

Industry Analysis: Electric Vehicle Infrastructure

Equity Research Division - April 2023

Report Description

The objective of this report is to provide a contextual framework for the upcoming equity valuations which will encompass an analysis of companies operating within the electric vehicle (EV) charging sector.

Key Contents

- Industry Overview
- Market Trends
 - i. Drivers
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- Competitive Landscape

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Key Figures

- \$5.86 billion market value
- \$53.25 billion projected value in 2028
- 174,000+ charging stations worldwide
- 2.6 Industry Herfindahl Hirschman Index
- 6-12 month lead time for semi-conductors in the supply chain

Market Leaders

- ChargePoint (United States)
- Allego (Netherlands)
- TGOOD (China)
- Tesla (United States)
- ABB (Sweden)
- Blink Charging (United States)

Industry Overview

The electric vehicle (EV) charging sector emerged in the 1990s following the introduction of the first mass-produced electric cars. Due to the scarcity of charging infrastructure, EV owners encountered difficulties when traveling long distances. Although companies such as AeroVironment and Coulomb Technologies began constructing charging stations in the early 2000s, the market remained limited.

Substantial expansion in the EV charging industry occurred in the 2010s when Tesla established its Supercharger network, enabling long-distance travel in electric vehicles. Consequently, ChargePoint, EVgo and Greenlots, among others, developed fast-charging networks, which experienced swift expansion. By the close of the decade, tens of thousands of public charging stations were available worldwide.

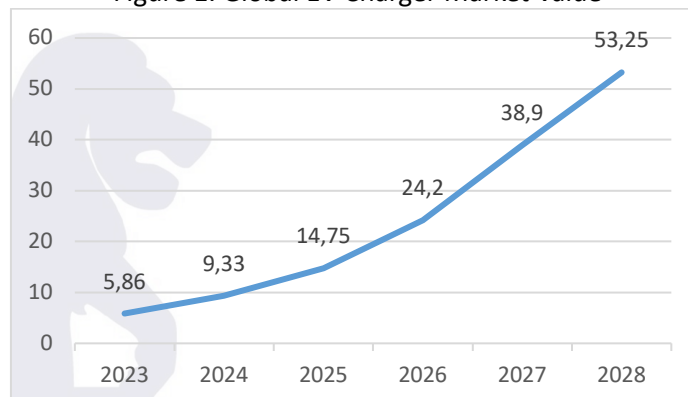
The EV charging industry has grown more diverse and innovative, with new entrants introducing inventive charging solution ideas such as wireless and portable chargers. Governments and utilities are supporting charging infrastructure expansion through programs such as the European Union's Green Deal and the US' Infrastructure Bill, while the European Union's ban on CO₂-emitting vehicles and the United States Inflation Reduction Act are spurring growth in the overall EV market.

The market for EV chargers is currently valued at around \$5.86 billion (Mordor Intelligence). Opportunities for new technologies and expanded consumer awareness offer new drivers of demand for the future to accompany government action. The industry faces challenges, however, especially given the fact it is still very young and certainly awaits future regulations which may impede certain businesses.

As disruptions in the global supply chain continue to have a greater effect on macroeconomic trends, sourcing materials and where to find them is of growing importance to companies around the globe. The Asia-Pacific is currently the largest and fastest-growing market, followed by Europe and the United States. The market is currently dominated by a few companies around the globe.

The EV charging sector has progressed significantly since its inception, and we anticipate substantial growth opportunities for the market in the future. The market is expected to reach \$53.25 billion in value over the next five years at a Compound Annual Growth Rate (CAGR) of 44.44%.

Figure 1. Global EV Charger Market Value



Source: Minerva Investment Management Society Estimates, Mordor Intelligence

Market Trends

Market Drivers

Global government initiatives and policies striving to reduce or eliminate carbon emissions from gasoline-powered vehicles have perhaps been the leading driver for demand for EVs and in turn, EV charging infrastructure worldwide.

