



WESTERN
GOVERNORS'
ASSOCIATION



SPECIAL REPORT

Electric Vehicles Roadmap Initiative

The Chair's Initiative of Oregon Governor Kate Brown

2021

Dear Friends and Colleagues,

One thing was clear as we developed the central policy initiative of my year as Chair of the Western Governors' Association: It should put the people of the West above all else. Because that's how Governors approach their work with WGA: We set aside political differences to help the entire region succeed.

The *Electric Vehicles Roadmap* Initiative doesn't represent the policy of one side or another. Instead, it promotes collaboration across the aisle and across the West to elevate and energize an issue that states are already working on, both individually and collaboratively.

Collaborating on electric vehicle (EV) infrastructure isn't a new idea. The first charging stations were installed in 2011 for what has become the West Coast Electric Highway. It now stretches north from California through Oregon, Washington and into British Columbia. Similarly, the Regional Electric Vehicle Plan for the West was established in 2017 by the Governors of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.

Like any other big idea, EV infrastructure planning and deployment requires continued coordination and shared investment across multiple parties to keep growing efficiently. It was our goal to determine how best to do that. We started with a series of Initiative work sessions that assembled the brightest minds from the public and private sectors, including EV manufacturers, charging station network operators, utilities, and technical and nonprofit experts, and focused on the hard questions of infrastructure, finances, and logistics that affect EV planning.

And we tried to understand those issues across the region, from major cities to tiny rural communities, because we knew the best solutions would be the ones that benefit everyone.

After the work sessions, WGA hosted a series of webinars and podcasts that further explored central issues, such

as: meeting the increased demand on the grid from the growth of EVs; how to use smart workforce investments to train and build a robust EV workforce, and how to support EV adoption and infrastructure in rural areas.

The fruits of that labor are represented in this report. For one, the work of the Initiative has resulted in an umbrella agreement among several western states on a shared set of principles regarding infrastructure planning. And the report contains specific recommendations on federal policy issues that affect public and private investments in EV infrastructure across the West, including opportunities for Congress and the Administration to leverage multi-state partnerships to effectively deploy federal EV infrastructure funds and pursue legislative changes to improve the business case for EV charging infrastructure deployment at federal rest areas.

EV design, manufacturing, sales and maintenance, and infrastructure deployment represents a valuable and growing economic opportunity across the West. Western states are leveraging creative public-private partnerships to encourage EV drivers to visit and support rural communities, and the growing medium and heavy-duty EV sectors will lead to economic opportunities in both urban and rural communities.

We all recognize that a robust and efficient transportation sector is key to meeting future economic goals and connecting businesses to regional and international markets. The *Electric Vehicles Roadmap* Initiative helps create a roadmap to that future.

With warmest regards,



A handwritten signature in black ink, appearing to read 'Kate Brown', written over a white background.

Oregon Gov. Kate Brown
WGA Chair



Dear Friend of the West,

One of the distinguishing characteristics of a WGA Chair Initiative is that it drives to action. So it is with Chair Kate Brown's *Electric Vehicles Roadmap* for the West.

Among other things, the yearlong effort has produced an agreement among multiple western states to coordinate on electric vehicle (EV) infrastructure. This agreement will have a demonstrably positive effect on our region for years to come. Moreover, the initiative is an excellent illustration of the bipartisan and cooperative nature of the policy work of Western Governors.

A penetrating examination of multiple EV issues – conducted through focused work sessions, webinars, and podcasts – revealed a suite of challenges common to all western states. This report elucidates those challenges and offers specific suggestions for overcoming them. WGA urges Congress and the Administration to pay particular attention to the bipartisan proposals for federal action contained at the end of the report and to integrate those recommendations into legislative measures and agency planning.

Efficient EV infrastructure planning and development requires coordination among multiple entities, including vehicle manufacturers, EV charging station developers, utilities, and state and local agencies. WGA is proud to have facilitated collaboration among these and other parties, and we are confident that this report will be a catalyst for expanded cooperation on EV issues across geographic and political boundaries.

WGA owes an enormous debt of gratitude to the multiple state officials, utility representatives, EV and equipment manufacturers, and transportation infrastructure experts who contributed to the success of this project. We offer a special note of thanks to the National Association of State Energy Officials, which manages the Regional Electric Vehicle Plan for the West, for its active participation in and support of the initiative.

The *Electric Vehicles Roadmap* is a recent but hardly isolated example of Western Governors – the most effective group of bipartisan elected leaders in the country – leading the way. I am especially grateful to Chair Brown for her clear vision and dedication to this project. Under her outstanding leadership, Western Governors have continued to demonstrate that bipartisanship is not a talking point but an essential component of effective governance.

Respectfully,



Jim Ogsbury
WGA Executive Director

INTRODUCTION

Oregon Governor Kate Brown launched the *Electric Vehicles Roadmap Initiative* in July 2020 to examine opportunities to improve the planning and siting of electric vehicle (EV) charging infrastructure in western states.

The Chair Initiative of the Governor assembled states engaged in the West Coast Electric Highway (which includes California, Oregon and Washington) and the Regional Electric Vehicle Plan for the West (REV West, which includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming). Together, they assessed opportunities for enhanced coordination on voluntary technical standards related to EV infrastructure hardware, payment methods, signage, and best practices for siting and location.

The work of the Initiative has resulted in an umbrella agreement among the states participating in these sub-regional efforts. States have developed a shared set of principles regarding EV infrastructure planning and identified a suite of voluntary standards to optimize the effectiveness and accessibility of public and private EV infrastructure investments.

In addition to facilitating western states' discussions, WGA brought together key stakeholders at work sessions to explore important issues affecting EV adoption and infrastructure deployment in the West.

WGA also hosted webinars and a podcast series that provided a public forum to explore grid infrastructure, financing and workforce issues influencing EV infrastructure planning and investment.

This report presents findings from these work sessions, webinars and podcasts, and examines state programs and coordination opportunities; grid infrastructure planning and the role of utilities; medium-duty (MD) and heavy-duty (HD) EVs; EV fleets; permitting and siting practices; and economic and workforce development opportunities associated with EVs.

In addition, the report contains targeted recommendations on federal policy issues that affect public and private investments in EV infrastructure across



Initiative Work Session Series

WGA designed and facilitated a biweekly, virtual work session series during the fall of 2020. Work sessions examined key EV topics raised by state officials. Work session participants included representatives from Governors' staff and state agencies, utilities and electric cooperatives, EV manufacturers, charging station network operators, and nonprofit organizations with EV expertise. WGA hosted sessions on:

1. Opportunities to Support the Battery EV and Hydrogen Fuel Cell EV Sectors
2. Supporting the Medium and Heavy-Duty EV Sectors
3. Examining Utility Investment and Rate Structures
4. Streamlining Permitting and Siting
5. Exploring Charging Station Inconsistencies Across States
6. Coordinating State Investments Along Tourism Corridors
7. Expanding EV Fleets in Urban and Rural Areas
8. Identifying Opportunities for Coordination between States and Clean Cities Coalitions

the West. The recommendations encourage Congress and the Administration to:

- Leverage multi-state partnerships to effectively deploy federal EV infrastructure funds;
- Promote flexibility within the Federal Highway Administration's Alternative Fuel Corridors Program;
- Enhance EV infrastructure deployment opportunities at federal rest areas;
- Support the U.S. Department of Energy Clean Cities Coalition program; and
- Create efficient permitting and siting practices for EV infrastructure installations on federal lands.

Throughout the Initiative, WGA examined EV topics of critical interest to western states, such as differences in EV use cases in urban and rural communities and the availability of tailored utility program offerings for EV drivers. WGA and Initiative participants also looked at access to EV dealerships and maintenance technicians and states' capacity to support EV investments. These issues speak to disparities in EV adoption and infrastructure deployment across the West. The report's findings and recommendations provide useful insights for Governors, states, utilities and local entities evaluating possible EV policies, programs and investments.

FINDINGS AND RECOMMENDATIONS

KEY FINDINGS

Section One: State Programs and Multi-State Collaboration Opportunities

Many western states already support EV adoption and investments in EV infrastructure in a variety of ways. These include: deploying charging infrastructure investments with state and Volkswagen settlement funds; creating statewide transportation electrification plans; entering strategic partnerships with charging station network companies; offering EV purchase rebates; and coordinating with utilities on novel rate designs for residential and commercial EV charging.

The actions that individual states prioritize are influenced by their citizens' interest in and purchase of

EVs. Consumers have a wide range of EV options to choose from, with varying levels of access to battery EVs (BEVs), hybrid EVs (HEVs), plug-in hybrid EVs (PHEVs), and even hydrogen fuel cell EVs (FCEVs). Annual purchases of EVs range from the low hundreds in some western states to approximately 150,000 in California.

The U.S. Department of Energy's Argonne National Laboratory tracks monthly sales of passenger EVs. In April 2021, nationwide sales included 73,110 HEVs (22,170 cars and 50,940 light trucks); 45,105 plug-in vehicles (32,115 BEVs and 12,990 PHEVs); and 397 FCEVs.

EV Adoption and Infrastructure Planning

Planning and buildout of EV charging networks is often described as a "chicken or egg" paradox whereby a requisite amount of EV charging infrastructure is needed to serve EV drivers. At the same time, a sufficient number of vehicles are necessary to economically support deployment of that infrastructure. The level of consumer adoption and availability of EV charging in a particular area will invariably affect whether a state elects to prioritize consumer EV adoption strategies, such as vehicle rebates, or charging infrastructure buildout. In many cases, states are pursuing these adoption

Know Your Terminology

This report references a variety of technical terms commonly used in the EV sector. Here is information about some important EV and electric system terms and topics.

