NARUC
National Association of Regulatory Utility Commissioners

Models for Incorporating Equity in Transportation Electrification

Considerations for Public Utility Regulators

An addendum to the NARUC report, Electric Vehicles: Key Trends, Issues, and Considerations for State Regulators (2019)

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Summary

Momentum for the electric vehicle (EV) transition is well underway, and the utility sector plays an important role in supporting its success. For frontline communities, the transition offers a promising solution to improve environmental and public health outcomes, economic development, affordability, and transit equity. However, the transition will need to involve care and intention to ensure that the needs of underserved communities are prioritized throughout the planning, decision-making, and implementation processes. States have taken the lead in some cases, as profiled in **Box 6**. Whether driven by state commissions or utilities themselves, utilities have a range of options available to ensure equity is central in their transportation electrification plans and programs by drawing from a variety of existing and emerging experiences, as summarized in **Table 1**.

Introduction

Across the United States, local, state, and federal governments as well as private industry have signaled support for transportation electrification and the transition of the nation's fleet of vehicles from internal combustion engines (ICE) to electric batteries. As of June 2022, 13 states have adopted zero-emission vehicle (ZEV) standards requiring a certain number of ZEV sales per year,[1] and in August 2021, President Biden signed an executive order (EO 14037) targeting 50 percent of all new passenger cars and lights trucks sold in 2030 to be zero-emission vehicles.[2] Through the Infrastructure Investment and Jobs Act (IIJA), enacted in November 2021, more than $30.7 billion was made available for electric vehicles and charging infrastructure through programs such as the National Electric Vehicle Infrastructure Formula Program, National Electric Vehicle Infrastructure Grant Program, Clean School Bus Program, and Low- and No-Emission Transit Bus Program.[3]

These investments coincide with a growing prioritization of social equity in state and federal policy, which includes consideration that the EV transition should involve careful and intentional planning to ensure that its benefits are realized by all communities. This means both minimizing the negative impacts and maximizing the beneficial opportunities of the EV transition, particularly for communities that have been historically disenfranchised and harmed by burdens such as high energy and transportation costs, limited mobility options, and environmental pollution. At the federal level, the U.S. government has committed to directing 40 percent of the overall benefits from federal climate and clean energy investments toward disadvantaged communities through the Justice40 Initiative.[4]

Throughout the states, public utility commissions and other agencies have been required to consider equity in their decision-making. Recent legislation mandating such considerations include Colorado's SB 350, 2021; Illinois' Climate and Equitable Jobs' Act (SB 2408, 2021); Maine's HP 1251, 2021; Massachusetts' S.9, 2021; and Oregon's HB 2475, 2021.[5] In 2020, Massachusetts, Connecticut, Rhode Island, and the District of Columbia signed a Memorandum of Understanding, launching the Transportation & Climate Initiative Program (TCI-P) to develop the clean energy economy and reduce carbon emissions from the transportation sector. The TCI-P included a commitment to invest at least 30 percent of the program proceeds for the benefit of communities overburdened by pollution and underserved by the transportation system. TCI-P now includes participation from 13 Northeast and Mid-Atlantic states, as well as the District of Columbia.[6]

State public utility regulators play a key role in the equitable deployment of EVs, as they are responsible for reviewing the rate design and infrastructure investments proposed by investor-owned utilities (IOUs). Through transportation electrification plans (TEPs) and other filings, utilities have begun laying out comprehensive plans for how they will support the deployment of electric vehicles, including elements such as incentives for vehicle purchases and electric vehicle supply equipment (EVSE), time-varying rates, education and outreach, and targeted investments in frontline communities.

This issue brief, published as an addendum to the 2019 NARUC report *Electric Vehicles: Key Trends, Issues and Considerations for State Regulators*, provides an overview of the utility programs and business models that are intended to center equity and captures key considerations for state utility regulators around these models.

Characterizing the Benefits and Disparities in the EV Transition

Environmental and Health Benefits

The benefits of the deployment of EVs are multifold. The transportation sector currently accounts for 27 percent of greenhouse gas emissions in the United States[7] and both states and utilities are recognizing the need to decarbonize. Currently, 24 states, the District of Columbia, and Puerto Rico have established targets to reduce state-wide emissions across sectors,[8] and 81 percent of customer accounts in the United States are served by an individual utility or a utility owned by a parent company with a carbon-reduction target.[9] Transportation electrification can play a significant role in mitigating the impacts of climate change on public health, ecosystems, and the economy as EVs result in fewer emissions than the average ICE vehicle.[10] Further, as the electricity grid shifts to cleaner generation sources[11] and charging occurs off-peak, the benefits of EVs compared to ICE vehicles will increase. The benefits of mitigating emissions are perhaps even greater for frontline communities, and a 2021 analysis by the U.S. Environmental Protection Agency found that socially vulnerable[12] populations may be more exposed to the highest impacts of climate change as it relates to air quality, extreme temperature, and coastal and inland flooding.[13]

Replacing fossil fuel-burning vehicles with EVs can improve local air quality by reducing the concentration of tailpipe pollutants such as particulate matter, carbon monoxide, and nitrogen dioxide, thus improving local public health outcomes. While these benefits improve conditions for all, they can be especially impactful in communities that have been disproportionately exposed to higher levels of air pollution and consequently face a higher risk of illness and premature death. This includes racial and ethnic minorities, individuals navigating low incomes, individuals with limited educational attainment, and individuals living near major sources of pollution.[14]

Box 1. Quantifying the Health Impacts of the EV Transition

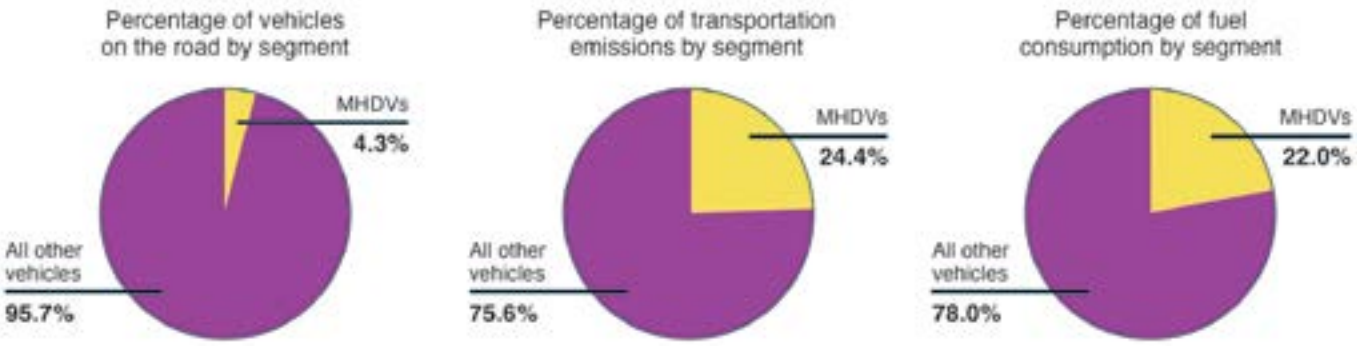
A study by the American Lung Association found that a widespread transition in the United States to a zero-emission transportation sector could by 2050 generate $72 billion avoided health harms, saving approximately 6,300 lives, avoiding more than 93,000 asthma attacks and 416,000 lost workdays annually. Additionally, the avoided climate change impacts could be worth more than $113 billion in 2050.

American Lung Association, (2020), The Road to Clean Air: Benefits of a Nationwide Transition to Electric Vehicles

A study evaluating the disparities in exposure to fine particulate air pollution found that light-duty gasoline and heavy-duty diesel vehicles were among the top emission sources contributing to disparities among racial-ethnic minorities.[15] Medium- and heavy-duty (MHD) vehicles also have an outsized impact on the environment and health. MHD can be found on road or off road, such as at ports, construction sites, and in warehouses.

As shown in **Figure 1**, MHD vehicles contribute to 24.4 percent of transportation emissions, despite only representing 4.3 percent of the vehicles on the road.[16] School buses, specifically, pose a disproportionate risk to frontline communities. Of the more than 20 million children that ride the bus to school, 92 to 95 percent of the buses they ride run on diesel and 60 percent of students from low-income communities use buses to commute to school compared to 45 percent of students from higher income households. In addition, children with disabilities often spend more time on the bus.[17] Increasing access to electric mobility in these communities can, in part, relieve some of their pollution burden. Despite lower levels of adoption in these markets, Black and Latino households are just as interested, if not more, than White and Asian households about low-emission vehicles due to air quality concerns.[18]

Figure 1. The Disproportionate Impact of MHD Vehicles on U.S. Transportation Emissions and Fuel Consumption



Economic Development Benefits

In addition to the direct benefits to the environment and public health, the transition to EVs also provides opportunities to strengthen the local workforce. The deployment and maintenance of EV charging infrastructure can facilitate the creation of new jobs and spur increased investment in the local economy. A report for the Electric Transportation Community Development Corporation, for example, found that supporting the buildout of 500,000 DC fast chargers (DCFC) under the National EV Charging Network by 2030 would generate workforce needs of around 28,950 job-years from 2021 to 2030.[19] In addition, given charging times, community charging locations can also be an opportunity to increase interest in local shops and restaurants.