- **European Union:** The European Union is already the global frontrunner in EV adoption policy. In February 2023, the European Parliament formally approved a law to effectively ban the sale of new fossil fuel cars from 2035, aiming to achieve a 100% cut in CO₂ emissions on any new cars sold. This new law also sets a 55% cut in CO₂ emissions from 2030, higher than the previous target of 37.5% set in 2021. New vans must comply with the 100% CO₂ cut by 2035 and a 50% cut by 2030. As a result, many European major carmakers have announced heavy investments in electrification.
- **United States:** California, amongst other states, has mandated zero-emission vehicles by 2035. Since the Inflation Reduction Act (IRA), effective as of August 2022, only passenger vehicles assembled in North America qualify for the \$7,500 federal tax incentive, catalyzing growth in the American market as this alleviates supply chain disruption concerns. Furthermore, the IRA lifted the previous manufacturer's cap of 200,000 sold vehicles for this tax incentive as of January 2023, eliminating a major roadblock for the continued development of the EV market in the United States. The IRA provides further incentives and rebates to drastically reduce the upfront costs of purchasing an EV for middle-class consumers, which until now has been perhaps one of the largest barriers of the EV industry, offering large tax credits to customers who qualify under set income brackets purchasing a car within set price brackets. The IRA additionally provides new incentives for used vehicles and commercial vehicles and trucks used in fleets. As a result, American carmakers have since announced major investments in electrification.
- **Asia-Pacific:** The Asia-Pacific region is likely to play a key role in the development of the EV market, as countries are rolling out incentives for the adoption of new technologies. China offers subsidies for EV purchases, as well as tax exemptions and other incentives. The Japanese government aims to transform all new cars sold in the country into electric or hybrid by 2050, also aiming to reduce CO₂ emissions from vehicles by 80% by that same year. South Korea offers tax incentives for EV purchases, as well as subsidies for the installation of public charging stations. As a result, Chinese, Japanese and Korean carmakers have announced heavy investments in electrification.

Technological advancements in charging infrastructures have further driven its market adoption.

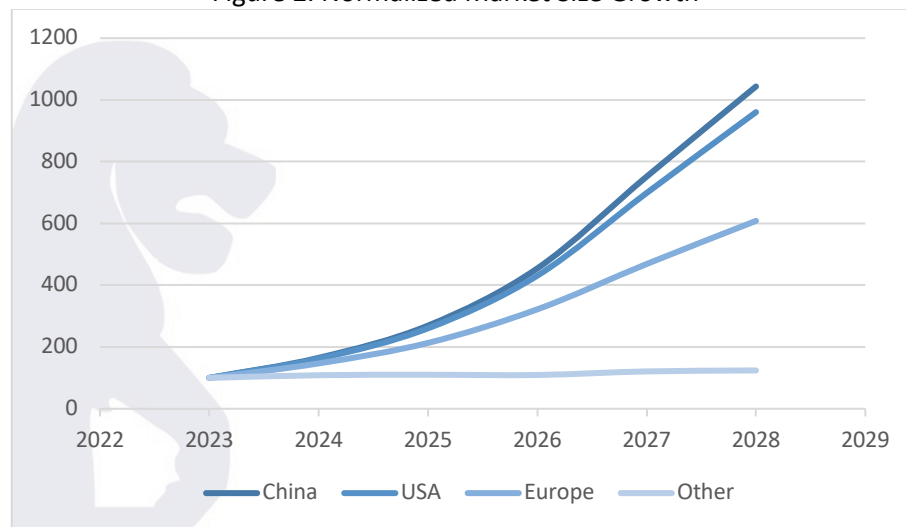
- **High-Speed Charging:** The development of high-speed charging stations has allowed for much faster charging times, making electric vehicles more practical for long-distance travel. For example, some charging stations are now capable of delivering up to 350 kW, which can provide 200 miles of range in as little as 20 minutes.
- **Smart Charging:** The integration of smart charging systems allows for more efficient charging and can help reduce peak electricity demand. These systems can optimize charging times to take advantage of off-peak electricity rates or when renewable energy sources, such as wind or solar, are producing excess energy.

- **Connectivity:** Many new charging stations now have built-in connectivity, allowing drivers to access charging information and status updates through their smartphones or other devices. This connectivity can also provide data to charging operators to help optimize charging schedules and ensure that stations are functioning properly.

There has also been a significant increase in customer awareness of electric vehicles and EV charging infrastructure in recent times which has catalyzed the industry's growth.

