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Electric Utility Investment in Truck and Bus Charging

A Guide for Programs to Accelerate Electrification

Union of Concerned Scientists

The time has arrived for electric trucks and buses. To accelerate their deployment, electric utilities have two key roles to play: investing in charging programs and designing fair, sensible electricity rates.

Both steps would catalyze the market for these vehicles and help maximize the benefits of electrification for all electricity customers. Those benefits include the potential to reduce local air pollution and heat-trapping greenhouse gas emissions.

Utilities are well suited to be early investors in vehicle charging programs. For one thing, they face lower barriers to making grid-related investments than do other entities. Just as important, utilities have expertise about the electric grid. They are a critical partner in managing electric truck and bus loads to enhance the grid services these vehicles can offer.

Already, electric utilities in many states have begun to pursue charging programs for electric vehicles (EVs). With the exception of programs in California, where nearly two-thirds of the $975 million approved to date is for charging trucks, buses, and other heavy-duty vehicles, utility programs have focused largely on passenger cars and light trucks (CPUC n.d.a). However, the need for widespread vehicle electrification to meet goals for reducing greenhouse gas emissions, as well as for improving local air quality and public health, is too urgent to delay truck, bus, and other heavy-duty charging programs. In addition to catalyzing the electric truck and bus markets, the timely development of charging programs will enable utilities to prepare the electricity grid now for the eventual widespread deployment of medium- and heavy-duty EVs.

In 2018, the Union of Concerned Scientists (UCS) identified key principles that should guide utility investments in the nation's EV infrastructure (Gatti 2018). Building on those principles, UCS now provides recommendations for proactive steps that electric utilities can take to develop the infrastructure and rate designs needed for truck and bus charging.

The Importance of Electric Trucks and Buses

Medium- and heavy-duty vehicles, including trucks and buses, represent only about 5 percent of the vehicles on US roads and highways, but they contribute 29 percent of the climate emissions from vehicles (BTS 2018; OTAQ 2018). Trucks and buses also generate a large amount of localized, smog-forming air pollution that affects health, heightening risks of heart and lung diseases among other ailments (Heffling and O'Dea 2018). Moreover, these vehicles expose communities near highways, freight facilities, and ports to especially high levels of pollution. The residents of those communities are likely to be low-income or people of color (Mikati et al. 2018).

Fortunately, advances in vehicle and battery technologies make electrification increasingly viable for addressing pollution from trucks, buses, and other medium- and heavy-duty vehicles. Nine manufacturers now offer electric versions of standard, 40-foot transit buses (O'Dea 2018a). Already, more than 340 electric buses operate on US roads, with another 1,200 transit buses on order (Raudebaugh 2018). Across the country, commitments to transit electrification by cities and states are adding up to a major transition in the nation's fleet of about 64,000 buses (NTB 2018). For example, New York City plans to electrify all 5,700 of its buses by 2040 (McKenna 2018). California's transit bus standard will result in more than 14,000 battery- and fuel cell–electric buses by 2040 (O'Dea 2018a).

