Operation and Maintenance of Electric Vehicle Charging Infrastructure

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July 3, 2024

EV drivers rely on widespread and accessible charging stations to recharge their vehicles' batteries. To ensure reliable, stable, and scalable EV charging networks, Charge Point Operators (CPOs) invest significantly in both physical and logistical infrastructure, as well as in the software platforms that manage the charging networks behind the scenes. These infrastructure investments can be considerable. This blog explores the costs and processes involved in setting up, operating and maintaining EV charging networks, as well as the revenue models that make EV charging a viable business.

Set-up and Operating Costs of EV Charging Network

Set-up Costs and Challenges

Charging stations do not just spring up like weeds between the cracks in the pavement. To establish a new public charging station requires extensive planning and investment.

Real Estate - finding the right locale for a new charging station requires the same kind of analysis applied to launching a new branch of a fast food restaurant, café or supermarket. Deciding factors include local traffic patterns, access to highways and major thoroughfares, proximity to housing developments and business centers, and presence of competing charging stations. Also critical is the cost per square foot or meter of useful land to buy or lease.

Zoning and Permitting - even the ideal physical location for a charging station may not satisfy local zoning requirements. Some communities ban certain types of commercial establishment and have singled out filling stations in particular. Once a viable location has been selected, developers and CPOs usually must apply for permits to install charging equipment, as well as optional storage and solar generation facilities on-site.

Grid and Broadband Access - In most countries, the electric grid serves the majority of locales, even in remote locations. But not every lot is provisioned to meet the needs of a charging station. A new charging station may require additional electric service lines and will definitely need installation of industrial-strength wiring, breakers and meters. The same is true of Internet access: broadband coverage reaches ever-wider swaths of the globe, but local and regional ISPs may not yet offer high-bandwidth service to support new charging point locations.

Equipment Acquisition and Installation - charging equipment costs vary based on factors such as charger type, features and application. Features to consider include:

- Output type (Type I, II or III, AC or DC) and power (in kilowatts)
- Number and type of connectors
- Number of vehicles that can charge simultaneously
- Network connectivity and point-of-sale integration
- Sturdiness/theft resistance
- Available warranties and service plans

The cost for residential chargers varies from free (for Type I included with vehicle) and from US$250 to US$650 for higher current Level II chargers. For industrial-strength public chargers, acquisition costs run higher: US$1,500 to US$5,000 for Type II, and up to US$100,000 per connector for high-end Type III fast DC chargers. The number of charging ports at public charging stations can number over one dozen (four, on average), representing a substantial investment by station developers.

An additional set of costs come from on-site renewable generation and storage. Charging station operators increasingly complement grid connection with solar panels and battery storage, costing additional funds to buy or lease. With installation of "the full boat" - multiple chargers, electrical hookup, generation and storage capabilities, public - charging station sunk costs can reach several hundred thousand US dollars or more.

Operating and Maintaining an EV Charging Network

Operating and maintaining EV charging networks, like any modern business, includes a range of cost factors.

The Cost of Electricity

The primary operation cost for EV charging stations is of course electricity. While CPOs usually enjoy access to wholesale pricing from utilities, their actual costs depend upon

- the type of equipment installed and the current drawn
- the time of day and length of time customers charge their vehicles
- cost offset from onsite solar generation and time-of-day rate offset from local battery storage
- discounts and incentives from utilities for peak load reduction participation (and fines and overage charges from exceeding contractual limits)

Maintenance Costs

Unlike legacy diesel and gasoline pumps, electric charging stations have very few moving parts and in theory, boast much longer MTBF (mean time between failures). General maintenance for physical charging infrastructure includes

- periodic parts replacement and upgrades
- equipment cleaning
- repair and troubleshooting
- preparation for inspection by regulating authorities and required modifications

Equipment Warranties

Warranty pricing and coverage varies by charger manufacturer and model. While routine charging infrastructure maintenance is typically minimal, repairing broken chargers can be costly if out of warranty. Since charger availability is the main cause of "charging anxiety", maintenance contracts should include guaranteed repair tech response times, times for different types of repair, and equipment uptime guarantees. Charging station operators should anticipate maintenance costs of up to US$400 annually, per charger, with fast DC chargers costing double that amount.