Charging Levels

EV drivers can charge their vehicle via three methods, or "levels," with the charging rate increasing with higher levels.

- Level 1 charging is almost exclusively completed at home and allows EV drivers to conveniently charge overnight. Level 1 charging equipment is compatible with a standard, 120V outlet.
- Level 2 charging can be completed either at home or at public charging stations. Level 2 charging equipment utilizes a 240V outlet and is often sited at workplaces, hotels and shopping malls. Both Level 1 and 2 charging use alternating current.
- Direct Current Fast Charging (DCFC), sometimes referred to as "Level 3," utilizes specialized equipment to deliver direct current power to the vehicle's battery. This process supports faster and more efficient charging. DCFC stations are often located along highway travel corridors and in urban locations with high visitation, such as grocery and retail stores.

Charging Speed

The speed at which charging equipment fills an EV's battery depends on multiple factors, including the charging equipment level, the vehicle range, the battery's acceptance rate, and the amount of stored electricity in the battery. Level 1 charging can take upwards of 12 hours to fill the battery; Level 2 charging can take a few hours; and some DCFC equipment can fill a battery in approximately an hour. When using DCFC equipment, the rate of charge decreases when a vehicle's battery is approximately 80% full. This practice helps optimize battery life.

Three-phase Power

Three-phase electric power is the most common system of electricity generation, transmission and distribution and is used to power heavy electric loads. By contrast, single-phase power systems can be found in rural areas with less overall electricity usage. The presence of three-phase power infrastructure can help support high-capacity EV charging installations and reduce project costs associated with EV charging infrastructure deployment.

Volkswagen Settlement Funds

Many initial investments in EV charging infrastructure have been supported by funds distributed to states and territories as a result of the 2016 emissions settlement between Volkswagen and the U.S. government. Approximately \$3 billion in Environmental Mitigation Trust funds has been made available for states and territories to subsidize vehicle adoption, technology conversions, or charging and fueling infrastructure deployment that reduces emissions. States and territories may use up to 15% of their allocated funds to support EV charging infrastructure deployment.



EV 101 Document

WGA developed an “EV 101” document that summarizes technical aspects of different kinds of EVs and their respective charging or fueling technologies. The document provides accessible technical descriptions of BEVs, HEVs, PHEVs, and FCEVs, and different levels of EV charging technologies.

Level	Approximate Power	Approximate Range per Hour of Charging	Equipment	Use Cases
1	1-3 kW	3-5 miles/hour of charge	120V (standard) outlet, charger provided with vehicle purchase Connector: J1772, Tesla adapter	Home, overnight
2	3-19 kW Typically 6.2-7.6 kW	14-35 miles/hour of charge	240V outlet, home charger usually sold separately Connector: J1772, Tesla adapter	Home, workplace, parking garages, grocery stores, hotels, shopping centers, etc.
3 (DCFC)	50 kW, 150 kW, 350 kW Typically 50-150 kW	50 kW: 2-3 miles/minute 150 kW: 6-9 miles/minute 350 kW: 12-18 miles/minute	Dedicated 480 V outlet, required amps for a dedicated circuit range from 60 to 420 Connector: CCS, CHAdeMO, Tesla Supercharger	Highway and travel corridors, shopping centers, grocery stores *Most PHEVs can only use Level 1 and 2 equipment.

and infrastructure deployment strategies in tandem.

While many western states are leaders on EV planning, there are a suite of issues that complicate public and private planning efforts. A key challenge is how to optimize investments in infrastructure to address consumers’ “range anxiety” – the concern that they will be unable to charge their EV before its battery is depleted. Multiple consumer studies have cited either vehicle cost or range anxiety as the main factor inhibiting purchase of an EV. Concerns about the length of time to charge an EV and the need to plan charging stops on long trips are other common factors that reduce consumer interest in purchasing an EV.

Prospective EV owners may not be aware of the ability to charge their vehicles at home. In a 2019 study, the Electric Power Research Institute estimated that approximately 80 percent of charging is accomplished at home, 15 percent is completed at work, and 5 percent occurs at public charging stations. While proportionally little charging is conducted at public stations, increasing the availability of both urban and corridor charging stations could help address consumer range anxiety concerns. Aside from providing additional charging capacity and convenience, the increased prevalence of public charging infrastructure plays an important role in consumer perceptions of EV technology and purchasing considerations.

Other crucial factors affecting states’ EV planning efforts involve barriers to physical and digital infrastructure in less populated areas. For example, many rural areas in western states lack three-phase

power. The absence of three-phase power can either preclude or add substantial costs to the installation of DCFC stations in rural areas. Given that DCFC stations provide comparably quick vehicle recharge times, this grid infrastructure challenge has significant effects on the development of charging networks that support convenient, regional EV travel. These grid infrastructure limitations and costs also influence how states balance investments in Level 2 and DCFC stations and support the creation of functional EV charging networks within their borders.

The availability of either cell phone service or onsite wi-fi is another factor that can influence EV infrastructure planning and siting. A lack of connectivity can inhibit the use of app-based/smartphone payment systems and prevent a charging station from being “networked.” Networked chargers are digitally connected to a larger infrastructure network and contain technology that enables enhanced functionality of the individual charging station. Common functions of networked chargers include electricity consumption tracking, visibility on mapping platforms and remote maintenance accessibility. Many networked chargers can also generate energy consumption and driver

usage reports, which can be especially useful for station operators or site hosts who must complete state or federal reporting requirements.

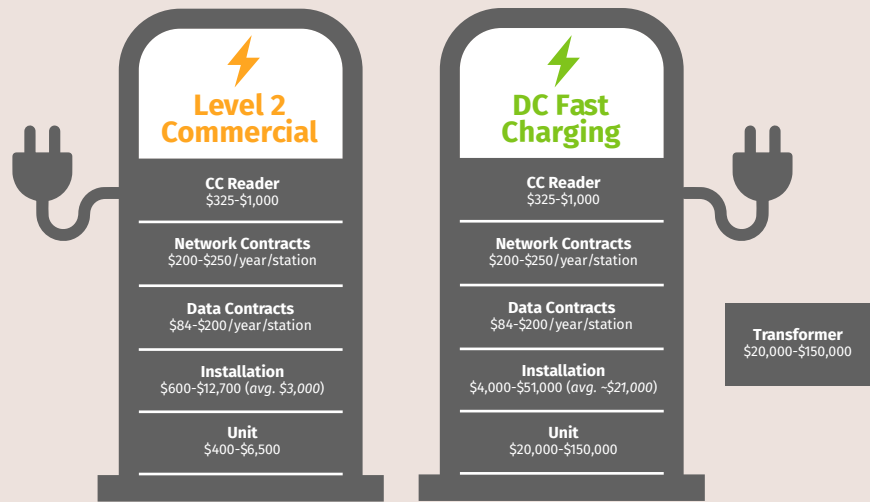
Due to their enhanced functionalities, initiative participants from states, utilities and charging station network companies all expressed preferences for installing networked chargers. Participants did share examples, such as installations at national parks, where non-networked chargers provided a useful solution.

While many western states are focused on planning and siting EV charging infrastructure along travel corridors, a number are beginning to place additional emphasis on identifying charging solutions for residents who lack access to home or workplace charging. Increasing access to charging solutions in urban areas and at multi-unit dwellings requires close coordination between municipalities, utilities, property owners and charging network operators, and can help increase consumer access to EVs, especially for residents who do not have access to a private garage or designated parking space.

Initiative participants also discussed how multiple western states have sought to

EV Charging Technologies and Costs

The costs of installing EV charging infrastructure depend on multiple local factors, including the charging station level, the presence or absence of electric supply infrastructure (transformer, conduit, etc.), and the physical readiness of the site itself. This graphic shows various, approximate costs associated with EV infrastructure installation. Installation costs, especially for DCFCs, tend to be higher in rural areas where electric service upgrades are needed.



promote consumer EV access by enacting legislation that allows EV manufacturers to sell their vehicles directly to consumers outside of the traditional franchise dealership model.

Technological Advancements

The rapid pace of change with EV battery, vehicle and charging technology is enabling increased driving ranges and charging speeds. While these innovations are helping to make EV ownership more convenient and reduce consumer range anxiety, they do have effects on state EV planning. For example, some new DCFC stations provide up to 350 kW of charging output, which enables newer EV models with a high power acceptance rate to be charged very quickly. This innovation has

led some states to prioritize “future-proof” charging infrastructure projects that have adequate electric capacity to support the addition of advanced, ultra-fast DCFC stations. The ability of individual states to support these projects, however, is highly dependent upon their own budget capacity, local cost and infrastructure factors, and the status of EV infrastructure buildout within the state.

Charging Equipment

The process of charging an EV is naturally compared to filling an internal combustion engine (ICE) vehicle with gasoline or diesel fuel. ICE drivers have become accustomed to an easy, standardized fueling process,

regardless of location or vendor, that takes only a few minutes to complete. The process of charging an EV currently lacks this level of uniformity due to differences in charging levels and equipment across vehicle manufacturers and charging network operators.

To promote consumer accessibility and acceptance and a more predictable user experience, some western states have adopted regulations addressing EV charging station hardware, payment methods, display screen requirements, and other technical and design factors. The most common cause of confusion for prospective EV drivers centers on the use of different charging connectors for various charging practices.

