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Transit Electrification: Challenges and Opportunities

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Introduction

In recent years, states embracing transportation electrification have come to realize that different parts of the transportation sector come with their own challenges and needs. Electrifying the transit sector is no different. Here we focus on the electrification of public transit and highlight some of the major topics that both transit agencies and public utility commissions (PUCs) can expect to confront as they endeavor to electrify transit services. The goal of this paper is to help utility regulators begin appreciating some of the fundamental challenges faced by transit agencies as they start to use electric buses, this relatively new electric end use. The paper also seeks to help transit agencies better understand electrification opportunities. Sharing these perspectives should be useful as states seek to secure the benefits of electrifying public transit fleets.

Transit Agencies and Electric Buses

As transit agencies around the United States look to convert their fossil-fueled bus fleets to electric vehicles (EVs), it is important to maintain focus on the goal that many states have adopted: reducing air pollution from the transportation sector. This is critical for meeting climate goals and improving public health by reducing exposure especially to frontline communities. The transportation sector is the No. 1 source of greenhouse gas emissions in

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the country. Air pollution emitted from transportation also contributes to smog and poor air quality, which have negative impacts especially on poorer communities located in close proximity to busy roadways.

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Pursuing a strategy that reduces emissions from bus tailpipes is an obvious way to pursue the goal. But, like any other business owners, transit providers need to deliver services that their customers value. They need to be certain that the conversion to electric transportation does not negatively affect the quality of the services that they offer.

Bus riders are sensitive to reliability and frequency. If buses don't show up as scheduled because they are pulled from service, or the agency must schedule them to run less frequently because it cannot keep enough buses in service, people will ride transit less and use personal vehicles, ridesharing, taxis, and other forms of driving more. Because transit agencies have experienced problems with the performance of electric buses, there is still a risk that transit agencies converting quickly to electric fleets could inadvertently cause people to ride transit less and drive individual vehicles more, defeating both the agency's service goals and a state's efforts to reduce pollution and improve public health.

The initial performance of electric buses themselves has been spotty, despite their promise to reduce air pollution and provide cleaner and more comfortable rides for passengers. For example, in 2018, the Los Angeles Times reported that the Los Angeles County Metropolitan Transportation Authority (Los Angeles Metro) found that their newly acquired electric buses "stalled on hills, required service calls much more frequently than older buses, and had unpredictable driving ranges below advertised distances." Despite those challenges, in October 2021, Los Angeles Metro announced its first 100% electric bus line, a roughly 20-mile route served by 40 electric buses. In the Los Angeles suburbs, Foothill Transit, with one route that runs 17 miles up into the San Gabriel mountains, concluded that a number of its electric buses had shorter than expected useful lives. In July 2021, Foothill indicated that it would return 13 first-generation electric buses, purchased in 2012 and 2013 with support from the Federal Transit Administration, that are experiencing multiple mechanical problems. According to Foothill Executive Director Doran Barnes: "With this first fleet, we have demonstrated a technical solution that for the most part has worked, but the economics behind it didn't work."

Some transit officials have expected such problems as new technology makes its debut on busy city routes, and that environmental benefits are worth the gamble. Some experts predict that electric buses will save transit agencies money over time through lower maintenance and fuel costs. Others are not so sure. A recent analysis at the Maryland Transit Administration indicated that, while an electric bus's operational costs would be nearly half those of a diesel bus, those savings would not make up for the current

procurement cost, though they might as procurement costs diminish due to future demand and achievement of economies of scale. Whether it is economical for transit agencies to convert to electric buses will depend heavily on variables like the upfront cost of buses, their useful lifespan, and the costs of fueling (charging) and maintenance. If buses must be pulled from service or replaced more frequently than their diesel or hybrid counterparts, related costs could be higher.

As transit agencies go through this transition, it will be critical to conduct acceptance and validation testing so they can rely on the electric buses they acquire. Agencies should use the acceptance period of their contract to test the full operation and functionality of each bus, under all the conditions that they expect a bus will encounter while in service. Validation testing includes assessing a bus's operating range under different conditions and its maneuverability in challenging parts of its service territory. It will also require a determination of a bus's level of performance under varying loads and when batteries are at a low state of charge.

As transit agencies explore this transition, these factors, including further federal government support, will continue to be important.

