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PRODUCT 0-7169-P3

LONG-TERM STATEWIDE EV INFRASTRUCTURE PLAN

Texas Department of Transportation Project 0-7169, Post-NEVI Electric Vehicle Infrastructure Research (Freight, Fleet, and Multifamily Housing)

Task 6. Develop Long-Term EV Infrastructure Strategic Plan

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ABSTRACT

This document is Product 0-7169-P3, *Long-Term Statewide EV Infrastructure Strategic Plan*, which the research team developed as part of Task 6 of Texas Department of Transportation (TxDOT) Project 0-7169, Post-NEVI Electric Vehicle Infrastructure Research (Freight, Fleet, and Multifamily Housing). The purpose of the long-term strategic plan is to guide infrastructure investment across the state, with a goal of a stable and consistent electric vehicle (EV) charging network. The plan is intended to help guide future charging infrastructure funding opportunities and provide guidance to effectively and equitably distribute available funding.

The strategic plan is based on the findings of Tasks 2–5 of TxDOT Project 0-7169 and provides recommendations to adapt EV charging infrastructure consistent with public demand. The strategic plan discusses federal programs and initiatives, ongoing state-level EV legislation and policies, state-level EV charging plans and activities, concerns and recommendations from EV charging stakeholders, a prototype tool to project EV charging demand, and challenges and opportunities for Texas. These components of the strategic plan are supportive of TxDOT's overarching goal to develop a statewide plan to determine and guide EV infrastructure investment across the state and create a stable and consistent EV charging network.

The strategic plan provides recommendations that describe how TxDOT could coordinate best practices through engagement with transportation agencies within and outside of Texas. The strategic plan provides recommendations to facilitate stakeholder partnerships to advance network opportunities and identify opportunities to educate stakeholders through outreach efforts that support the goals of the statewide plan. Finally, the strategic plan highlights how to engage with electric utilities and regulatory agencies to enable electrified mobility and adapt the transportation infrastructure to support electrified mobility.

DISCLAIMER

This research was sponsored by TxDOT and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

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ADA	Americans with Disabilities Act
AFC	Alternative Fuel Corridor
AFV	Alternative Fuel Vehicle
BABA	Build America, Buy America Act
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CPUC	California Public Utilities Commission
DC	Direct Current
DCFC	Direct Current Fast Charger
DBE	Disadvantaged Business Enterprise
DOT	Department of Transportation
EMS	Emergency Medical Services
EO	Executive Order
ETC	Equitable Transportation Community
EV	Electric Vehicle
EVI-Equity	Electric Vehicle Infrastructure for Equity Model
EVITP	Electric Vehicle Infrastructure Training Program
EVSE	Electric Vehicle Supply Equipment
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GWh	Gigawatt Hour
ICE	Internal Combustion Engine
IRA	Inflation Reduction Act
IIJA	Infrastructure Investment and Jobs Act
kW	Kilowatt
MHDV	Medium- and Heavy-Duty Vehicle
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NCDOT	North Carolina Department of Transportation
NEVI	National Electric Vehicle Infrastructure
SB	Senate Bill
TDLR	Texas Department of Licensing and Regulation
TxDOT	Texas Department of Transportation
USDOT	U.S. Department of Transportation
ZEV	Zero-Emissions Vehicle

INTRODUCTION

Need for the Strategic Plan

With the growing adoption of electric vehicles (EVs) in the United States and by Texans, Texas has a need for adequate and comprehensive coverage of EV charging infrastructure. While EVs currently comprise slightly more than 1 percent of all registered vehicles in Texas, projections forecast that EVs could comprise up to 55 percent of all vehicles by the year 2040. This significant industry shift will require considerable and proactive efforts to support this transition, focusing on infrastructure readiness; customer experience; interregional connectivity, equity, and economic impacts; and other consequences related to the closure or repurposing of gas stations.

Texas needs to identify optimal places where infrastructure will be needed in advance of federal and local funding that will be available to build EV charging infrastructure. Since implementation of EV charging infrastructure will occur in phases over multiple years, a long-term strategic plan is necessary to guide the development of EV infrastructure, ensure that the Texas Department of Transportation (TxDOT) meets the needs of EV stakeholders, and maximize financial opportunities available to the state.

This document is Product 0-7169-P3, *Long-Term Statewide EV Infrastructure Strategic Plan*, which the research team developed as part of Task 6 of TxDOT Project 0-7169, Post-NEVI Electric Vehicle Infrastructure Research (Freight, Fleet, and Multifamily Housing). The purpose of the long-term strategic plan is to guide infrastructure investment across the state, with a goal of a stable and consistent EV charging network. The plan is intended to help guide future charging infrastructure funding opportunities and provide guidance to effectively and equitably distribute available funding. In addition to the strategic plan, TxDOT Project 0-7169 developed two additional products, a *Tool to Estimate Electric Vehicle Charging Demand* (0-7169-P1) and a *Policy Analysis Framework* (0-7169-P2), which complement the strategic plan and are available as separate documents.

Development of the Strategic Plan

The strategic plan is based on the findings of Tasks 2–5 of TxDOT Project 0-7169 and provides recommendations to adapt state highway infrastructure consistent with public demand. The strategic plan consists of the following sections:

- **Federal Programs and Initiatives:** a description of federal programs, initiatives, and activities with regard to EV charging, including infrastructure laws and regulations, updates to utility accommodation rules and regulations, and alternative energy corridor network rules and requirements.
- **State-Level EV Legislation and Policies:** a description of recent legislative measures and policies affecting EV infrastructure at state transportation agencies.
- **State EV Charging—Plans and Activities:** a description of state plans and activities with regard to EV charging.
- **EV Charging Stakeholder Concerns and Recommendations:** a summary of concerns, considerations, and recommendations from EV charging stakeholders that attended the research team's workshops.

- **Projection of EV Charging Demand:** a description of a tool developed as part of Project 0-7169 that can be used to estimate EV charging demand in Texas.
- **Challenges and Opportunities for Texas:** a discussion of recommendations based on the findings of the research project.

The components of the strategic plan are supportive of TxDOT's overarching goal to develop a statewide plan to determine and guide EV infrastructure investment across the state and create a stable and consistent EV charging network. Each of the first five section includes a bulleted list of findings related to the section discussion. The last section, "Challenges and Opportunities for Texas," provides a listing of recommendations for the development of a stable and effective charging network across Texas based on the findings of the research project, including policies, plans, and programs to support the development of EV infrastructure from a variety of entities.

The strategic plan provides recommendations that describe how TxDOT could coordinate best practices through engagement with transportation agencies within and outside of Texas. The strategic plan provides recommendations to facilitate stakeholder partnerships to advance network opportunities and identify opportunities to educate stakeholders through outreach efforts that support the goals of the statewide plan. Finally, the strategic plan highlights how to engage with electric utilities and regulatory agencies to enable electrified mobility and adapt the transportation infrastructure to support electrified mobility.

FEDERAL PROGRAMS AND INITIATIVES

Infrastructure Investment and Jobs Act

The 2021 Infrastructure Investment and Jobs Act (IIJA) represents a significant investment in U.S. infrastructure, especially in electrifying transportation and providing clean energy to support that electrification. The legislation includes efforts across all modes of transportation, often with a focus on climate change or reducing emissions (*1*). A key component of reducing emissions, as well as the overall environmental footprint from transportation, is promoting the use of alternative fuels (e.g., through the use of EVs). To that end, the IIJA intends to build a national network of EV chargers that would enable greater adoption of EVs by providing access to long-distance travel and filling the gaps in communities across the United States. In addition to charging infrastructure funding, the IIJA also provides additional support for clean school buses and other transit.

The investment provided through the IIJA highlights the new federal priorities in terms of transportation—a transportation system focused on cleaner vehicles such as EVs. The IIJA also establishes the need for minimum standards regarding new infrastructure, such as EV chargers. The Federal Highway Administration made effective its final rule regarding standards for the National Electric Vehicle Infrastructure (NEVI) Program on March 30, 2023, and updated these rules on June 2, 2023, and June 11, 2024 (*2*). The IIJA mandates that minimum standards and requirements be developed in the following six areas:

- Installation, operation, and maintenance.
- Interoperability.
- Traffic control devices and on-premises signs.

- Data.
- Network connectivity.
- Information on location, pricing, real-time availability, and accessibility through mapping applications.

These requirements include a minimum of four charging ports per station, each with combined charging system Type 1 connectors, direct current fast chargers (DCFCs) that provide 150 kW of power, and Level 2 chargers that provide at least 6 kW per port. These regulations are intended as a minimum, so states can include additional ports, higher power requirements, or additional connector types as desired. Chargers located along alternative fuel corridors (AFCs) have an uptime requirement of 100 percent (i.e., 24 hours a day, 7 days a week), while chargers located outside designated AFCs must maintain accessibility for use during their regular business hours. Additional requirements relate to accessible methods of payment, equipment certification, cybersecurity, long-term stewardship, and the use of qualified personnel such as technicians. All electricians must be certified by the Electric Vehicle Infrastructure Training Program (EVITP) (*3*). In terms of customer or consumer protection, mechanisms must exist to report issues and safeguard data privacy. This rule also establishes compliance with the *Manual on Uniform Traffic Control Devices for Streets and Highways* and federal outdoor advertising rules for on-premises signs (*4, 5*). While these requirements are defined for the conditional use of federal funds, they also present a baseline for EV charging infrastructure and charging station development across the United States. These requirements may become the industry standard depending on state adoption of alternative requirements or feasibility.

Inflation Reduction Act

The Inflation Reduction Act (IRA), while not focused on transportation, includes a number of provisions that will impact the number of EVs on the road and the subsequent need for charging infrastructure (*6*). The light-duty EV tax credit was extended through 2032 with modifications to eligibility. Manufacturer caps were replaced with vehicle manufacturer suggested retail prices and requirements for assembly and sourcing of EV materials. In addition, the tax credits were limited based on purchaser incomes, e.g., to an annual adjusted gross income of $300,000 for married couples filing taxes jointly or $150,000 for individuals. The credit can also be transferred to the dealer at the point of sale, enabling a reduction in the overall purchase price for the consumer. The IRA also provides a tax credit for used EVs of up to $4,000 or 30 percent of the sale price as well as a commercial EV tax credit. These tax incentives are intended to promote the growth of EV sales within the United States alongside the investment in charging infrastructure. Regarding charging infrastructure, the IRA also extends the tax credit for charging equipment. Other provisions related to EVs and charging infrastructure include incentives to electrify the U.S. Postal Service fleet and funds for clean heavy-duty vehicles.

Executive Orders and Federal Requirements Related to EV Infrastructure

Recent initiatives and executive orders (EOs) at the federal level highlight the federal funding and programming priorities over the next 4 years. Equity in transportation is playing a greater role in decision-making and priorities than it has previously. The renewed focus on transportation equity is highlighted by the Justice40 Initiative as well as EO 13985, *Executive Order on Advancing Racial Equity and Support for Underserved Communities through the*

Federal Government (*7*). The EO calls for the fair allocation of federal resources and the equitable delivery of government benefits and opportunities. The U.S. Department of Transportation (USDOT) responded to the EO with an equity and access policy statement that affirmed the agency's support for the EO, emphasizing the importance of removing language barriers and ensuring environmental justice to comply with the EO (*8*). These policies are now included in criteria and guidance for the use of both grant and formula-based funding. Any proposed policy and funding framework should acknowledge these policy inclusions because federal funding remains the key source for EV infrastructure.