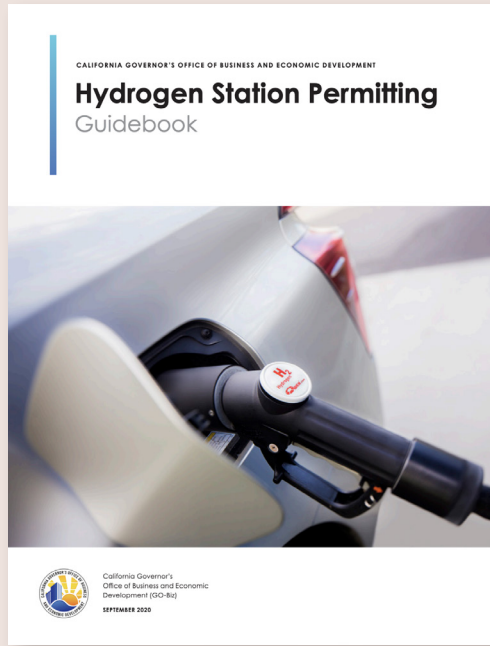
Heavy-Duty Charging Connector

Vehicle manufacturers, charging station developers and the scientific research community are currently engaged with testing and developing a global Megawatt Charging System (MCS) standard for HD EV charging. There is a desire in the HD EV trucking sector to avoid the costs and confusion associated with the lack of a single, standard connector for LD EV charging. The Charging Interface Initiative (CharIN), a non-profit association focused on e-mobility solutions, is leading the development of this inlet hardware and connector technology in concert with the EV industry.



California Permitting Guidebooks

The California Governor’s Office of Business and Economic Development has developed state charging station and hydrogen fueling station permitting guidebooks, which provide guidance to private industry, utilities and local agencies on siting considerations, safety concerns, and permitting best practices. Charging station and hydrogen fueling representatives involved in the Initiative provided positive feedback on the utility of these guidebooks and encouraged other western states to consider developing similar, state-specific resources.



Level 1 and 2 charging, for example, is accomplished with a North American standardized connector (SAE J1772) and is compatible with all non-Tesla EVs. However, in a DCFC context, there are currently three common connectors: CCS Combo, CHAdeMO, and Tesla Supercharger. The CCS Combo standard is used by most American and European plug-in EVs, the CHAdeMO standard is used by most Japanese and Korean automakers, and the Tesla Supercharger is only compatible with Tesla models. Most public DCFC charging stations are equipped with both CCS and CHAdeMO connectors. Tesla operates its own DCFC network of Tesla Superchargers.

Ongoing coordination between states, vehicle manufacturers, and charging network operators can help support the creation of appropriate guidelines that promote an accessible, consistent charging experience while leaving room to support innovations in charging hardware equipment, payment methods, and communication protocols.

Current and prospective EV drivers also expect fair and transparent pricing information. In many states, EV charging is billed on a dollar-per-kilowatt-hour (\$/kWh) pricing schedule, which provides a direct measurement of the electricity dispensed into the vehicle’s battery. In other states, EV charging is billed on a

per-minute basis, which provides less transparent information on electricity received. Throughout the Initiative work session series, charging station representatives highlighted that certain states classify charging station operators as “public utilities,” which impedes their ability to offer \$/kWh pricing. One charging station participant emphasized that whether their company is classified as a “public utility” is the regulatory issue with the largest effect on their business practices.

Multi-State Collaboration

Many western states are working across geographic and political boundaries to support the creation of functional, regional EV charging networks. The West Coast Electric Highway and REV West agreements provide forums for planning and investment on a regional basis and are helping support the expansion of EV charging corridors that deliver connectivity and economic benefits to multiple states.

Through the Initiative, several Western Governors have agreed to an EV infrastructure Memorandum of Understanding (MOU) that seeks to promote coordination among states engaged in the West Coast Electric Highway and REV West. The MOU includes an appendix of voluntary minimum standards to assist state agencies with EV infrastructure planning. (See it on page 20).

West Coast Clean Transit Corridor

The West Coast Clean Transit Corridor Initiative (WCCTCI), a study commissioned by nine electric utilities and two agencies representing more than two dozen municipal utilities, assessed grid infrastructure readiness for MD and HD charging infrastructure deployment along Interstate 5 and connecting highways in California, Oregon and Washington. The engineering firm HDR helped conduct the corridor analysis and provided an overview of results during an initiative work session. The study showed many utilities have sufficient capacity to support grid interconnections in urban areas for proposed MD charging sites, but that most proposed HD charging sites would require a new substation and line interconnection. In rural areas, capacity constraints would affect the siting of some MD charging sites. Daimler Trucks North America and Portland General Electric have opened a first-of-its-kind, publicly available HD charging site, known as “Electric Island,” that is aligned to the blueprint of the WCCTCI.

EV Fleet Planning Tools

The Electrification Coalition recently launched its Dashboard for Rapid Vehicle Electrification (DRVE) tool. The DRVE tool is open-source and can be used by prospective fleet managers, including states, to better estimate costs associated with LD, MD, and HD fleet electrification.

The National Association of State Energy Officials is working with state agency leads under the Volkswagen Environmental Mitigation Trust Settlement to develop a shared database of alternative fuel vehicle fleet data and associated charging and fueling infrastructure. The database, hosted by NREL's LiveWire Program, will allow states to upload and aggregate common economic, energy, and emissions data from fleet purchases or infrastructure investments funded through the VW Settlement Trust. This shared data can then be leveraged by states as they work to support the adoption of electric vehicles and other alternative fuel vehicles.



Section Two: Grid Infrastructure Planning and the Role of Utilities

Utilities and electric cooperatives across the West are playing a central role in EV infrastructure planning, education and investment. Planning and siting public EV charging infrastructure often requires close collaboration and shared investment between charging network operators, charging site hosts and local utilities. WGA involved a diverse set of investor-owned utilities, municipal utilities, and rural electric cooperatives throughout the initiative to gather information on utility permitting and siting processes, infrastructure financing models, and regulatory factors affecting utilities' involvement with EV charging infrastructure.

Grid Infrastructure

The majority of EV charging occurs at home. While at-home charging currently does not have major effects on overall electricity grid loads, upgrades to local distribution infrastructure may be needed to support the installation of DCFC stations, MD and HD charging sites, or commercial EV fleet charging depots. The need for these upgrades can be exacerbated in rural areas with less robust grid infrastructure.

The need to perform local distribution network upgrades, such as the installation of transformers at DCFC sites, can add substantial costs and time to EV charging projects. Whether localized grid effects can be mitigated with

demand response (DR) programs or will require physical upgrades is a common question for utilities and charging network operators. Initiative participants also discussed EV owners' increasingly common usage of at-home, Level 2 chargers and the potential for localized grid effects in areas where the use of this charging hardware is prevalent.

Rates and Demand Charges

Many Initiative discussions focused on the role of utility pricing structures for residential and commercial EV charging use cases. On the residential side, utilities and electric cooperatives across the West are experimenting with "time-of-use" (TOU) programs that encourage EV drivers to charge their vehicle when demand on the grid is lowest, usually overnight. These programs can reduce overall strain on the grid and provide substantial cost savings to EV owners. Initial results from certain utility TOU programs indicate that EV drivers can be willing to significantly alter their charging practices in exchange for reduced rates.

Utility rate structures and the effects of demand charges on the business case for commercial EV installations received significant attention during Initiative work sessions. Utility bills often include pricing breakdowns based not only on the consumer's overall electricity usage, but also the peak amount consumed

in a particular period, such as 15 or 30 minutes. How these pricing structures are designed has significant effects on the overall costs of EV charging infrastructure, especially for projects that result in a significant amount of electricity being consumed in a short period of time. DCFC installations, MD and HD charging sites and EV fleet charging depots are all especially affected by these rate structures and any demand charges that may be directed to the respective charging network operator, charging site host or fleet manager.

Demand charges can disproportionately affect rural areas that may experience low initial utilization of EV charging infrastructure. While relatively little electricity may be consumed at these sites on a monthly basis, the total costs to the charging network operator or site host can be relatively high if multiple drivers are charging their EVs simultaneously. Since rate and demand charge structures vary greatly between utilities and electric cooperatives and across states, these costs could have substantial effects on the private business case for deploying EV charging infrastructure, especially DCFC stations, in the rural West.

Some utilities in western states are beginning to offer customized rates and demand charges for certain EV charging use cases, such as transit agency buses.



During Initiative discussions, utility participants communicated appreciation for utilities that provide transparent information about EV-oriented rate structures and demand charges, as it allows other utilities and electric cooperatives to adopt best practices employed by those with more experience in addressing EV issues. Charging station and utility representatives also encouraged states and Governors to work with their respective public utility commissions (PUCs) and utilities to identify and promote rate and demand charge structures that support effective investments in EV charging infrastructure.

Utility Programs

Many utilities and electric cooperatives manage programs that improve the business case for private EV charging infrastructure investment, support charging solutions for residential and commercial customers, and deliver educational materials on EV adoption and technologies. State regulations determine the degree to which utilities and electric cooperatives can invest in and manage EV charging infrastructure. In some states, utilities may own and operate all EV equipment, including the charging stations. Utilities in other states are limited to managing electricity supply and service connecting equipment, often referred to as “make-ready” infrastructure. Due to these differences, business models and relationships between charging station network operators, utilities, and site hosts can vary across states.

Utilities across the West are increasingly pursuing partnerships with charging station network companies and local businesses to deploy workplace charging solutions within their service territories. These programs can help provide additional charging options for EV drivers, especially those without access to at-home charging, and long-term revenue and marketing opportunities for partnering businesses and site hosts. One utility work session participant shared that their workplace charging sites are providing valuable data on load profiles and demand charges for informing effective commercial charging installations and rate structures.



Many utilities and electric cooperatives are also engaged with educational campaigns focused on providing accessible information to their customers on EV and charging technologies. Work session participants discussed how these utility-led education projects can address consumer concerns or confusion with EV models and use cases, range anxiety, and vehicle recharging times. A non-profit organization initiative participant expressed frustration with PUC regulations that limit the amount of funding that utilities can spend on EV educational campaigns.