Box 2. Modeling the Economic Impact of Deploying EV Equipment and Infrastructure

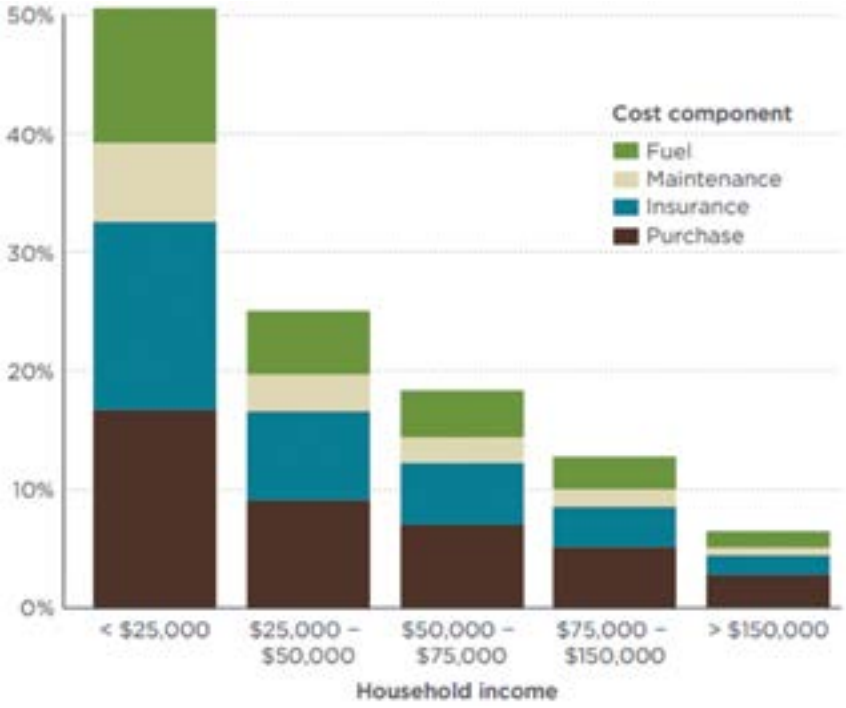
The U.S. Department of Energy's Argonne National Laboratory developed the JOBS EVSE model, an online tool that allows users to estimate the economic impacts associated with the development, construction, and operation of EV charging stations in states, regions, or the United States as a whole. The impacts range from job creation to ripple-effect economic activity, such as local spending.

Argonne National Laboratory. JOBS EVSE. https://www.anl.gov/esia/jobs-evse

Fuel and Maintenance Cost Benefits

Although the average initial cost of purchasing a new EV is currently higher than the average gasoline vehicle, analyses have shown that the total cost of ownership of an EV is lower, which includes fueling, repair, and maintenance costs.[20, 21] An analysis by the National Renewable Energy Laboratory and the Idaho National Laboratory based on 2019 data also found that although the cost to charge an EV varies by the price of electricity, type of EVSE, cost of installation, and vehicle use, EV owners can save an average of $3,000 to $10,500 compared to gasoline vehicles over a 15-year time horizon. Further, the study found significant variations in savings at the state level, with savings ranging between $14,500 (in Washington) to no savings estimated in four states (Alabama, Hawaii, Mississippi, and Tennessee).[22] This is meaningful for low-income vehicle owners who tend to spend a larger portion of their income on vehicle-related expenses. As shown in **Figure 2**, for example, households earning less than $25,000 spend 50 percent of their income on vehicle ownership and operation. The savings are potentially higher for residents in rural areas. Rural America, which only represents approximately 20 percent of the country's population, makes up nearly 70 percent of the country's vehicle miles traveled. As a result, transportation expenditures are higher in rural areas than in urban areas.[23]

Figure 2. Total Cost of Vehicle Ownership as Percent of Income, by Annual Household Income[24]



Electricity Rate Reduction Benefits

As discussed in NARUC's *Electric Vehicles: Key Trends, Issues and Considerations for State Regulators*, EV adoption has the potential to reduce electricity rates for customers, provided that the utility revenues from EV charging outnumber the utility system costs.[25] This can help relieve energy burden, or the proportion of a households' income that is spent on home energy costs, for all ratepayers. However, the effect is most notable for households that disproportionately experience energy burden — low-income, Black, Hispanic, Native American, renters, and older adult households. Approximately 25 percent of U.S. households are experiencing high energy burdens, paying more than 6 percent of their income on energy bills. For the EV transition to be sustainable and accessible for all, this energy burden must be addressed to ensure that EV charging does not exacerbate the burden these households are already experiencing.[26] For regulators, this means prioritizing the equitable allocation of costs and benefits so that higher-income customers do not benefit from EV infrastructure at the expense of low-income customers who are paying for those investment through increased electric rates.

Disparities in Vehicle Ownership

Inequities in the transportation system are evident in the rates of private vehicle ownership, and data show stark differences in ownership based on race, ethnicity, and income. Two-thirds of Black households, for example, own vehicles compared to about 86 percent of White households. Additionally, only 61 percent of households in the lowest income quantile own a vehicle, compared to 90 percent of household in the highest income quintile.[27] For electric vehicles, these differences are even more apparent and buyers are primarily male, high-income earners, highly

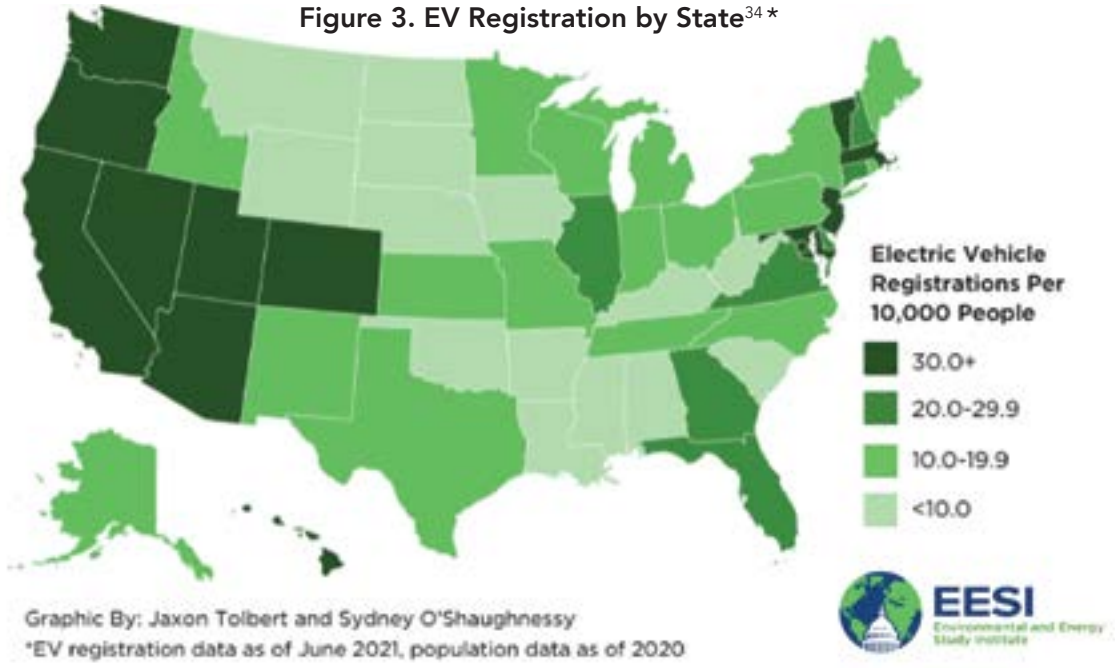
Box 3. Mapping to Prioritize EVSE Siting in Disadvantaged Communities

The U.S. Department of Transportation created the Electric Vehicle Charging Justice40 Map to help EV charging planning efforts align with the Justice40 goal of 40 percent of federal investment in clean transportation going to disadvantaged communities. The tool includes data for 36 indicators related to fossil dependence, energy burden, environmental and climate hazards, and vulnerability (socioeconomic, housing burden, transportation burdens, etc.).

Argonne National Laboratory. Electric Vehicle Charging Equity Considerations. https://www.anl.gov/esia/electric-vehicle-charging-equity-considerations

educated, are homeowners, have multiple vehicles in their household, and have access to home charging.[28] In California, the state with the highest EV ownership, only 2 percent of EV buyers are Black and only 14 percent of buyers have incomes less than $50,000.[29] These discrepancies are partially due to the higher sticker price of new EVs compared to other vehicles. In May 2022, the average price of a new EV was $64,338, compared to an industry average across all vehicle types of $47,148.[30] Renters across the U.S. are also less likely to own EVs due to the lack of dedicated parking spaces and the difficulty of making EV infrastructure investments in a property they do not own.[31] Adoption of EVs in rural communities and regions is also approximately 40 percent lower than the rate of adoption in urban areas[32] with new rural EV registration rates below one percent in 2021.[33] As shown in **Figure 3**, states with higher rural populations have significantly lower rates of EV ownership.