EV Charging Management Software

EV charging stations are not just glorified electrical sockets. The business of operating an EV charging network and the stations that comprise that network is quite complex. EV Charging Management Software serves to manage and optimize the EV charging process, with benefits for CPOs and vehicle owners alike.

This software, usually delivered as a cloud-based SaaS (Software-as-a-Service), provides

- a streamlined user charging experience, especially via mobile apps
- real-time information on charging station operation, availability and charging speeds
- charging point occupancy and energy consumption
- automated charge session billing and payment processing
- support for roaming among charging networks and across state and international borders
- reporting and mitigation of power and equipment outages with alerts and diagnostics

Charging management software is quintessential infrastructure – its presence is invisible to EV drivers, but CPOs who use it for operating and maintaining EV charging networks, enjoy increased efficiency, improved revenues, rich data for decision-making and a bridge to future business.

In the past, CPOs spent considerable sums to develop proprietary charging management software, and even more over the lifetime of the management platform to maintain and enhance that software. Initial development and integration costs can run to hundreds of thousands of US dollars, with additional expenditure required for self-maintenance. Today, charging network operators have the option of integrating and customizing off-the-shelf EV charging management platforms, with more cost-effective professional support from dedicated vendors, including Driivz.

EV Charging Station Revenue

EV charging stations are resellers of electric power from the grid, and sometimes also act as micro-utilities, with their own generation capabilities.

EV Charging Fees

Charging EVs at home still represents the most cost-effective practice. But EV owners also need to charge their vehicle batteries when they are out and about town and on the road. When away from home, they look to public charging stations.

Commercial Charging

Charging EVs may appear to be a public service, but it's also a business, with costs to cover (see above). Those costs are passed onto EV drivers in three ways:

- Flat fees
- Charging time-based fees
- Fees tied to electric rates

Consumers either pay at the charging point with a credit card (as with gasoline fuel pumps) or increasingly, sign up for charging subscriptions offered by network operators and other third-parties. Subscription-based charging offers multiple advantages – discounts for network affinity and access to mobile apps that let EV drivers reserve charge points, find available stations, transparent roaming, and other conveniences.

Free EV Charging

Public charging points collocated with shopping malls and other retail locations sometimes offer free charging as an amenity for EV-driving consumers – customers leave their vehicles charging while they shop. Actual electric costs are typically borne by the site owner and passed onto commercial tenants embedded in rent.

But free public charging has caught to attention of local and state governments as a tax revenue generator (or a tax loophole). EV charging stations in several U.S. states now collect an electric fuel excise tax of 2-4 cents per kWH to compensate for fuel taxes lost to EVs. Moreover, in accordance with the Bipartisan Infrastructure Deal, charging stations will shift to charge EV drivers for the actual electricity used during a charging session, rather than how long they're plugged into a charger.

Data Collection

Today, any "serious" business treats data as a high-value commodity, with multiple opportunities to monetize that data through greater efficiency. For EV charging stations, this data can include customer information, system uptime and utilization, and myriad additional types of data. Such operational data can aid in load balancing, help track progress towards corporate and government energy goals, and determine whether pricing models and promotions are successful. Such "big data" also helps network operators assess the need for incremental investment in charging ports, generation and/or storage capacity, and even site selection for new charging stations.

Conclusion

Merriam-Webster defines *infrastructure* as

1. the resources required for an activity
2. the underlying foundation or basic framework (as of a system or organization)

EV charging fits this definition to a tee. Without the right hardware, software, economics and expertise for operating and maintaining EV charging networks, the ongoing revolution in transportation would not be possible. The next time you pull into a charging station and plug in your EV, remember the substantial technical and economic investment that enables your charging experience.