

Team Project Report 1
Report on EV Charger Industry (1 x 8 = 8 p)
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Names of students who actively worked on this report: Zach Haley, Mike Fortin, Saheel Chavan, Jenny Patel, Naveen Murali

Note: each section is 1 p.

Industry Overview:

The electric vehicle (EV) charging market is expanding at a very rapid rate due to high EV adoption and supportive government policies. According to Axios [1], the United States alone has over 207,000 public EV charging stations, with California leading in infrastructure development. The worldwide EV charging market is predicted to experience a compound annual growth rate (CAGR) of 30% between 2023 and 2030 due to the demand for clean transport options [2].

It is also being prompted by technology. Ultra-high-speed DC chargers with a speed of up to 500 kW are significantly reducing the charging duration. Next-gen EVs have 800V battery packs which can charge and receive up to 300 kilometers of range from 10 minutes of charging time, as said by The Verge [3]. All such developments are not only making owning an EV quite convenient and comfortable but also simplifying it as well.

The other major driver of growth is the expansion in charging infrastructure. Virta Global [4] foresees that the charging points in the U.S. will rise from an estimated 4 million currently to over 35 million by 2030. This is required to accommodate the growing number of EVs on the road and remove the anxiety of running out of range for charging.

Government policies are also propelling the development of industry. The US government has already initiated several incentive programs, including the National Electric Vehicle Infrastructure (NEVI) program offering \$5 billion to create a national charging network [5]. California's proposal to phase out gasoline-powered cars by 2035 is also going to create further demand for charging infrastructure [6].

Trends:

- **Policy & Regulations**

In the U.S., potential policy reforms under the Trump presidency, like removing EV incentives and imposing fresh tariffs, might influence sales [7]. Meanwhile, the EU is proposing measures to boost EV demand, including zero tolls for zero-emission vehicles and stricter local battery manufacturing requirements [8].

- **Market Trends**

China continues to dominate the EV sector, with BYD leading global sales in 2024 at 4.3 million units [9]. In contrast, the U.S. and European markets experienced slowed growth due to reduced subsidies and high-interest rates, leading to Tesla's first year-on-year decline in a decade [9].

- **Challenges & Investments**

Slipping consumer demand has led companies like BMW to halt planned EV investments, as seen in its £600 million upgrade pause at the Oxford Mini plant [10]. Additionally, automakers like Stellantis and Ford are implementing layoffs to cut costs [11]. Limited charging infrastructure and high charging costs remain major barriers to wider EV adoption [12].

- **Technological Developments**

Advancements in battery technology, such as solid-state batteries, aim to enhance range and affordability [11]. Additionally, increasing the number of charging stations and optimizing their distribution are critical to accelerating EV adoption [12].

- **Second-Life EV Batteries and Recycling Initiatives**

The EV industry is prioritizing battery recycling and second-life applications to improve sustainability. Closed-loop recycling methods help recover valuable materials like lithium and cobalt, while repurposed batteries are being used for renewable energy storage. Governments, particularly in the EU and China, are enforcing stricter recycling regulations to enhance sustainability [13].

Overall, the EV industry remains one of the key drivers of the global energy transition, despite a complex and evolving market landscape.

Current Industry Challenges:

The transportation sector is a key driver of all developed nations, and the EV sector has evolved into a corporate behemoth. Despite its rise, 65% of Americans have never purchased an EV or owned one [14]. EV acceptance is positive with younger demographics, and expansion is in progress. The sector faces significant challenges, nonetheless. Overcoming these challenges is key to long-term growth and increased adoption. Five are the main challenges the EV sector needs to overcome as it moves forward.

- i. **Purchase cost**

The primary challenge in the EV industry is high purchase costs, due to expensive battery materials. While EVs save owners \$4500- \$12000 in operating costs [14], upfront prices remain steep, with fewer models under \$30,000. Gasoline vehicles continue to dominate the market with lower prices. As production scales increase costs should decline.

- ii. **Range Anxiety**

Range anxiety remains a key barrier to EV adoption, particularly in winter, when below freezing temperatures significantly reduce battery range [14]. While most EVs offer 200-300 miles per charge in temperature conditions, long trips require frequent recharging every 3-4 hours. With 80% of public chargers being level 2, charging can take 4-6 hours or more limiting convenience

compared to gasoline vehicles. Despite the average US driver travelling 36 miles per day (13,500 miles/year), EV infrastructure improvements are needed to support longer trips efficiently.

iii. Limited Selection

EV options in the U.S have grown from 3 models a decade ago to 28 models from 18 manufacturers in 2022 [14]. While sedans, hatchbacks and SUVs are expanding, truck and minivan choices remain limited. The Ford F-150 lightning saw such high demand that scheduled production already presold for an entire year in advance.

iv. Competition and technician availability

EV owners depend on dealerships for a service due to a shortage of trained independent technicians, making repairs more expensive [15]. While EVs require less maintenance than gasoline cars they lack competition to bring prices down. The slow growth of independent repair shops reduces affordability, while closed-loop service models from manufacturers like Tesla and Rivian further restricts competition.

v. Infrastructure & Profitability Concerns

Inadequate charging infrastructure is a source of range anxiety, but the \$7.5 billion Infrastructure Investment and Jobs Act will add 500,000 chargers to 75,000 miles of U.S. corridors [16]. Public charging networks, despite 56,000 units already installed, are grappling with profitability due to low revenue and costly installation and maintenance of fast chargers.

