Electric Vehicle Charging Stations: Rate Considerations for Cooperatives

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Electrifying a significant portion of the U.S. light-duty vehicle fleet could provide kilowatt-hour sales growth opportunities for electric cooperatives. While distribution system upgrades may be required to accommodate large-scale use, much of the needed EV infrastructure already exists.

This report looks at the three types of electric vehicle (EV) charging stations (Levels 1, 2 and 3) and their characteristics while touching on the rate design of each.

Overview

Battery technology continues to revolutionize the utility and automotive industries. For electric cooperatives, EVs—whether plug-in hybrids (PHEV) that rely on the combination of an internal combustion engine and rechargeable batteries for propulsion or all-electric (battery-only) models (BEVs)—will impact utility operations both in terms of electricity sales and accommodating an emerging demand for EV charging stations.

EV batteries (16 kWh and larger) are generally fully charged after eight to 12 hours when connected to a regular 120-V outlet (Level 1 charging, up to 16 A) or more quickly (three to eight hours) using a Level 2 (240 V, usually around 40 A) charging station. Of course, charging times will take longer in cold temperatures.

Fast-charging stations using AC current (Level 3, 240 V, drawing up to 96 kW) and high-speed DC chargers (at 480 V DC and up to 120 kW) can replenish fully depleted EV battery packs to 80 percent strength in approximately 30 minutes. Fast-charging stations are being deployed at public locations (e.g., airports, shopping centers and highway truck stops) around the country to meet growing demand, although some EVs cannot use them at present time.

Charging Level Summary

Level	Charge Hub Markers	Power (kW)	Approximate Charging Time (Empty Battery)
1		1	8 to 12 hours
2		3 to 20, typically 6	3 to 8 hours
3 (BRCC)		25 – 120	30 – 60 Minutes

Level 1 and 2 Charging Stations

Level 1 equipment, standard on EVs, provides charging through a 120-V AC plug—a standard household outlet. Level 1 generally takes eight to 12 hours to completely recharge a fully depleted battery and will most likely take place at an EV owner's residence overnight.

Level 2 equipment offers charging through a 240-V AC plug requiring a dedicated 40-A circuit and installation of special charging stations. These units typically are compatible with all BEVs and PHEVs. Depending on the battery technology used, Level 2 takes four to six hours to completely recharge a fully depleted battery. Level 2 chargers are commonly found at apartment complexes, public parking areas, workplaces and commercial settings.

Level 3 Charging

Level 3 technology, usually high-speed DC chargers, works through a 480-V plug and results in an 80 percent charge in 30 minutes. Interestingly, no industry standard exists.

ChargePoint, which operates the nation's largest third-party network of charging stations, supplies charging equipment and software while leaving ownership of the hardware and electricity sales to local service providers. Other providers, like NRG EVgo, a division of NRG Energy, control all aspects.

Tesla Motors offers free high-speed DC charging for Tesla cars equipped with supercharging capabilities at 151 North America locations. Tesla's superchargers, which produce up to 120 kW of power, can deliver 170 miles of range in 30 minutes; in comparison, a Level 2 station would provide just 10 miles of charge (estimated for 30 A/7 kW) during the same period.

Load Management Worries

By helping spur investment in charging stations across the country, the NRG EVgo and Tesla networks will likely have a positive influence on EV adoption rates. However, their focus on high-speed DC charging coupled with a lack of time-of-use pricing could potentially create new peak demand concerns for electric cooperatives.

For Level 1 and Level 2 charging, no special metering is needed unless an electric cooperative desires to account for the charging separately from other loads. Level 3 charging, though, entails a very different approach. High-speed DC charging stations with appropriate equipment require 200 to 600 volts at varying amperages and 25 kW to 60 kW of demand; a few options are expected to reach 120 kW. Because of their commercial nature, Level 3 stations operate during the day and in large numbers will stress local and regional grids. In addition, the low load factor associated with Level 3 charging greatly affects rate designs.

Rate Studies

For Level 1 residential use, EV owners will likely recharge at night, where additional load is often welcome. Basic time-of-day (TOD) rate structures with discounts for off-peak load fit this profile.

Of course, large-scale penetration of Level 1 and Level 2 EV charging stations will lead to a boost in electric distribution investment and create some cost-allocation issues. Most EV applications apply to sales behind the consumer's meter, with TOD rate tariffs having energy charges differentiated by the generation component. Demand charges broken down by TOD periods are also a consideration.

Unbundled TOD rates provide valuable information to the consumer and, being more economically efficient, should interest electric cooperatives. The peak-to-off-peak differential in these rates has

narrowed in recent years as generation portfolios reflect an increasing penetration of natural gas in the power supply mix. For example, from an energy perspective, the heat-rate differences at current natural gas prices are narrow enough to not result in large cost variances; likewise, the construction price tag of a baseload combined cycle natural gas plant compared to a single-cycle peaking turbine remains fairly close. Therefore, when considering TOD rates, an electric cooperative must consider whether the structure should be cost-based, or alternatively, a TOD rate should be constructed to subsidize off-peak use to the detriment of peaking times.

Level 3 charging stations, as noted, are quite different. The demand they place on an electric system will occur during peak periods. Coupled with the investment in equipment, this will produce significant costs for a 30-minute charge. With Level 3 charging, imposing a demand component may be called for although the demand cost by itself could make service to such loads uneconomical.

Unfortunately, attempting to capture costs in the Level 3 energy charge would not likely produce a better result, and TOD rates may not be particularly useful since they fashion a peak rate for the anticipated use period. This type of problem is common when serving low load factor accounts. Therefore, flat rates—where consumers pay the same rate for each kilowatt-hour of electricity used, regardless of how much they consume—may be preferred for Level 3 stations.

To promote Level 3 charging stations and make them truly useful on a large scale, a subsidy that decreases the charging price by reducing demand-related costs may be necessary.

Main arguments for such subsidies are:

- Security: Produce a rate that would allow Level 3 charging stations to operate.
- Environmental improvements: Help reduce carbon dioxide and other emissions, fulfilling national policy.

Main arguments against energy subsidies are:

- They create inequities that are forced onto other consumers.
- May call for future distribution system expansion, which may further exacerbate the subsidy.
- Creates a slippery slope—what is the difference between a good subsidy and a bad subsidy?
- Cooperatives become a tool for social engineering.

Regulatory Policy

Because commercial EV charging stations not owned by a state-regulated or franchised utility could stand in violation of electric regulatory statutes, some states are beginning to wrestle with the subject. In Pennsylvania, third-party EV charging station owners are required to purchase electricity from utilities and resell that power to EV drivers with the goal of earning a profit. But that framework may restrict the ability of EV charging stations to actually turn a profit, which in turn serves as a barrier to entry. Similar laws regarding electric sales for resale codified in the Federal Power Act could also affect sales to non-utility EV charging stations and their providers.