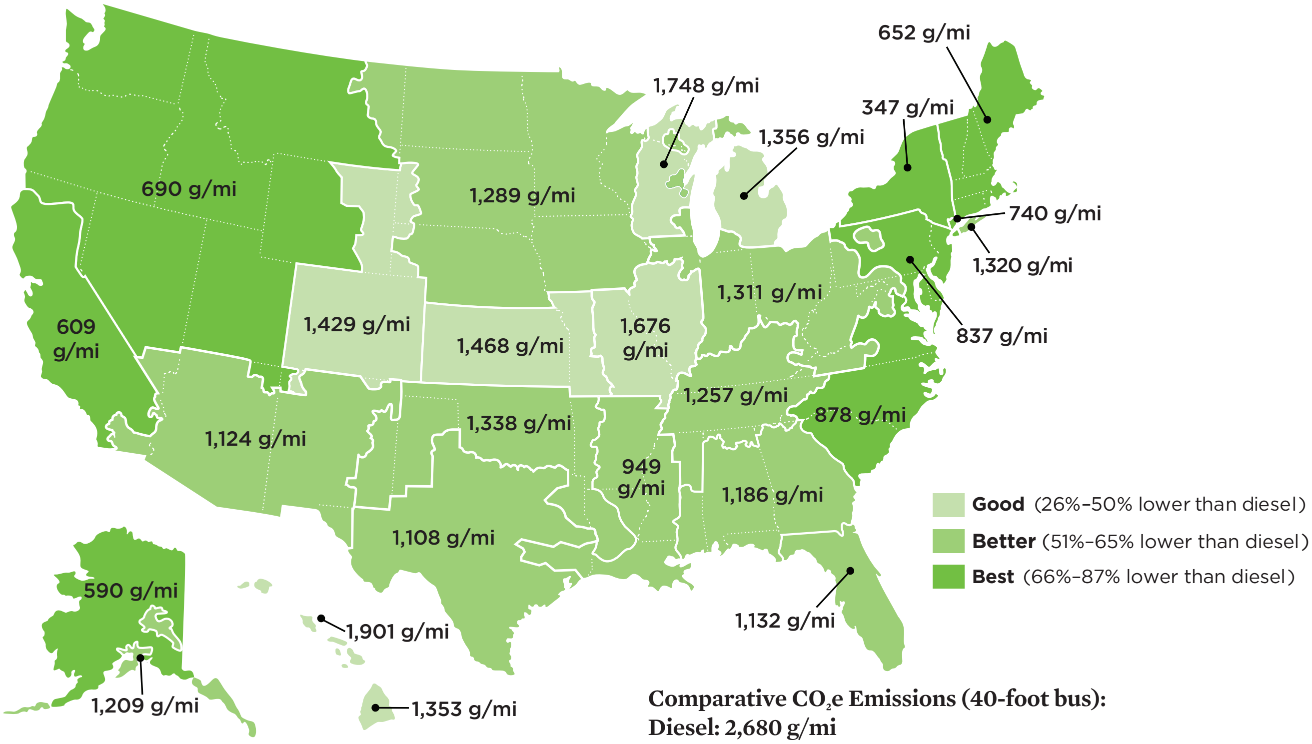
[*In every state, electric transit buses have lower greenhouse gas emissions than do diesel- or natural gas–powered buses.*]

Fossil fuels still dominate electricity generation nationally, yet UCS has found that, in every state, electric transit buses have lower greenhouse gas emissions than do diesel- or natural gas–powered buses (Figure 1). For example, the electricity mix used to fuel a 40-foot electric transit bus in New York State emits only 347 grams of carbon dioxide–equivalent per mile (g CO_2e/mile) (O'Dea 2018b). A comparable diesel bus emits 2,680 g CO_2e/mile, and a comparable natural gas–powered bus emits 2,364 g CO_2e/mile (O'Dea 2018b).

Further, EVs are getting even cleaner as more renewable resources come online and emissions from generating electric

Cover photo: Greensboro Transit Authority

FIGURE 1. Per-Mile Life Cycle Greenhouse Gas Emissions for an Electric Bus, by Grid Region



Comparative CO_2e Emissions (40-foot bus):
Diesel: 2,680 g/mi
Natural gas: 2,364 g/mi
Electric bus (US average grid): 1,078 g/mi

In every region of the country, buses charged on the electric grid have lower heat-trapping greenhouse gas emissions compared with diesel- and natural gas–powered buses.

Note: Values represent per-mile emissions over the fuel life cycle of equivalent 40-foot electric, diesel, and natural gas buses made by New Flyer. Regional greenhouse gas emissions based on EPA 2018. Emissions from electric, diesel, and natural gas production estimated with ANL 2017a and ANL 2017b. 100-year global warming potential of greenhouse gases from IPCC 2014.

power decline. Available models range from school buses to delivery trucks to port equipment, and truck manufacturers continue to bring new products to market.

In addition to greenhouse gas reductions and improved air quality and pubic health, replacing trucks and buses with electric models can benefit the electricity grid itself and thus all utility customers. EV charging is a somewhat flexible load on the electric grid: fleet managers have some ability to shift charging to times that are better for the grid to take advantage of times with lower rates. For example, overnight charging, when other demands on the grid are low, is often compatible with the charging needs of truck and bus fleets. Managed charging can use grid resources more efficiently and make it easier to incorporate renewable resources into the electric power mix (O'Connor and Jacobs 2017). Using grid resources more efficiently and spreading transmission and distribution costs over additional electricity sales from EV loads can put downward pressure on electricity rates, a benefit for all electricity customers (Cohen 2017).

Advancing Electric Truck and Bus Deployment: Recommendations for Utility Programs

Utilities are at various stages of considering investments in charging infrastructure and rate designs for the growing market of electric cars, trucks, and buses. Based on current utility efforts and on consultations with various stakeholders, UCS has developed a set of strategic, robust recommendations for designing utility programs for truck and bus charging. Utilities can make their investments more effective and more broadly beneficial by incorporating the UCS recommendations into program and electricity rate designs and accompanying the designs with sensible ratepayer protections.