Existing and new federal formula and grant programs also include updated guidance that places a larger emphasis on equity in practices, processes, and decision-making. Any strategy for developing EV infrastructure should understand the importance of equity when leveraging federal funding. Federal initiatives and programs also focus on environmental goals, such as emissions reduction and increased use of non-single-occupant-vehicle modes of transportation.

The Justice40 Initiative began in January 2021 with EO 14008, *Tackling the Climate Crisis at Home and Abroad* (*9*). This initiative directs certain programs and projects that receive federal funding to provide 40 percent of the benefits to disadvantaged communities. The Climate and Economic Justice Screening Tool was developed and released in 2022 to provide guidance on communities that are considered disadvantaged based on the following categories and their criteria (*10*):

- Climate change.
- Clean energy and energy efficiency.
- Clean transit.
- Affordable and sustainable housing.
- Reduction and remediation of legacy pollution.
- Critical clean water and wastewater infrastructure.
- Health burdens.
- Training and workforce development.

These categories also guide the programs that the Justice40 Initiative covers across the federal government. For USDOT, this initiative includes 39 programs across five modes (*11*). The related tool uses publicly available and nationally consistent databases to measure the relevant criteria under each category, such as projected flood risk or energy costs. This tool is intended to assist both eligible grant applicants and funding recipients as well as the federal government in locating disadvantaged communities in the United States. USDOT developed a complementary tool—the Equitable Transportation Community (ETC) Explorer—that provides greater insight into transportation disadvantage (*12*). The ETC Explorer provides additional data on the following:

- Transportation access.
- Environmental burden.
- Social vulnerability.
- Health vulnerability.
- Climate and disaster risk burden.

The ETC Explorer does not identify areas as disadvantaged or not disadvantaged but instead aims to provide information on the cumulative impacts that result from a lack of access to transportation (*13*). USDOT is in the process of developing a method for calculating the benefits and burdens of its programs as well as incorporating the Justice40 Initiative requirements into its notice of funding opportunities.

Other federal requirements that apply to EV charging infrastructure include the Americans with Disabilities Act (ADA) and the Disadvantaged Business Enterprise (DBE) Program. While no specific ADA design standards have been released for EV charging stations, the U.S. Access Board provides guidance in its *Design Recommendations for Accessible Electric Vehicle Charging Stations*, and the Department of Energy provides guidance on complying with the ADA for workplace charging installations (*14*, *15*). This guidance includes the recommended number of accessible charging spaces per lot (if charging stations are in a parking lot) as well as spacing and access standards. The ADA requirements apply to public charging stations and thus must be considered when developing EV infrastructure plans and policies. Any use of federal funds also requires consideration of DBEs. This consideration should again be reflected in policies that relate to EV infrastructure, where necessary, to ensure compliance. The NEVI Program formula funds are not currently subjected to DBE requirements, but future federal funding may differ in its requirements. Similarly, the Build America, Buy America Act (BABA) requirements can be waived for EV charging infrastructure to allow time for domestic markets to mature. Looking beyond the NEVI Program, these two programs may apply when leveraging federal funds for an EV infrastructure project.

Importance to Texas EV Planning

With the passage of the IIJA, the federal government and the current administration signaled a strong interest in promoting electrification across transportation to meet climate and equity goals. Subsequent legislation continued that interest in developing a robust electric mobility landscape in the United States through advancements in battery technology and improvements to the supply chain. In addition, EOs and federal initiatives have emphasized the focus on the climate and the environment as well as on equity and justice in transportation. Federal EV legislation and policies provide a broad framework for transportation investments that are determined and finalized at the state and local levels. These policies—through their dedicated funding levels and the requirements associated with this funding—have implications for EVs and charging infrastructure in Texas. Finally, after the IIJA and the NEVI Program expire, Texas decision-makers will need to consider how to maintain EV infrastructure capacity throughout the state, beyond the scope of these initial programs and funding.

Policies and regulations at the federal level play a role in Texas's EV infrastructure planning by providing funding and establishing requirements for EV charging infrastructure that is likely to be maintained after the end of the NEVI Program. Texas is set to receive $407.8 million over the 2022–2026 fiscal years from the NEVI Program. This funding will be leveraged to support private investment in an EV charging network across Texas. Texas's NEVI plan follows the program guidelines by building out infrastructure on the AFCs before expanding the network across the state in later years. Year one of Texas's NEVI Program funding will focus on those AFCs, ensuring spacing of no more than 50 miles between charging stations. Years two and three will focus on rural counties and small urban areas, as well as metropolitan planning

organization (MPO) needs in large urban areas. However, a state the size of Texas will require continued planning, monitoring, and investment in the EV charging network to ensure accessibility that enables widespread adoption of EVs.

Researchers found that policies and regulations at the federal level have created a need to support the work of public agencies in Texas that work with federal grant programs in order to maximize grant program results for Texas. Specifically, researchers identified the following needs:

- **Need for grant program guidance.** Many stakeholders were concerned with the number of potential grant programs in the EV space, along with understanding what government programs are available and how to apply.
- **Need for grant-writing expertise and support.** Many stakeholders were concerned about having sufficient staff, expertise, and data to support applications for funding programs.
- **Need to provide guidance for the Justice40 Initiative.** Stakeholders mentioned that there does not seem to be much guidance available to implement the Justice40 Initiative. There also seems to be an overall lack of discussion or thought leadership. One issue is that there are so many options to address the requirements. For example, job opportunities, charger placement, air quality improvements, or direct health outcomes could be included, but some benefits will be difficult to prove.

Furthermore, researchers identified programmatic needs beyond the NEVI Program, such as charging infrastructure for freight and fleet applications, as well as support for multifamily housing. Although a smaller number of vehicles require access to charging, freight and fleet applications may require additional investment due to increased power needs relative to light-duty vehicles. Utility coordination is necessary to ensure adequate available infrastructure for these types of vehicles. In addition, multifamily housing poses a unique challenge; individuals living in multifamily housing may not have easy access to at-home charging. While these EV owners will benefit from a robust public charging network, multifamily housing may also require an in-neighborhood solution to ensure the necessary range. Post-NEVI charging needs will be influenced by the current federal regulations to a certain extent because the uptime, charging capability, power, data, and customer service standards may become the norm.

STATE-LEVEL EV LEGISLATION AND POLICIES

State-level policies, regulations, and legislation vary greatly by state in terms of their breadth and depth. For example, California has a number of regulations intended to increase EV or zero-emission vehicle (ZEV) use with a particular focus on medium- and heavy-duty vehicles (MHDVs) and fleets, while states such as Iowa are currently focused on incentivizing the purchase of electric vehicle supply equipment (EVSE) or low- to zero-emission vehicles. Some states also limit the sales of internal combustion engine (ICE) vehicles. Policies, regulations, and legislation from 14 peer states (Arizona, California, Colorado, Florida, Georgia, Illinois, Iowa, Michigan, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, and Tennessee) were analyzed to help establish a policy and funding framework for Texas. The states were selected based on criteria relevant to funding and finance, such as lane miles per capita, as well as technological progress and goals. Researchers identified policies and regulations related to utilities, EV charging station definitions, air quality and the environmental, funding and

financing for EV charging infrastructure, freight and MHDVs, fleets, zoning and land use, and multifamily and residential housing. In addition to the policy and legal review, researchers considered plans and programs related to EV infrastructure.

Utility-Related Policies and Regulations

EV charging station locations and types may interact with utilities based on their right-of-way requirements or surrounding interconnection requirements. In the dynamic landscape of EV infrastructure development, the interaction between EV charging stations and utilities is a critical aspect governed by various state regulations and codes.

Updates to Rate Schedules

In California, the state is actively involved in shaping the integration of EVs into the grid. The California Public Utilities Code §740.16 mandates the development of strategies and metrics for feasible and cost-effective EV grid integration by January 1, 2030 (*16*). This mandate includes consideration of demand, time-of-use rates, and adherence to National Institute of Standards and Technology standards for cybersecurity. Simultaneously, the California Vehicle Code permits utility owners to request data on the addresses of EV owners but not their names (*17*).

Another significant California statute aims to facilitate the development of technologies for grid integration, consistent with §740.16 (*16*). It addresses policies supporting rate strategies to mitigate the impacts of demand charges and establishes a tariff for MHDVs. In 2022, California passed Assembly Bill 2700, requiring the collection of fleet data by the California Public Utilities Commission (CPUC) in collaboration with the California Air Resources Board (CARB) and the Energy Commission (*18*).

Colorado allows utilities to establish rates and charge schedules to facilitate the return on investments in EV programs (*19*). Electric utilities must submit specific rate proposals to the commission that encourage vehicle charging and support the electric grid.

Recent legislation in New York establishes a commercial tariff on EVs that may urge utilities to explore alternative demand-based rate structures or provide other operating cost-relief mechanisms to facilitate faster charging (*20*).

Iowa requires an electricity dealer license to sell or dispense electricity as a vehicle fuel outside of a residence (*21*). Pennsylvania Code mandates that each electric distribution company addresses third-party owned and operated EV charging stations in its tariff (*22*). Oklahoma restricts municipal utilities from using revenue from the sale of electric power to fund the maintenance or construction of EV chargers (*23*).

Utility EV Infrastructure and Resources

The California Public Resources Code tasks CPUC with creating a website that provides consumer resources, including residential utility service upgrade requirements, basic charging circuit requirements, utility rate options, and load management techniques (*24*).

California's Assembly Bill 841 mandates CPUC's approval or modification of utility transportation electrification programs (*25*). These programs, including EV charging stations, are to be deployed through a reasonable cost recovery mechanism that does not unfairly compete with nonutility enterprises. At least 35 percent of investments must be directed toward underserved communities. Utilities must file a new tariff to design and deploy all electrical distribution infrastructure for all customers installing separate meters, with costs to be recovered as other distribution infrastructure authorized in the utility's general rate case revenue requirement.

EV Charging Station Definitions under State Law

Policies and regulations related to EVSE range from infrastructure classification as a utility (due to the provision of electricity) to building code updates and ease of installation. EVSE or charging stations provide electricity to refuel a vehicle; in some states, definitions of a utility or public utility may apply to charging stations or equipment owners. The rules and regulations for public utilities are extensive and can be prohibitive for installing, operating, and maintaining charging equipment. To address these issues, 43 states and the District of Columbia have specified that their definition of a public utility does not include owners of EV charging stations (*26*). Depending on the state, the language in the regulation can broadly exclude EV charging facilities from the definition of a public utility or can specify that charging facilities owned by non-utilities will not be regulated as a public utility.

Air Quality and the Environment

EV markets and charging networks are developing partly in response to air-quality- and emissions-related regulations in certain states. California has the most aggressive targets and often sets the standard for other states through the CARB standards. Environmental goals are increasingly focused on low- to zero-emission vehicles to reduce the overall emissions accounted for by transportation. With 28 percent of U.S. greenhouse gas (GHG) emissions attributable to the transportation sector, EVs—and therefore EV charging—will be part of the overall solution (*27*).

