To: Stephanie Pollack, Deputy Administrator, Federal Highway Administration (FHWA)

From: The GridWise Alliance, 1800 M Street, NW, Suite 400S, Washington, DC 20036

Date: 01/28/2022

Re: Development of Guidance for Electric Vehicle Charging Infrastructure Deployment (Docket No. FHWA-2021-0022)

The GridWise Alliance (GridWise) is pleased to submit this response to the Request for Information (RFI) seeking input from stakeholders to inform the development of guidance for electric vehicle charging infrastructure deployment. GridWise commends you for soliciting stakeholder input in this regard and encourages you to continue to do so.

The GridWise Alliance leads a diverse membership of electricity industry stakeholders focused on accelerating innovation that delivers a secure, reliable, resilient, and affordable grid to support decarbonization of the U.S. economy. GridWise is unique in its focus on the electric grid's broader ecosystem, advocating the value of integrating technologies that modernize and transform the grid. We drive impactful change through our diverse membership of utilities, manufacturers, and researchers united in a common belief that the electric grid is the critical enabling infrastructure of a decarbonized economy.

GridWise is a highly regarded industry leader and is well positioned to provide feedback on electric vehicle (EV) integration to the grid. Our members are deeply involved in this area and can be found researching, manufacturing, engineering, deploying, and planning this important transition at all levels across the country.

The GridWise Alliance broadly shares the following recommendations for policymakers to consider regarding EV charging infrastructure deployment:

1. Require early and frequent collaboration with grid operators and utility planners. This will enable existing grid tools to be leveraged to plan for and shape the transition proactively and efficiently.
2. Ensure funding can be used for fortifying and building out grid-side infrastructure to integrate EV charging infrastructure.
3. Provide clarification and flexibility around federal and state strategies to serve rural, disadvantaged, and other underserved communities with EV charging infrastructure.
4. Require a cost-share component of grant funding to incentivize responsible EV charging infrastructure development and ensure that funded projects have ongoing operations and maintenance plans to ensure the longevity of funded infrastructure.
5. Recognize and be sensitive to state and regional variations which will require differing strategies for EV-grid integration. We urge caution in establishing requirements that are too prescriptive or don't acknowledge differences in types and locations of charging infrastructure.

We provide responses to many of your stated consideration areas in the pages below. GridWise stands ready to be a resource and looks forward to continuing to work with you and your colleagues.

Sincerely,

Aurora Edington
Policy Director, GridWise Alliance
(857) 997-0441
aedington@gridwise.org

COMMENTS BY CONSIDERATION AREA

EV Charging Program

1. The distance between publicly available EV charging infrastructure;

Reliable EV charging on interstates and other highways/arterials is necessary to support long-distance driving and encourage drivers to convert to electric. Providing adequate coverage along highways will be essential, even if chargers are not as highly utilized as in high-traffic urban areas.

While standardizing the distance between publicly available EV charging infrastructure illustrates an intention to provide reliability and stability to electric vehicle drivers, we do not recommend a federal distance requirement be established. This is because there are many factors that should be considered when determining how far apart EV charging infrastructure should be, and those factors differ by state and region. Example factors include population density, geography, number of EVs in a particular state or region, through-traffic on highways, miles traveled by EVs, expected ranges of EVs on a full change, and the ratio of electric vehicle supply equipment (EVSE) plugs to EVs on the road.

We do recommend that it be a priority to identify areas where no infrastructure exists, and if there is already infrastructure in an area, then that specific location should be assessed based on the ability of and need for additional infrastructure to serve nearby communities, as well as through traffic. In other words, any federal requirements should not disincentivize investment in an area already served by a charging provider, especially if additional infrastructure is needed based on traffic, charger queue times, local EV adoption rates, etc.

If a distance requirement was set, it would need to be a minimum threshold subject to periodic review because changes in factors like EV deployment, EV adoption, and population density would necessarily affect it over time. For the same reasons, any distance requirement should only focus on highway charging needs given that it is more relevant for long-distance highway travel.