Energy Management Innovations

Innovations in load management technologies, dynamic energy pricing structures, and energy storage technologies are helping to minimize overall strain on the grid, reduce the need for grid hardware upgrades, and defray demand charge costs for charging network operators and site hosts. For example, certain utilities and charging station developers are assessing opportunities to integrate energy storage technologies, such as on-site batteries, into EV charging infrastructure

projects, especially DCFC sites. These storage technologies can help deploy electricity to EV drivers when demand is high, thereby reducing grid strain and associated demand charges for the charging network operator or site host. Initiative work session participants also discussed examples of these storage technologies being used to limit the need for grid infrastructure upgrades for charging station sites located in rural areas with less robust electric capacity.

Initiative participants also discussed innovations with smart charging, vehicle-grid integration (VGI) and vehicle-to-grid (V2G) technologies. These technologies can enable advanced communications and the bi-directional exchange of electricity between EVs and the grid, leading to energy system resiliency benefits and the potential mitigation of grid hardware upgrades. While many of these technologies are not ready for wide-scale deployment across the West, they are gaining state and utility attention. Initiative participants acknowledged that additional research and modeling are needed to assess how these technologies may be integrated into various utility and regional use cases across the West.



Section Three: Infrastructure Permitting & Siting

Authorities Having Jurisdiction

Municipal and county governments serve as the “authority having jurisdiction” (AHJ), meaning they have primary responsibility for permitting EV infrastructure. Given that the EV sector is still developing, many of these localities have little experience with permitting and siting EV charging and hydrogen fueling infrastructure. Prior to submitting a permit application to an AHJ, charging station developers and utilities may engage in substantial planning processes related to local EV adoption and associated demand for public charging, electric grid capacity, access to rights-of-way (ROWS) and easements, and other factors that determine the optimal location for public EV infrastructure sites. The exact processes and timeframes for reviewing and approving these permit applications can vary widely between local jurisdictions, which can lead to confusion and frustration for project developers.

There are significant differences in geography, technical expertise, staff capacity, and ROW policies across local jurisdictions. AHJs need the

flexibility to integrate these unique, local factors into their planning procedures, but Initiative participants suggested that states can serve a valuable role by promoting permitting best practices and encouraging coordinated permitting procedures across local jurisdictions within their borders. Identifying the proper balance between adopting regionally similar permitting procedures and preserving local flexibility could help promote more cost and time-effective investments in EV infrastructure.

Permitting and Siting Best Practices

Initiative work session participants discussed multiple best practices that can promote permitting and siting predictability and efficiency for EV project developers, utilities and AHJs. These include:

- AHJs can streamline zoning reviews by designating EV chargers of all types as an “accessory land use.”
- AHJs can make permit application documents available to be downloaded and submitted digitally with the ability to provide electronic signatures.

- States can clarify that EV charging station reviews are limited to health and safety requirements found under local, state and federal laws, and that local aesthetic or landscaping requirements do not meet this threshold.
- States and utilities can develop educational materials that provide information on EV charging and fueling technologies and associated planning considerations for local jurisdictions’ use.
- Infrastructure siting partnerships between gas stations and charging station developers can eliminate the need for local traffic studies.
- Projects can be expedited by organizing pre-application meetings and designating single points of contact between charging station developers, utilities, and local AHJs. These pre-application meetings can also help utilities conduct efficient screening reviews for proposed locations, thereby saving time and money on full reviews.

Section Four: Medium-Duty and Heavy-Duty EVs, EV Fleets

The sections above have primarily focused on EV planning and infrastructure investment for passenger and light-duty (LD) vehicles. The developing battery and hydrogen fuel cell medium-duty (MD), heavy-duty (HD), and EV fleet sectors present even more complex challenges for grid infrastructure planning, multi-party coordination, and infrastructure permitting and siting. While the MD, HD and EV fleet sectors are still nascent, lessons learned from the LD EV sector provide valuable insights on how to effectively plan for and support the infrastructure needed to charge and fuel these vehicles. Planning and developing MD, HD and EV fleet infrastructure projects can be time- and capital-intensive and requires close, ongoing coordination between utilities, project developers and local agencies.

There are a wide range of EV fleet use cases spanning the LD, MD and HD sectors in the West. Many state agencies have invested in LD EVs. Delivery companies are deploying electric vans and box trucks. Municipalities are using electric garbage trucks, and school districts are purchasing more electric school buses. While there are significant differences in initial investment levels and operating strategies for these various EV use cases, there are crossover challenges related to planning, financing and optimizing fleet operations.

Grid Infrastructure and Charging Use Cases

MD and HD EVs require substantially more electricity to operate than passenger EVs and can pull much more electricity off the grid in short intervals, thereby exacerbating the grid infrastructure planning concerns previously discussed in an LD context. The exact effects of MD and HD charging sites on local grid infrastructure depend on technical factors related to existing electric delivery capacity, the ability to integrate load management technologies, regular charging schedules, and other project-specific factors. Many of the

utility rate and demand charge issues discussed previously can be especially significant in MD, HD and fleet contexts.

The charging schedules of MD and HD EVs and EV fleets have substantial effects on charging costs, operational logistics, and grid infrastructure. For example, a transit agency that operates a fleet of EV buses could plan its routes and charging schedules to optimize the use of overnight charging and realize the benefits of associated low electricity rates. By contrast, an HD, long-haul truck operators may desire faster charging to meet shipping deadlines. There are many charging use cases such as these that can affect MD, HD, and EV fleet planning and operational costs. Advanced technologies related to data analysis, load management, and bi-directional charging will serve an important role in the MD, HD, and EV fleet sectors in the years to come.

Project Challenges and Opportunities

The long planning horizons associated with planning and building MD, HD and fleet charging infrastructure have the potential to create project challenges. Transparent, predictable processes coordinated across project developers, utilities, local agencies and fleet managers are needed to ensure that plans progress efficiently and that major infrastructure upgrades, such as the installation of sub-stations, are not instituted late in the project development process. During the Initiative work session series, state agency participants discussed opportunities to better integrate energy and transportation system planning activities, and that MD, HD and fleet charging projects could serve as useful case studies on electric infrastructure siting in highway ROWs.

Aside from issues with grid infrastructure planning and investment, MD and HD charging station developers may encounter challenges with access to suitable real estate for charging station siting in urban areas. Existing industrial zones could offer optimal

access to robust grid infrastructure and interconnection opportunities, but many of these industrial zones are already densely occupied. Identifying adequate space needed for truck parking, charging, ingress, and egress can be another common challenge for MD and HD project developers.

Initiative participants also discussed differences between large and small EV fleet operators. While major delivery companies and transportation network companies may elect to construct and manage their own fleet charging depots, access to public charging infrastructure, especially DCFCs, may help smaller businesses integrate certain EVs into their existing fleet operations. It is worth noting that many MD EVs, such as delivery vans and box trucks, can use standard LD charging equipment. Initiative participants recommended that MD EVs not be expected to rely on LD charging sites, as they may have specific logistical needs, such as larger parking spaces and the ability to pull through a parking area.

Total Cost of Ownership

The “total cost of ownership” (TCO) is the primary factor that determines whether a public or private entity will invest in a particular EV technology or convert to an EV fleet. While many EVs have higher upfront costs than comparable ICE vehicles, savings associated with reduced maintenance, federal and state rebate opportunities, and more predictable fuel costs can lead to overall lifetime savings for the vehicle or fleet.

Determining the TCO for a particular EV fleet can be challenging. Highly local factors related to planned routes, rider usage, terrain, and utility rate structures have significant effects on TCO. Given the difficulties with generalizing the TCO of EV fleets, work session participants emphasized the importance of local demonstration projects for assessing the potential success of major public EV fleet investments. Common practices that can increase EV fleet costs include: not coordinating the fleet investment with



the local utility; not incorporating vehicle operation and maintenance training into the fleet purchase; and investing in expensive load management technology that is not recouped through regular energy savings.

Initiative work session participants also discussed the importance of identifying whether battery electric, hydrogen fuel cell, or a combination of the two technologies could provide the best solution for a particular fleet. While hydrogen fuel cell buses and fueling infrastructure have higher upfront costs than battery electric buses and associated charging infrastructure, the faster refueling times for hydrogen fuel cell buses can enable more efficient operations for certain fleets.

State EV Fleet Purchases and Programs

Many western states have invested in EV fleets to support state agency operations.

States can face challenges, however, in procuring and financing EVs for fleet applications. Budget factors that can inhibit state EV fleet investments include: narrow purchase windows that do not align with state budget periods; agency practices that require all funds to be allocated prior to vehicle purchases; and a lack of reliable data on the resale value of particular EV models (thereby complicating TCO calculations). Further, certain state fleet needs may be insufficient to qualify for bulk purchasing deals. To address these barriers, state and local agencies are increasingly pursuing multi-jurisdictional bulk purchasing options, including through the SourceWell platform and Climate Mayors EV Purchasing Collaborative.

A few western states are beginning to institute EV programs expressly focused on supporting the creation or

expansion of EV fleets. Work session participants discussed strategies to ensure that EV fleet pilot projects scale properly and deliver all intended benefits to local communities or riders. A broadly supported suggestion focused on the need for fleet projects to “pilot the end solution” and integrate the charging or fueling equipment that would be used with a fully developed fleet. Conducting a pilot project with high-capacity DCFCs, for example, can provide valuable feedback on charging schedules and utility costs, and generally create a more favorable environment for successfully scaling a project. Work session participants encouraged state EV program managers to examine how EV fleet funding applicants intend to scale their installations and distribute funding to projects with a high likelihood of successful expansion.