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Electric delivery trucks, such as this Coca-Cola delivery truck in Washington, DC, not only have lower greenhouse gas emissions compared with conventional trucks, they also generate no tailpipe pollution—a major benefit to the communities in which these trucks operate.

In developing these recommendations, UCS found that electric utilities are well positioned to advance the deployment of electric trucks and buses and support "smart charging" practices through several types of programs. These include direct investments in the charging infrastructure, rebate incentives that encourage the hosts of charging sites to install infrastructure, and fair rate structures that remove undue barriers to electrification.

CONSIDER VARIOUS STRATEGIES TO ADDRESS BARRIERS TO TRUCK AND BUS CHARGING

For each utility service territory, the combination of strategies to accelerate truck and bus electrification will depend on a balance of factors, including the current availability of EV models and the overall business case for switching each type of vehicle to electric. Such factors will evolve as the market develops and the business case for investing in charging infrastructure improves.

In terms of infrastructure, utilities could provide different levels of support on the customer side of the meter (Figure 2). In the "make-ready" model, the utility invests in infrastructure, including upgrading electrical panels, digging trenches, and laying wires, thus making the site ready for installing electric vehicle service equipment (EVSE). In the "end-to-end utility ownership" strategy, the utility funds, owns, and operates all infrastructure, including the charger. A third approach is for the utilities to offer incentives, typically as full or partial rebates, to the site host for the costs of installing make-ready infrastructure, purchasing and installing the EV charger, or both.

Programs already approved by utility commissions have taken one or more of those approaches, and utilities have adjusted their strategies as the markets for electric truck and buses and the associated EVSE have evolved. San Diego Gas & Electric's Priority Review Projects,[1] which the California Public Utilities Commission approved in January 2018, include end-to-end utility ownership for the utility's Fleet Delivery Services and Port Electrification programs. (See the table on p. 9 for a summary of these and other programs discussed in these recommendations.) The commission noted, "Due to the nascent state of many [medium-and heavy-duty] EVs and associated charging equipment, it is acceptable for SDG&E to own all the infrastructure, including the EVSE, in this instance" (CPUC 2018a). Then in November 2018, San Diego Gas & Electric submitted a settlement agreement that excludes utility ownership for its larger-scale Medium- and Heavy-Duty EV Program. This change indicates that the regulatory and market conditions in California have matured enough to make utility ownership of EVSE unnecessary for successfully implementing truck and bus charging programs for many vehicle applications.

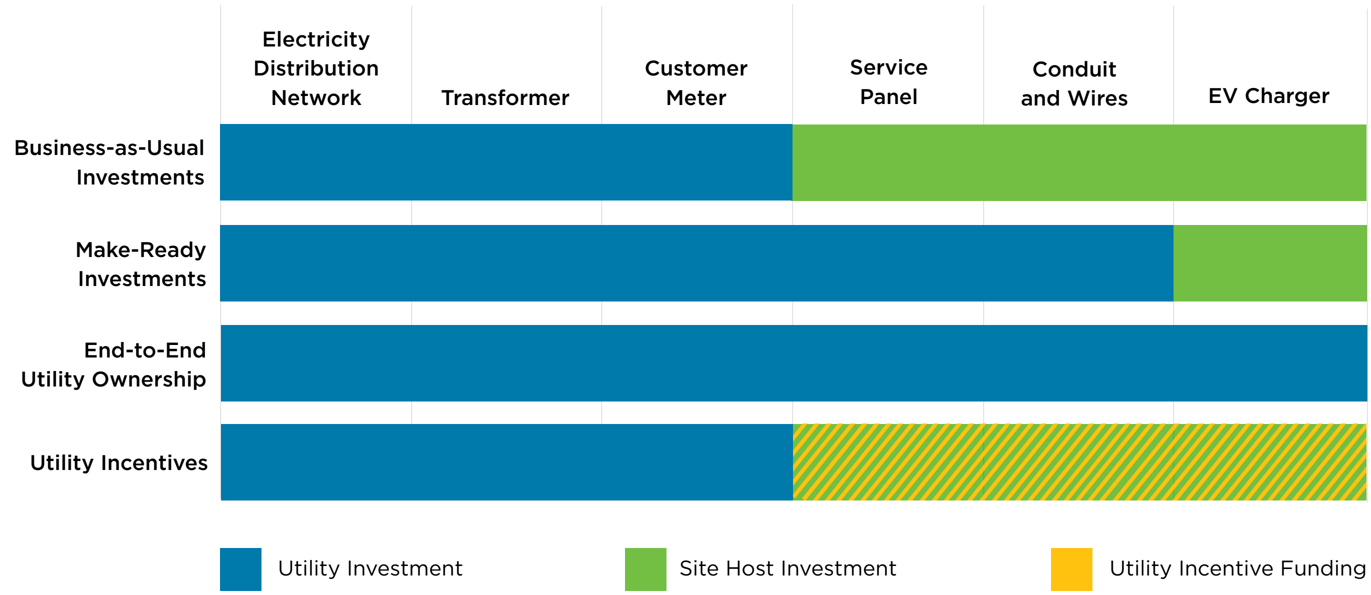
In some cases, multiple approaches may be appropriate within a single program. For example, both Pacific Gas & Electric's (PG&E's) FleetReady Program and Southern California Edison's Medium- and Heavy-Duty Vehicle Charging Program provide only make-ready infrastructure for most program participants. However, in both programs the utility offers rebates covering part of the charger and installation costs to transit and school bus fleets as well as to fleets that operate in communities that are most burdened by truck and bus pollution (CPUC 2018b).[2] This is because the cost of the EV charger and its installation is overly burdensome for public entities with limited budgets and access to capital. Moreover, offering a rebate for chargers and installation costs in pollution-burdened areas prioritizes electrification in communities where it yields the greatest improvements in public health.