Figure 3. EV Registration by State[34] *



Disparities in Distribution of Charging Infrastructure

Similar to the patterns of ownership among various demographic groups, access to EV charging infrastructure is also uneven across socio-economic factors. As most EV charging occurs at home,[35] opportunities for charging are limited for individuals living in multi-family housing, many of whom are navigating low incomes.[36] The cost of a charger installation also acts as a barrier, with the total cost of installation averaging $1,000 to $2,500.[37] Their access to charging therefore relies on public EV charging infrastructure if their workplaces or housing complexes do not offer such solutions. However, studies have shown that disparities exist in public EV charger access based on race and income,[38, 39] creating what are known as "charging deserts." However, increasing the concentration of public charging stations in low-income communities may not provide the most financially accessible solution, as public charging can be 2 to 4 times more expensive than home charging.[40]

In rural areas, there is currently a low density of EV charging infrastructure, which impedes EV adoption in these communities. Where metropolitan areas have 500 to over 1,000 public chargers per 25 square miles, most rural areas have no charging

Box 4. Mapping the Distribution of EV Charging Infrastructure

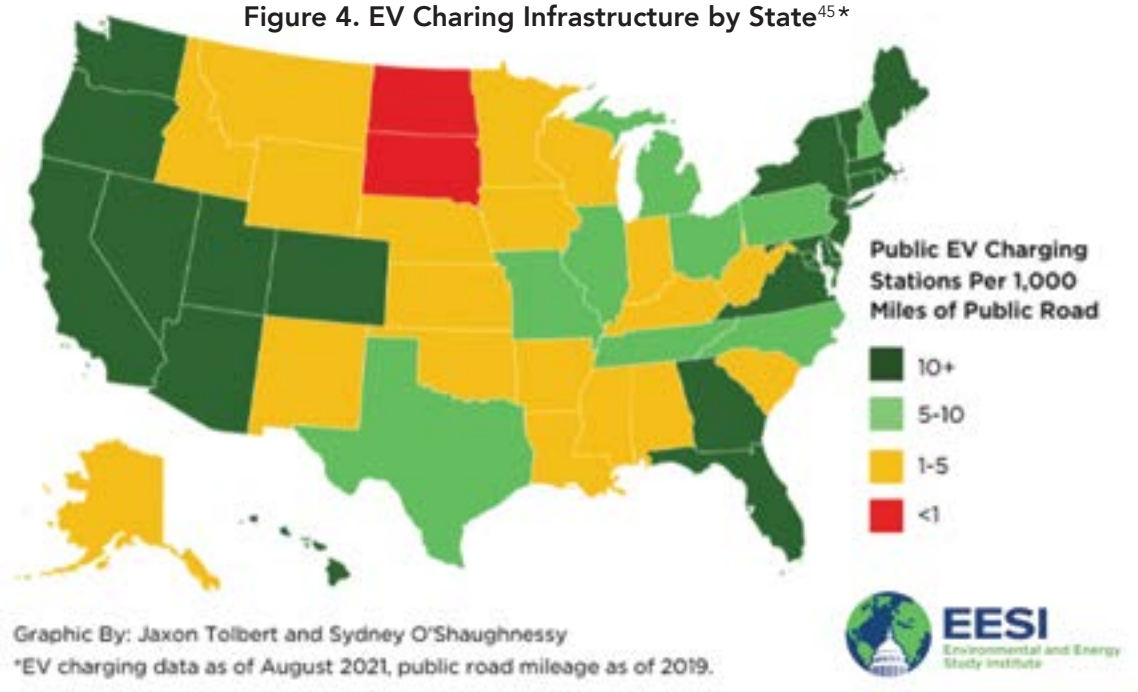
Data produced by the U.S. Department of Energy's Alternative Fuels Data Center maps the location of every public EV charging station in the U.S. and illustrates where there are existing infrastructure gaps.

See: https://afdc.energy.gov/stations/#/find/nearest and ESRI, https://storymaps.arcgis.com/stories/bff8036074824dcabdf9531b6ee82f4a

infrastructure.[41] This urban-rural divide can be inferred in **Figure 3**, where many of the rural states have low concentrations of EV charging infrastructure.

Grid modernization is another key consideration that is critical to the deployment EV charging infrastructure, and research examining existing grid limits has shown that hosting capacity for distributed energy resources (DER) is correlated with race, where increasingly Black-identifying and disadvantaged communities have less hosting capacity to accommodate EV charging or other DER interconnections.[42] Rural areas also have a less robust electrical infrastructure[43] and may lack three-phase power, which is necessary for DC fast charging,[44] thus potentially requiring grid upgrades or other on-site modifications to host charging infrastructure.

Figure 4. EV Charing Infrastructure by State[45]*



Disparities in Access to Mobility

After housing, transportation represents the second largest household expenditure. This includes the high fraction of fixed costs associated with private vehicle ownership (see **Figure 2**), which present a major mobility burden for low-income households.[46] Public transit is often an affordable alternative to vehicle ownership; however, certain populations have less access to reliable and safe forms of transportation to essential services such as food, school, work, and healthcare. Funding for public transit is heavily correlated with local household income, and data have shown that higher-income areas are benefiting more from transit access than lower-income areas.[47] This is despite lower-income groups, in addition to Black and Hispanic individuals, immigrants, and individuals under 50, being more likely to use public transportation on a regular basis.[48] Electric school buses and electric transit are key opportunities to both improve transportation equity in a community and improve air quality by reducing emissions from medium- and heavy-duty vehicles.

Box 5. Mapping the Social Vulnerability Related to Transportation

The U.S. Department of Transportation Volpe Center developed a prototype geospatial tool, Transportation for Social Equity (TransportSE), which allows users to explore the relationships between indicators of transportation burdens, demographic metrics, and social vulnerability. While public utility commissions have limited involvement in state transportation planning, this tool may be useful for evaluating the socio-economic context for utility investments in frontline communities.

U.S. DOT. (2022). Transportation Equity for All, https://www.volpe.dot.gov/our-work/transportation-equity-all

Box 6. Examples of Equity Considerations in State Electric Vehicle Initiatives

Compiled by Kelly Aves, Legal & Policy Advisor to Commissioner Maria Bocanegra, Illinois Commerce Commission

North Carolina

In 2018, North Carolina issued Executive Order No. 80, titled "North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy Economy."[1] This order directs the state Department of Transportation to develop a ZEV Plan designed to increase the number of registered ZEVs in the state to at least 80,000 by 2025. The state ZEV Plan, released in 2019, highlights the importance of affordability, as well as prioritizing low-income and rural areas for charging infrastructure to spur adoption.[2]

Two state utilities, subsidiaries of Duke Energy, jointly filed an electric transportation plan,[3] with the first phase of the pilot approved in November 2020.[4] Phase one of the pilot includes plans for a Public Level 2 Charging program, Multifamily Dwelling Charging, Direct Current Fast Charging, and EV School Bus Charging programs. As of summer 2022, phase two of the pilot was under investigation and revisions.[5]

Illinois

The Climate and Equitable Jobs Act (CEJA), passed in September 2021, addresses the utility's role in transportation electrification through the Beneficial Electrification Plan (BEP).[6] "Beneficial electrification programs" lower carbon dioxide emissions, replace fossil fuel use, create cost savings, improve electric grid operations, reduce increases to peak demand, improve electric usage load shape, and align electric usage with times of renewable generation. Under CEJA, the BEP is EV focused with equity provisions throughout. The PUC held stakeholder workshops before utilities began to file docketed proceedings, in which feedback and ideas from the workshops may be included in their BEPs.

In Illinois, the utility BEPs are mandated to support at least a 40 percent investment of make-ready infrastructure and a 5 percent investment target in electrifying school bus and diesel public transportation vehicles, both in environmental justice or low-income communities. Utilities must also provide resources to support private investment in charging equipment for uses in residential, multi-family, fleet, transit, community, and corridor applications.