Section Five: Economic and Workforce Development

Economic Development

Many western states and communities are seeking to leverage EV infrastructure to bolster local economic development initiatives. Some efforts have focused on rural tourism opportunities, as EV drivers can explore downtown areas and support restaurants, shops and local tourism attractions while their vehicles charge. Partnerships between charging station operators, state and local agencies, and tourism-oriented businesses can further amplify the economic development benefits associated with EV tourism.

Employment opportunities in the EV and transportation electrification sectors are growing across the nation and in the West. The *2020 U.S. Energy & Employment Report* (USEER), developed by the National Association of State Energy Officials, the Energy Futures Initiative, and BW Research Group, shows that the motor vehicle industry added approximately 76,000 alternative fuels vehicles jobs from 2015-2019. Nationwide, there were approximately 276,000 jobs within this sector, with 77,000 of those concentrated in 19 western states. The *USEER Wages, Benefits, and Change Report* shows that the 2019 median hourly wage within

the alternative transportation sector was \$22.13, 15.6 percent above the geographically weighted median.

Workforce Development

A number of states and utilities are assessing how growing workforce needs within the EV sector will affect vehicle adoption and infrastructure deployment. The continued expansion of the EV sector will create additional demands for workers engaged in vehicle design and software engineering, utility infrastructure improvements, charging station installation and repair, vehicle maintenance, and many other EV and energy system sub-sectors. A lack of qualified workers to meet these new workforce demands could affect the overall development of the EV sector and the deployment and maintenance of EV infrastructure. Effective partnerships between the EV industry; transit agencies; universities, community colleges and trade schools; utilities; and state workforce programs can help provide training and upskilling opportunities for workers who are interested in entering or increasing their experience in the EV sector.

Workforce demands for EV maintenance technicians in rural areas may influence

consumer and fleet EV adoption in the rural West. While the routine maintenance needs, such as regular oil changes, for EVs are less than ICE vehicles, a lack of access to local EV experts and maintenance offerings could create inconveniences for rural EV owners.

EV maintenance and infrastructure installation training programs are expanding. The Electric Vehicle Infrastructure Training Program, for example, provides credentialed curriculum for electricians seeking training opportunities with EV charging infrastructure installation and maintenance. Expansion of credentialed training programs such as these can address EV workforce gaps and create high-paying jobs in urban and rural communities. Initiative participants emphasized the role that community colleges can serve in providing in-demand EV skills training, especially when programs partner with or are informed by EV manufacturers. Initiative participants further encouraged states to consider opportunities to support credential reciprocity structures that promote EV training and employment opportunities on a regional basis.



FEDERAL POLICY RECOMMENDATIONS

The *Electric Vehicles Roadmap Initiative* has provided valuable information on planning, financing, and infrastructure issues affecting public and private investments in EV infrastructure across the West. A number of these challenges may be addressed through federal policy actions. Federal policy recommendations arising from the initiative include:

1. Congress and the Administration should leverage existing multi-state partnerships to effectively deploy federal EV infrastructure funds and support the expansion of regional charging networks. The REV West and West Coast Electric Highway provide useful mechanisms to efficiently promote targeted investments and partnerships with charging station network companies that expand cohesive, regional EV charging networks.
2. The Federal Highway Administration should promote expanded flexibility within the Alternative Fuel Corridors Program to recognize the unique geographic and infrastructure conditions in western states. Multiple western states have experienced challenges in meeting the defined “corridor-pending” and “corridor-ready” metrics due to the lack of electric infrastructure and suitable charging locations in sparsely populated areas. The tethering of future federal funding opportunities to these “corridor-pending” and “corridor-ready” designations could adversely impact western states and inhibit the expansion of regional EV charging networks, especially in rural areas.
3. Congress should pursue legislative solutions to address provisions within 23 U.S.C. 111 that prohibit the issuance of a fee for EV charging infrastructure sited at federal highway rest areas. This prohibition significantly complicates the business case for siting EV charging infrastructure at these rest areas and creates challenges for expanding EV charging networks in portions of the rural West that may have few suitable locations for EV charging.
4. Congress should continue to support the Clean Cities Coalition program managed by the U.S. Department of Energy’s Vehicle Technologies Office. Local Clean Cities Coalitions often serve a crucial role in urban and rural communities by leading EV infrastructure planning and implementation projects.
5. Federal land management agencies should begin to create and implement efficient practices for permitting and siting EV infrastructure on federal lands. Many federal lands serve as regional tourism attractions and support economic development in rural western communities. Implementation of effective EV infrastructure permitting practices will help ensure that EV drivers continue to visit federal lands and surrounding communities. Western Governors and states welcome the opportunity to collaborate with federal land management agencies on consistent and effective EV infrastructure planning procedures.

WEBINARS

Electric Vehicles Roadmap Initiative Launch

Oregon Gov. **Kate Brown**, asserting that “we are on the precipice of a historic transition,” launches the *Electric Vehicles Roadmap Initiative* during this webinar. “My Initiative (is) an issue that states across the West are already working on, both individually and collaboratively,” the Governor says. “It is an issue that bolsters our current economies and creates a roadmap, both literally and figuratively, to the future.” The webinar concludes with presentations about the West Coast Electric Highway and the Regional Electric Vehicle Plan for the West by Tonia Buell of the Washington State Department of Transportation and Katie Pegan of the Idaho Governor’s Office of Energy & Mineral Resources.

Examining Transmission and Distribution Infrastructure Across the West

This roundtable examines how to meet the increased demand for electricity resulting from the increased use of electric vehicles (EVs) by consumers, government and private industry. The panelists highlight the upgrades required for existing charging infrastructure as well as strategies to reduce upgrade costs. **Moderator:** Jeff Morris, Schneider Electric. **Panelists:** Michael Kintner-

Meyer, Pacific Northwest National Laboratory; Kellen Schefter, Edison Electric Institute; Annie Schneider, Utah Governor’s Office of Energy Development.

Electric Vehicle Workforce Needs and Opportunities

There are significant gaps in the EV workforce and a need for more training. This webinar analyzes how smart workforce investments can address these gaps, and the economic benefits of investing in a robust EV workforce. **Moderator:** David Terry, National Association of State Energy Officials. **Panelists:** Dr. Linda Little, IBEW/NECA Electrical Industry Training Center; Jannet Malig, California Community Colleges; Michael Graham, Columbia-Willamette Clean Cities Coalition.

State, Local, and Private Funding Investments in EV Infrastructure

A discussion of EV infrastructure partnerships, funding, and how to optimize investments in EV charging and fueling infrastructure for corridor and urban use cases. **Moderator:** Kevin Moss, WGA; **Panelists:** James Campbell, Rocky Mountain Power; Alicia Cox, Yellowstone-Teton Clean Cities Coalition; Bill Elrick, California Fuel Cell Partnership; Dedrick Roper, ChargePoint.



OUT WEST PODCASTS

Electric Vehicles in Rural Areas

The inaugural podcast episode for the *Electric Vehicles Roadmap Initiative* highlights that consumer ownership of EVs is expanding across the West, but that rural citizens face particular challenges owning and operating the vehicles. WGA Policy Advisor Kevin Moss moderates the conversation with Alliy Sahagun of the Gunnison County Electric Association in Colorado and Roger Hoy of the Nebraska Tractor Test Laboratory. They discuss barriers, and solutions, to the adoption of EVs in rural areas.

Electric Vehicle Research and Innovation

Advances in EV technology are transforming transportation in the western region. This podcast features a discussion of how innovations in battery technology, as well as fleet charging and fueling systems, are enabling more diverse uses of EV cars, trucks, and buses in the region. WGA Policy Advisor Kevin Moss moderates the conversation with Alex Keros of GM; Kim Okafor of Trillium, and Eric Wood of the National Renewable Energy Laboratory.

Electric Vehicles & Economic Development Opportunities

EVs aren’t just for driving. States also are leveraging EV charging infrastructure to drive tourism and economic development in rural communities. WGA Policy Advisor Kevin Moss moderates a conversation about that trend, as well as how the economics of EV production, marketing, sales, and repairs compare to traditional, gasoline vehicles. Panelists include Scott Bricker, interim Vice President of Destination Development at Travel Oregon, and Jim Chen, the Vice President of Public Policy for Rivian.



On The Web:

Find Electric Vehicles Roadmap Initiative news, webinars, podcasts and resources at: <https://westgov.org/initiatives/>



Portland General Electric collaborated with the City of Portland to address the scarcity of public charging in many city neighborhoods. See Page 19.

STATE AND REGIONAL CASE STUDIES

STATE

Alaska

The Alaska Energy Authority (AEA) is supporting the installation of DCFC stations along the Railbelt from Homer to Fairbanks. AEA plans to install up to 14 stations by leveraging its state allocation of Volkswagen Settlement Funds and supplemental grant sources. The charging installations will be located within five miles of the highway and every 50 to 100 miles to support the buildout of a charging corridor across the 600-mile stretch of highway. AEA is also working with the local utilities to identify effective rate structures that encourage participation from prospective charging site hosts. Site buildout will begin later in 2021.

Arizona

The state has adopted consumer-friendly policies that include tax benefits, insurance discounts, access to HOV lanes,

and parking privileges to encourage consumers to buy an EV. Gov. Doug Ducey joined seven other governors to establish an Intermountain West Electric Vehicle Corridor that promotes best practices among participating states and supports the expansion of infrastructure needed to drive an EV across the region's major transportation corridors. Interstate 10 (I-10) through Arizona is also designated as an Alternative Fuels Corridor for EV charging.

The Arizona Department of Transportation partnered with Pima Association of Governments to deploy additional EV charging stations along I-10 from California to New Mexico. These plans will expand on the state's current total of 710 stations and 1,808 outlets, which place Arizona within the top 20 states for most charging stations. In 2018, the Arizona Corporation Commission mandated utility companies to devise new rates and pilot programs that

encourage EV ownership. The Arizona Statewide Transportation Electrification Plan established a Phase 1 roadmap to capitalize on the environmental and economic benefits EVs present. Phase 2 is currently underway to support EV growth in the state.