Zero-Emission Vehicle Promotion

CARB adopted a regulation in 2022 that bans the sale of new gasoline-powered cars and light trucks by 2035 (*28, 29*). Other states have adopted similar targets, including Colorado's low-emission automobile regulation that added a ZEV program in 2019 and New York's ZEV sales requirement under Senate Bill (SB) 7788 (*30, 31*). Establishing these targets often requires additional planning or rules and regulations to help enable the transition to 100 percent ZEV sales by a set date. For example, California developed a ZEV promotion plan—the ZEV Market Development Strategy—to provide specific directives to agencies that can influence ZEV adoption and incentivize state fleets to make the transition. Specific tasks in the plan include the following:

- Establish infrastructure to support 1 million ZEVs.
- Update the 2016 ZEV Action Plan with a focus on low-income and disadvantaged communities.

- Support and recommend policies that will facilitate the installation of EV infrastructure in homes and businesses (*32*).

To support these tasks, the California Energy Commission partnered with the California Department of Motor Vehicles to develop a dashboard that tracks sales and the total number of light-duty ZEVs in the state (*33*). The dashboard has expanded to provide a variety of information on ZEVs including information for medium-duty vehicles and buses. This type of information can help regions and local governments effectively plan infrastructure investments and make decisions regarding their EV charging networks.

Emissions Standards and Targets

Reducing emissions from transportation supports overall environmental goals but can also increase cooperation among state agencies and between states. California has the highest number of air quality and environmental policies and regulations that relate to EVs and EV infrastructure: 19 different policies and programs, including funding programs, aim to reduce emissions or the use of gasoline and diesel fuels. California has mobile source emission reduction requirements, CARB standards for conversions and retrofits, and low-carbon fuel use requirements for its state agencies (*34, 35*). Select other states, such as New York, have adopted California's emission standards (*36*). California's Clean Miles Standard Program, which attempts to address the annual emissions of transportation network companies by establishing emissions reduction targets, is also being considered by other states. Both California and New York also have several funding programs in place to help incentivize emissions reductions, discussed in the following section.

Colorado, Illinois, and North Carolina have all developed roadmaps, plans, or targets that incorporate EVs and charging infrastructure. Colorado developed its GHG Pollution Reduction Roadmap 2.0, which includes eight near-term actions related to transportation. One of those actions is to streamline EV charger deployment (*37*). The Illinois Beneficial Electrification Plan includes similar strategies and goals with the intent of reducing pollution from transportation and ensuring that EV adoption does not place significant additional burdens on the electric system while creating benefits for Illinois residents (*38*). North Carolina's targets, from 2018, included reducing GHG emissions to 40 percent below 2005 levels, in part by increasing the number of registered ZEVs to at least 800,000 (*39*). Attaining this target will require the development or incentivization of EV charging as well.

States have also developed broader policies and programs focused on clean transportation that help to incentivize or promote the installation of EV infrastructure. Colorado developed a Clean Fleet Enterprise that offers incentives to governments and fleets for alternative fuel vehicles (AFVs) but also allows the enterprise to assess a clean fleet retail delivery fee (*40*). In New York, the Port Authority of New York and New Jersey prohibits trucks older than model year 1998 to operate at its marine terminals; this prohibition is in part to address the environmental challenges associated with ports (*41*).

Although each state has different targets and strategies related to air quality and emissions, all states are considering the impact of transportation to a greater extent. These plans, programs, and goals not only set standards, regulations, or incentives, but they also promote cooperation

between different state agencies. While the implementation of EV charging infrastructure and the distribution of NEVI Program funds place departments of transportation (DOTs) in a unique and unprecedented position, they also offer the opportunity to collaborate with other state agencies and provide a transportation-specific perspective to those targets and goals.

Funding and Finance for EV Charging Infrastructure

State-level policies and legislation around funding and finance can reduce the regulatory burden for the installation and development of EV charging infrastructure. Tax incentives reduce the burden on private developers, while regulations on financing and investment can enable local governments to safely invest in infrastructure or partner with private charging providers. Other policies or initiatives provide streamlined processes for fleet procurement or provide financing options for local governments.

Tax Incentives

Tax credits, exemptions, and deferrals help to spur investment and reduce barriers to investment for private entities. Table 1 details the tax incentives provided in the peer states.

Table 1. Tax Incentives for EV Infrastructure.

State	Statute/Legislation	Description
California	Cal. Rev. & Tax. Code §6377 (2022)	Extends the sunset of the sales tax exemption from the state's General Fund portion (3.9375%) for the purchase of zero-emission buses eligible under the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project from January 1, 2024, to January 1, 2026.
	Cal. Rev. & Tax. Code §7284.3 (2022)	Utility user tax exemption for electric public transit bus.
Colorado	Colo. Rev. Stat. §39-22-516.7 (2022)	Tax credit for qualified EVs.
	Colo. Rev. Stat. §39-22-516.8 (2022)	Tax credit for innovative trucks. The credit amount for any qualifying truck is limited to the difference in manufacturer's suggested retail price between the qualifying truck and a comparable truck that operates on either gasoline or diesel fuel.
	Colo. Rev. Stat. §39-26-719 (2022)	Conversion parts are exempt from sales and use taxes.
	Colo. House Bill 1272, 74th Gen. Assem., Reg. Sess. (2023)	Extends tax credit and creates a temporary specific ownership tax rate reduction on a portion of the sale of electric medium- and heavy-duty trucks.

State	Statute/Legislation	Description
Georgia	Ga. Code Ann. §48-7-40 (2023) Alternative Fuel and Advanced Vehicle Job Creation Tax Credit	Annual tax credit (available for 5 years) for businesses that manufacture alternative energy products for use in battery, biofuel, and EV enterprises. Credit amounts differ by county and are based on the number of employees.
	Ga. Code Ann. §48-7-40.16 (2023)	Clean vehicle tax credits of 10% of the cost of the charger and installation (up to $2,500). Only available to businesses. The charger must be greater than 130 volts and designed for on-road vehicles.
Illinois	35 Ill. Comp. Stat. 200/10-390 (2023) Reimagining Energy and Vehicles Tax Credit	Tax credit for eligible EV, EV component parts, and EV charging station manufacturers. Credits are available in two tiers. Tier 1 credits are available to EV, EV component, and EV charging station manufacturers that invest a minimum of $20 million and create at least 50 new jobs within 4 years in Illinois. Tier 2 has several criteria, such as investing $1.5 million and creating at least 500 jobs within 5 years.
Iowa	Iowa Admin. Code r. 701—42.42 (2023)	The High-Quality Jobs Program offers state-level tax incentives to business projects for the production of biomass or alternative fuels. Incentives may include an investment tax credit; a refund of state sales, service, or use taxes paid to contractors; and a local property tax exemption based on the value added to the property.
Michigan	Mich. Comp. Laws §207.803-809 (2022)	Industrial property that is used for high-technology activities or the creation or synthesis of biodiesel fuel may be eligible for a tax exemption. High-technology activities include those related to advanced vehicle technologies such as EVs, hybrid electric vehicles, or AFVs and their components. To qualify for the tax exemption, an industrial facility must obtain an exemption certificate for the property from the Michigan State Tax Commission.
North Carolina	NC Gen. Stat. §105-164.13 (2023)	No retail sales and use taxes for alternative fuels.
Oklahoma	Okla. Stat. tit. 68, §2357.22 (2023)	AFV tax credit. Tax credit varies by the weight of the vehicle, ranging from $5,500 to $100,000.

State	Statute/Legislation	Description
	Okla. Stat. tit. 68, §2357.22 (2023)	Alternative fuel infrastructure tax credit. Tax credit for up to 45% of the cost of installing alternative fuel or EV infrastructure.

As the light-duty market develops, states are ending tax exemptions or credits for those vehicles and focusing their efforts on MHDVs. California, Colorado, and Oklahoma all have tax credits aimed at supporting alternative fuel or electric trucks. States such as Oklahoma, Illinois, and Georgia also provide tax credits or exemptions to support infrastructure. These tax credits or exemptions allow states to spur investment without providing grant funds. Programs can also support workforce development and draw jobs to the state.

Regulations, Policies, and Programs Related to Financing and Revenue

Broad policies on financing and revenue relate to both operational issues with charging infrastructure and programs that enable cost savings from AFVs. California's SB 123 requires that charging stations accept both credit and mobile forms of payment (*42*), providing consumers with additional options when paying for charging. Florida has also protected consumers by prohibiting insurance companies from assessing a surcharge to insure EVs. The restriction applies to surcharges that would be based on factors such as new technology, weight-to-horsepower ratio, types of materials, or passenger payload (*43*).

Colorado enacted rules around vehicle fleet maintenance and cost savings contracts as well as utility rates and schedules (*44*). Utilities are required to submit a report to the utility commission on the cost of providing electricity to support EV charging at commercial and industrial sites (*45*). Illinois has also offered to provide reimbursements to qualifying school districts for the cost to convert gasoline buses to alternative fuel buses (*46*). Iowa has authorized the purchase of AFVs for research and testing needs if funds are available. Eligible funding is for alternative fuel demonstration grants (*47*).

North Carolina and Illinois have developed programs to support or require EV charging infrastructure. North Carolina has an Alternative Fuel Revolving Fund that uses credits to support projects. The North Carolina Department of Transportation (NCDOT) is eligible to receive the proceeds from this fund and use them to purchase alternative fuels, develop alternative fuel infrastructure, or purchase AFVs (*48*). Illinois required the Illinois State Toll Highway Authority to construct and maintain at least one EV charging station at any location where fuel, garages, stores, or restaurants are provided by 2016 (*49*). The authority assessed a fee for charging to offset its costs.

Florida has several statutes aimed at enabling local governments to finance or help finance the installation of charging stations and charging equipment. The EV Charging Station Financing Authorization Act allows local governments to offer funding to property owners to support charging stations (*50*). In addition, local governments can use income from the infrastructure surtax to support alternative fuel infrastructure (*51*).

Policies Relating to Freight and Fleets

Freight and fleet electrification is in various stages of development depending on the vehicle classification. Light-duty fleets are easier overall to transition but still require a different set of policies and procedures than traditional fuels regarding maintenance and end of life. Medium- and heavy-duty trucks are in the earlier stages of development, but manufacturers are ordering electric trucks and piloting their potential capacity (*52, 53*). Most states and state DOTs are in the initial planning stages regarding freight and fleet charging infrastructure needs, but an expectation exists that greater charging capacity will be required. Most of the peer states are not setting specific targets for medium- and heavy-duty trucks but are regulating or incentivizing their government fleets to switch to alternative fuels.

Freight Plans and Assessments

Most states noted that their efforts focus on developing a light-duty charging network while encouraging freight operators to coordinate and communicate their electrification needs with both state agencies and utility providers. However, both California and Colorado are developing plans or assessments that will prepare the transportation system for further freight electrification. California is conducting a Zero-Emission Freight Assessment—codified under California Government Code as the Clean Freight Corridor Assessment Program—that will identify the needs for charging across key freight corridors in the state (*54, 55*). This assessment requires consultation with local governments, regional agencies, and key community stakeholders. Colorado is about to complete a freight electrification study that assesses the need for freight-specific charging infrastructure within the state.