Wisconsin

We Energies proposed pursuing low-income programming as part of its recent application to the Wisconsin Commission for EV charging pilots: (1) a separate EV meter billed at a new time-of-day rate specifically designed for EVs, and (2) combined metering for household and EV usage on the same time-or-day rate. Both rate plans allow for customers to enroll in a payment plan for the upfront EV charging infrastructure costs. Although their proposals did not offer distinct programs specifically for low-income customers, the Commission allowed the utility to investigate which of the two EV pilot rates would be best suited for low-income customers through community engagement and to report back on the results.[7]

Nevada

The Nevada PUC recently approved NV Energy's Economic Recovery Transportation Electrification Plan.[8] The three main components of the plan are: "strategically expanding charging station access - prioritizing placement in historically underserved communities; increasing access to clean energy job opportunities;

continued

1 https://governor.nc.gov/media/967/open

2 https://www.ncdot.gov/initiatives-policies/environmental/climate-change/Documents/nc-zev-plan.pdf

3 https://starw1.ncuc.gov/NCUC/page/docket-docs/PSC/DocketDetails.aspx?DocketId=91938680-6514-4d49-b64a-273e806567d2

4 https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=1c1665d0-d645-4293-82d8-ae9d7e672e3d

5 https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=fa2ca23c-77e3-4601-b84a-011ae3f945f8

6 https://www.ilga.gov/legislation/ilcs/documents/002006270K45.htm

7 https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=419438

8 https://pucweb1.state.nv.us/PUC2/DktDetail.aspx

Box 6 (continued). Examples of Equity Considerations in State Electric Vehicle Initiatives

and supporting EV driver tourism."[9] The plan includes provisions for interstate corridor and urban charging depots, public agency charging, transit and school bus electrification, recreation and tourism, workforce development, and public outreach and education. There is also a carveout to ensure that 40 percent of all spending goes toward communities that have been systematically and historically underinvested.[10]

9 https://www.nvenergy.com/cleanenergy/ertep

10 https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/cleanenergy/ertep/ERTEP-Overview_2022-01.pdf

Utility Proposals for Equitable Transportation Electrification

An Overview of Models

Through the Atlas Public Policy EVHub dashboards, NARUC identified states where equity was included as an element in utility transportation electrification-related filings. As of July 8, 2022, 41 utilities across 27 states have filed plans proposing a variety of equity-focused initiatives, representing approximately $985 million in investments in underserved communities. NARUC examined these filings to identify common program models that centered equity; the key considerations associated with each model are summarized and descried in more detail in **Table 1**.

Table 1. Summary of Equity Considerations for Utility Regulators

Utility EV Equity Model	Initiative Sub-Category	Opportunities	Concerns / Questions	Examples
Education and Outreach	Stakeholder and Community Engagement	Builds community trust and ensures diverse input in utility planning and investments		New Jersey: Public Service Electric & Gas; Atlantic City Electric; Jersey Central Power & Light
	Customer Education and Outreach	Can close the gap in customer awareness of EVs	Some commissions may hesitate to allow education and outreach to be funded via ratepayers	
Rate Design and Managed Charging	Time-of-Use Rates	Can provide individual customer savings and apply downward pressure on electric rates	Customers on whole-home time-of-use (TOU) rates may not be able to shift their load; Customers with below average electricity use may have higher bills; A separate meter, AMI, or in-vehicle telemetry may be necessary for EV-only rates	Kansas: Electric Transit Service rate New Jersey: Public Service Electric & Gas; Atlantic City Electric; Jersey Central Power & Light
	Managed Charging	Can provide incentives or savings to customers; enables grid optimization to integrate clean sources of energy		

continued

Utility EV Equity Model	Initiative Sub-Category	Opportunities	Concerns / Questions	Examples
Rate Design and Managed Charging	Demand Charge Relief	Can enable EV adoption in low utilization areas	Challenges adopting demand charge relief mechanisms may depend on legal precedent and application of rate design principles	New Jersey: Public Service Electric & Gas; Atlantic City Electric; Jersey Central Power & Light demand charge credits
Investments and Incentives in Ride-Hailing and Carsharing		Can improve local air quality in frontline communities; expands clean mobility options	Grey area regarding commission authority to regulate	Minnesota: EV Spot Network
Incentives and Investment for EVSE in Frontline Communities	Utility-Owned EVSE	Commission can oversee equitable siting and rates	Could result in cost-allocation burdens for low-income customers	California: Southern California Edison Charge Ready Program
	Make-Ready EVSE	Can increase the pace of deployment and lower infrastructure costs	Could impart inefficiencies in the pace of deployment; commission lacks oversight of equitable siting and rates	New York: Joint Utilities of New York EV Make-Ready Program
	Rebates for EVSE	Provides upfront incentives	Could impart inefficiencies in the pace of deployment; commission lacks oversight of equitable siting and rates	Maryland: Potomac Edison EV Charging Station Multifamily Rebate
Investments and Incentives for Medium- and Heavy-Duty Electrification	Electric School Buses	Can improve local air quality in frontline communities; expands clean mobility options; potential resilience benefits from large mobile batteries	High upfront cost barrier; grid infrastructure needs	Illinois: Ameren Illinois Electric Bus Program
	Electric Transit Buses	Can improve local air quality in frontline communities; expands clean mobility options	High upfront cost barrier; grid infrastructure needs	Oregon: Portland General Electric TriMet electric bus program
EV Purchase Incentives	EV Purchase Rebates	Encourages EV adoption by reducing the upfront cost	May minimize system benefits of reduced pollution if EVs do not stay in the community; PUCs may lack authority to approve ratepayer funds	Colorado: Xcel Energy EV Purchase Rebate

Education and Outreach

Stakeholder and community engagement is integral to utility transportation electrification planning. This ensures that all perspectives, and particularly those of frontline community members, are meaningfully involved in the transportation electrification decision-making process to ensure that utility investments are the most appropriate to meet a community's needs. This need is resonated in a resolution from the National Association of State Utility Consumer Advocates *on Urging the Adoption of Policies and Regulations to Protect Ratepayers and Electric Vehicle Adoption Rates Increase*, which "encourages dialogue in each state among stakeholders with the goal of developing consensus policy solutions for electric vehicles that protect the interests of all ratepayers."[49] Further, early and consistent engagement is key to informing program design and building trust with frontline communities.[50] The Mobility Equity Framework, developed by The Greenlining Institute, provides a strong model for how community needs can be considered in transportation planning and investments and includes the following steps:

1. Community Needs Assessment: involves determining community-identified mobility needs; educating the community on mobility equity; and community brainstorming project ideas.
2. Mobility Equity Analysis: involves equity analysis of projects; prioritization of projects; and project proposals.
3. Community Decision-Making: involves strategies to elevate equity and community decision-making power

Figure 5. Mobility Equity Framework by The Greenlining Institute

Several utilities have involved stakeholders in the development of their EV program proposals. Xcel Energy, for example, engaged in a stakeholder engagement process in Minnesota facilitated by the Great Plains Institute in 2018 for their EV pilot programs. The programs were approved by the Minnesota PUC in 2019. The stakeholder engagement process included representation from groups such as electric utilities, consumer advocates, environmental advocates, municipalities, and EV manufacturers. Xcel also developed the following set of guiding principles to inform the goals of a successful utility EV program:

1. Empower customers with information, tools, and options
2. Increase access to electricity as a transportation fuel in an equitable manner
3. Encourage efficient use of the power grid and integrate renewable energy
4. Improve air quality and decrease carbon emissions
5. Ensure reliability, interoperability, and safety of equipment
6. Leverage public and private funding opportunities
7. Provide benefits to all customers, both EV drivers and non-EV drivers
8. Ensure transparency and measure results[51]

Utilities have an important role of facilitating **customer outreach and education**; however, there has been limited focus to date on such programs. These programs, however, may be necessary to close gaps in consumer awareness of EVs.[52] Some commissions have opted to disallow the use of ratepayer funding to support utility education and outreach programs, whereas others have authorized those programs through web portals, ride and drive sponsorships, and customer experience centers. Several commissions have also mandated or encouraged utility investment in education and outreach, such as the Washington Utilities and Transportation Commission and the Arizona Corporation Commission.[53]

Rate Design and Managed Charging

Where PUCs have authority over electric utility rates, utility rates can be designed to mitigate the energy and transportation costs for low-income customers and help offset the costs of EV infrastructure that would be transferred through increased electric rates.[54] **TOU** rates deliver price signals to encourage customers to charge their vehicle during off-peak periods when marginal costs of energy supply are low and there is excess capacity in the system.[55] If customers effectively shift their load through TOU rates, cost savings can be realized for all ratepayers and the utility.[56] However, there is no guarantee that all customers will be able to take advantage of these savings. If customers are on whole-home TOU rates and cannot shift their load, they may be on the hook for higher energy bills.[57] Advocates have also expressed concerns that customers who have below-average electricity usage will pay more under TOU rates than they would under a tiered pricing structure.[58]

Through an EV-only TOU rate, customers can exercise more flexibility with their home energy usage but will need access to either a separate meter, advanced metering infrastructure (AMI), a smart charger or in-vehicle telemetry,[59] some of which can present additional costs. In New Jersey, some utilities base EV-only rates on the whole-house TOU, but all customers receiving incentives agree to share charging data that will inform a future EV-only rate setting.