Arizona's rapidly expanding EV manufacturing ecosystem is bolstered by innovators developing next generation EV technologies. Within the past 16 months, the state has celebrated three EV manufacturing groundbreakings and two major semiconductor manufacturing expansions, in addition to welcoming more supply chain innovators. Luxury EV manufacturer Lucid Motors announced completion of its Lucid AMP-1 factory. Phoenix-based Nikola Motor Company, the first publicly-traded hydrogen fuel cell and battery-electric heavy-duty truck manufacturer, broke ground in July 2020 and will begin manufacturing its trucks in nearby Coolidge, Arizona. In March 2021,



ElectraMeccanica selected Mesa, Arizona for its new U.S.-based assembly facility and engineering technical center to produce its flagship SOLO EV.

California

In 2021, ChargePoint completed a multi-year effort to install 65 charging sites covering several highway routes across California. The project enables EV drivers to find convenient charging options on long-distance trips up the Northern California coast, through the Central Valley to destinations such as Lake Tahoe, Yosemite National Park, Las Vegas, Arizona, and more. Site hosts encompass a variety of businesses – including fueling, retail, restaurants and lodging – as well as properties owned by cities and tribal nations. Many sites are in rural and/or disadvantaged communities, and each site offers ChargePoint DC fast charging stations and Level 2 charging stations to serve both quick pitstops and longer dwell times alike. As of April 2021, more than 55,000 charging sessions have taken place at these sites, enabling more than 2.8 million electric miles and displacing more than 111,000 gallons of gasoline.

The project was primarily funded by the California Energy Commission's Clean Transportation Program. Two regional air districts – the San Joaquin Valley Air Pollution Control District and North Coast Unified Air Quality Management District – contributed additional funding to support installations in their respective areas. ChargePoint, which owns and operates the stations on space licensed from the site hosts, also funded a significant portion of the installation efforts. The California Department of Transportation, Mendocino Council of Governments and other local jurisdictions also supported various aspects of the project. Public-private partnerships such as these are particularly useful in building out charging along highway corridors through remote areas, the existence of which play an important role in consumer EV adoption decisions.

Colorado

In March of 2021 the Colorado Parks and Wildlife Commission voted unanimously to enter Colorado Parks

and Wildlife (CPW) into a partnership with Rivian, an EV company focused on the manufacturing of pickup trucks and SUVs. The goal of the partnership is to install an EV charger in every state park in Colorado. The effort is part of the 'Recharge Where you Recharge' campaign, which recognizes the need to have charging infrastructure in outdoor places residents want to visit.

Rivian will install at least two 11.5 kW Level 2 charging stations at 50 CPW locations and pay for their installation and maintenance for up to 25 years, at no cost to Colorado taxpayers. Along with electrifying all of Colorado's state parks, the Campaign is pushing for electrification of National Park Service and U.S. Forest Service vehicle fleets and the installation of EV charging stations at existing recreational facilities on public lands.

Hawaii

In 2019, the Hawaii State Energy Office (HSEO) and the Hawaii Department of Transportation (HDOT) participated in the Rocky Mountain Institute: Mobility Innovation Lab Accelerator designed to tackle obstacles to large-scale mobility transformation, which includes personal vehicles, fleets, transit, and freight. The cohort from Hawaii participated in Innovative Financing and Business Models, which focused on overcoming the financial hurdles associated with EV adoption and charging infrastructure deployment. One idea that was explored at the retreat was to procure EVs as a service. Vehicles as a service is a financing model that addresses upfront capital costs of EVs and charging infrastructure by capturing lifetime reductions in maintenance costs in a simple dollars-per-mile charge.

HDOT moved forward on this concept and obtained a service contract for all types of vehicles, from light-duty to buses to heavy equipment. The contract allows HDOT and other state and county agencies to obtain EVs and charging infrastructure as a service on a per-mile cost basis. By mitigating upfront barriers and capturing long-term benefits, state agencies can move now to adopt EVs during their standard vehicle replacement cycle.

Approximately one-third of the state's light-duty vehicle fleet (approximately 1,000 vehicles) are passenger cars. Fifty percent of these passenger cars are 11 or more model years old. These passenger cars are well suited to be replaced by the current EV as-a-service offering. HDOT and HSEO have moved ahead with the initial procurement of 44 EVs. Use of this service contract is expected to save approximately 75 percent in vehicle maintenance costs over the lifespan of each vehicle and an average of \$287 per vehicle per year in fuel costs.

New Mexico

On Jan. 1, 2021, New Mexico began providing a tax incentive for EV charging in residential and commercial buildings to support EV adoption. The incentive is provided through the 2021 Sustainable Building Tax Credit for both existing and newly constructed buildings that are EV-ready. The incentive is applicable to both affordable and non-affordable housing. Commercial and residential affordable buildings qualify for 100% of the charging product cost, up to \$3,000, and non-affordable buildings qualifying for 50% of product costs, up to \$1,500. The incentive promotes the environmental and economic benefits of EVs and helps New Mexico meet its state climate goals and accelerate EV market growth.

Oregon

The Oregon Clean Vehicle Rebate Program encourages EV adoption in the state. The program provides incentives through a suite of rebates for the purchase and lease of EVs by Oregonians and state businesses, non-profits, and local governments. The rebates fall into two main categories: (1) Standard Rebates for the purchase or lease of new EVs, with rebates ranging from \$1,500-\$2,500 depending on vehicle battery capacity. (2) Charge Ahead Rebates provide a flat \$2,500 rebate for the purchase or lease of a new or used EV and are specifically designed for low- and moderate-income households. In certain circumstances, the Charge Ahead Rebate can be combined with a Standard Rebate for a total incentive of up to \$5,000.

Recent legislative changes have increased the Charge Ahead rebate to \$5,000 for the purchase or lease of a new or used EV, which can also be combined with the Standard Rebate for a total incentive of up to \$7,500. Small fleet operators can now use the Standard Rebate and will be eligible for the Charge Ahead Rebate in February 2022 if they are a low-income service provider organization.

Utah

EVZion Project: In December of 2020, the Utah Clean Cities Coalition submitted a proposal for this project, which has a primary goal to connect Zion National Park and communities in Kane County through the development, deployment, and management of an electric shuttle system. The project was designed for universal scalability, with the potential for similar deployments in other high-traffic, environmentally sensitive communities near national and state parks throughout the United States. The pilot program for the shuttle system launched in early 2021 and will run in its pilot stage for a year.

The project was strongly supported by Utah's Department of Transportation and other rural gateway communities. This led to the creation of the Mobility Outdoor Visitor Experience (MOVE) Regional Collaborative Smart Mobility Project. Stakeholders across the public, private, and utility sectors in Southwestern Utah at the local, state, and federal level collaborated under MOVE to pledge approximately \$55 million to fund EV shuttles and public charging infrastructure to support the outdoor economy in southwest Utah using national monuments, national and state parks, and other heritage sites as anchor points for Utah's outdoor economy.

Electric School Buses: Salt Lake City School District is the first district in Utah to integrate electric school buses into its fleet. Through a partnership with the Utah Department of Environmental Quality, Division of Air Quality (DAQ), funding was provided from the Volkswagen Settlement Environmental Mitigation Trust for 65 percent of the cost for four new electric buses and

associated charging equipment. Another four electric buses are expected to arrive in November 2021 and will be funded at 45% through the DAQ's Utah Clean Diesel grant program, which currently has \$1.3 million available for electric school bus projects. The District is funding the remaining cost-share amounts for these projects and taking the project one step further by updating its bus depot to include solar power for the new electric buses' charging stations. The new bus depot will also include power for its existing diesel school bus fleet's engine heaters that reduce engine idling time at start-up.

Wyoming

Representatives from the Wyoming Department of Transportation, Department of Environmental Quality, and Energy Authority formed a steering committee to develop an electric vehicle supply equipment (EVSE) buildout plan with recommendations for prioritized locations based on key nodal points and optimum distances between stations. The report, developed by EV consultant EVIA, was completed in December 2020, and will allow Wyoming to maximize the use of EVSE installation funding.

REGIONAL

CORWest

The Electric Vehicles Corridor-West (CORWest) is an eight-state partnership between Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming that is led by the Utah Clean Cities Coalition and the National Association of State Energy Officials (NASEO). CORWest is the largest EV corridor collaborative in the United States and was designed to be fully replicable and scalable on a national level. The partnership was developed to improve EV markets and increase EV usage across the Intermountain West region. The partnership will seek to remove barriers to investment and enable private charging station and infrastructure development. CORWest also works to identify infrastructure gaps and develop solutions to deploy charging stations in rural regions required to complete alternative fueling highway corridors. Finally, the

regional effort will promote standards in educational tools, EV consumer awareness, signage and branding across state lines.

UTILITY CASE STUDIES

Gunnison County Electric Association

Gunnison County Electric Association (GCEA) has been a strong EV proponent in Colorado. GCEA was the first electric cooperative in the state to install an EV charger in its service territory and the first electric cooperative in the nation to offer an EV test drive program to its members. To educate its members and bring awareness to Gunnison County about electric vehicles, GCEA purchased a 2018 Chevy Bolt EV that may be borrowed by GCEA members for a week at a time, free of charge and without mileage restrictions.

GCEA also offers guided test drives of its Tesla Model 3 and has used both vehicles for ride and drive events throughout its service territory. The test drive program provides members the chance to see how an EV fits into their lifestyle and consider whether an EV purchase makes sense. The program has resulted in an over 200% EV growth in its Colorado service territory since the program started, propelled by those who have participated in EV test drives.