2. Connections to the electric grid, including electric distribution upgrades; vehicle-to-grid integration, including smart charge management or other protocols that can minimize impacts to the grid; alignment with electric distribution interconnection processes, and plans for the use of renewable energy sources to power charging and energy storage;

Our comments are organized by the sub-sections noted in consideration area 2:

Related to connections to the electric grid, including electric distribution upgrades:

Policymakers, system planners, and grid operators need to be sensitive to state, regional, and multi-jurisdictional variations which necessarily call for differing strategies for EV grid integration. For example, regions with ample power capacity and low EV penetrations will look significantly different from regions with constrained capacity and/or higher EV penetrations. In the case of the former, infrastructure development in distribution areas with ample capacity could result in faster deployment of public charging infrastructure. Identifying variables that contribute to differing grid circumstances and then understanding what is needed to reliably integrate electric vehicles is key.

Utilities, EVSE owners and operators, state transportation departments, and state energy offices must collaborate to ensure rapid and cost-effective deployment of EV chargers. It is critical that utilities are engaged early in the EV charging infrastructure deployment process to plan strategic grid investments that can prevent delays, abate costs, and mitigate the need for additional grid upgrades in the future. This early engagement between the EVSE vendor, site host, and utility should be a requirement to secure federal funding. Additionally, EV charging infrastructure deployment programs should consider eligible the costs of electrical infrastructure that is integral to the functioning and operations of EV charging infrastructure, which could include grid modernization expenses, battery energy storage, and upgraded transformers.

It will also be important to streamline the process for creating new service points for DCFC or for upgrading existing service to support direct current fast chargers (DCFC). There are major differences in process, timelines, and degree of review across various utilities—even at times within the same utility across different territories. This has the potential to increase project soft costs and delays. Federal funding should encourage a streamlined approach to the creation of new service points for DCFC. This process can be considered analogous to the early days of residential and commercial solar interconnection, where interconnection processes were not coordinated and caused significant delays and additional costs. We encourage FHWA to review the lessons learned from streamlining solar interconnection processes and apply those to charging station interconnection.

Forecasting EV loads at public highway sites will be an important component of determining strategic investment needs. Loads could grow very rapidly as drivers convert to electric so initial EV charging installations should be planned with the potential for additional capacity in future years to reduce total costs. Utilities coordination is important early on in the planning process. Utility hosting capacity maps and knowledge of existing infrastructure will help to determine the cost of interconnection to the grid and can suggest siting considerations. This knowledge can support efforts to maximize the benefits of incremental load on the system while minimizing impacts to the grid.

GridWise suggest the following specific considerations on forecasting load and planning for distribution upgrades:

- In order to plan for future distribution upgrades to support transportation electrification and public charging, examples of needed data include[1]:
  - Knowledge of existing EV adoption by vehicle type and location,
  - Hosting capacity of the network,
  - Location of charging infrastructure and intended types of chargers,
  - Distributed energy resource (DER) generation profiles,
  - Local weather patterns,
  - Current and projected customer load patterns.
- Oftentimes, data is not readily available or is too costly to obtain, prohibiting the necessary analysis to conduct distribution planning around electric vehicles and public charging. In some instances where this data is not available, industry research or assumptions may be used that may not reflect the unique characteristics of their respective distribution system and local EV market. We encourage state, utility, and third-party collaboration to make this data available to support forecasting efforts.
- Medium- and heavy-duty vehicles (MHDV) and DCFC chargers have very different infrastructure and make-ready requirements than light-duty vehicle (LDV) Level 2 chargers. While most focus has been on deployment of Level 2 chargers, their impact on the grid is minimal compared to the impact of Level 3/DCFC or MHDV, which may need to charge at MW type of levels and could have implications on transmission infrastructure.[2]
- This will be similar to transmission grid upgrades needed for renewable energy growth. For example, consider New York state, where transmission owners are currently moving forward with system upgrades to address the State's Climate Leadership and Community Protection Act (CLCPA) mandates, which require 70% of power in electric generation sector to come from renewable sources by 2030 and 100% from emissions-free sources by 2040. National Grid will be upgrading over 1,000 circuit miles of transmission across its upstate New York service area to unbottle current and planned renewable generation and ensure delivery to customers. Concurrently considering fleet and public charging needs during this process could support the state's environmental goals, while also preemptively addressing infrastructure needs due to EVs. A similar approach could be taken to build transmission to accommodate current and future DCFC along highways.
- Another example pointing to the need for strategic planning and load forecasting is related to the overall electricity demand of a region. Today, electric systems are typically considered to be "summer peaking" or "winter peaking". These terms identify the time of

[1] For your reference, here we provide an example of a recent medium- and heavy-duty EV forecasting and load growth study.