Utilities could also consider financing options to help public-sector customers address the up-front costs of electrification. Under such a financing arrangement, the utility pays for the charger and other electrical equipment, and the customer repays the utility as part of its regular electric bills. Over time, the customer recovers the equipment cost through

1 *Priority Review Projects are pilot-scale projects that receive expedited review by meeting certain criteria, including a maximum budget of $4 million and a maximum duration of one year.*

2 *Customers operating fleets in disadvantaged communities do not qualify for rebates if the customer is a Fortune 1000 company (CPUC 2018b).*

FIGURE 2. Models of Utility Investment in Electric Vehicle Charging Infrastructure



There are several approaches that utilities can take to invest in charging infrastructure and equipment.

Note: Under business-as-usual investments, a contribution from the customer may be required on the utility side of the meter for investments that expand utility service.

reduced fuel and maintenance expenses and can use these savings to pay the monthly installments. Already, on-bill programs have facilitated energy efficiency upgrades in buildings. For example, National Grid's energy-saving program for small businesses offers Massachusetts, New York, and Rhode Island customers the opportunity to pay the costs of energy efficiency upgrades as part of their electricity bill over 24 months (NGMA n.d.; NGRI n.d.; NGUNY n.d.). Utility financing could also assist public entities in paying for the incremental cost of EVs.

SET FAIR COMMERCIAL RATES THAT ACCOUNT FOR TRUCK AND BUS CHARGING AND PROVIDE INCENTIVES FOR GRID SERVICES

Operating costs are one of the most important factors that fleet managers consider when deciding whether to invest in electric models. In general, the per-mile cost of electricity is significantly less than that for diesel or compressed natural gas.

However, many commercial electricity rates include a "demand charge," the component of the utility bill related to the maximum power "demanded" by the customer during the billing period. Demand charges can reduce the fuel-cost savings of electrifying trucks and buses, undermining the economic case for fleet adoption.[3] The demands that electric trucks and buses place on the grid and services they offer to it are distinct from those of traditional commercial electricity customers, and historical rate structures generally do not account for those impacts and benefits. This leaves ample room to restructure rates to incentivize transportation electrification, including reducing or eliminating demand charges without shifting costs to other customer classes.

Utilities have taken a number of approaches to redesigning electricity rates to address demand charges and fairly account for how and when vehicle charging draws electricity from the grid. Typically, the redesigned rates apply only to vehicle charging and offer electric truck and bus operators the potential for significant fuel savings. Southern California Edison offers a rate that eliminates demand charges for the next five years and recovers all costs through fees based on the amount of electricity consumed. The rate gradually reincorporates demand charges at a lower level over the following five years. In Rhode Island, National Grid has secured approval for a similar idea it is implementing via a demand

3 *In general, demand charges are in place because utilities must invest in grid hardware and technologies to accommodate the maximum power demand on their grid. However, demand charges do not always account for whether a particular customer's highest demand coincides with the highest demand experienced by the whole electric system. As a result, demand charges do not fairly charge customers for costs they cause for grid transmission and distribution.*

charge rebate that phases out gradually, and it has proposed the same design in Massachusetts.