Multistate efforts are also attempting to address the issues surrounding MHDVs. The Northeast States for Coordinated Air Use Management convened a ZEV taskforce that developed an action plan. Development of the plan was supported by 17 states and the District of Columbia (*56*).

Permissive Rules for Alternative Fuel Trucks

A key concern in the short term for EVs is the weight of the battery and therefore the overall weight of the vehicle. In terms of freight, the additional battery capacity required may reduce the payload potential for trucks. Several states (e.g., Arizona, California, Colorado, Oklahoma, and Pennsylvania) have adopted policies to offset this disadvantage and allow alternatively fueled trucks, including electric trucks, to exceed the maximum weight allowances by up to 2,000 lb.

Clean Truck Regulations

Similar to ZEV requirements for light-duty vehicles, states are also developing clean truck regulations to spur the transition to alternative fuels for MHDVs. California introduced its Advanced Clean Truck Regulation in 2019 that requires all new MHDVs sold in the state to be ZEVs by 2045 (*57*). Required sales percentages were developed by CARB and included within the regulation. New York adopted the same clean trucks requirement as California, with increasing sales percentage requirements starting in 2025 (*36*). This requirement is in addition to the clean truck requirements at the Port Authority of New York and New Jersey.

Fleet Transition Requirements

States are taking varying approaches—using either regulations or incentives—to transition certain types of fleets away from gasoline-powered vehicles. Some states have requirements that extend beyond traditional light-duty government fleets to include buses or shuttles. Table 2 provides an overview of the statutory requirements relating to fleets.

Table 2. Government Fleet Requirements.

State	Statute/Policy	Description
Arizona	Ariz. Rev. Stat. §9-500.04 (2023)	Requires certain cities and towns to develop a vehicle fleet plan to encourage use of AFVs.
	Ariz. Rev. Stat. §49-474.01 (2023)	Requires use of AFVs where possible in air quality control areas.
	Ariz. Rev. Stat. §49-573 (2023)	Encourages progressive use of AFVs for federal fleets operating within the state.
	Ariz. Rev. Stat. §15-923 (2023)	Eases the process to buy electric school buses.
California	Cal. Code Regs. tit. 17, §95690 (2024)	Requires all airport fixed-route shuttle fleets to be 100% ZEVs by 2035.
	Cal. Code Regs. tit. 17, §95480–95486 (2023)	Requires low-carbon fuel use by state agency fleets.
	Cal. Code Regs. tit. 13, §2023.3 (2023)	The Zero-Emission Bus Bonus Credit provides a bonus credit system for buses that use alternative fuels.
	Cal. Pub. Res. Code §25726 (2023)	Requires 75% of vehicles within a procurement contract (for city, county, and special districts) to be energy efficient.
	Cal. Pub. Res. Code §25722.5 (2023)	Includes vehicle acquisitions and petroleum reduction requirements and data requirements for the Department of General Services to determine compliance.
	Cal. Health & Safety Code §39719.2 (2023)	Established the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program.
Colorado	Colo. Rev. Stat. §24-30-1104 (2023)	Requires the Department of Personnel and Administration to purchase AFVs where possible.
	Colo. Rev. Stat. §43-4-1203 (2023)	Allows an enterprise to impose a clean transit retail delivery fee to fund its operations. Issues grants, loans, or rebates to support electrification of public transit.

State	Statute/Policy	Description
	Colo. SB 21-260, 72nd Gen. Assem., Reg. Sess. (2021)	Aims for sustainability of the transportation system. Created the Clean Fleet Enterprise that aims to incentivize fleet transitions.
Florida	Fla. Stat. §286.29 (2023)	Requires vehicles described in paragraphs a–h, when being processed for purchase or leasing agreements, to be selected for the greatest fuel efficiency available for a given use class when fuel economy data are available.
Illinois	105 Ill. Comp. Stat. 5/29-5 (2023)	Requires the Illinois Department of Education to reimburse any qualifying school district for the cost of converting gasoline buses to more fuel-efficient engines or to engines using alternative fuels (restrictions may apply).
Iowa	Iowa House File 2128, 89th Gen. Assem., Reg. Sess. (2022)	AFV acquisition requirements require at least 10% of new vehicles purchased for the state to be AFVs.
New York	NY EO 22 (2022) (*58*) SB 2838, 2021–2022 Gen. Assem., Reg. Sess. (2022)	Defines fleet transition and state fleet procurement plan requirements per the Department of Environmental Conservation and New York State Energy Research and Development Authority. Requires 100% ZEVs by 2035 for light-duty vehicles and by 2040 for MHDVs.
North Carolina	NC Gen. Stat. §143-341d (2023)	States preference for energy-efficient vehicles when purchasing fleet vehicles.
	NC Gen. Stat. §143-215.107c (2023)	Sets goal that 75% of new light-duty vehicles purchased will be alternative fuel or low-emission vehicles.
	2013 NC Sess. Laws p. 265	Requires petroleum displacement plans for state agencies, universities, and community colleges, further encouraging the use of AFVs in their fleets.
Ohio	Ohio Rev. Code Ann. §125.834 (2023)	Establishes certain requirements related to AFVs within state fleets.
Oklahoma	Okla. Stat. tit. 74 §130.3 (2023)	Defines AFV acquisition requirements.
	Okla. Stat. tit. 74 §78 & §130.2 (2023)	Defines access requirements for state alternative fueling stations (access is discontinued if a privately owned alternative fueling station opens within 5 miles).

State	Statute/Policy	Description
Pennsylvania	EO 2019-01 (2019) (*59*)	Requires all agencies under the governor's jurisdiction to replace 25% of the state passenger car fleet with battery electric and plug-in electric hybrid cars by 2025 and to evaluate opportunities for the reduction of vehicle miles traveled and incorporation of new technology where appropriate.
Tennessee	Tenn. Code Ann. §4-3-1109 (2023)	Requires that agencies attempt to purchase 100% AFVs. Requires that at least 25% of new vehicle purchases be energy efficient or use alternative fuel in nonattainment areas.

In addition to establishing targets for AFVs, these statutes also provide relief from certain procurement rules to enable the purchase of EVs (e.g., in Arizona) and make fleet charging infrastructure available to the public to support the state's charging network (e.g., in Oklahoma). Reducing the regulatory burden is often key to incentivizing AFV purchases, especially when these vehicles can be more expensive or require additional training for maintenance workers. Pennsylvania is developing demonstration projects to understand the needs of electric freight and EV charging; these projects allow both the state and businesses to test the viability of electric trucks within the state. As states develop their charging networks, ensuring efficient utilization of all assets can reduce the amount of public funding required to support EV charging needs.

Planning, Zoning, and Land Use

Planning, zoning, and land use are important considerations with publicly accessible EV charging stations. Locating charging equipment within existing parking facilities has required additional regulations. Codes and ordinances have also been developed to help ease the process of installing charging at a variety of locations. Local and regional entities must regulate zoning and land use and provide permitting procedures. Certain states have played a leading role by providing model codes and ordinances and streamlining permitting procedures to reduce the number of different processes across the state.

Parking Regulations

State statutes work to reduce the patchwork of rules across a state. Regarding EV parking regulations, these statutes define the use of and prohibitions on EV parking spaces for charging. Table 3 provides an overview of the statutes across six states.

Table 3. State EV Parking Regulations.

State	Statute or Legislation	Description
Arizona	Ariz. Rev. Stat. §28-876 (2023)	Prohibits non-EVs from parking in EV charging spaces.

State	Statute or Legislation	Description
	Ariz. Rev. Stat. §28-877 (2023)	Allows AFVs to park in carpool spaces when not meeting typical requirements.
California	Cal. Veh. Code §22511 (2023)	Allows a local authority (by ordinance or resolution) and a person in lawful possession of an off-street parking facility to designate stalls or spaces in an off-street parking facility owned or operated by that local authority or person for the exclusive purpose of charging and parking a vehicle that is connected for electric charging purposes. Allows a local authority (by ordinance or resolution) to designate stalls or spaces on a public street within its jurisdiction for the exclusive purpose of charging and parking a vehicle that is connected for electric charging purposes (*60*).
Colorado	Colo. Rev. Stat. §42-4-1213 (2023)	EV parking regulations. Prohibits any vehicle that is not actively charging from parking in designated EV charging parking spaces. An EV is presumed to not be charging if it is parked at a charging station and is not connected to the charger for longer than 30 minutes. Some exclusions apply, including EVs parked at lodging or airports, and between the hours of 11 p.m. and 5 a.m. The penalty for violation is $182.
Florida	Fla. Stat. §366.94 (2023)	Prohibits non-EVs from occupying EV charging spaces.
Illinois	625 Ill. Comp. Stat. 511-1308	Prohibits a non-EV from parking in an EV charging station designated for use by EVs, including an EV charging station on any private or public off-street parking facility. A person may park only an EV in an EV charging station space designated for use by EVs.
New York	NY Veh. & Traf. Laws: §1202 (2022)	Prohibits stopping, standing, or parking in EV charging spaces unless actively charging an EV. Allows a 30-minute grace period.

Codes, Ordinances, and Permitting

Although EV charging infrastructure is expanding, many local governments do not have the appropriate codes and ordinances to meet the use case, especially for charging outside of traditional parking facilities and for larger stations. To ease the process at the local level, California and Colorado statutorily required the development of permissive local ordinances or model codes. Assembly Bill 1236 (passed in 2015) set standards for the local permitting process and required the adoption of an ordinance to expedite and streamline the permitting process for EV charging stations (*61*). Colorado House Bill 1362 (passed in 2022) required the Colorado Energy Office and Department of Local Affairs to appoint an energy code board to develop two sets of model codes for counties, municipalities, and state agencies. The codes address electric and solar ready requirements as well as low-energy and low-carbon requirements (*62*).

Updates to codes and ordinances have typically related to the permitting process. Due to the limited standards and procedures applicable to EV charging infrastructure, the permitting process can range from months to over a year, according to interviewees. These difficulties with permitting can deter private-sector investment and reduce the incentive to switch to an EV. To date, California is the only state to legislate a streamlined permitting process under Assembly Bill 1236 and Assembly Bill 970. Assembly Bill 970 relates to streamlining the permitting process for charging at buildings (*63*). The California Governor's Office of Business and Economic Development has developed a variety of model languages, checklists, and materials to support local governments wanting to streamline their procedures (*64*). A guide to planning and zoning for EV charger deployment was also created by the Sustainable Energy Action Committee, in coordination with Rocky Mountain Institute, and the Interstate Renewable Energy Council to support local code officials (*65*).

Prohibitions on Rules and Regulations

States have also used prohibitions and exemptions to enable the installation of EV charging. California prohibits the execution of leases on commercial property that restrict the installation or use of charging equipment (*66*). Colorado passed House Bill 1233 in 2023 that forbids prohibitions on EV charging and parking by private entities and local governments. The bill also requires local governments to count EV charging spaces toward parking minimums (*67*). These statutes help ensure reliable business practices across a state.

EV Charging at Residential Properties

Charging availability at home remains a challenge with current EV ownership levels, but it is crucial to developing a robust network. Policies and regulations within peer states are aimed at ensuring access to home charging and reducing the barriers to installation for homeowners. The term *right to charge* is emerging, which helps define legislation that supports the installation of charging at residential properties and regulates community groups (e.g., homeowners' associations) such that they cannot prevent the installation of charging equipment. In addition, states have developed additional rules and regulations on EV charging equipment to protect renters and lessors of buildings.