- **Environmental Concerns:** Climate change and environmental concerns have been at the forefront of public discourse, leading to increased awareness about the impact of transportation on the environment.
- **Marketing and Media Coverage:** The growing media coverage of electric vehicles and the associated charging infrastructure has helped to raise awareness and educate the public about the benefits of EVs. Automakers and charging infrastructure providers have also increased their marketing efforts, targeting potential customers and educating them about the benefits of electric vehicles and the availability of charging infrastructure.

Figure 2. Normalized Market Size Growth

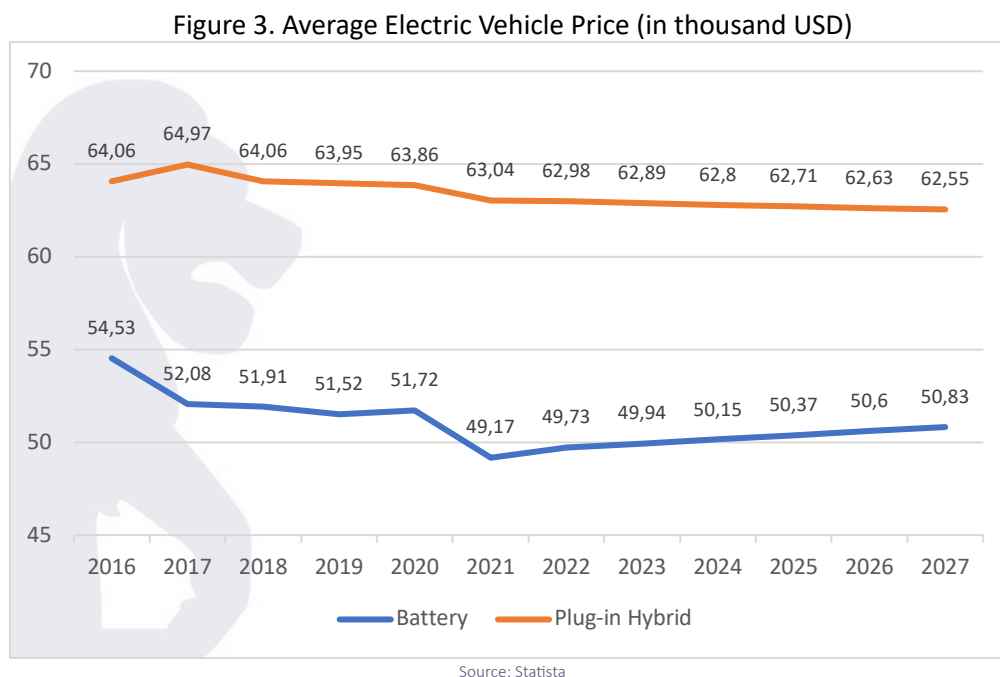


Source: Minerva Investment Management Society Estimates

Market Restraints

A key market restraint in the EV industry is the high upfront cost of purchasing an electric vehicle. This is largely due to the high cost of the batteries that power electric vehicles, as well as the relative lack of economies of scale in the production of EVs compared to traditional vehicles. While the total cost of ownership for an electric vehicle is typically lower than a traditional vehicle due to lower fuel and maintenance costs, the high upfront cost can still be a barrier to adoption for some consumers. While a variety of incentives and subsidies are available in certain geographies, EVs are still generally uncommon within certain social classes.

While the range of EVs has been increasing in recent years, it is still limited compared to traditional gasoline-powered vehicles. This can be a concern for consumers who regularly travel long distances.



Opportunities

The EV market has been characterized by high growth in past years; growing demand for EVs will need charging infrastructure to accompany it, justifying positive forecasted growth figures.

The development of new technologies, particularly within the charging space, is expected to further propel the demand for EVs and EV chargers.

- **Wireless Charging:** In recent years, there has been progress in wireless charging technology, which could eliminate the need for cables and plugs. With wireless charging, vehicles can simply park over a charging pad and begin charging automatically. While still in the early stages of development, this technology shows great promise for convenience and ease of use, which may further increase the consumer's willingness to adopt it.
- **Battery Swapping:** Some companies are exploring the use of battery-swapping stations, where a depleted battery can be quickly replaced with a fully charged one. This technology could help address the issue of range anxiety and allow for even longer trips without having to stop for an extended period to charge.