Things That PUCs Can Do to Support Electrification of Public Transit

Notwithstanding the many technical challenges associated with this transition, electrification presents an important opportunity to improve our public transportation sector. As transit agencies look to manage their way through this complexity, PUCs will also play an important enabling role. Existing utility practices and policies can help or hinder the ability of transit providers to successfully transition to electrification. Utility regulators can ensure those practices and policies serve the public interest. PUC actions can directly affect the cost of electrifying public transit, and because the technology itself is costly, anything that PUCs can do to remove barriers and reduce cost will be helpful to transit agencies.

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Planning

One way to support the adoption of electric buses is to ensure that utilities are prepared for how this will affect both the demand for and supply of electricity. States, through PUCs, can use their existing authority to ensure that utilities plan their investments through integrated resource planning (IRP) and distribution system planning.

IRP processes can provide utilities, regulators, and public participants an in-depth look at

energy demands over an agreed-upon planning horizon, such as 10 to 20 years. Fundamental to the success of IRP is credible modeling of projected demand trajectories. As states consider their ability to accommodate different types of EV charging needs, it will be useful to assess various deployment scenarios to gain a better sense of electric demand from the transportation sector.

Distribution system planning is another important way to anticipate distribution system needs as transportation electrification increases. The modern electric grid includes not only centralized power plants, but also distributed energy resources that may be located close to customers. Through "load management," for example, smart charging, utilities can manage distributed resources to provide customers with all or some of their immediate power needs. These resources are often flexible and can either reduce demand or serve as supply to help meet the grid's needs for energy, capacity, or ancillary services. This is the rationale behind managed EV charging and has implications for transit providers.

The traditional utility function of electricity distribution is being rapidly transformed into a complex net load management function involving thousands of points of power supply and millions of points of power delivery. Planning for and integrating this fast-developing assembly of resources — which can include the storage capacity of transit buses — requires a distribution system capable of measuring and responding to information from both system operators and consumers.

Distribution planning helps utilities optimize investments in their distribution systems and take into consideration the role that distributed resources like electric buses can play in providing efficient, economical, and reliable service. And regulatory oversight of distribution planning ensures the public interest is served.

As utilities and regulators analyze their ability to accommodate different types of EV charging needs — especially charging that requires high capacity, like the daily charging that transit agencies can expect to do — it could be useful for them to first inventory their subtransmission resources, i.e., power lines that typically operate at a voltage below 100 kV, and especially those that are underused or may have been abandoned. PG&E, for example, developed a guide and proprietary mapping tool for charging providers to identify sites with sufficient grid capacity and driver demand. The value in looking for existing subtransmission resources in this context is that they may be suitable for charging infrastructure. Vehicle charging could be an added use and produce an even greater return on these investments than was initially expected.

Finally, it should be emphasized that utilities and regulators need not undertake formal IRP or DSP processes to prepare themselves to respond effectively to the challenges associated with transportation electrification. The key is to undertake analyses that lay out rigorous scenarios in an integrated manner, in order to review the suitability of potential investments before they are made.

Recommendations:

Regulators, ensure that utilities:

- Model rigorous EV adoption scenarios and consider all resources – including supply, demand and DERs on the grid side – to ensure that power grids and supplies can meet the needs of EV adopters, like transit agencies, in the most advantageous and cost-effective ways; and
- Take responsibility to prepare for change by proactively engaging their customers, especially those with transit fleets, about their plans, and likely specific locations for incremental demand.

Transit agencies and advocates:

- Encourage utility regulators to see that electric utilities are planning meaningfully for electrification of public transit.

Make-Ready

The decision to connect a customer to a utility grid is influenced by policies and regulations that determine who pays for the infrastructure and what costs and benefits are considered at the time the decision is made. Today, the cost of line extensions is typically shared between the utility and the new customer. The utility's portion is included in its rate base, which is the total of all long-lived investments made by the utility to serve consumers, net of accumulated depreciation. It is recovered from all ratepayers because, over time, newly connected customers, through paying their bills, are expected to contribute additional funds to the utility's capital costs and eventually pay back the other ratepayers for this portion of their line extension and service line costs.