Right-to-Charge Laws

Several peer states have updated their statutes to provide renters, homeowners, and commercial tenants with the right to install an EV charging station within the bounds of their property. California's Civil Code includes provisions for renters, commercial tenancies, and restricted covenant communities (*66, 68, 69*). Colorado has similar provisions under its state statutes to allow for installation of Level 1 or 2 charging stations on leased premises and within *common interest communities* (*70, 71*). Both Florida and New York have statutes that prohibit condominium associations or restrictive covenants from disallowing the installation of charging equipment (*72-74*).

Rules and Regulations Relating to EV Charging Equipment at Residential Properties

Rules and regulations relating to housing can also reduce the burden of installing charging equipment by updating building codes to provide make-ready or EV-ready buildings the standard. California has developed mandatory EV charging station building standards that require either EV charging stations or capabilities for EV charging in new builds, and has established requirements for charging stations in parking facilities (*75*). Colorado passed House Bill 1233 in 2023 that directs the state electrical board to adopt rules that facilitate the installation of EV charging in multifamily buildings. In addition, the state limited the ability of the electrical board to restrict the installation of EV charging stations (*67*).

EV Charging and Multifamily Housing

During interviews with state DOTs, MPOs, and other stakeholders, additional challenges associated with EV charging at multifamily housing or dwellings were discussed. Due to the structure and location of these residential properties, it can be difficult to determine the appropriate location and number of chargers required to support all residents. Interviewees mentioned offering EV charging at central locations within apartment complexes or in the general neighborhood to avoid the need for specific chargers at multifamily residences. Another challenge is funding for the purchase and installation of equipment; apartments, townhomes, or condominiums that restrict entry to residents may not be eligible for certain government funding. States noted difficulty in allocating all funding that is currently available for multifamily housing. Existing residential buildings can be difficult and expensive to retrofit, while new builds that incorporate EV charging capabilities may not necessarily need the funding to justify their investment. Because EV charging is currently viewed as an amenity for residential properties, ensuring the correct incentives and allocation of public funding can be complex.

Equity

Specific policies and regulations that require equity to be included when installing EV charging stations are limited at the state level, but many states have programmatic guidance that focuses on equity or ensuring that the benefits of funding reach underserved communities. In recent years, states have shifted their grant funding programs to either focus on disadvantaged communities or provide a greater level of funding to those areas. Colorado, Illinois, and New York all either include additional incentives for specific communities or guarantee a certain amount of total funding for those communities (*76-78*).

California passed legislation that focuses on equity within alternative fuel planning. SB 1251 (passed in 2022) requires the Governor's Office of Business and Economic Development to develop a "shared, cross-agency definition of equity" and establish an equity agenda for the deployment of ZEVs, supporting infrastructure, and workforce development (*79*). The bill also establishes an equity advocate for the department to serve as a point of contact for stakeholders with concerns or suggestions on equitably achieving ZEV goals. The state budget bill in 2023 updated the requirements to include recommendations on actionable steps to improve access to ZEVs, charging infrastructure, and ZEV transportation options, as well as metrics to measure progress (*80*). An assessment of progress is also required for the equity action plan and would include tracking state and federal subsidies and different ownership structures for ZEVs.

State-Level EV Legislation and Policy Findings

The following is a list of findings applicable to Texas based on the review of state-level EV legislation and policies:

- **EV charging equipment legislation is in progress.** SB 1732 and SB 1001, both passed during the 2023 legislative session, address charging equipment standards and the rules surrounding utility investment and provision of charging. This legislation helps to establish a baseline expectation of the charging network as well as a cooperative and collaborative partnership with TxDOT and its EV infrastructure planning efforts.
- **Electrification assessments are useful to develop implementation timelines.** Understanding the infrastructure needs for freight and fleets is one of the key challenges when switching to EVs or electric trucks. The electrical capacity requirements can present an issue in terms of both cost and time for managers hoping to transition. Utilities need advance notice of freight and fleet electrification plans to manage and upgrade capacity when necessary. Electrification assessments for freight and fleets are a way for both utilities and fleet managers to understand load requirements and develop a realistic transition timeline. Expanding the use of these assessments and developing forecasts of demand based on current and planned investment in EVs will allow for effective infrastructure planning. While many fleets will use depot charging, those traveling longer distances may use public charging; freight electrification planning can determine the appropriate need and location of these charging stations.
- **Freight electrification plans are useful for freight electrification planning.** Based on the peer state review, California and Colorado conduct or have conducted freight electrification plans to determine needs and corridors of interest. Key to understanding freight needs will be identifying fleets within the state that intend to electrify and the use cases of those trucks. This will enable TxDOT to identify potential corridors or charging locations that should be accessible to MHDVs. Combining existing data, fleet electrification data, and freight planning into an internal dashboard can support both the state and MPOs in their planning efforts.
- **Updated policies are needed.** Improving the availability and access to charging will require new policies and legislative actions to support the growth of transportation electrification. These include updated policies on data and private installation of charging, as well as plans and programs to support freight, fleet, and economic development needs. Policies and legislative actions could include the following:

- **Infrastructure data sharing.** Data sharing is key to EV preparedness, especially in terms of the MHDV space. Establishing a data-sharing policy between utilities, fleet managers, and key public agencies will support transportation electrification by streamlining utility planning efforts, ensuring adequate capacity, and providing all parties with accurate timelines to support EVs.
- **Freight and fleet planning coordination.** Freight and fleet electrification needs are unique and vary greatly from existing light-duty needs and assumptions. Coordinating with freight planning efforts to identify key corridors, areas that require additional capacity, or places where fleet charging depots can be shared will be critical to developing a charging network that supports freight and fleet applications.
- **Economic and workforce development.** Electrification can spur economic development within the state and already has with the increase in battery manufacturing in Texas. However, there is still a need to develop connections to ensure Texas remains competitive, especially in terms of the existing and future workforce. Accelerator or mobility platforms connect businesses to Texas. These efforts could be supported by existing TxDOT task forces. Ensuring continued growth will require a focus on workforce development. Establishing training programs and requirements and supporting new curricula in schools can better position Texas for the increase in jobs related to EV infrastructure.
- **Home and residential charging installation support for private property owners.** Smoothing the process for residential charging ensures a robust charging network. State-level policies that limit prohibitions on installing charging equipment reduce barriers across jurisdictions. Model codes and ordinances for local governments can help to establish a standardized process that protects all parties and reduces the overall planning and permitting timeline.

STATE EV CHARGING—PLANS AND ACTIVITIES

States and regions are developing plans and programs that address challenges or unanswered questions around electrification. Activities include developing multistate coalitions and addressing prevalent issues such as equity, requirements for freight and fleets, economic and workforce development, and grid and power concerns. Researchers categorized state plans and activities into the following groups:

- Transportation electrification planning.
- Equity.
- Economic development.
- Workforce and education.
- Energy.

This section summarizes the research team's findings for each topic group based on the literature review, stakeholder workshops, and interviews with peer state representatives.

Transportation Electrification Planning

Many of Texas's peer states have either previously completed transportation electrification plans or have been legislatively required to complete a study. California requires a biannual statewide

assessment of EV charging infrastructure (*81*). The California Department of Transportation (Caltrans) is required to incorporate elements of the state's ZEV Action Plan and assessment into the California Transportation Plan, including addressing emissions reductions and forecasting the impacts of emerging technologies (*32, 82*). The plan should also include a review of progress made toward policies and goals. In addition, Caltrans must conduct a zero-emission freight assessment and incorporate the findings into its plan (*54*). In a similar manner, Colorado has developed an Electric Vehicle Plan that separately considers equity and freight (*83, 84*). Colorado statutes require an annual report detailing progress toward both the EV Plan and the Greenhouse Gas Pollution Roadmap (*85*). Florida, Georgia, Iowa, New York, and North Carolina have all completed transportation electrification plans (*86-90*). Statutes often direct coordination between relevant agencies, such as environmental protection and energy agencies and public service commissions that regulate utilities. New York's report analyzes the benefits of expanding the statewide inventory of EVs and EV charging stations while considering access to charging, EV incentives, and the state vehicle fleet (*91*). North Carolina requires a performance dashboard be maintained by NCDOT that includes data on hybrid and EV registrations (*92*).

Regarding regional or multistate planning efforts, the Regional Electric Vehicle West Initiative and the Lake Michigan Electric Vehicle Circuit Tour have developed memoranda of understanding (MOUs) and plans to ensure a cohesive network in their regions. Other interstate planning and coordination efforts exist—often coinciding with the NEVI Program efforts—but these efforts have not resulted in formal MOUs or plans at this stage. The Regional Electric Vehicle West Initiative is comprised of eight governors from Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming (*93*). The coalition was developed to enable those traveling across state lines to be able to access EV charging. The MOU calls for a framework to develop an Intermountain West EV corridor. These states share similar challenges with EV charging including high altitude, cold weather, and large distances between population centers. This agreement allows them to share best practices and present a unified voice when addressing rules and regulations that impact their states. The Lake Michigan Electric Vehicle Circuit Tour is a multistate collaborative project between Illinois, Indiana, Michigan, and Wisconsin to ensure accessibility to EV charging in the region (*94*).

Equity

Equity is an important consideration to ensure fair access to charging and to meet the requirements of federal grant funding. Plans and programs across the peer states are incorporating equity considerations by requiring robust community engagement, providing priority to disadvantaged communities, and ensuring agencies have the data needed to assess the equity of their EV infrastructure plans. As noted in the federal policies and regulations discussion, several recent EOs have introduced equity requirements into transportation planning and projects. The Justice40 Initiative applies to all clean transportation funding programs, and USDOT, along with other agencies, has a stated commitment to equity. Incorporating equity into programs and projects can take a variety of forms. The following tools and programs offer data to analyze equity impacts and examples of programs that focus on equity for EVs and EV infrastructure:

- **Electric Vehicle Infrastructure-Equity by the National Renewable Energy Laboratory.** The Electric Vehicle Infrastructure for Equity Model (EVI-Equity)

evaluates the environmental justice, energy justice, and energy equity impacts of the nationwide charging network (*95*). The tool aims to define equitable charging, assess equity in the current network, and guide thoughts about justice and equity in charging moving forward. The tool uses high-resolution spatial analysis based on individual households to inform these topics. EVI-Equity can create a visualization map that acts as the basis for further analysis and development of an equitable EV infrastructure plan.

- **ETC Explorer by USDOT.** A summary is provided in the "Executive Orders and Federal Requirements Related to EV Infrastructure" section.
- **Climate and Economic Justice Screening Tool.** A summary is provided in the "Executive Orders and Federal Requirements Related to EV Infrastructure" section.
- **California Clean Mobility Options.** California's Clean Mobility Options is a statewide program that empowers under-resourced communities to better understand their mobility options and overcome any obstacles. The program provides vouchers for funding community needs assessments and for clean, shared, zero-emission projects.

Economic Development

Transportation electrification offers the opportunity to provide new, well-paying jobs across the United States. However, states often compete to attract these businesses and development opportunities. Existing positions within transit and fleet maintenance, as well as for consumer vehicles, will require training and new educational programs (discussed in the next section). States are developing tax incentives, business accelerators and incubators, and partnerships to attract investment and jobs in their state.