In general, there is currently a lack of EV charging infrastructure in many areas, which can make it inconvenient for EV owners to charge their vehicles. This can also be a concern for potential EV buyers who are worried about being stranded without a charging station; we view this as a market opportunity given charging infrastructures' upside potential as they are already in demand.

EV charging infrastructure companies are generally still relatively new and immature. This poses them as highly geared towards central bank action. In the foreseen potential situation of interest-rate cuts, notably where rate hikes have been the trend in recent times as in most geographies of interest, this would disproportionately benefit these young firms with such high-growth potential.

Challenges

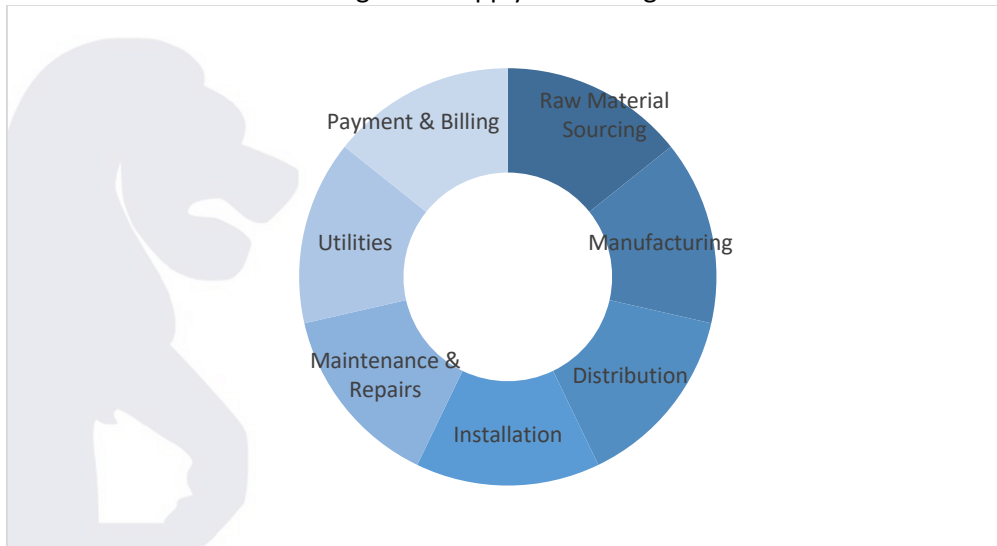
Regulatory barriers are a significant risk for the electric vehicle charging industry and are most likely subject to change given the market being juvenile and high growth. The lack of uniform regulations across regions and countries, or the rapid and volatile regulation changes within one geography itself can create confusion and uncertainty for businesses operating in the electric vehicle charging industry, leading to delays in investment decisions and slower market growth. Additionally, changes in government policies and regulations can lead to unexpected costs and operational challenges for electric vehicle charging companies.

The integration of electric vehicle charging infrastructure into the electric grid poses potential risks as well. Another concern is the potential strain on the grid if too many electric vehicles are charging simultaneously. This could lead to power outages or blackouts in certain areas, questioning the ability of the grid to handle the increased demand for electricity as more electric vehicles are adopted. The integration of charging infrastructure requires significant investment and upgrades to the grid, which can be costly and time-consuming. There is also a risk that the infrastructure may become outdated quickly as technology continues to evolve.

Supply Chain Analysis

The EV charger supply chain is evolving rapidly as the demand for electric vehicles continues to grow. This trend, which seems to be more consistent in the future, presents opportunities for companies involved in the supply chain from raw materials suppliers to end-user manufacturers. To keep pace with this demand, manufacturers must continually optimize their supply chain processes to ensure that they can deliver high-quality EV chargers to customers in a timely and cost-effective manner.

Figure 4. Supply Chain Stages



Source: Minerva Investment Management Society

Sourcing requirements for EV charging stations require specialist suppliers to have equipment, processes, and know-how to accommodate large form factors and highly aesthetic plastic housings. In addition, these suppliers must be able to provide mechanical housings that meet the demands of sealing, installation, maintenance, and repair.