"Make-ready" refers to different types of infrastructure upgrades provided in the normal course of business by utilities to connect EV chargers to the grid. Typically, make-ready would apply to the utility's side of the customer meter and would include a line drop from the distribution system, transformer, trenching, concrete work, protective structures, and other construction-related costs. Make-ready can also include, on the customer's side of the meter, higher-voltage electric panels, conduit, and wiring.

The State of California recently determined that "utility-side make-ready" should be available to all customers, that it reduces costs of installing charging stations for cars, trucks, and buses by about 25%, and thus improves the economics of electrifying the transportation sector. The California PUC also directed investor-owned utilities (IOUs) "to educate and offer each applicant taking service under the new Rules about available IOU and third-party load management solutions."

Recommendations:

Regulators and transit agencies, consider encouraging utilities to propose make-ready tariffs for transit providers to lower agency charging costs, and condition service on the utility educating the customer about the potential benefits of load management or other smart charging offerings.

Rate Design

Rate design — the ways we pay for electricity — to signal value to consumers is not a new strategy for recovering utility costs and managing electricity demand. Utility companies should design rates for public transit charging that are time-sensitive and effectively communicate the costs at different times of the day to enable transit providers to take advantage of potentially lower-cost and less-polluting vehicle charging opportunities. There is a likelihood, for example, that system demand and system costs are usually lowest in the overnight hours, when it will usually be most convenient to charge transit buses.

In addition to a per kWh commodity charge that can vary over time, utility rates often impose demand charges — a charge per kW rather than per kWh — for commercial and industrial electricity consumers, the rate category in which transit agency charging depots are likely to fit. Demand charges give customers an incentive to manage how they use electricity to spread out their usage to reduce their individual peak demand. But demand charges do not necessarily provide an incentive for customers to adjust their usage in a way that is helpful for managing system peaks. If utilities and regulators are going to expect transit agencies to assist in managing their charging loads, this barrier needs be addressed.

There are various alternatives to recovering costs through fixed demand charges — for example, volumetrically, as is the case with Pacific Gas & Electric's Schedule 38 Large Nonresidential Optional Time-of-Day Standard Service. Another approach reflected in Southern California Edison's Schedule TOU-EV-9 Rate provides a moratorium on the use of demand charges with a phased-in approach. However rate designs are configured, they should ensure that the choices customers like transit agencies make to minimize their own bills are consistent with the choices that the utility would make to minimize system costs.

Recommendations:

Regulators and transit agencies, work with utilities to ensure that they are offering rate designs that afford transit providers access to reasonably priced electric energy, and encourage their most economical use of the power grid and the storage capacity of their buses while continuing to provide reliable transit service.

Advisory Services

A fleet manager's job is to ensure an organization's efficient transportation of people and goods. They are expert in a complex set of arrangements that include planning, budgeting, financing, purchasing, operations and maintenance, and scheduling vehicles that use fossil fuels. How can they readily understand their options for alternative vehicles like electric buses, and fuels like electricity? The answer is with the help of "advisory services."

These are programs or services offered by utilities or other companies that see an opportunity and are designed to educate and enable consumers like fleet managers or individuals. Advisory services can fill the gap between what consumers like fleet managers already know about transportation and what they need to know about electric transportation. While available in different models, advisory services have one thing in common; they manage the complexity, a very real barrier to the adoption of electric transportation.

Advisory services might help a transit provider that is interested in electrifying its fleet. These services could help match the transit agency's needs with, for example, the capabilities of different types of vehicles, vehicle procurement, planning to meet the needs of the operator's fleet driving patterns, helping the operator plan to support those routes by strategically locating infrastructure, analyzing the related costs of doing so, and other performance issues.

Recommendations:

Transit agencies, to better ensure the successful transition of your fleets, determine whether utilities in your jurisdiction offer advisory services or if they cooperate with other companies providing these services. Furthermore, encourage utility regulators to see that utilities are providing support to transit agencies as they endeavor to electrify their fleets.

Regulators, encourage utilities to provide these services, and to seek reasonable cost recovery for their provision. Recognize that third parties may be able to provide the same service at competitive rates.

Conclusion

Public utilities and utility regulators can promote their state clean energy and public health goals by helping transit agencies to transition their services into the 21st century. With the engagement of transit providers and the support of utility regulators, this modernization can take place with significant benefits for the public.

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