The Michigan Mobility Platform provides incentives to technology developers working within the state. Iowa and Colorado have a mix of tax incentives and programs that support business development in clean technologies, including vehicle electrification, within the state. The Governor of Georgia established the Georgia Electric Mobility and Innovation Alliance, which is led by the Department of Economic Development (*96*). The initiative brings together government, industries, electric utilities, nonprofits, and other relevant stakeholders. This partnership intends to grow the electric mobility ecosystem within the state and strengthen Georgia's ability to attract electrification-related manufacturing and innovation.

Oklahoma and Arkansas have partnered to develop the Super Region for Advanced Mobility in the Heartland (*97*), with the intent of developing a national hub for advanced mobility with support from the Tulsa Innovation Labs and Runway Group. The effort will include drones, electric and autonomous vehicles, battery manufacturing, and transportation and logistics solutions. The effort includes new research and testing space, support for local advanced mobility startups, incentives to attract new companies, and partnerships with industry corporations to test and scale new technologies.

Workforce and Education

The expansion of an EV charging network across the United States will require new training programs and workforce development initiatives to ensure the correct knowledge, skills, and abilities are available to meet demand. The Bureau of Labor Statistics identified the following six industry sectors that would see an increase in employment due to EVs:

- Scientific research.
- Design and development.
- Manufacturing.
- EV maintenance.
- Infrastructure development.
- Sales and support (*98*).

While new curricula will be required in secondary and postsecondary education, states are starting to consider the need for on-the-job training and upskilling.

California passed legislation that requires specific workforce training. Assembly Bill 841 requires that installation crews have at least 25 percent of their members certified under the EVITP (*99*). The EVITP provides training to qualified electricians on the unique needs of EV charging installations (*3*). While the EVITP is a common training requirement for EV charging installations, more formal standards and training requirements do not currently exist. Other training programs do exist, and many charging equipment providers provide their own training.

In Texas, the Northeast Texas Community College has developed an EV Automotive Technician Certification Program—the first of its kind to be offered by an accredited college (*100*). This program allows students to work on EV systems, learn their unique maintenance needs, and gain firsthand experience in conversions.

ChargerHelp has developed a three-track system to provide workforce development opportunities:

- The community track.
- The reskill track.
- The EVSE technician track (*101*).

The community track establishes a baseline understanding of charging operations and maintenance. The reskill track identifies charger maintenance workforce gaps that can be filled with existing community members through retraining or upskilling. The EVSE technician track identifies EVSE technicians in a community that would be able to maintain charging infrastructure. Organizations can also receive an assessment of their charging infrastructure and their hiring needs.

Energy

Energy and grid integration are critical issues for EV charging, which have led to the involvement of state energy offices in funding or providing resources for charging stations. In addition, the federal government created the Joint Office of Energy and Transportation that allows the Department of Energy and USDOT to work together to provide technical assistance and support for transportation electrification and other energy issues. Energy issues are especially important in rural or remote areas that require utility infrastructure upgrades or potential off-grid solutions to avoid additional utility costs.

State energy offices have a key role to play in transportation electrification. The power requirements for a state will increase as more EVs are sold and the charging network is developed. Many state energy offices have taken a leading role by providing grants, guidance, and technical assistance for both EV owners and charging providers. In addition, these offices have provided assistance or led coordination for NEVI planning. California, Colorado, New York, and Tennessee all have highly engaged state energy offices that complete plans and/or collect data to support transportation electrification. California requires an integrated energy report that considers zero-emission impacts on state energy needs (*102*).

Joint Office of Energy and Transportation guidance includes a public agency EV checklist, community guidance, and technical assistance help sheets. The public EV charging station site selection checklist provides information on the background research required, the site selection process, and the available resources to support next steps (*103*). The community engagement guidance describes how to ensure the process is equitable, how to develop meaningful and ongoing engagement, and how to document feedback from the community (*104*). The Joint Office assists states and local governments but also highlights the need for coordination between these two areas as transportation fuel use shifts away from gasoline and diesel.

Because grid integration can be challenging in rural and remote areas, off-grid charging solutions that co-locate solar or another renewable energy source for power are being considered. While this approach offers a unique opportunity for certain areas that will see an increased demand for charging, the upfront cost can be prohibitive for both public agencies and private charging providers. Understanding the current utility system and the need for upgrades is critical to meeting future charging network needs. Colorado representatives noted during their interview that their major utilities are now required to forecast energy needs. This requirement has led to greater coordination between businesses, fleets, and utilities to understand the expected demand.

State EV Charging Plans and Activities Findings

The following is a list of findings applicable to Texas based on the review of state EV charging plans and activities:

- **Need for MHDV electrification.** Electric trucks and MHDVs are still more expensive than vehicles using ICEs. Programs and funding are needed to bring electric MHDVs closer to cost parity with ICE vehicles.
- **Need for direct current (DC) fast charging for fleet vehicles.** For a fleet vehicle that is in use 12–14 hours a day and has a large battery on board, the only charging option is use of DCFCs. A concern is that relying on DC fast charging alone will decrease battery life over time. Some DCFC technology for fleet vehicles exists but is still expensive, difficult to implement, and not yet widely available.
- **Need to evaluate and support equity considerations.** Equity can have many dimensions, such as geographic equity that distributes EV chargers equitably over a region. There is also price equity, which takes into consideration the time cost to access EV chargers, and land use equity, which considers equitable use of available public space.
- **EV infrastructure workforce development is needed.** As the charging network expands, workforce development to ensure reliable charging and accessible charging at

home or in residential locations will be critical to meeting consumer demand for charging. Texas can leverage existing training programs and can require certification by the EVITP. However, ensuring economic benefits to the state may be best supported through accelerators or platforms that support business within or relocating to the state. Michigan and Oklahoma have developed programs to support the electrified mobility industry within their states, and Oklahoma has statutorily required an alternative fuels technician certification. In terms of residential charging, policies that support the inclusion of make-ready infrastructure or that preclude prohibitions on installing charging equipment help to ensure access to at-home charging. Local governments may require support in developing codes and ordinances that require a certain number of charging ports in parking facilities or that require developers to ensure charging can be easily installed. Laws and policies that support the installation of charging equipment at residential properties are in effect in California, Colorado, and New York.

- **Importance of a central information repository or clearinghouse.** A central location for information related to the EV charging infrastructure development simplifies management and access to EV charging infrastructure. For example, a website can list contacts for those interested in working within the state. Municipalities can list information, certification, or registration requirements to conduct local business. Other states—for example, Colorado and Louisiana—use simple tools such as Google forms to build this database (*105*).

EV CHARGING STAKEHOLDER CONCERNS AND RECOMMENDATIONS

Researchers hosted three stakeholder workshops in 2022 and 2023 to inform the research on a long-term plan for EVs in Texas. The purpose of the workshops was to discuss TxDOT's current plans related to EV charging infrastructure with stakeholders and to collect feedback from workshop participants regarding priorities, active initiatives, and planned activities. Researchers solicited information about estimating energy demand and factors that drive energy demand, policy considerations, and potential strategies, including financial strategies. Researchers considered current state and federal policies with requirements tied to funding as a priority in the stakeholder engagement process.

Several hundred stakeholders from more than 100 organizations attended the workshops virtually and in person and participated in a variety of breakout discussions, providing insight into issues and considerations from Texans with a diverse range of perspectives. Researchers grouped these issues into three groups:

- Stakeholder coordination.
- EV charging infrastructure implementation.
- Other findings.

Some of the findings echo answers and conclusions found during the review of state legislation, plans, and activities.

Stakeholder Coordination

The following summarizes findings based on the discussions with stakeholders in Texas that relate to stakeholder coordination:

- **Consensus for TxDOT leadership in coordination efforts.** Stakeholders in general perceived TxDOT as the clear leader or convenor for ensuring interagency coordination statewide. This leadership is supported by TxDOT's role in the NEVI Program and its role in coordinating other transportation-related initiatives statewide. A bill introduced in the current legislative session would have required establishment of the Texas Transportation Electrification Council made up of senior representatives from a range of public entities and administratively located at TxDOT, but it did not pass (*106*). Regardless of this outcome, stakeholders saw TxDOT as the leader for future coordination efforts, whether mandated by state law or otherwise.
- **Challenges with interagency coordination.** Agencies are working with accelerated timelines to address EV charging issues, which makes effective interagency coordination challenging. Another challenge that may have to be overcome for successful interagency coordination is the need to balance inclusivity with stakeholder fatigue; involving a diverse group of stakeholders sometimes results in too many meetings. If possible, meetings or events should be combined with other stakeholder engagement processes. It is also a challenge to find the right organizations to include in meetings, as well as the right people within the organizations.
- **Need for balancing coordination goals.** Interagency coordination should balance state-level goals with local goals. A model of interagency coordination mentioned by participants was the Volkswagen mitigation settlement funding allocation process (*107*). Another example was the improvement of traffic safety in a process coordinated by the National Highway Traffic Safety Administration that required each state to establish a high-level safety office as part of the governor's office or at a similar level (*108*).
- **Need for partnership with TxDOT.** Stakeholders discussed how TxDOT could support activities of local public transportation agencies. Although TxDOT has a large amount of data, it is not always clear how the data can be used. However, once performance measures are developed, data needs will be clearer. Under the NEVI Program, utilization data at individual charging stations will be reported quarterly, which will be useful. The level of needed data aggregation, however, is not clear at this point.
- **Need for coordination among MPOs.** Coordination is needed among MPOs to share best practices and approaches with regard to EV charging infrastructure planning. Smaller MPOs might not currently have a platform to engage. However, collaboration might be limited by federal discretionary funding programs if MPOs are competing for funding against each other.
- **Need for non-metro coordination coalitions.** The Clean Cities Coalition Network has greatly promoted EVs and provided resources but is geared toward more urban areas. A coalition-type approach would be beneficial in supporting currently underserved areas, similar to the Clean Cities Coalition Network model. This approach would be a creative way to help stakeholders and promote equity across Texas. Similar types of organizations for the non-metro areas of the state would also be helpful. Since the needs are different in less populous areas of the state, there may be a need for a different perspective for the

coalitions, which may include more infrastructure facilitation than an emphasis on clean air/clean cities.

- **Need for coordination among fleet transition stakeholders.** Depending on the type of fleet, some attendees are engaging with fire, emergency medical services (EMS), sustainability, and parking organizations. The internal communication is still being worked out for most organizations that want to electrify their fleets. There are a lot of internal groups to consider and include in the conversation. Some of the outside stakeholders to engage with include the local electrical utility companies. Collaborative programs between stakeholders are also being established. A partnership called Resilient Now, between the City of Houston and CenterPoint Energy, was established to develop a regional master energy plan (*109*). This action should help the city prioritize its investment in transitioning its fleet.
- **Need for a central database of grant applications.** It would be very useful to have a database of grant applications, including grants that did not get approved. Even if they were not successful for the NEVI Program, they might be useful for other programs.