Case Study 1:

The industry leader in Electric Vehicles (EVs), Tesla, has once again continued to lead the evolution of EVs as it has focused in recent years on how to increase both supply and efficiency in their EV charging stations across the country Tesla first announced the use of its Supercharger station in 2012, and through the use of lean techniques, such as optimizing placement of their stations, standardization, and eliminating waste in their process has allowed Tesla to expand its EV charging network to keep up with the recent surge in demand for EVs [17].

Due to being the industry leader, Tesla has experienced multiple growing pains with implementing their charging stations, but through lean techniques has allowed the company to continue paving the way for the industry. One of the largest issues EV charging has faced since it was implemented was the long wait and charge times involved. Through rapid technological advancements within their Supercharging stations, Tesla has been able to improve charging times, now adding up to 200 miles in just 15 minutes, and a full charge in as little as 30 minutes [18]. To further improve their wait time issue, Tesla is set to implement a virtual queue system, which will improve wait times in high volume areas which will include things such as a reservation system that can help optimize efficiency in and out of the charging station.

Combined with implementing lean techniques such as Just-In-Time, Tesla has added over 7000 Supercharger stations worldwide to help match the growth in EVs on the road, which allows access to both Tesla and non-Tesla branded EVs [19]. Combined with these most recent changes, Tesla has recently announced upgrades to their Supercharger which includes the use of V4 chargers which allow up to 500kW of power, and changes to the layout of their stations such as larger spaces and longer charging ports [20]. This shows Tesla's use of lean has expanded, as they have been able to improve their current process and layout to adapt to the higher volume of EVs on the road, as well as appeal to non-Tesla EVs. The use of being able to charge across

brands will have a profound impact as result state policy changes, California in particular, are seeing a shift from combustion engines to fully electric vehicles by 2035

Overall, being the industry leader in EV, Tesla has experienced many headaches and issues as they have looked to improve their current processes. However, through lean and striving to improve their current processes, they have continued to lead the way in supplementing EV charging to match the ever-growing demand for EV vehicles.

Case Study 2: EVgo's Expansion of Fast Charging Stations

With EV adoption increasing, charging infrastructure needs to scale up quickly. Many drivers still worry about charging availability and reliability, especially on long trips. EVgo, one of the largest public fast-charging networks in the U.S., has been working to expand its network efficiently while overcoming key challenges [21]. A major part of EVgo's strategy is partnering with retailers like Walmart, Whole Foods, and Kroger. This allows drivers to charge while shopping, making EV ownership more convenient, while retailers benefit from increased foot traffic [22].

However, expansion comes with hurdles. Installation costs are high, some locations require power grid upgrades, and permit approvals can take months [23]. Additionally, charger downtime is a major issue, affecting both customer trust and station profitability [24]. To tackle these problems, EVgo adopted lean strategies:

- Standardized Installations → Reduced costs and sped up deployment.
- Utility Partnerships → Coordinated grid upgrades early to prevent delays.
- Predictive Maintenance → Implemented remote monitoring to detect and fix issues before they cause downtime.

By optimizing its processes and using technology to improve reliability, EVgo has expanded faster than competitors while maintaining efficiency [25]. Their approach highlights how lean practices, strategic partnerships, and proactive maintenance can help scale EV charging infrastructure effectively.

Current Industry *Lean* Challenges and Opportunities

The EV charging industry is growing rapidly, but expansion needs to be efficient and cost-effective. Here are some key challenges and opportunities for improvement:

- High Installation Costs & Slow Deployment – Fast chargers are expensive to install, and permit approvals can take months or even years [26].
Opportunity: Streamlining approvals and using modular charger designs can speed up deployment and cut costs.
- Lack of Standardization – Different EVs use varied connectors and payment systems, complicating the charging experience [27].
Opportunity: Universal charging standards and seamless payment systems would improve convenience and efficiency.

- **Charger Reliability Issues** – Many stations suffer from frequent breakdowns and slow speeds, frustrating EV drivers [28].
Opportunity: Remote diagnostics and predictive maintenance can keep chargers running smoothly.
- **Supply Chain Disruptions** – Shortages of key components like semiconductors and transformers slow down charger production [29].
Opportunity: Diversifying suppliers and increasing local production can reduce supply chain risks.
- **Meeting Consumer Expectations for Speed & Convenience** – EV owners want faster charging, more availability, and easy access [30].
Opportunity: Expanding ultra-fast charging, optimizing charger locations, and improving payment options can enhance the user experience.

For EV charging to scale effectively, companies must focus on speed, reliability, and smart planning, using lean strategies to reduce costs and improve service quality.

Proposed company to work with for Part 2

We chose to work with Evercharge, a charging solution company founded in 2013, specializing in EV infrastructure constraints and limited power availability [31]. Their product line includes Level 2 chargers, DC fast chargers, and charge-management software, with their patented SmartPower system optimizing power distribution based on real-time demand [32]. This innovation allows for increased charger installations without major electrical upgrades, making their solutions ideal for commercial and fleet applications [33]. Our connection to Evercharge comes through a team member's father. We are examining their EV charging manufacturing processes for lean implementation, as the company has yet to adopt such practices. According to the head of operations, “we do not practice much, if any, lean processes on our line,” though they acknowledge the potential benefits of doing so. We aim to establish a continuous information stream to provide valuable insights to the operations team. Currently, Evercharge faces operational challenges in meeting delivery expectations. While sales continue to secure projects, operations require up to two years to fulfill large orders—a critical issue as they struggle to keep pace with competitors [34].

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