vehicle

¹² PHEV: Plug-in HEV

¹³ BEV: Battery EV

high-power chargers, fast-charging batteries and efficient vehicle powertrains represent a threat to the companies involved in hydrogen infrastructure and fuel-cell vehicles such as Toyota and Honda, and might also close the opportunity window for companies involved in battery swap solutions like NIO and Aulton.

Strict CO2 targets will push EV/HEV share to 38% of all passenger vehicles in 2026, representing a US\$5.6 billion market opportunity for various semiconductor technologies and power devices. In this regard, the market research and strategy consulting company Yole deeply analyzed the e-mobility industry in its latest report released last month: [Power Electronics for E-Mobility 2021](#).

All year long, *Yole Développement* publishes numerous compound semiconductor and power electronics reports and monitors. In addition, experts realize various key presentations and organize key conferences.



In this regard, Yole's analysts invite you to join them at the electronic displays Conference 2021 - [PCIM Europe 2021](#):

On May 4th:

- **Abdoulaye Ly, Technology & Market Analyst specialized in Electronic Power Systems**, will present the “EV DC Chargers, a New Opportunity for Power Electronic Players”

- **Ana Villamor, PhD, Technology & Market Analyst, Power Electronics & Milan Rosina, PhD, Principal Analyst, Power Electronics and Batteries**, will present “Battery, SiC, 800V... What else is needed by an Electric Vehicle Manufacturer to Differentiate from its Competitors?”

On May 5th:

- **Shalu Agarwal, Technology & Market Analyst, Power Electronics & Materials at Yole** will present “Power Module Packaging: Good enough Aspect is a New Target” on Wednesday May 5, 2021 at 2:00PM during the Industry Forum

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About our analysts

Milan Rosina, PhD, is Principal Analyst, Power Electronics and Batteries, at Yole Développement (Yole), within the Power & Wireless division. He is engaged in the development of the market, technology and strategic analyses dedicated to innovative materials, devices and systems. His main areas of interest are EV/HEV, renewable energy, power electronic packaging and batteries. Milan has 20 years of scientific, industrial and managerial experience involving equipment and process development, due diligence, technology and market surveys in the fields of renewable energies, EV/HEV, energy storage, batteries, power electronics, thermal management, and innovative materials and devices. He received his PhD degree from Grenoble Institute of Technology (Grenoble INP) in France. Milan Rosina previously worked for the Institute of Electrical Engineering in Slovakia, Centrotherm in Germany, Fraunhofer IWS in Germany, CEA LETI in France, and utility company ENGIE in France.

Abdoulaye Ly is a Technology & Market Analyst specializing in Electronic Power Systems at Yole Développement (Yole). As part of the Power Electronics & Wireless division at Yole, Abdoulaye's expertise is focused on power electronics system design. Prior to Yole, Abdoulaye served as an electrical engineer and power electronics system engineer at Centum Adetel Transportation Solution for 3 years, where he was in charge of converter design. He also performed simulations for catenary free tramways, tested qualifying Auxiliary Power Supplies (APS) for railway applications and managed a team developing a new battery cooling system. Abdoulaye graduated with a technical degree in 2014 from Bethune University Institute of Technology and in 2017 received an electrical engineering degree from Grenoble Institute of Technology.

Ana Villamor, PhD, is a Technology and Market Analyst for power electronics and compound semiconductors within the Power and Wireless division at Yole Développement (Yole). She participates in many custom studies and reports focused on emerging power electronics technologies, including device technology, and reliability analyses on MOSFETs, IGBTs, HEMTs, Power ICs, etc. She is also involved in various aspects of EV/HEV, and she has acquired in-depth knowledge of the power electronics industry. Dr. Villamor previously worked for ON Semiconductor as a Device Development Engineer, where she obtained her Ph.D. in a collaboration with CNM-IMB-CSIC. Moreover, she holds an Electronics Engineering degree and a master's degree in Micro and Nano Electronics from Universitat Autònoma de Barcelona (SP). Dr. Villamor has authored and co-authored several papers, as well as a patent.

About the reports

DC Charging for Plug-In Electric Vehicles 2021

EV DC chargers are a growing opportunity for power electronic devices, worth \$347M by 2026. – Performed by Yole Développement

Companies cited:

ABB, AVX, Blink, BTC Power, Chargepoint, Circontrol, DBT, EDF, Efacec, ENGIE, ENEL X, e.on, EVBOX, Evgo, EV Power, Exicom, Fortum, Greenlots, Hasetec, Hitachi, Huber+Suhner, Infineon, Ingeteam, Ionity, Izivia, JAE, JFE, Murata, Nichicon, Nio, Numocity, Okaya, OnSemi, Power Charge, Rectifier, Semikron, Senku, Setec Power, ShinDegen, Sicon EMI, Sinexcel, StarCharge, State Grid, STMicroelectronics, Tata Power, TDK, Tesla, TEPCO, Tgood, Tritium, Tvesas, UUGreenPower, Vestel, Watt&Well, Xcharge, Xpeng and more...

Power Electronics for E-Mobility 2021

Strict CO2 targets will push EV/HEV share to 38% of all passenger vehicles in 2026, representing a \$5.6B market opportunity for various semiconductor technologies and power devices. – Performed by Yole Développement

Related reports:

- [Li-ion Battery Packs for Automotive and Stationary Storage Applications 2020](#)
- [Power SiC: Materials, Devices and Applications 2020](#)
- [Status of the Power Module Packaging Industry 2020](#)
- [Status of the Power Electronics Industry 2020](#)



Press Release

About Yole Développement

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide... [More](#)

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