EV Charging Infrastructure Implementation

The following summarizes findings based on the discussions with stakeholders in Texas that relate to EV charging infrastructure implementation:

- **Challenges with identification of EV charging infrastructure locations.** Having the right tools and expertise to use the tools to identify EV charger locations is a challenge for many stakeholders. In addition, the process of identifying EV charger locations is unclear to some stakeholders, as is knowing whether TxDOT, the county, or the city has any say about what locations are permissible. Parking regulations and zoning ordinances may need to be modified to accommodate EV charging infrastructure. It would be useful to have model ordinances as a starting point.
- **Concerns about EV charging site environment.** Stakeholders had questions about amenities, restrooms, restaurants, and security that should be available at an EV charging location. For example, do restrooms and other amenities need to be open and accessible 24 hours a day, or can availability be limited? Scoring of available amenities may help with site selection.
- **Understanding of local EV adoption and demand.** Stakeholders were concerned about how to determine or estimate current and future numbers of EVs in order to determine current and future demand for EV charging infrastructure.
- **Concerns about rural EV charging infrastructure needs.** In rural areas, where there may not be a clear financial incentive for the private sector to provide EV charging services, an approach modeled on utility cooperatives may be needed to ensure access and service to customers and EV users.
- **Need for EV charging infrastructure guidance.** During planning, installing chargers may involve more work than simply placing a charger. Electrical infrastructure may need to be updated, and the location may need to be approved and permitted.
- **Challenges with blocking of EV charger parking spots.** There was concern about how to enforce the misuse of EV charging parking spots by ICE vehicles. A related issue is EVs parked in quick-charging spots overnight. Since they are not charging the entire time

they are parked there, another EV could be charging at that location. One possible solution is to have a sensor to track if the EV is still there. Then, a gross amount could be charged for parking over the allotted amount of time needed to charge the EV.

- **Need for EV charger accessibility.** Stakeholders discussed the need to make EV chargers accessible for the disabled population. In addition, charging should be as simple as possible and not include unnecessary technological hurdles, such as requirements for certain applications or payment systems.
- **Interpretation of ADA requirements for EV charging.** Complaints regarding a municipality's lack of ADA accessibility for EV chargers were filed with the Texas Department of Licensing and Regulation (TDLR). Now that federal guidelines have been released, cities must adhere to TDLR rules at the state level, but there were questions about the interpretation of the rules. Discussion centered on how legislation at the state level may solve some of the challenges cities and others are facing when looking to install EV chargers and infrastructure. The technical memorandum issued by TDLR on EV charging stations in 2012 was withdrawn in July 2023, and TDLR started working with the Elimination of Architectural Barriers Advisory Committee to develop new rules that will become part of Texas Administrative Code Chapter 68. TDLR has also formed an EVSE stakeholder working group that is developing a regulatory framework for EV charging stations. Working draft rules were published on May 16, 2024.
- **Concerns about EV fast-charging installation costs.** The main items that have increased EV fast charger installation costs include the electrical grid interconnection to make the site ready and the ADA accessibility requirement. The interconnection cost is very location specific and will vary depending on where chargers are located. Although TxDOT cannot help with the make-ready cost, TxDOT may be able to bring awareness to the issues involved in the make-ready cost.
- **Concerns about return on investment for EV charging infrastructure investments.** Many stakeholders agreed that it is currently challenging to determine the estimated return on investment for EV charging infrastructure.

Other Findings from Stakeholder Workshops

Stakeholders provided feedback on several issues related to EV charging infrastructure that TxDOT may not be able to address. The following findings are included here to complete and supplement the overview of stakeholder concerns:

- **Need for small business support programs.** Stakeholders discussed ideas to support the goals of DBE programs. TxDOT will be in a good position to support these goals and can make sure that contractors follow these programs. Ideas included the use of DBE lists that could be published by TxDOT, new DBE goals for lead contractors and not just subcontractors, and requirements for DBE outreach.
- **EV charging infrastructure workforce development.** Stakeholders talked about apprenticeship programs for electricians. Some local/municipal programs focus on that topic—such as the City of Dallas Green Job Skills initiative—but it is uncertain whether funding will be available to build new or maintain existing programs (*110*). Texas State Technical College and the Texas Workforce Commission could be great resources in this area.

- **Interest in direct pay programs.** A direct pay program implemented by the state in lieu of a tax credit will benefit not-for-profit agencies that do not have a tax liability.
- **Investigation of electric rate incentives.** Electric companies can set rates that are advantageous to the adoption of EVs. For example, they can allow charging at night at low or no cost. This strategy should be accompanied by education and outreach to EV owners.
- **Capturing of sales tax revenue for EV charging.** In some areas, such as malls and other commercial areas, EV charging could induce revenue that could be captured by a sales tax. This option could become part of the discussion to replace the declining gas tax revenue.
- **Incentives for electric grid infrastructure expansion.** Incentives may be important to ensure more electrical generation infrastructure is built in a timely manner to support EVs.

PROJECTION OF EV CHARGING DEMAND

Researchers developed a methodology to forecast EV charging demand in Texas based on a review of available datasets and tools. The research team presented the findings of the literature review to the project management committee, which resulted in a decision to use the National Renewable Energy Laboratory's Electric Vehicle Infrastructure Projection Lite. The research team developed the methodology with a bottom-up approach to predict EV charging demand in Texas for different scenarios. This methodology can predict EV charging demand at different hours of the day in each zip code and county in Texas.

Among different factors, researchers identified temperature as an influential factor critical in planning for EVs in Texas. Results showed the optimum charging demand occurs at an average daily temperature of 68°F. The total daily EV charging demands at the state level for 220,000 and 1 million EVs were predicted to be 2.15 and 9.56 GWh, respectively. Results showed that charging at extreme temperatures, such as −4°F or 104°F, can cause an increase of more than 50 percent in EV charging demand compared to charging at 68°F.

Results further showed the significance of different charging strategies on magnitude and time of peak EV charging. Adding an extra load on the grid in peak hours due to EV charging demand can potentially be a concern from a reliability point of view. Findings revealed that charging strategies that schedule charging during nonpeak hours are critical components of planning for EV charging demand.

The methodology developed in this study was used to create a prototype EV charging demand estimation tool that allows users to quickly evaluate different EV charging scenarios (Figure 1.) The tool's data architecture allows for updates of the underlying data as new datasets become available. Similarly, new modules and scenarios can be added based on future research. The tool also allows for application of various temporal and spatial distributions that allocate EV charging demand to different areas. Moreover, this model can be expanded to investigate EV charging demand along with other factors (e.g., demographic data) targeting specific groups and populations.

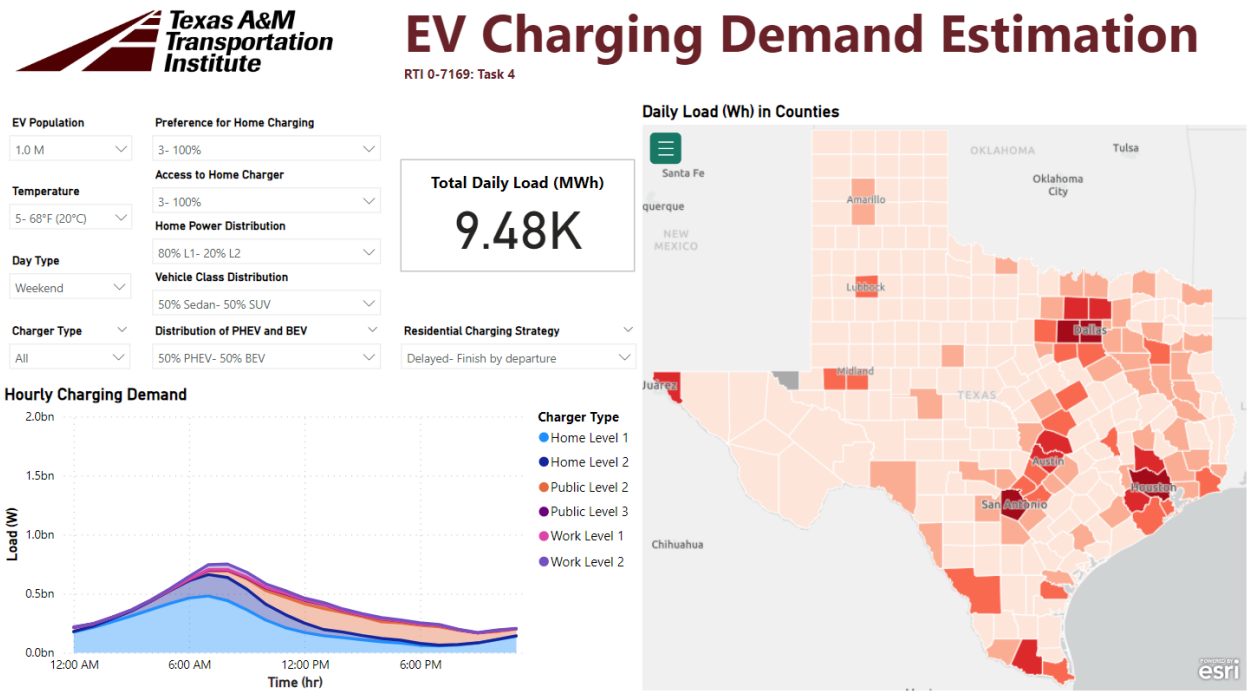

Figure 1. EV Charging Demand Model Prototype.

CHALLENGES AND OPPORTUNITIES FOR TEXAS

Ensuring a robust charging network across Texas requires an understanding of the unique challenges associated with the state, including its size, large rural population, and reliance on freight movement. Reducing anxiety regarding the availability of charging will require strategic public chargers across Texas, even in rural locations. Providing the number of charging ports necessary to support demand while also ensuring accessibility in remote areas will be complex. Off-grid solutions or Level 2 charging may be the most cost-effective in areas with low current demand. However, freight electrification may raise additional challenges due to the capacity and space requirements. While NEVI charging stations may provide options for certain MHDVs, these stations will not be enough to meet the needs of most heavy-duty use cases. In addition, ports of entry could be key freight charging centers due to the wait times during processing and inspection; however, truck parking may need to be upgraded to provide access to charging. Conducting freight plans and electrification assessments and providing policies and regulations to support efficient charging will be necessary. The policy and funding framework will provide potential policy and planning options to address the remaining challenges for Texas.

Developing a stable and effective charging network across Texas will require policies, plans, and programs that support the development of EV infrastructure from a variety of different entities. Texas's business-friendly environment offers an opportunity for greater private investment in EV charging equipment that will ultimately provide additional employment. Leveraging existing EV-related businesses in the state to develop further electrified mobility workforce development and education options is a key opportunity. Engagement of utilities in the EV charging space provides an opportunity for additional investments to ensure grid capacity and support the growth in transportation electrification. Ensuring that the required capacity is available during unpredictable weather events will remain a challenge, but utility providers are working to reduce

EV-related costs and provide support for EV-related infrastructure. Finally, while charging for multifamily housing is a challenge, most existing housing is single-family homes. This allows for the easy installation of at-home charging, reducing the burden on neighborhood and public charging needs. Texas can focus on ensuring a smooth process for installing charging equipment within existing properties and supporting make-ready policies for new developments.

This section provides recommendations for actions and programs that would improve EV charging readiness and deployment of EV charging infrastructure. TxDOT could develop these actions or programs as a lead agency or jointly with other stakeholder groups. Recommendations are based on the review of applicable literature, discussions and feedback from EV stakeholders, and analysis of policies and funding opportunities.