Both Southern California Edison and National Grid's approaches address the demand charge problem in the early days of EV deployment. As the utility phases in the demand charge or reduces the rebate, and as the number of EVs simultaneously increases, the demand charge spreads over more vehicles and reduces the per-mile burden.

Even so, challenges will remain for individual truck operators and truck and bus operators that have small fleets or fleets that cannot stagger charging. PG&E has developed a design that, in addition to other benefits, may better accelerate EV adoption among these users. In the PG&E design, the commercial rate for EV charging replaces demand charges with a fixed subscription fee based on charging capacity. This restructured rate should lower bills for EV operators. Furthermore, it is not temporary like Southern California Edison's rate design. Instead, it gives vehicle operators more certainty about how rates will affect their fuel costs in the longer term and helps secure future investments by vehicle operators.

In Minnesota, Xcel Energy offers a commercial rate that caps the demand charge for customers that consume relatively little electricity overall. In effect, this rate phases in demand charges for customers based on their total use of electricity. Notably, this example is "technology neutral": it is available to all commercial customers, not just EV operators.

Time-varying pricing for electricity consumption is another important aspect of rate design for electric trucks and buses. Under a time-varying rate, the price of electricity depends on the time of the day and its correlation to expected or historical demands on the grid. Time-varying prices provide an incentive to charge vehicles when demand on the grid is lower and when renewable energy generation is high. The commercial EV rates from National Grid, PG&E, and Southern California Edison each include a time-of-use component. The design of rates can also encourage operators to provide grid services, such as using the vehicle battery to supply power to the grid, through rate components that compensate vehicle owners for providing such services.

[Time-varying prices provide an incentive to charge vehicles when demand on the grid is lower and when renewable energy generation is high.]

Regardless of the configuration, new rates for electric trucks and buses should account fairly for charging demands on the grid, while also reducing the barrier to electrification posed by legacy rate structures that do not consider vehicle charging patterns.

SCALE UP PROGRAMS BASED ON THEIR POTENTIAL IMPACT AND THE READINESS OF VEHICLES FOR ELECTRIFICATION

Utilities should determine the scale of charging programs for trucks and buses according to the relative maturity of EVs in specific medium- and heavy-duty applications and the potential for those applications to serve the grid, reduce greenhouse gases, and improve public health. For example, 40-foot electric transit buses are readily available, and programs to electrify transit fleets have a relatively high impact on greenhouse gas emissions and air pollution because buses drive many miles—40,000 miles per year, on average, in the United States (CARB 2017). Moreover, just one transit agency can electrify dozens or even hundreds of buses. Delivery trucks and port equipment are similarly ready for electrification. These vehicle applications can have a large potential impact on greenhouse gas emissions and local air pollution when a large number of highly utilized vehicles are electrified.

However, despite the potential impact and readiness of many vehicle applications for electrification, the upfront cost of converting to electric models, including the cost of charging infrastructure, remains a barrier. For example, the total cost of a bus depot charger runs around $100,000, with about half for the charger and half for the make-ready infrastructure (CARB 2017). Large-scale utility programs for transit buses, delivery trucks, and port equipment will greatly accelerate beneficial transportation electrification by reducing the upfront cost of charging infrastructure that the customer would have to pay for in-full under the business-as-usual utility investment model.

For more nascent medium- and heavy-duty EV applications, utilities can invest in pilot programs to test and refine technologies and policies that hold potential to serve the grid. For example, electric school buses travel fewer miles than transit buses, but they may have a substantial positive impact by providing storage services to the grid. Indeed, school buses are particularly well suited for the study of EVs as storage because they operate on a regular schedule with significant down time at midday and during the summer. This means that school buses can store excess energy at times of low demand or high renewable energy generation, including solar power in the afternoon, and discharge this energy into the grid as needed outside their operation schedule. In addition,

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When not in use, electric school buses have the potential to store electricity when renewable energy is at its peak, and then discharge it back to the grid when demand is high.

school bus pilot programs can provide empirical evidence on the effects of charging and discharging cycles on the degradation of battery capacity. Further, electric school buses reduce the exposure of children to pollution, thus serving a demographic particularly vulnerable to suffering health impacts from air pollution. Finally, electric school bus programs can familiarize children, parents, and school employees with EV technology in general. PG&E and Consolidated Edison are among the utilities studying the potential for grid services from electric school buses through pilot programs. As more electric models become available, utilities should consider opportunities to advance electrification and assess the potential grid benefits of additional vehicle applications, such as regional and long-haul trucking.