TOU pricing can also be offered to non-residential customers, such as transit operators. The Kansas Corporation Commission approved Evergy's new Electric Transit Service rate option for transit customers. It is a TOU rate with a 12-hour peak that aligns with most fleet depot charging patterns and does not include a demand charge.[60]

In addition to or separate from TOU pricing, **managed charging**, can be used to relieve stress on the grid, provide savings and/or incentives for customers, and enable the integration of more intermittent clean energy resources.[61]

In areas where EV adoption and charger utilization is still low, such as in underserved or rural areas, **demand charges** for fast charging infrastructure may pose a significant cost barrier. As discussed in Electric Vehicles: Key Trends, Issues and Considerations for State Regulators, "demand charges are additional charges or higher rates added to a customer's electricity bill based on the customer's peak capacity usage, traditionally used to recover the nonfuel costs of generation, transmission, and distribution. They are charged to commercial and industrial customers to incentivize these customers to level out their load and avoid steep increases in usage that could overload the distribution system." Demand charges are a concern for DC Fast Chargers (DCFC) due to their high-power capacity and can disincentivize charging station hosts from deploying infrastructure. However, commissions and utilities can consider several options to help relieve the demand charge burden, which are categorized by the Alliance for Transportation Electrification as:

1. Short-term mitigation of demand charges: waiving or applying a discount to demand charges for a temporary period until utilization becomes sufficient (e.g., demand charge holidays)
2. Permanent cost-based rates without demand chargers: commercial rates for demand charges for users with certain load profile characteristics who do not have significant demand
3. Rates with embedded demand charges: subscription rates in which fixed costs are incorporated into a monthly subscription charge to the EVSE
4. Targeted incentives that vary with site utilization: demand charge assessment is tied directly to station utilization in the tariff

A commission's adoption of these alternatives, however, will depend on the legal precedent and the application of rate design principles.[62]

An example of a recent short-term mitigation of demand charges is Jersey Central Power & Light's public DCFC demand charge credit with a 50 percent demand charge discount in the first two program years and a 25 percent discount in the third and fourth years. It was approved by The New Jersey Board of Public Utilities in June 2022.[63] Public Service Electric & Gas has a similar program. Atlantic City Electric has a negotiated rate. All are required to collect data and to develop an EV-only rate to create a long-term solution. New Jersey also created a uniform data collection process across all state and utility programs for this purpose.

Investments and Incentives in Ride-Hailing and Carsharing

Providing incentives for private EV ownership is only part of a broader set of solutions to increase access to clean mobility. Because ownership is not feasible or practical for every household, it is important that transportation electrification planning prioritize the unique transportation needs of a community with consideration of solutions such as electric public transit and ride-hailing, which are disproportionately used by low-income households.[64] The case for supporting the electrification of **ride-hailing and carsharing services**, and the associated EV charging infrastructure, is underscored by the demographics of users of these services and the impact of ride-hailing on climate and air pollution. According to the transportation network company (TNC) Lyft, 46 percent of the company's rides in the U.S. and Canada start or end in low-income areas and 52 percent of riders identify as members of racial and/or ethnic minority groups[65] (compared with 41 percent in the U.S. population[66]). A study by the Union of Concerned Scientists found that a typical ride-hailing trip is about 69 percent more polluting than the trip it replaces.[67]

Whereas ride-hailing and carsharing services themselves may be out of the purview of a PUC, IOUs can provide utility funding to support the electrification of such services. In their January 2021, DTE Energy filed an application with the Michigan Public Service Commission to expand their existing Charging Forward pilot program to include, among other elements, rebates for TNC drivers. DTE proposed a rebate of $5,000 for vehicles that meet partnering TNCs' requirements and is exploring incentive payout structure to ensure the vehicles will continue to be used for ride-hailing.[68] Equitable EV carsharing programs are typically funded through a combination of federal grants, state programs, private foundation grants, and utility ratepayers.[69] A program by Xcel Energy in Minnesota, for example, offers funding for equitable EV shared mobility. In July 2021, the Minnesota PUC approved Xcel's petition for approval of a Multi-Dwelling Unit (MDU) EV Pilot Program, through which Xcel would install, own, and maintain make-ready infrastructure at participating MDU sites and carsharing would be made available to eligible affordable-housing MDUs (more discussion about make-ready below). The carsharing initiative involves a partnership between a partnership between the cities of St. Paul and Minneapolis, Xcel Energy, the American Lung Association, and HOURCAR and leverages funding from the Twin Cities Electric Vehicle Community Mobility Network, which was awarded funding from DOE to advance EV carsharing in affordable-housing MDUs. Through what's called the EV Spot Network, the public has access to a series of 70 renewably powered curbside EV charging locations and an all-electric carshare service.[70, 71, 72]

Incentives and Investment for EVSE in Frontline Communities

As introduced in Electric Vehicles: Key Trends, Issues and Considerations for State Regulators (2019), there are several equity considerations related to the various approaches of utility charging infrastructure ownership. For **utility owned EVSE**, a commission can exercise its authority to enforce the equitable siting of chargers and rates. An example is Southern California Edison's Charge Ready 2 program, which was approved by the California Public Utility Commission in August 2020, and provides chargers at multi-unit dwellings in underserved communities that are owned and operated by the utility. However, distributing costs of utility-owned investments to all ratepayers could result in cost-allocation that burdens low-income customers who are not using EV infrastructure. In a **make-ready EVSE** approach, because the utility is only investing in the equipment necessary to connect the EV infrastructure to the grid, it can increase the pace of deployment and lower the infrastructure costs by leveraging private capital. The lower installation costs could also incentivize the

installation of chargers in areas with lower EV adoption. One of the potential barriers of make-ready infrastructure is that it may impart inefficiencies that make implementation difficult, such as by requiring the site host to research, select and purchase the charging stations. Further, the lack of commission regulation over the charger means there is a risk that charger siting and rates are not equitable, and charger reliability may not be consistent. Some commissions are paying particular attention to these potential challenges. In July 2020, the New York Public Service Commission issued an order establishing an EV infrastructure make-ready program with $701 million of ratepayer funding, $120 million of which was allocated to benefit disadvantaged communities. The order stipulates that at least 20 percent of each utility's budget for EVSE be located within 1-2 miles of disadvantaged communities and aim to increase.[73]

Box 7. Estimating Emissions Reductions from Transit Bus Electrification

The U.S. Department of Transportation Federal Transit Administration developed the FTA Transit Bus Electrification Tool v1.0 that helps estimate the partial lifecycle greenhouse gas emissions savings associated with replacing standard bus fleets with low-emission or zero-emission transit buses. Visit: https://www.transit.dot.gov/regulations-and-programs/environmental-programs/fta-transit-bus-electrification-tool

The U.S. Environmental Protection Agency recently updated the Diesel Emissions Quantifier as well, which evaluates clean diesel projects and upgrade options for medium-heavy and heavy-heavy duty diesel engines. Visit: https://cfpub.epa.gov/quantifier/index.cfm?action=main.home

Rebates for EVSE are another way utilities have supported the deployment of EV infrastructure and are often paired with make-ready investments to deploy EVSE in low- and moderate-income or underserved communities.[74] In early 2019, the Maryland Public Service Commission approved an EVSE pilot program for the state's four largest utilities, which included EVSE rebates for multi-unit dwellings.[75] New Jersey's programs offer rebates for make-ready from the utilities with state-offered rebates on chargers. In addition, the same proceeding required demand-charge solutions and rate parity for MUD customers. The challenge with rebates for EVSE, as previously alluded to, is that without the utility's expertise and involvement, deployment may be stalled and the commission does not have oversight of siting and rates.