EV Charging Infrastructure Implementation

The following summarizes recommendations for TxDOT applicable to the implementation of EV charging infrastructure:

- **Consider the development of support tools for the determination of EV charging location infrastructure.** Provide support to identify potential locations for EV charging infrastructure based on local priorities and requirements, including equity considerations.
- **Evaluate EV charger on-site energy storage opportunities.** The NEVI plan for EV charging stations does not include sufficient funds for on-site energy storage, which can be critical during peak hours. In some cases, regulations might not allow EV charging stations to generate energy on-site and store it in batteries to sell during peak-hour demand. TxDOT might be able to help with the infrastructure to store energy on-site and use it as needed.
- **Evaluate alternative energy sources for EV charging.** A range of alternative energy sources for electricity generation, including wind and solar, could be combined with EV charging infrastructure. However, the installation of solar infrastructure at EV charging stations might reduce the competitiveness of a bid under federal grant programs. In addition, TxDOT could evaluate alternative uses of its right of way for renewable energy generation.
- **Research options for alternative uses of right of way.** TxDOT could investigate alternative uses of right of way that do not interfere with the primary purpose of transportation and can support a combination of DCFC implementation and renewable energy generation.
- **Evaluate EV charging at multifamily housing units.** Some renters cannot install EV chargers in their rented domicile. Due to the lack of sufficient charging options, there are unsatisfactory trade-offs for EV owners who are renting. From a public charging perspective, apartment complexes and offices will need at minimum Level 2 if not Level 3 chargers. This issue could be addressed from various perspectives, including guidance for rental unit owners to support EV charging, local policies that require EV charger access, or local on-street charging solutions.
- **Address issues with EV charging station maintenance.** Addressing EV charging station maintenance in areas with lower use and lower or no profitability will become increasingly important. Charging locations in areas with less demand or non-NEVI corridors might operate at a loss and receive less maintenance than needed. There should

be a discussion on what can be done to address this issue. To ensure that all EV chargers are functional, TxDOT could analyze data received from DCFC owners. TxDOT could further analyze how well the 5 percent holdback of federal reimbursement funds is working and could consider a company's maintenance record in future applications.

- **Adapt the EV charging implementation process as needed.** Uncertainty exists with the current predictions of EV adoption, so the EV charging implementation process should be flexible and adaptable. Continual feedback and updates to the EV implementation model are important to ensure that the growth expected is in line with the capacity of the electric infrastructure in the time period needed. The number of chargers in the NEVI plan are only 8–10 percent of the number of chargers that will ultimately be needed in Texas.
- **Assess EV charging technology improvements.** The NEVI Program and other programs are intended to provide funding for several years, during which technology will likely change and improve. For example, a minimum of 150-kW charging capacity might not be sufficient in a few years.
- **Expand on the analysis of EV charging demand.** Texas needs an analysis of EV charging demand that includes local, regional, and interstate demand. This analysis should be regularly updated and widely shared with EV charging stakeholders. This analysis could build on the tool that was developed by this research team.
- **Review EV charging performance specifications.** There are some questions regarding performance requirements for EV charging implementation under the NEVI Program—for example, with regard to installation dates. Completing the installation of a DCFC station might take 6–18 months, depending on the location and other factors. There is no guaranteed delivery date due to supply chain disruptions for the EV charging equipment. This issue affects partnering with equipment providers and manufacturers.
- **Consider development of new EV grant programs.** New grant programs would be useful to address current equity problems and support EV adoption. For example, a program could support neighborhood EVs in disadvantaged and low-income communities. Programs could also support micromobility options, such as partnerships with rideshare companies. Grants are also needed to support the needs of transit agencies.
- **Evaluate EV charging during emergency events.** Uncertainty exists regarding EV infrastructure and vehicles in areas that are prone to flood or weather events, like hurricanes. It is not clear what safety measures need to be in place for the vehicles and infrastructure. For example, during a hurricane, many gas stations have gas but no electricity to pump the gas into vehicles. Emergency evacuation routes have an infrastructure shortage to support existing EVs during an emergency. TxDOT should focus on resiliency and redundancy for evacuation routes and consider mobile charging trucks to be used during emergencies. Some private companies have started using mobile trucks for roadside assistance but may not be able to support future demand during emergencies.

Support for Grant Programs/Maximizing Grant Program Results for Texas

The following summarizes recommendations for TxDOT applicable to supporting grant programs and maximizing grant program results that are available to Texans:

- **Consider development of resources and training opportunities for EV grant programs.** Stakeholders voiced interest in how to communicate benefits and use of EVs; receive more information about case studies, success stories, and general implementation best practices; and implement best practices in rural areas with predominantly heavy-duty and farm vehicles. A program could be established to create resources to support this need. This program could also investigate needed data products specifically geared toward the data needs of federal EV funding programs.
- **Develop grant preparedness workshops.** It would be beneficial to have future workshops that bring private and public stakeholders together to prepare for and discuss strategies for upcoming grants. These events could be held regionally, leveraging stakeholder engagement in the NEVI Program. Meetings should include the MPO's local planning partners. These events could also support grants under the federal Charging and Fueling Infrastructure Grant Program.
- **Develop an EV teaming dashboard.** Several states have created central websites to provide information about EVs, including adoption rates, charging information, and other related information; one example is the Oregon DOT. TxDOT could expand its current NEVI Program website to add more information that stakeholders are looking for.

Stakeholder Coordination

The following summarizes recommendations for TxDOT applicable to EV charging infrastructure stakeholder coordination:

- **Develop the Texas Transportation Electrification Council.** A diverse group of EV charging stakeholders could address ongoing and future challenges with EV infrastructure through communication, collaboration, and coordination. This effort could expand on an existing group that TxDOT recently formed to address EV charging infrastructure concerns.
- **Consider developing a community engagement and education program.** A program to provide outreach to communities on the benefits of EVs and to involve the community in assisting with EV charger site selection may be helpful. Job training programs could be key for community engagement.
- **Continue sharing EV charging data.** TxDOT will receive data from EV charging infrastructure every quarter and will share it with others. These data will be an important source of information for ongoing EV charging infrastructure development.

Medium- and Heavy-Duty Vehicle Electrification

The following summarizes recommendations for TxDOT applicable to MHDV electrification:

- **Evaluate the electric grid infrastructure for fleet charging.** Upgrading electric networks to enable fleet charging may be a challenge since fleets may want to charge

quickly, will have a high electricity demand, and will have many vehicles. That combination could be a challenge from an electric grid perspective. As of today, fleets are expected to take a minimum of 6 years to electrify, while electrification of school buses may take 12–14 years. Although it remains to be seen how quickly fleet charging will be adopted in Texas, it is expected to be a gradual process and therefore should be manageable from an electric grid infrastructure planning perspective. Fleet charging is seen as a point problem since a great amount of electricity is needed at a particular location. Point problems may be addressed by providing charging at multiple locations since EVs can drive to a location where the grid has power. Thus, fleet EVs may need to be flexible in terms of charging locations. The availability of suitable fleet charging locations could affect actual versus planned operation of fleet EVs and fleet EV charging infrastructure.

- **Develop fleet EV transition guidance.** More in-depth guidance on how fleets can transition to EVs is needed. The Transportation Research Board and National Cooperative Highway Research Program may have some guides and information. However, information to determine locations for EV charging infrastructure is mostly focused on light-duty vehicles and not fleets.
- **Consider developing a program to support commercial vehicle electrification.** Many EV programs currently focus on passenger vehicles. There is a need for federal and/or state programs that focus on electrification of MHDVs or commercial vehicles. A pilot project that involves the commercial vehicle industry could provide insight and lead to topics that could be addressed by future research. For example, a pilot project could involve commercial drayage operations in Laredo, where trucks conduct multiple short-range trips daily using heavy commercial trucks across the U.S.-Mexico border.
- **Consider participating in federal pilot programs for MHDV corridor infrastructure plans.** The U.S. Department of Energy has started funding several projects to develop innovative MHD EV charging and hydrogen corridor infrastructure plans. Future rounds of funding could involve pilot research studies in Texas, such as research planning for MHDV depots using the megawatt charging standard, and options for mobile charging including in-ground and overhead charging. These types of projects might lead to a future federal program for MHDVs similar to the NEVI Program for light-duty vehicles. Getting involved in this type of program would benefit Texas by ensuring that research topics are relevant to TxDOT infrastructure.
- **Develop a research roadmap for MHDV electrification.** Although MHDV electrification is still in its infancy, standards are being developed, relevant regulations are under review to determine necessary updates, and development is occurring at a high speed. TxDOT would greatly benefit from the development of a research roadmap for MHDVs that defines TxDOT's priorities for research in this area in the following years.

Policy and Funding

The following summarizes recommendations for TxDOT applicable to EV charging infrastructure policies and funding programs:

- **Ensure ongoing compliance with changing BABA regulations.** EV chargers must comply with the BABA, but EV chargers assembled domestically are covered by a BABA waiver. The waiver limits the amount of steel and iron that must be domestically

sourced to the EV charger enclosures and housing if they are predominantly made of steel or iron. Domestic manufacturing of those components must occur in the United States, including all processes—from melting to pouring to final application of coatings. Starting July 1, 2024, the cost of domestic content for EV charger components must be at least 55 percent of the component cost. EV charger components that do not meet the standard must be installed no later than October 1, 2024.

- **Create a dedicated fund to support transportation electrification efforts that support demonstration and pilot projects as well as planning efforts.** Through recent legislation, such as SB 1002, the state is working to ensure a competitive marketplace for EV charging. Ensuring that private EVSE providers can operate cost-effectively within the state should ensure both broad network coverage and options for EV drivers when charging in denser areas. Establishing dedicated revenue to support electrification would enable public agencies to develop broader plans and programs to support electrification. Colorado and Oklahoma direct a portion of their EV registration fee revenue to a specific fund that supports EV infrastructure. While this would require a legislative change because SB 505 directs Texas's EV registration revenue to the State Highway Fund, it presents an option to help address the charging investment needs within the state.
- **Develop demonstration or pilot project programs to test freight and fleet applications.** While investing in charging equipment will largely be accomplished through local, regional, and private investments, TxDOT and state-level programs can support those investments. Demonstration and pilot projects that highlight the capabilities of different charging equipment to support freight, fleets, or housing applications can reduce the perceived risk for the private sector. A similar model to NEVI Program funding could be created, with a private partner providing the matching funds. States such as California, New York, and Pennsylvania have programs that provide data for companies to assess the cost of investment.
- **Explore options to stabilize revenue from AFVs to better position Texas to meet future transportation system needs.** The increase in both EVs and other AFVs will reduce transportation revenues in the long term. While EV registration fees help to address the current deficit, increased fuel efficiency and increased use of other fuels will continue to erode revenue. In addition, rising construction costs, partly due to inflation, reduce the purchasing power of those revenues. Some of the peer states are addressing this by indexing the registration fee to the consumer price index, while other states are assessing alternatives. Alternative revenue options, such as a per-mile fee, a road usage charge, or a per-kilowatt fee for vehicle charging, could be explored to test their feasibility and potential implementation challenges.

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