The market for electric trucks and buses is evolving rapidly. Utilities need to evaluate carefully which truck and bus applications are ready for large-scale programs and which are appropriate for pilot-project investments.

PRIORITIZE SERVING COMMUNITIES OVERBURDENED BY AIR POLLUTION

Local air pollution from medium- and heavy-duty vehicles is not distributed equally, nor are the resulting human health impacts. They particularly affect communities with high concentrations of truck and bus activity. The burden of truck tailpipe pollution includes health risks, including premature death, at every stage of life (Heffling and O'Dea 2018). Notably, low-income people and people of color make up a disproportionately large percentage of overburdened communities (Mikati et al. 2018). To address these inequities, utilities and public utility commissions should place a high priority on programs that reduce the impacts of air pollution in overburdened communities and increase access of those communities to the benefits of electrified transportation.

A common way of achieving those aims is to dedicate part—or all—of a program's budget or planned charging ports to serving overburdened communities. California requires transportation electrification programs to benefit "disadvantaged communities," prioritizing communities that "suffer economic, health, and environmental burdens" (CPUC n.d.b).[4] Utilities have responded by siting many truck and bus pilot programs in or adjacent to overburdened communities and by allocating a portion of larger programs to these communities. Early targets for electrification to reduce disproportionate pollution impacts have included port projects by Southern California Edison at the Port of Long Beach and by San Diego Gas & Electric at San Diego International Airport.

For other pilot projects, the California Public Utilities Commission has required utilities to carry out the projects in disadvantaged communities, even if the initial proposal for a project did not include that condition (CPUC 2018a). This is the case for PG&E's Electric School Bus Renewables Integration Project. For larger-scale projects, utilities can dedicate a portion of program funds to disadvantaged communities. For example, San Diego Gas & Electric's proposed large-scale Medium- and Heavy-Duty EV Program would allocate 30 percent of its budget to infrastructure installation in disadvantaged communities (SDG&E 2018).

COORDINATE AND LEVERAGE MULTIPLE FUNDING SOURCES

Although electric utilities play a critical role in advancing the electrification of trucks and buses, other funding sources, such as the Volkswagen settlement and state and federal grants, are becoming available to support vehicle electrification. Utilities should consider such funds as they design their own charging programs. By leveraging various funding sources, utilities can amplify the effect of infrastructure investments without relying solely on ratepayer funds, yet still

4 *In California Public Utilities Commission decisions, areas have qualified as disadvantaged communities by ranking in the top quartile of most-polluted census tracts on a statewide or utility territory basis (whichever is broader) according to the California Environmental Protection Agency's CalEnviroScreen (CPUC 2018a).*

secure a wide range of benefits for ratepayers from transportation electrification.

To leverage external sources of funding and advance truck and bus electrification, utilities can design programs and rate structures that complement non-utility programs. This is best done proactively, when state agencies and others are planning their own investments in EVs. However, utilities also can design programs after such plans take shape. For example, National Grid provided for a number of transit bus chargers in its latest program in Rhode Island as a way to support buses funded by the Volkswagen settlement (RI.gov 2018). In addition, utilities can reduce the expenses for make-ready infrastructure, chargers, or equipment rebates by the amount of other applicable grants or rebates.

CONSIDER FLEET PROGRAMS THAT ACCELERATE ELECTRIFICATION ACROSS VEHICLE CLASSES

Often, utility programs dedicated to medium- and heavy-duty vehicles will most effectively implement charging infrastructure needed by electric trucks and buses. That said, utilities can identify opportunities to include light-duty vehicles alongside medium- and heavy-duty EVs in fleet programs. Fleet managers of all vehicle classes typically need infrastructure support and information from utilities to determine fuel costs as they transition to electric models. Moreover, an inclusive fleet program would best serve managers that handle multiple classes of vehicle. For their part, utilities need information from fleet managers about how quickly managers will transition to EVs and what the power requirements and charging schedule will be in order to plan for increased grid demands. As partners, a utility and a fleet manager can establish a managed charging program that minimizes potential grid stress and maximizes the ancillary grid services that fleets may be able to offer.