The EV chargers supply chain can be quite complex. These are the several stages involved:

- **Raw Material Sourcing:** The components used to manufacture EV chargers include steel, aluminum, copper, plastics, and electronic components such as transformers and rectifiers. These raw materials are sourced from suppliers located around the world. This stage sees two facets: raw materials; semiconductors and electronic components. The most-known players regarding the former are Codelco, Alcoa, Tesla and Panasonic; regarding the latter, STMicroelectronics and Molex.
- **Manufacturing:** The manufacturing process for EV chargers involves several steps, including component assembly, circuit board assembly, final assembly, and testing. The manufacturing process may be outsourced to contract manufacturers or completed in-house by the charger manufacturer. The main companies involved in this segment are ABB, ChargePoint, Siemens and Schneider Electric.

- **Distribution:** Once the EV chargers are manufactured, they are shipped to distribution centers, which can be located locally or internationally. The distribution centers may also stock replacement parts and accessories for the chargers.
- **Installation:** EV chargers are typically installed by licensed electricians or by companies that specialize in EV charging station installation. The installation process includes connecting the charger to the electrical grid, ensuring that it is grounded properly, and testing the charging functionality. The main companies that operate in the installation field provide maintenance and repair services as well; the most important ones being AECOM, Black & Veatch and Burns & McDonnell.
- **Maintenance and Repairs:** After the EV chargers are installed, they require regular maintenance to ensure that they continue to function properly. Manufacturers may offer maintenance and repair services directly, or these services may be outsourced to third-party providers.
- **Utilities:** Electric utilities are also key players in the EV charging supply chain, as they provide the electricity that powers EV chargers. Some utilities, such as Pacific Gas and Electric (PG&E) and Southern California Edison (SCE), are also investing in EV charging infrastructure.

Other key players that are worth mentioning are the ones that operate in the Payment and Billing market such as Greenlots and EV Connect.

Overall, the EV charging supply chain involves a wide range of companies and stakeholders, from manufacturers to service providers to utilities and beyond, including both established players and new entrants in the market.

The current supply chain for electrification, however, reveals 6-12 months of lead time for semiconductors alone, given the ongoing component shortages. It comes as no surprise that the supply chain for the electric market is not nearly as mature as the traditional automotive supply chain, which is largely dependent on a regional supplier network and driven by mechanical parts. When it is time for necessary components to be delivered, trucks transport them. Those parts join the line as needed, resulting in assembly line fluidity.

Competitive Landscape

Global EV Market Overview

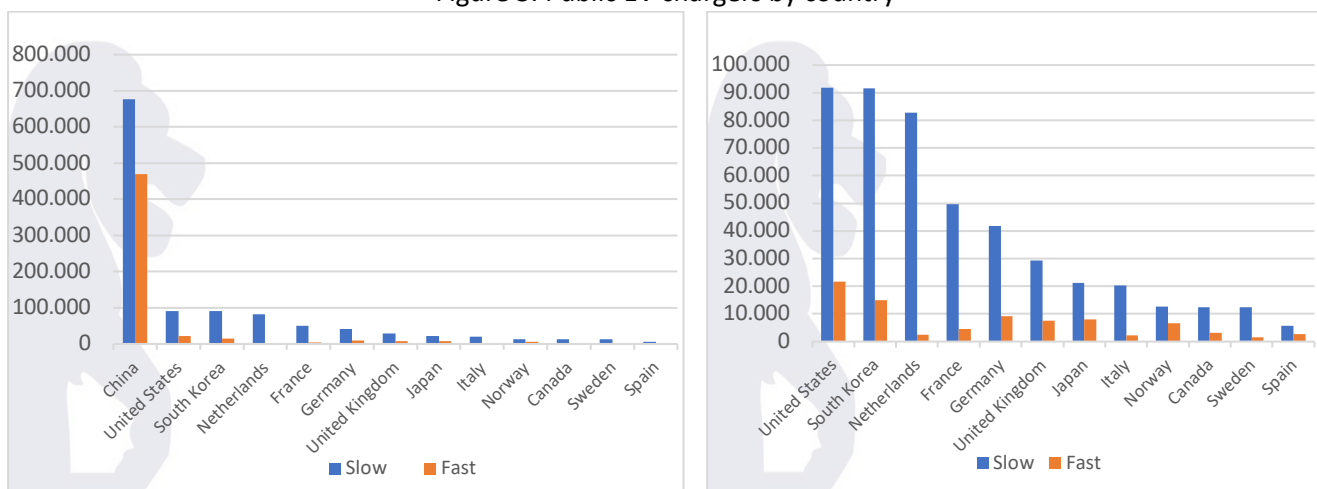
The economics of this fast-growing market is fundamentally different in the three major geographic areas: the United States, Europe and the Asia-Pacific. As things currently stand, in the United States, the percentage of fully electric vehicles sold is roughly 6%, while it has surpassed 20% in Europe. The market share of electric vehicles in China is roughly over 18%, 7% in South Korea and 6% in Japan.