Idaho Power

For the past several years, Idaho Power has collaborated with the Treasure Valley Clean Cities Coalition to deliver EV first responder training in Idaho and eastern Oregon. First responders learn the differences between electric and conventional vehicles and the proper procedures for safely addressing incidents involving EVs. Course participants attend a class taught by a certified instructor and then receive hands-on training with Idaho Power's electric fleet vehicles. Participants also earn continuing education credits. Idaho Power is proud to help bring this unique, important training to our communities.

NV Energy

NV Energy, which has long supported clean transportation solutions, began offering customized EV rates in 2007



and partnered with commercial and government customers in 2013 through the Electric Vehicle Charging Station Shared Investment Program. In 2015, NV Energy partnered with the Nevada Governor's Office of Energy and launched the Nevada Electric Highway to connect the state's urban and rural areas for EV drivers. NV Energy has also been involved with many efforts adopted by the Nevada State Legislature. These include: the Electric Vehicle Infrastructure Demonstration Program created by SB145 in 2017; electric school bus offerings enabled by SB299 in 2019; and SB448, a sweeping clean energy bill passed in 2021. SB448 will further accelerate EV infrastructure deployment to meet climate goals and reduce greenhouse gas emissions, create clean energy jobs in support of economic recovery, and invest in historically underserved communities to ensure an equitable and inclusive clean energy transition.

In addition to infrastructure deployment, NV Energy has found EV tariffs help residential and commercial customers adopt EVs. EV time-of-use rates for residential and commercial customers have not only reduced the fuel costs for EV drivers, but shifting EV load off-peak has helped better manage grid integration to the benefit of all customers. Most recently, to assist customers using DCFs, NV Energy introduced the Electric Vehicle Commercial Charging Rider, which provides a 10-year demand charge transition period for large commercial charging locations. This tariff supports critical public charging infrastructure necessary to support transportation electrification in its early stages as utilization of the charging stations increases over the 10-year period.

PacifiCorp

PacifiCorp, Maverick Gas Stations, and Utah State University's Aspire Center have partnered to help develop an EV charging corridor along Interstate 15. In 2018, this collaborative successfully deployed charging stations at eight locations covering over 350 miles, enabling EV travel between Salt Lake City, Las Vegas and Los Angeles. PacifiCorp provided funding and technical support;

Maverick served as the charging site host and operator and committed property and funding; and the Aspire Center performed data analysis on traffic and grid effects. Constructing the project at-scale, versus constructing each installation individually, enabled a quick and effective project delivery timeframe. This collaboration across the business, utility and academia communities demonstrates the importance of partnerships and can be model for future deployments and construction of a successful EV highway corridor.

Portland General Electric

EV ownership in Portland, Oregon, is low among people who rent their homes, and communities with low homeownership are disproportionately communities of color. EV drivers predominantly charge their vehicles at home as it maximizes the convenience and cost-effectiveness of EV ownership. While that is great for homeowners who can invest in home chargers, renters must rely on landlords to make these upgrades and are often dependent on public charging infrastructure.

To address the scarcity of public charging in many city neighborhoods, Portland General Electric (PGE) collaborated with the City of Portland on a limited pilot project to install Level 2 charging stations directly on existing utility or light poles. PGE hypothesized this application would significantly reduce installation costs by eliminating all civil work and limiting permitting requirements, while addressing a major barrier for many prospective EV drivers. PGE found this to be largely true and believes that these applications are a simple and cost-effective way to increase access to public EV charging, especially for those without access to off-street parking.

Salt River Project

Salt River Project (SRP) offers a rebate to business customers for installing Level 2 (L2) EV charging stations for workplace, fleet, or public charging opportunities. These business customers include commercial, multifamily and homeowner

association properties, municipalities, non-profits, and schools. SRP first implemented this rebate in 2019 and offered customers \$500 per port to install any commercial-grade L2 charger of their choice. This resulted in the installation of 56 L2 charging ports during fiscal year 2020. In 2020, SRP changed the program requirements and increased the rebate to \$1,500 per port for networked L2 EV charging stations and limited the rebate to the first 50 charging ports installed per customer per program year. To accelerate economic recovery and the adoption of EVs coming out of the COVID-19 pandemic, SRP provided additional funding starting in December 2020 to municipalities, non-profits, and schools, to help cover the make-ready costs to install these chargers. In total, SRP installed 410 L2 ports during fiscal year 2021, with 201 of these ports a result of SRP's make-ready rebate. SRP marketed this program using its public affairs and business account representatives and through its commercial customer program trade allies and qualified service providers.

Tri-State Generation & Transmission Association

Tri-State Generation and Transmission Association has partnered with several of its cooperative members and Geotab to form the Colorado-based SmartCharge Rewards program. The SmartCharge program is a one-year profiling study to better understand EV driving and charging behavior in Colorado. The program accepted participants from six different electric cooperatives across the state and will include up to 175 EV drivers. Participants received a \$100 enrollment bonus, along with an easy-to-install telematics device that collects charging data directly from their EV. This anonymized data, which includes when and where EVs charge, will be analyzed to better understand how EVs impact existing electric infrastructure and provide insights into infrastructure needs as EV adoption increases. Additionally, the data will be used to gather insights that support future programs, EV-specific electric rates, and resource planning.

ELECTRIC VEHICLES ROADMAP INITIATIVE MOU

The Western Governors' Association managed and facilitated the *Electric Vehicles Roadmap* as Oregon Governor Kate Brown's fiscal year 2021 WGA Chair Initiative. The initiative was focused on the planning, siting and coordination of electric vehicle (EV) infrastructure in western states. The initiative's primary goals were to pursue opportunities, among interested states, to standardize technical specifications between existing sub-regional state EV collaboratives and produce an expanded regional agreement on EV infrastructure deployment to be signed by Western Governors.

Whereas, rapid technological and economic changes have made zero-emission vehicles a growing part of the transportation fleet in the western states, including light-, medium-, and heavy-duty vehicles;

Whereas, trends of increasing vehicle model availability, increasing capability, and decreasing component cost are likely to continue and accelerate;

Whereas, the electrification of the transportation fleet and expansion of zero-emission vehicles can facilitate commerce and tourism across western states;

Whereas, the electrification of the transportation fleet and expansion of zero-emission vehicles contributes to fuel savings and energy resilience in western states;

Whereas, the electrification of the transportation fleet and expansion of zero-emission vehicles benefit public health and the climate by reducing vehicle emissions;

Whereas, the electrification of the transportation fleet and expansion of zero-emission vehicles may help enhance operations of the electricity grid to the benefit of all electricity users.

Whereas, states can collaborate on the development and sharing of best practices regarding permitting and siting of public EV charging infrastructure to promote equitable access, particularly in rural areas, underserved communities, or anywhere that users do not have the ability to charge at home;

Whereas, private zero-emission vehicle infrastructure networks, utilities, local and state governments, and other actors participate in planning and are investing in zero-emission vehicle infrastructure across major corridors in Western states;

Whereas, expansion of interoperable zero-emission vehicle infrastructure networks across western states can facilitate commerce and tourism by extending driving distances, ensuring consumer protection,

and reducing range anxiety by battery electric and fuel cell electric vehicle drivers;

Whereas, expansion of interoperable zero-emission vehicle infrastructure networks across western states would increase equitable access to EV charging and fueling in rural and other communities that have been underserved by investments in zero-emission infrastructure to-date;

Whereas, knowledge sharing of best practices and adoption of voluntary minimum standards for the siting, signage, technical requirements, payment options, pricing and regulatory structures for corridor charging infrastructure can accelerate the build-out of an interoperable network of DC fast-charging stations across western states that is convenient, reliable, and safe for EV drivers;

Whereas enabling interstate zero-emission freight can help accelerate adoption of medium- and heavy-duty zero-emission trucks, improving air quality along major shipping routes;

Whereas, western states can facilitate interstate commerce along major shipping routes through coordination and application of emerging standards for megawatt charging and high capacity hydrogen fueling infrastructure for zero-emission medium- and heavy-duty commercial vehicles, including power and plug specifications; distancing of charging and hydrogen fueling stations; and the appropriate sizing and layout of stations to accommodate larger vehicles;

Whereas, many western states already participate in sub-regional agreements such as the Regional Electric Vehicle Plan for the West (REV West), the Pacific Coast Collaborative, and the West Coast Electric Highway to coordinate their vehicle electrification efforts and this agreement expands upon that existing collaboration;

Whereas, western states that are not currently party to a sub-regional EV agreement are welcome to enter into this MOU, either as full signatories or in an observer, educational status.

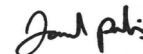
We the undersigned members of the Western Governors' Association endorse the principles above with the express goal of creating and expanding an integrated and interoperable network of zero-emission vehicle infrastructure to facilitate travel and commerce across our states. We further agree, to the extent reasonable and feasible within individual states, to promote the voluntary minimum standards contained in the appendix of this agreement. These voluntary standards are based on standards contained in the sub-regional agreements in which many of our states participate.



Governor Doug Ducey, Arizona



Governor Gavin Newsom, California



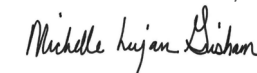
Governor Jared Polis, Colorado



Governor Brad Little, Idaho



Governor Steve Sisolak, Nevada



Governor Michelle Lujan Grisham, New Mexico



Governor Kate Brown, Oregon



Governor Spencer Cox, Utah



Governor Jay Inslee, Washington



The voluntary minimum standards below will be promoted to the extent reasonable and feasible within individual states. State agencies will work collaboratively on a regular basis via their sub-regional managing organizations to update these voluntary standards in the event of technological changes with zero-emission vehicle (ZEV) charging and fueling infrastructure. Updates to the voluntary minimum standards shall be considered once every two years or as states determine they are needed.