Xcel Energy in Minnesota has proposed a pilot fleet program that includes multiple types of vehicle. The utility's partners operate fleets of different classes, including Metro Transit buses, the Minnesota Department of Administration's fleet of light-duty vehicles, and the City of Minneapolis's mixed fleet. Each fleet manager will work with Xcel to install charging for its respective fleet needs. Through the proposed program, Xcel says it will "learn more about the challenges to electrifying a variety of vehicle types" (Xcel Energy 2018).

> ***Utilities can identify opportunities to include light-duty EVs alongside medium- and heavy-duty EVs in fleet programs.***

CONSULT WITH TRUCK AND BUS FLEET MANAGERS WHEN DEVELOPING PROGRAMS

Utilities can leverage customer relationships to design successful programs. Customers that are on the forefront of electrifying their truck and bus fleets can be valuable sources of information in the development of utility programs. Consulting with vehicle operators during program design will strengthen a utility's program by incorporating into the design process firsthand accounts of the needs of fleet vehicles and possible impacts on the grid.

Strategic partnerships are particularly important for pilot projects as utilities and participants embark on programs at the edge of their collective expertise. Strategic partnerships have featured in most of the pilot projects under way in California. For instance, San Diego Gas & Electric has partnered with San Diego International Airport, the San Diego Unified Port District, and United Parcel Service for pilot projects. Southern California Edison has partnered with the Port of Long Beach for two pilots. As noted, Xcel Energy has taken on three strategic partners in Minnesota in its proposed Fleet EV Service Pilot.

Utilities should continually collaborate with vehicle and fleet operators to understand the use and charging needs of the vehicles in order to inform rate designs. As noted, utilities and fleet managers can work together to explore demand charge solutions and time-varying rates that account for the volume and timing of charging demands on the grid and provide affordable charging solutions for fleets.

SET MINIMUM CHARGING SYSTEM CAPABILITIES TO ENABLE MANAGED CHARGING

The practice of reducing or shifting EV loads based on grid conditions is known as "managed charging." The ability to manage charging is key to both unlocking the grid benefits of EVs and enabling EV operators to minimize their fuel costs.

Typically, utilities provide incentives to encourage vehicle and fleet managers to practice managed charging. For example, rates are often lower for charging at times of excess capacity in the electric system and higher when demand is high. Utilities may also target better integration of renewable electricity generation onto the grid by providing incentives to shift charging to coincide with periods of high renewable electricity production. Managed charging enables truck and bus managers to minimize fuel costs by providing the opportunity to shift charging to times of lower cost.

Summary of Programs and Rate Designs Discussed in These Recommendations

State	Utility	Program	Description
Rate Design Programs			
California	Pacific Gas & Electric	Commercial EV Rate (proposed)	Subscription fee in 10-kilowatt or 50-kilowatt increments, depending on maximum anticipated demand. Time-of-use rates for electricity volume that are the same across seasons.
California	Southern California Edison	Commercial EV Rates	Demand charges waived and all costs recovered through volumetric rates in years 1–5. Demand charges phased in over years 6–10, but remain at a lower level. Time-of-use rates for electricity volume that vary by season and by weekday vs. weekend/holiday.
Minnesota	Xcel Energy	A-14 General Rate Schedule	Billing demand shall be no greater than the value in kilowatts determined by dividing the kilowatt-hour sales by 100 hours per month. Volumetric rates do not vary by time of day.
Rhode Island	National Grid	Demand Charge Discount Rebate	For General Commercial and Industrial customers with dedicated DC fast-charging loads, including transit agencies. A per-kilowatt credit covering 100% of the demand charge for three years. Phaseout of the discount will be determined in the next Multiyear Rate Plan.
Infrastructure Programs			
California	Pacific Gas & Electric	Electric School Bus Renewables Integration Project	Make-ready infrastructure for managed school bus charging and renewable energy integration. Implemented in a school district that serves one or more disadvantaged communities.
California	Pacific Gas & Electric	FleetReady Program	Make-ready infrastructure for medium- and heavy-duty EV fleets, plus marketing and outreach. Rebates for EVSE and installation in disadvantaged communities and for transit and school buses. Minimum 25% of budget for installations in disadvantaged communities.
California	San Diego Gas & Electric	Airport Ground Support Equipment Priority Review Project	Chargers to support electric-powered ground support equipment at San Diego International Airport (SDIA) and integration with SDIA's 5.5 megawatt photovoltaic system.
California	San Diego Gas & Electric	Fleet Delivery Services Priority Review Project	End-to-end utility ownership of DC fast chargers and Level 2 chargers for medium-duty delivery EVs, including EVs in UPS's fleet. Remaining chargers to serve minority- or women-owned business participants. Load management plan. Enrollment in time-varying rates required.
California	San Diego Gas & Electric	Medium- and Heavy-Duty EV Program (proposed settlement)	Make-ready infrastructure for medium- and heavy-duty EVs, including off-road vehicles. Rebates for school and transit bus EVSE. Minimum 30% of budget allocated for installations in disadvantaged communities.
California	San Diego Gas & Electric	Port Electrification Priority Review Project	End-to-end utility ownership of charging infrastructure at San Diego Unified Port District to support grant-funded medium-duty, heavy-duty, and forklift EVs.
California	Southern California Edison	Medium- and Heavy-Duty Vehicle Charging Program	Make-ready infrastructure to serve medium- and heavy-duty EVs. Time-varying rate required. Rebates for EVSE and installation for disadvantaged communities and school and transit buses. Minimum 40% of budget for installations in disadvantaged communities.
California	Southern California Edison	Port of Long Beach Priority Review Projects	Make-ready infrastructure to charge rubber tire gantry cranes and terminal yard tractors at the Port of Long Beach.
Minnesota	Xcel Energy	Fleet EV Service Pilot Program (proposed)	Make-ready infrastructure for fleets of light-, medium-, and heavy-duty EVs and electrification advisory services. Option for either customer or utility to both install and own EVSE. Time-varying rate is required.
New York	Consolidated Edison	School Bus Vehicle-to-Grid Program	School buses to provide power to the grid during summer months. Utility funds 25% of bus cost, 25% of charger cost, and all of vehicle-to-grid costs.
Rhode Island	National Grid	Charging Station Demonstration Program	Make-ready charging infrastructure to support public transit buses purchased with Volkswagen settlement funds.