The Asia-Pacific has by far the fastest-growing market. Geographical differences up to now have depended on several factors:

- Government and Politics: Asia-Pacific governments have employed larger incentives aimed at increasing both EV demand and EV production. Incentives in the US have not been as constant, with certain policy discrepancies between each state.
- Demand: The demand from both private customers and fleet managers is higher in China, Japan and South Korea, also because of the higher environmental awareness and cultural differences. Meanwhile in the US and Europe demand is driven only by customers from a few large cities, while it is still low elsewhere.
- Technology: The reason China's market is so developed is because of the advantages coming from their quasi-monopoly on batteries. China's investments started before everyone else's, granting them a huge competitive advantage. Other countries instead are forced to import batteries, increasing costs and complexity.

The more the EV market is developed in a country, the more the demand for EV infrastructure such as charging stations. Moreover, the reason demand keeps rising in Eastern Asian countries is that the existing infrastructure is more flexible and convenient. It comes as no surprise that Chinese companies account for the largest share of the market, also selling the most charging stations yearly.

Figure 5. Public EV chargers by country



Source: Statista

Competitive Landscape: EV Charging Stations

The market for EV charging stations is dominated by few players: the first 5 companies account for most of the market share, resulting in a concentration ratio close to 60%, although there are at least other 10 players which are be considered at least relevant with approximately 5% share each.

- USA: ChargePoint, Tesla, SemaConnect, BlinkCharging, Electrify America,
- Europe: Allego, ABB, Siemens, Wallbox, EVBox, Schneider Electric
- China: TGOOD, China State Grid, Star Charge, YKCCN

The Herfindahl Hirschman Index (HHI) for this market is estimated at 2.6. This indicates being right in between a high and a moderately concentrated one. Despite the high concentration ratio, some differentiation exists between the players, mainly because of the segmentation of the industry. Furthermore, economies of scale play a key role due to the rising demand: because of the lower range of electric vehicles compared to traditional ones, the importance of always available chargers is boosted. As environmental awareness and the demand for sustainable vehicles rises, having enough available and fast charging options creates an opportunity for firms.

While in 2021 only 1,600 charging stations were installed every week, this number is projected to reach 6,000 by 2025 and surpass 10,000 weekly units by 2030, insinuating that big players can leverage size to fill the existing gap. This is true for both companies that sell to private customers and for those that sell to commercial or public customers. Geographical location is of utmost importance; while installation demand will fiercely rise in established countries, underdeveloped areas and those in which the EV market has not yet expanded are not likely to witness the effects of the sustainable revolution.

Following is a brief overview of the select players mentioned above:

- ChargePoint: By far the market leader in the US with its 174,000 charging slots. What allowed this company to grow so big is that it predicted customer needs, anticipating not only the need for private chargers but also the needs of fleet owners and organizational entities. Rather than only relying on its hardware, the company chose to focus on the software side, developing a full-fledged network that offers many unique features such as the possibility for independent owners to even set the price to charge to their customers.
- Tesla: Known for its electric vehicles, this US-based company entered the charging stations market to fulfill its strategy of related diversification (batteries, solar panels, charging stations, and EVs). Tesla's Supercharger offers exceptional value for its price, making it more convenient for owners.
- Allego: With a unique approach, instead of selling its products or software to other parties, Allego relies on its proprietary software (Allamo) to locate premium charging locations by analyzing traffic data. The analysis is then used to forecast demand in strategic locations such as highways and other main roads. A last note to be mentioned is that Allego is fully committed to sustainability and climate goals: it only uses 100% green energy to power its charging network, which delivered 83 GWh of clean energy in 2021, equivalent to 414 million green km of driving.

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