Investments and Incentives for Medium- and Heavy-Duty Electrification

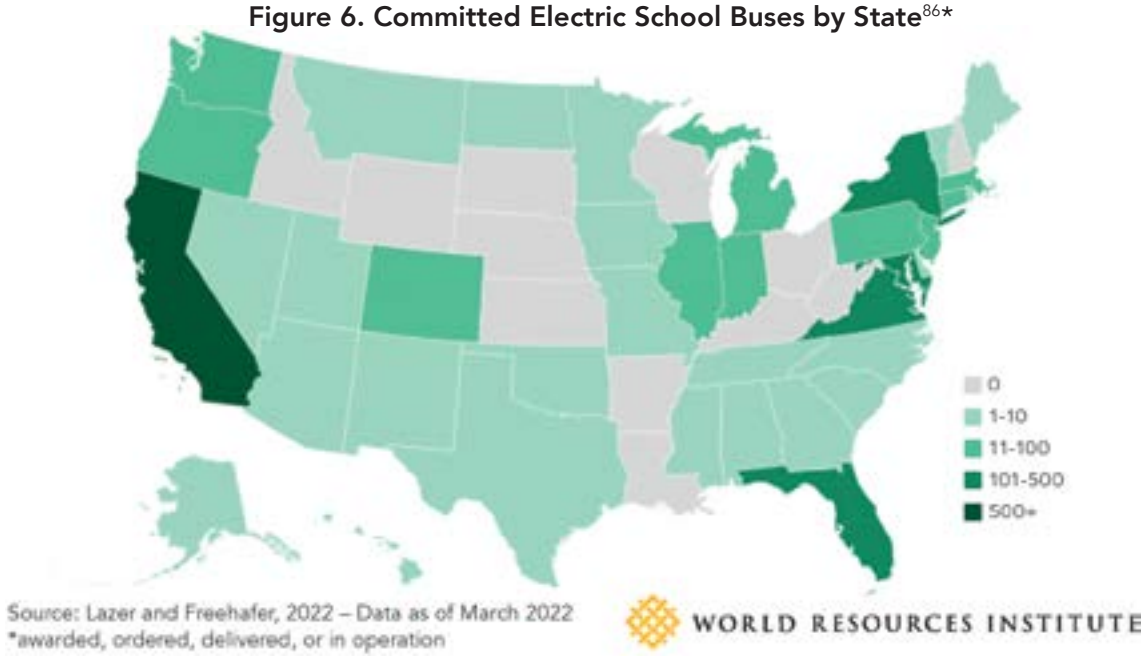
The deployment of **electric school buses** can improve local air quality, improve the health outcomes in frontline communities, and can also serve as a grid resource by providing energy storage and utilizing vehicle-to-grid technology. As of March 2022, there were 12,275 committed electric school buses across 38 states in the United States, and the concentration of these commitments by state are shown in **Figure 6**.[76] Utilities can advance electric school bus deployment in several ways, including by investing in EVSE for bus charging depots or routes, helping to finance the upfront costs of purchase, and by introducing smart charging systems to maximize renewable integration.[77] In July 2021, the Illinois Commerce Commission approved several EV charging tariffs by Ameren Illinois that would enable access to charging for frontline communities. Of the six tariff options, two were focused on MHD electrification: one for education facility charging and the other for transit facility charging. Both offer special delivery rates and incentives for electric school bus and public transit bus operators.[78] A 2022 Maryland Public Service Commission EV working group recently recommended acceptance of fleet electrification proposals by two utilities in the state that included a detailed examination of barriers and solutions. If accepted by the Commission, the utilities will include additional incentives for fleet electrification to customers that operate in Census track locations of historically disadvantaged communities.[79]

Across the country, transit agencies have been making advancements to convert their fleets to **electric transit buses**. Utilities such as Pacific Gas & Electric in California, Xcel Energy in Colorado and Minnesota, Hawaiian Electric, DTE Energy in Michigan, and Portland General Electric in Oregon have developed electric bus programs and play a key role in the transit agency's bus electrification planning. A study by Atlas Public Policy found that there is wide consensus that transit agencies and utilities should engage with each other early in the planning process. Utilities can provide valuable information about necessary upgrades, funding and financing, future proofing.[80]

Regulators can also ensure that utilities are prepared for the transition of transit fleets by requiring utilities to plan their investments through integrated resource planning or distribution system planning processes.[81]

The average electric transit bus costs approximately $750,000, compared to a diesel transit bus at $500,000, and the average electric school bus costs approximately $230,000 compared to a diesel school bus at $110,000.[82] Despite significant fuel and maintenance savings associated with electric buses, the up-front cost can serve as a significant barrier to operators looking to electrify their fleets. **Inclusive financing for electric transport** is an emerging approach that utilities and regulators can consider to reduce barriers and enable expanded adoption. Through an inclusive financing mechanism, such as Pay as You Save® (PAYS) for Clean Transport,[83] "the utility pays the upfront cost for the charging infrastructure and the battery of the transit bus, reducing the upfront cost of the electric buses and new infrastructure for the customer, and leveraging any other funding available or financing needed to cover all the cost for the bus replacement. As with the energy efficiency upgrades, the utility recovers all the costs via a service charge the electricity bill of the transit agency or bus owner. The tariff caps the service charge to be less than the estimated savings from switching from diesel buses to electric buses."[84] In early 2022, DTE Energy was the first utility to propose this type of investment in their $17 million Charging Expansion proposal. The Michigan Public Service Commission is currently evaluating the proposal and a response is expected in Fall 2022.[85]

Figure 6. Committed Electric School Buses by State[86]*



EV Purchase Incentives

Financial purchase incentives have been shown to be a key lever in encouraging buyers to adopt electric vehicles,[87] and they can help to close the gap between early EV adopters and communities currently underrepresented in the EV market. In addition, compared to tax credits for EV purchases, rebates may provide more of an incentive for the vehicle purchase.[88] Although not widespread, utilities may be able to get commission approval for **EV purchase rebates** if the investments are allocated to low-income consumers. In January 2021, the Colorado Public Utilities Commission approved, as part of Xcel Energy's TEP filing, a $5 million rebate pilot program for the purchase of new EVs for income-qualified customers. Through the approved program, Xcel will offer $5,500 upfront rebates for the purchase of a new EV and $3,000 for used EVs for qualified customers.[89] Customers meet the qualification if they are enrolled in any of the following programs:

- State of Colorado Low-Income-Energy Assistance Program (LEAP)
- Energy Outreach Colorado's Colorado Affordable Residential Energy Program (CARE)
- Colorado's Weather Assistance Program (WAP)

- Xcel Energy income-qualified demand side management program
- Xcel Energy's income-qualified Community Solar Gardens program
- Supplemental Nutrition Assistance Program (SNAP)
- Temporary Assistance for Needy Families program (TANF)[90]

The program was approved after the commission rejected an initial proposal for a $30 million EV rebate program that did not place a cap on income or the vehicle price. Had the Commission approved the initial proposal, there is a risk that the subsidies would have been utilized to fund vehicle purchase for primarily higher-income customers. Environmental advocates have also expressed concern that EV rebates may minimize the system benefits of reduced point-source pollution is the EVs do not stay in the targeted communities.[91]

DTE Energy in Michigan and Southern California Edison are examples of two other companies that have filed recent proposals to provide purchase rebates for income-qualified customers. Xcel Energy's EV rebate proposal was rejected by the Minnesota Public Utilities Commission in March 2022 after concerns about the PUC's lack of statutory authority to allow ratepayer funds to be spent on EV rebates.[92]

Conclusion

Transportation electrification has the potential to benefit frontline communities through environmental and health benefits, economic development benefits, reduced costs of vehicle ownership, and potential electricity rate reductions. However, electric vehicle and charging infrastructure has not adequately benefited disadvantaged communities yet, as shown in recent data illuminating disparities in vehicle ownership, distribution of charging infrastructure, and access to mobility. To date, charging deserts exist within LMI areas, EV rebates have been flowing disproportionately to wealthy customers, and Black-identifying and disadvantaged communities have less grid hosting capacity to accommodate EV charging or other DER interconnections.

Recently passed federal funding will support significant growth in vehicle charging infrastructure and electric vehicle ownership. The Infrastructure Investment and Jobs Act (IIJA) allocated $5 billion in formula funding to help states install EV chargers along interstate highways. At least 50 percent of an additional $2.5 billion competitive grant (the Discretionary Grant Program for Charging and Fueling Infrastructure) is designed to strategically deploy accessible charging infrastructure to expand access to EV charging within rural areas, low- and moderate-income neighborhoods, and communities with a low ratio of private parking spaces. The Inflation Reduction Act (IRA) will provide income-qualified Americans with tax credits to purchase new and used electric vehicles and all businesses to purchase commercial EVs. IRA also offers $3 billion to help support access to EV charging for economically disadvantaged communities through the Neighborhood Access and Equity Grant Program.

All of the newly installed chargers will ultimately connect to distribution grids overseen by public utility commissions and add to the chargers that states, utilities, and charging companies will continue to install to build out the national and local infrastructure. Throughout this significant expansion of transportation electrification, all parties will need to collaborate to ensure that current disparities are overcome and benefits flow to all communities, particularly frontline communities.