Greensboro Transit Authority

Greensboro, NC, is just one of many US cities committed to increasing the number of electric buses in its fleet. By partnering with fleet operators, utilities can help bring more electric trucks and buses onto our roads.

To manage charging most efficiently and effectively, truck and bus managers need chargers that communicate with network management systems. Beyond the immediate benefits, capabilities for smart charging and networking are forms of "future-proofing." They allow for later upgrades to provide more sophisticated grid services, such as vehicle-to-grid power supply, as those capabilities become available for some vehicle applications. For these reasons, utilities should include minimum capabilities for the charging system that enable managed charging as a requirement of truck and bus charging programs.

FUTURE-PROOF INVESTMENTS BY PREPARING CHARGER SITES FOR ADDITIONAL DEPLOYMENTS

A key way to future-proof utility investments in the infrastructure for truck and bus charging is to go beyond the immediate needs of vehicle operators and get charging sites ready for additional vehicles and vehicles with higher demand for charging power. For example, the manager of a transit agency or delivery truck fleet might purchase only a few electric buses at first but have long-term plans to electrify the entire fleet. While the fleet manager may not initially install chargers to support the entire planned adoption, the utility should evaluate the appropriateness of installing make-ready infrastructure that accounts for the eventual load. This would be better than tearing up the ground a second time to lay additional distribution and connection wires as loads increase. Ideally, this sort of future-proofing would also provide flexibility for advances in charging technology, such as wireless charging.

No one-size-fits-all approach can future-proof all make-ready installations. Utilities and program participants should work together to size programs in ways that anticipate an accelerated deployment of electric trucks and buses while acknowledging uncertainties about the future. Future-proofing should also balance cost-benefit assessments over the duration of a program (typically three to five years) with cost-benefit assessments over the lifetime of infrastructure (typically 10 years or more).

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Electric Utility Investment in Truck and Bus Charging

A Guide for Programs to Accelerate Electrification

Utilities can kick-start charging investments and advance the use of electric trucks and buses through several strategies.

Electric trucks and buses can help tackle climate emissions, reduce diesel pollution, and improve health outcomes in communities burdened by air pollution. However, their widespread deployment requires investing in the infrastructure for charging them. Utilities can kick-start charging investments and advance the use of electric trucks and buses through several strategies, including the design of electricity rates, direct investments in charging infrastructure, and rebate incentives that encourage site hosts to install infrastructure. These recommendations, developed by the Union of Concerned Scientists, point to how utilities can accelerate the adoption of electric vehicles and ensure that utility customers and the electricity grid reap the benefits of infrastructure investments.

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