Light-Duty (LD) Station Site Standards:

Western states should work to ensure that corridor charging and fueling stations are sited in consumer-friendly locations that allow for:

- Public access 24 hours a day, each day of the year;
- ADA-compliance with wheelchair accessibility;
- Access to drinking fountains, bathrooms, and food or vending;
- Security cameras, adequate lighting, and an emergency shelter;
- Preferably within walking distance of full-service amenities such as local restaurants, retail shopping, or tourist attractions; and
- In areas that provide dedicated parking for the maximum number of vehicles that can be charged simultaneously.

LD Location Standards: Western states should strive to locate stations in a way that increases ZEV driver confidence, reduces range anxiety and provides a convenient user experience. Corridor charging and fueling stations sited under the following conditions can meet these objectives:

- Within 50-100 miles of the next station in either direction for charging stations and 200-250 miles for hydrogen fueling stations. For distances above 50 miles, consider elevation changes or driving conditions under extreme weather to ensure standard EV batteries can make the trip on a single charge.
- Preferably within 0.5 miles from a highway interchange or exit to maximize ZEV driver convenience, but no more than 1.0 miles.

LD Technical Standards: Corridor stations installed across western states should provide high-speed charging, durability, and reliability. Technical specifications should include:

- *Charging Stations:*
 - Charging power output of at least 50 kW, while encouraging charging power output of 150 kW or more to meet the anticipated charging needs of future electric vehicles.
 - Redundancy to better assure EV drivers of reliable access to charging, including

two or more DC fast chargers (each with one or more charging ports) at each charging station site.

- At least one CHAdeMO DC fast charging port and at least one SAE Combined Charging System (CCS) DC fast charging port should be installed at each EV charging station site, to enable charging access for all EV drivers.
- DC Fast chargers are preferably supported by 480-volt 3-phase power and adequate transformer capacity at each charging station site.
- Connected to a network that enables (i) interoperability allowing easy exchange of network service providers, (ii) universal roaming so that back-end networks can easily exchange customer billing information with other networks, and (iii) vehicle-grid integration capability, to support managed charging for utility demand-response programs.
- Networking protocols should be open access (i.e., no membership or subscription is required; enable subscribers of other EV charging networks to access charging and operational charger status information) and non-proprietary.
- *Hydrogen Fueling Stations:*
 - At least one H70 nozzle certified to meet SAE J2601, with a preference for two or more nozzles to provide redundancy.
- *Shared Charging and Fueling Standards:*
 - Designed for safety, durability, and all anticipated operating conditions.
 - Certified by an independent, third-party authority, such as Underwriters Laboratories or the National Electrical Manufacturers Association.
 - Capable of collecting and reporting on data related to station usage. It is highly encouraged that location, station operations and payment data be reported to the National Renewable Energy Laboratory’s Alternative Fuels Data Center.
 - Support multiple payment options including but not limited to the ability to pay-per-use with: (i) a credit/debit card (either Tap-and-Go, Euro Mastercard Visa (EMV) chip, or both), (ii) a toll-free number that provides the user with the option to initiate a charging session and payment at all times, (iii) a mobile payment device on the DCFE or payment kiosk; (iv) vehicle-based payments if available, and, if desired, (v) a separate subscription and/or membership in proprietary payment plans via a Radio-Frequency Identification (RFID) card or mobile app, with separate price schedules.
 - Pricing transparency, with simple, real-time pricing information available on a

- screen, in advance of charging/fueling.
- Operational status communications, so ZEV drivers can identify whether a station is working or not, displaying real-time operational status via a smart-phone network application or a third-party aggregator.
- Customer support service that is accessible 24/7 with either an onsite station operator or a toll-free telephone number clearly posted near the charging/fueling equipment that is available to ZEV drivers accessing the charging equipment.
- Customer support service capable of providing or dispatching service to address customer concerns at the charging station, including remotely rebooting the system if necessary.
- Strive for 95% up-time, to enhance reliability and ensure ZEV driver confidence.

Signage Standards: informs ZEV drivers and non-ZEV drivers alike that DC fast-charging and/or hydrogen fueling stations are available. The following conditions will identify locations and accommodate EV charging:

- Highway signs indicating their location (directional signage on and along the highway as well as trailblazer and on-site signage).
- Charging spaces should be marked with “EV Charging Only” signs.
- The federally-approved Alternate Electric Vehicle Charging Symbol sign (D9-11b Alternate) should be used for directional and on-site signage as specified in the Manual on Uniform Traffic Control Devices (MUTCD).

Additional Standards: The standards identified in the following section go beyond the above Voluntary Minimum Standards, and may be adopted and promoted by states as they see fit. Operational standards include:

- Uptime requirement for station owners/hosts of at least 97%, and repairs made within 2 business days for routine problems, and within 5 business days for complex issues.
- Backup Level 2 charger(s) co-located on site with DCFE stations in the event that DCFE stations are in use or in need of repair.
- Proactive station health monitoring which enables charging station service providers to repair faulty equipment before a customer submits a complaint.
- Adequate maintenance of charging pedestals and all ancillary equipment, including needed repairs and alterations, and keeping equipment safe, clean and presentable.



Initiative Participants

We would like to thank the Governors, states, companies, and organizations who participated in Electric Vehicles Roadmap Initiative surveys, work sessions, webinars and podcasts over the past year:

GOVERNORS' OFFICES AND STATE AGENCIES

Alaska

- Alaska Energy Authority

Arizona

- Office of Governor Doug Ducey

California

- Office of Governor Gavin Newsom
- California Air Resources Board
- California Community Colleges
- California Energy Commission
- California Go-Biz
- California Public Utilities Commission
- California Department of Transportation

Colorado

- Office of Governor Jared Polis
- Colorado Department of Labor and Employment
- Colorado Department of Transportation
- Colorado Tourism Office

Hawaii

- Office of Governor David Ige
- Hawaii State Energy Office

Idaho

- Idaho Governor's Office of Energy and Mineral Resources
- Idaho Department of Transportation

Kansas

- Office of Governor Laura Kelly

Montana

- Montana Department of Environmental Quality
- Montana Department of Transportation

Nevada

- Nevada Governor's Office of Energy
- Nevada State Parks

New Mexico

- Office of Governor Michelle Lujan Grisham
- New Mexico Department of Transportation
- New Mexico Energy, Minerals, and Natural Resources Department

Oklahoma

- Office of the Secretary of Energy & Environment

Oregon

- Office of Governor Kate Brown
- Oregon Department of Transportation
- Travel Oregon

New Mexico

- New Mexico Energy, Minerals and Natural Resources Department
- New Mexico Department of Transportation

Utah

- Utah Governor's Office of Energy Development
- Utah Department of Environmental Quality
- Utah Department of Transportation

Washington

- Office of Governor Jay Inslee
- Washington State Department of Transportation
- Washington State Energy Office

Wyoming

- Wyoming Department of Transportation
- Wyoming Energy Authority
- Wyoming Infrastructure Authority

UTILITIES AND ELECTRIC COOPERATIVES

- Arizona Public Service
- Avista Corporation
- Black Hills Energy
- Carbon Power & Light
- Eugene Water & Electric Board
- Gunnison County Electric Association
- Hawaiian Electric
- Highline Electric Association
- Idaho Power
- La Plata Electric Association
- Midwest Electric Cooperative Corporation
- Mountain Parks Electric, Inc.
- Mountain View Electric Association
- Northwest Rural Public Power District
- NV Energy
- Pacific Gas & Electric
- Pacific Power
- Portland General Electric
- Poudre Valley Rural Electric Association
- Puget Sound Energy
- Rocky Mountain Power
- Sacramento Municipal Utility District
- Salt River Project
- San Diego Gas and Electric Company
- San Isabel Electric
- Sangre de Cristo Electric Association
- Sioux Valley Energy
- Southern California Edison
- Tri-State Generation & Transmission Association
- Umatilla Electric Cooperative
- United Power
- Wheat Belt Public Power District
- Wyrulec Company
- Xcel Energy

VEHICLE MANUFACTURERS

- Audi
- Daimler
- GM
- Honda
- Rivian
- Tesla
- Toyota

CHARGING STATION NETWORK OPERATORS & EQUIPMENT MANUFACTURERS

- ChargePoint
- Electrify America
- EV Box
- EVgo
- Greenlots
- Tesla

NONPROFIT ORGANIZATIONS, ASSOCIATIONS AND TECHNICAL EXPERTS

- California Fuel Cell Partnership
- Center for Hydrogen Safety
- Center for Transportation and the Environment
- Edison Electric Institute
- Electrification Coalition
- Forth
- HDR
- International Selkirk Loop
- National Association of State Energy Officials
- National Electric Contractors Association – International Brotherhood of Electrical Workers Electrical Industry Training Center
- Nebraska Tractor Test Laboratory
- NGI Consulting
- Northeast States for Coordinated Air Use Management
- Northern Pacific Railroad Depot
- Nuclear Energy Institute
- Pacific Coast Collaborative
- Rocky Mountain Institute
- Ross Strategic
- Schneider Electric
- Trillium

CLEAN CITIES COALITIONS

- Columbia-Willamette Clean Cities
- Long Beach Clean Cities
- Northern Colorado Clean Cities
- Treasure Valley Clean Cities
- Utah Clean Cities
- Yellowstone-Teton Clean Cities

LOCAL AGENCIES

- City of Eugene
- Silver Valley Economic Development Corporation

FEDERAL AGENCIES AND ENTITIES

- National Renewable Energy Laboratory
- Pacific Northwest National Laboratory
- U.S. Environmental Protection Agency



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