Endnotes

1. K. Hartman and L. Shields. "State Policies Promoting Hybrid and Electric Vehicles" (National Conference of State Legislatures: 2022), https://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx.
2. White House, Executive Order on Strengthening Leadership in Clean Cars and Trucks, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/08/05/executive-order-on-strengthening-american-leadership-in-clean-cars-and-trucks/
3. GridWise Alliance, Near-Term Grid Investments for Integrating Electric Vehicle Charging Infrastructure, 2022, https://gridwise.org/wp-content/uploads/2022/02/GWA_22_NearTermGridInvestmentsEVChargingInfra_Final.pdf.
4. Executive Order 14008: Tackling the Climate Crisis at Home and Abroad, 2021, https://www.regulations.gov/document/EPA-HQ-OPPT-2021-0202-0012.
5. Farley et al., Advancing Equity in Utility Regulation (Lawrence Berkeley National Laboratory, 2021), https://emp.lbl.gov/publications/advancing-equity-utilityregulation.
6. Transportation & Climate Initiative, https://www.transportationandclimate.org/.
7. "Sources of Greenhouse Gas Emissions," U.S. Environmental Protection Agency, https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
8. "State Policy Hub," Center for Climate and Energy Solutions, https://www.c2es.org/content/state-climate-policy/.
9. "Utility Transformation Challenge," Smart Electric Policy Alliance, https://sepapower.org/utility-transformation-challenge/utility-carbon-reduction-tracker/.
10. Union of Concerned Scientists, Fact Sheet: Electric Vehicles Are Cleaner than Gasoline—and Getting Better, https://www.ucsusa.org/sites/default/files/2020-05/evs-cleaner-than-gasoline.pdf.
11. Ibid.
12. The EPA defined socially vulnerable populations based on income (Individuals living in households with income that is at or below 200 percent of the poverty level), educational attainment (individuals ages 25 and older with a maximum educational attainment of less than a high school diploma), race and ethnicity (individuals identifying as Black or African American; American Indian or Alaska Native; Native Hawaiian or Other Pacific Islander; and/or Hispanic or Latino), and age (individuals ages 65 and older).
13. Social Vulnerability Report, Environmental Protection Agency, https://www.epa.gov/cira/social-vulnerability-report.
14. https://www.ncbi.nlm.nih.gov/books/NBK100862/
15. https://www.science.org/doi/10.1126/sciadv.abf4491
16. L. Gonzalez, Medium- and Heavy- Duty Electrification: Weighing the Opportunities and Barriers to Zero Emission Fleets. Zero Emissions Transportation Association, 2022, https://fs.hubspotusercontent00.net/hubfs/8829857/ZETA-WP-MHDV-Electrification_Opportunities-and-Barriers_Final3.pdf.
17. L. Freehafer and L. Lazer, The State of Electric School Bus Adoption in the US. World Resources Institute, 2021, https://www.wri.org/insights/where-electric-school-buses-us?utm_medium=social&utm_source=toolkit&utm_campaign=adoption_blog,
18. S. Hardman, "A Perspective On Equity in the Transition to Electric Vehicles," MIT Science Policy Review, 2021, https://sciencepolicyreview.org/2021/08/equity-transition-electric-vehicles/.
19. E.W. Carr et al., *Workforce Projections to Support Battery Electric Vehicle Charging Infrastructure Installation*, Electric Transportation Community Development Corporation, 2021, https://etcommunity.org/assets/files/WorkforceProjectionstoSupportBatteryElectricVehicleChargingInfrastructureInstallation-Final202106082.pdf.
20. C. Harto, *Electric Vehicle Ownership Costs: Today's Electric Vehicles Offer Big Savings for Consumers*, 2020, https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf.
21. J. McMahon, "Electric Vehicles Cost Less Than Half as Much to Drive," Forbes, 2018, https://www.forbes.com/sites/jeffmcmahon/2018/01/14/electric-vehicles-cost-less-than-half-as-much-to-drive/?sh=386d09ec3f97.
22. B. Borlaug et al., Levelized Cost of Charging Electric Vehicles in the United States, Cell, 2020, https://www.cell.com/joule/fulltext/S2542-4351(20)30231-2#secsectitle0040.
23. https://www.bls.gov/cex/tables/calendar-year/mean-item-share-average-standard-error/cu-area-type-2019.pdf
24. G. Bauer et al., When might lower-income drivers benefit from electric vehicles? Quantifying the Economic Equity Implications of Electric Vehicle Adoption, International Council On Clean Transportation, 2021, https://theicct.org/sites/default/files/publications/EV-equity-feb2021.pdf.
25. Frost et al., 2019, Electric Vehicles Are Driving Electric Rates Down, https://www.synapse-energy.com/sites/default/files/EVs-Driving-Rates-Down-8-122.pdf.
26. A. Drehobl et al., How High Are Household Energy Burdens?, American Council for an Energy-Efficient Economy, 2020, https://www.aceee.org/sites/default/files/pdfs/u2006.pdf.
27. B. Sen, How the U.S. Transportation System Fuels Inequality, USA Streets Blog, 2022, https://usa.streetsblog.org/2022/02/04/opinion-how-the-u-s-transportation-system-fuels-inequality/#:~:text=Personal%20vehicle%20ownership%20rates%20by,86%20percent%20of%20white%20households.
28. https://sciencepolicyreview.org/2021/08/equity-transition-electric-vehicles/
29. https://escholarship.org/content/qt0tn4m2tx/qt0tn4m2tx_noSplash_36244609f162444f3e55c550dfc22cad.pdf.
30. "New-Vehicle Prices Flirt with Record High in May, According to Kelley Blue Book, as Luxury Share Remains Strong," Kelley Blue Book, 2022, https://mediaroom.kbb.com/2022-06-09-New-Vehicle-Prices-Flirt-with-Record-High-in-May,-According-to-Kelley-Blue-Book,-as-Luxury-Share-Remains-Strong.

31. L. Davis, , Evidence of A Homeowner-renter Gap for Electric Vehicles, Applied Economics Letters, 2019, https://doi.org/10.1080/13504851.2018.1523611
32. https://www.transportation.gov/sites/dot.gov/files/2022-01/Charging-Forward_A-Toolkit-for-Planning-and-Funding-Rural-Electric-Mobility-Infrastructure_Feb2022.pdf
33. J. Tolbert, Beyond Cities: Breaking Through Barriers to Rural Electric Vehicle Adoption, Environmental and Energy Study Institute, 2021, https://www.eesi.org/articles/view/beyond-cities-breaking-through-barriers-to-rural-electric-vehicle-adoption
34. Ibid.
35. Wei et al., "Personal Vehicle Electrification and Charging Solutions f or High-Energy Days," Nature Energy, 2021, https://www.nature.com/articles/s41560-020-00752-y.
36. https://sciencepolicyreview.org/2021/08/equity-transition-electric-vehicles/
37. "How Much Does it Cost to Install an Electric Vehicle Charging Station at Home?," Fixr.com, 2022, https://www.fixr.com/costs/home-electric-vehicle-charging-station.
38. Hsu and Fingerman, "Public electric vehicle charger access disparities across race and income in California," *Transport Policy*, 2021, https://www.sciencedirect.com/science/article/pii/S0967070X20309021.
39. Hafiz Khan et al., "Inequitable Access to EV Charging Infrastructure," The Electricity Journal, 2022, https://doi.org/10.1016/j.tej.2022.107096.
40. Scott Hardman et al., *A Perspective on Equity in the Transition to Electric Vehicles*, Science Policy Review, 2021, https://sciencepolicyreview.org/2021/08/equity-transition-electric-vehicles/.
41. J. Tolbert, *Beyond Cities: Breaking Through Barriers to Rural Electric Vehicle Adoption*, Environmental and Energy Study Institute, 2021, https://www.eesi.org/articles/view/beyond-cities-breaking-through-barriers-to-rural-electric-vehicle-adoption.
42. Anna M. Brockway, et al., "Inequitable Access to Distributed Energy Resources Due to Grid Infrastructure Limits in California," *Nature Energy*, 2021,https://www.nature.com/articles/s41560-021-00887-6.
43. Bilegt Baatar, et al., *Preparing Rural America for the Electric Vehicle Revolution*, University of California, Davis Environmental Policy & Management Program, https://epm.ucdavis.edu/sites/g/files/dgvnsk296/files/inline-files/Preparing%20Rural%20America%20for%20the%20Electric%20Vehicle%20Revolution.pdf
44. U.S. Department of Transportation, *Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure* 2021, https://www.transportation.gov/sites/dot.gov/files/2022-01/Charging-Forward_A-Toolkit-for-Planning-and-Funding-Rural-Electric-Mobility-Infrastructure_Feb2022.pdf.
45. J. Tolbert, *Beyond Cities: Breaking Through Barriers to Rural Electric Vehicle Adoption*, Environmental and Energy Study Institute, 2021, https://www.eesi.org/articles/view/beyond-cities-breaking-through-barriers-to-rural-electric-vehicle-adoption.
46. Gordon Bauer, Chih-Wei Hsu, and Nic Lutsey, When Might Lower-Income Drivers Benefit from Electric Vehicles? Quantifying the Economic Equity Implications of Electric Vehicle Adoption, International Council on Clean Transportation, 2021, https://theicct.org/sites/default/files/publications/EV-equity-feb2021.pdf.
47. https://www.urban.org/sites/default/files/publication/104697/in-search-of-equitable-transit-operations_0.pdf
48. Anna M. Brockway et al., "Inequitable access to distributed energy resources due to grid infrastructure limits in California," Nature Energy, 2021, https://doi.org/10.1038/s41560-021-00887-6.
49. "EV For All: Electrifying in Low-Income Communities," Citizens Utility Board, https://www.citizensutilityboard.org/wp-content/uploads/2020/06/EV-for-All.pdf.
50. P. Huether, Siting Electric Vehicle Supply Equipment (EVSE) with Equity in Mind, ACEEE, 2021, https://www.aceee.org/sites/default/files/pdfs/siting_evse_with_equity_final_3-30-21.pdf.
51. T. Drake, Approval of Xcel Energy's Electric Vehicle Pilots Highlights Key Considerations for Electric Utilities. E21 Initiative, 2019, https://e21initiative.org/approval-of-xcel-energys-electric-vehicle-pilots-highlights-key-considerations-for-electric-utilities/.
52. C. Smith, "Less Than Two Percent of Utility Investment Going Towards EV Awareness," Atlas Public Policy, 2019., https://www.atlasevhub.com/data_story/less-than-two-percent-of-utility-investment-going-towards-ev-awareness/.
53. Alliance for Transportation Electrification. The Missing Piece on Meeting Transportation Electrification Goals: Utility Education and Outreach Programs, 2020, https://evtransportationalliance.org/wp-content/uploads/2021/11/2020-Education-Outreach-White-Paper.pdf.
54. Jenifer Bosco and John Van Last, Principles for Fair and Equitable Investment in Electric Vehicles and Transportation Electrification, National Consumer Law Center, 2018, https://www.nclc.org/wp-content/uploads/2022/09/nclc-ev-principles-oct18.pdf.
55. Rate Design Task Force, Rate Design for EV Fast Charging: Demand Charges, Alliance for Transportation Electrification. 2022, https://evtransportationalliance.org/wp-content/uploads/2022/06/Rate.Design.TF_.Demand-Charge-Paper-Final-5.25.22.pdf.
56. Jason Frost et al., Electric Vehicles are Driving Electric Rates Down, Synapse Energy, 2020. https://www.synapse-energy.com/sites/default/files/EV_Impacts_June_2020_18-122.pdf.
57. Charles Harper et al., Electric Vehicles: Key Trends, Issues, and Considerations for State Regulators, National Association of Regulatory Utility Commissioners, 2019, https://pubs.naruc.org/pub/32857459-0005-B8C5-95C6-1920829CABFE.
58. Herman Trabish, "An Emerging Push for Time-of-Use Rates Sparks New Debates about Customer and Grid Impacts", Utility Dive, 2019, https://www.utilitydive.com/news/an-emerging-push-for-time-of-use-rates-sparks-new-debates-about-customer-an/545009/.
59. Rate Design Task Force, Electric Rate Design Principles for Regulated Utilities, Alliance for Transportation Electrification, 2022, https://evtransportationalliance.org/wp-content/uploads/2022/06/Phase-1-Rate-Design-paper-July-2021.pdf.

60. Kansas Corporation Commission. Docket No. 21-EMKE-320-TAR, https://estar.kcc.ks.gov/estar/portal/kscc/page/docket-docs/PSC/DocketDetails.aspx?DocketId=498756bf-7163-4125-80b1-0215a33add65.
61. Garrett Fitzgerald et al., Electric Vehicles as Distributed Energy Resources, RMI, 2016, https://rmi.org/insight/electric-vehicles-distributed-energy-resources/.
62. Rate Design Task Force, Rate Design for EV Fast Charging: Demand Charges, Alliance for Transportation Electrification, 2022, https://evtransportationalliance.org/wp-content/uploads/2022/06/Rate.Design.TF_.Demand-Charge-Paper-Final-5.25.22.pdf
63. New Jersey Board of Public Utilities, Docket No. EO21030630 https://publicaccess.bpu.state.nj.us/CaseSummary.aspx?case_id=2110251
64. P. Huether, Siting Electric Vehicle Supply Equipment (EVSE) with Equity in Mind. ACEEE, 2021https://www.aceee.org/sites/default/files/pdfs/siting_evse_with_equity_final_3-30-21.pdf.
65. Lyft. 2022. Lyft Economic Impact Report 2022. https://drive.google.com/file/d/1Zs7co1FuhC8FkFHp6aj_vmYAlrLeyuil/view
66. U.S. Census Bureau, "Population Estimates Program (PEP). Race and Hispanic Origin, White alone, not Hispanic or Latino," Measuring America's People, Places, and Economy,2021, https://www.census.gov/quickfacts/fact/table/US/PST045221.
67. Union of Concerned Scientists, Ride-Hailing's Climate Risk, 2020, https://www.ucsusa.org/sites/default/files/2020-02/Ride-Hailing%27s-Climate-Risks.pdf.
68. Michigan Public Service Commission, Case No. U-20836, 2022, https://mi-psc.force.com/sfc/servlet.shepherd/version/download/0688y000001oecmAAA.
69. R. Valova, Enabling Equitable Electric Vehicle Shared Mobility Programs, IREC, 2022, https://irecusa.org/wp-content/uploads/2022/02/Paving-the-Way-Enabling-Equitable-Electric-Vehicle-Shared-Mobility-Programs-Paper-Revised-6.10.22-compressed.pdf.
70. St. Paul, MN. EV Spot Network. https://www.stpaul.gov/departments/public-works/transportation-and-transit/ev-spot-network
71. Minnesota Public Utilities Commission, Docket No. E-002/M-20-711, https://efiling.web.commerce.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={9002687A-0000-C418-935D-B97C8739835C}&documentTitle=20217-175822-01.
72. R. Valova, Enabling Equitable Electric Vehicle Shared Mobility Programs, IREC, 2022, https://irecusa.org/wp-content/uploads/2022/02/Paving-the-Way-Enabling-Equitable-Electric-Vehicle-Shared-Mobility-Programs-Paper-Revised-6.10.22-compressed.pdf.
73. New York Public Service Commission, Case No. 18-E-0138, 2020.
74. P. Allen et al., Utility Investment in Electric Vehicle Charging Infrastructure: Key Regulatory Considerations, 2017, https://www.georgetownclimate.org/files/report/GCC-MJBA_Utility-Investment-in-EV-Charging-Infrastructure.pdf.
75. Maryland Public Service Commission. 2019. Order NO. 88997, Case No. 9578
76. Freehafer, L. and L. Lazer. 2021. The State of Electric School Bus Adoption in the US. World Resources Institute. https://www.wri.org/insights/where-electric-school-buses-us?utm_medium=social&utm_source=toolkit&utm_campaign=adoption_blog
77. E. Evans and S. Folger, Accelerating the Transition to Electric School Buses. Environment America and U.S. PIRG, 2021, https://uspirgedfund.org/sites/pirg/files/reports/US_EL%20buses%202021%20scrn_1.pdf.
78. Ameren Illinois, Ameren Illinois Electric Vehicle Charging Plan Approved by ICC, 2021, https://ameren.mediaroom.com/2021-07-08-Ameren-Illinois-Electric-Vehicle-Charging-Plan-Approved-by-ICC.
79. A. Best, Public Service Commission of Maryland PC44 Fleet Subgroup Summary Report. 2022, https://www.psc.state.md.us/search-case-files/.
80. N.Lepre et al., Deploying Infrastructure for Electric Transit Buses, Atlas Public Policy, 2022, https://atlaspolicy.com/wp-content/uploads/2022/05/Deploying-Charging-Infrastructure-for-Electric-Transit-Buses.pdf.
81. D. Farnsworth and B. O'Malley, Transit Electrification: Challenges and Opportunities, Regulatory Assistance Project, 2022, https://www.raponline.org/wp-content/uploads/2022/04/rap-transit-electrification-2022-april.pdf.
82. P. Maloney, Electric buses for mass transit seen as cost effective. American Public Power Association, 2019, https://www.publicpower.org/periodical/article/electric-buses-mass-transit-seen-cost-effective#:~:text=An%20average%20diesel%20transit%20bus,bus%2C%20according%20to%20the%20report.
83. The Climate Finance Lab. Pay as You Save for Clean Transport, https://www.climatefinancelab.org/project/pay-save-clean-transport/.
84. Clean Energy Works, Inclusive Utility Investments for Transportation: Questions & Answers, 2022, https://drive.google.com/file/d/1v_njHxmRJ2xlw_xoXklxftsGwzbYk6J-/view
85. Ibid.
86. L. Freehafer and L. Lazer. The State of Electric School Bus Adoption in the US. World Resources Institute, 2021,https://www.wri.org/insights/where-electric-school-buses-us?utm_medium=social&utm_source=toolkit&utm_campaign=adoption_blog.
87. S. Hardman, The effectiveness of financial purchase incentives for battery electric vehicles – A review of the evidence. Renewable and Sustainable Energy Reviews 2017, https://doi.org/10.1016/j.rser.2017.05.255.
88. Colorado Public Utilities Commission. Proceeding No. 20-0204E, 2021.
89. R. Walton, Colorado approves Xcel's $110M transportation electrification plan, with strong equity emphasis. Utility Dive, 2021, https://www.utilitydive.com/news/colorado-approves-xcels-110m-transportation-electrification-plan-with-st/593367/.
90. Income-Qualified Electric Vehicle Rebate, Xcel Energy, https://ev.xcelenergy.com/ev-rebate-co.
91. Colorado Public Utilities Commission. Proceeding No. 20-0204E, 2021.
92. E. McCarthy, As Minnesota regulators reject Xcel's $150M EV rebate plan, focus moves to legislation. Utility Dive, 2022, https://www.utilitydive.com/news/as-minnesota-regulators-reject-xcels-150m-ev-rebate-plan-focus-moves-to/621330/.

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