[2] For your reference, here we provide a recent study on the electric load implications of electric fleets. While fleet charging is different than highway charging, both use cases are expected to be points of large electric demand. Highway drivers will likely want to charge as fast as possible and get back on the road. This could lead to large amounts of 150 kW or 350 kW charging, and even faster rates for medium- and heavy-duty vehicles, that lead to multiple megawatts of demand.

year with the highest levels of electricity use. Knowing when an electric system peaks is important because the grid operator conducts a lot of planning to ensure they can meet peak electricity demand. These peak electricity days are the most expensive days of the year. Today, New England is a summer peaking system, where the most electricity use occurs during hot summer months when air conditioning is at full blast. As more vehicles are electrified and electricity demand increases, both due to electric heating and the reduced range of lithium-ion batteries in cold temperatures, it's possible that this region (as well as others) could become winter peaking systems. This type of broad system shift needs further research, as it will significantly affect grid operators in those regions.

One way to reduce the demand on highway charging involves taking a full system perspective and considering the EV charging habits of customers. Consider a system where EV owners are incentivized to have home chargers. Home chargers will be convenient for many users to satisfy their EV charging needs. If more charging activity occurs at night during off-peak hours, this could have the effect of spreading charging demands out away from peak load centers and avoid extreme demands on publicly available charging sites.

Related to vehicle-to-grid integration, including smart charge management or other protocols that can minimize impacts to the grid:

Managed charging programs may be less appropriate for highway charging infrastructure. This is because charging expectations and needs for drivers on highways are significantly different than residential and fleet managed charging. Users of public highway stations likely will want to charge immediately to complete travel to their destination and might not respond well to managed charging structures in highway settings.

As a result, effective planning with grid operators for site loads is, again, the most important way to support minimizing impacts to the grid. GridWise Alliance members have experience and insight into managed charging best practices and case studies for residential and fleet charging infrastructure, and would be happy to share this with FHWA if requested.[3]

Interoperability

Interoperability is critical to mitigate the risks of stranded assets and deliver superior customer experience. Any funding through this program or along highways should require charging infrastructure to conform to a standardized set of interoperability requirements. There are two main forms of interoperability that should be in place (1) vehicle to charger, and (2) vehicle to network. All public chargers should be interoperable with different charging networks and charging locations should be able to charge most vehicles. A charger is more than just hardware. Software enables the many features of a charger and allows it to communicate with charging operators, drivers, payment systems, vehicles and more. Interoperability promotes key outcomes for public infrastructure including: safety, scalability, savings, security, and simplicity for consumers.

[3] For one example, see a case study on a PG&E Vehicle-to-Home Pilot Demo.

Networked Chargers

In many instances it may be beneficial for chargers to be networked and connected to the cloud. Connected chargers enable key functions that customers and drivers expect from an EV charger including: remote monitoring and diagnostics to ensure reliability; simple and various payment options; the ability to monitor the ongoing charge session while away from one's vehicle; roaming on different charging networks; and more. Networked charging infrastructure will also require a unified communications standard. While vehicle-to-grid (V2G) is a nascent technology still requiring research, development, standardization, and a stronger market, broad adoption of a unified communication standard is pivotal to enabling this networked functionality.

In our 2021 response to the Department of Energy's RFI on Integrating Electric Vehicles onto the Electric Grid (DE-FOA-0002528),[4] we provide more information on a unified communication standard. In short, however, the Institute of Electrical and Electronic Engineers (IEEE) Standard for Smart Energy Profile Application Protocol (IEEE 2030.5)[5] has been chosen by leading utilities as the standard communication protocol for connecting DERs to the smart grid, including EVs. IEEE 2030.5 is the most advanced industry standard to interconnect to DERs and builds on all existing standards to provide a comprehensive data model and the ability to securely connect over the Internet to reach even the smallest, most granular DERs. The use of a global standard such as IEEE 2030.5 will ensure there are not interoperability issues across jurisdictional and utility boundaries. As mobile DERs, EVs naturally move across state lines and utility service territories and therefore it is critical to have consistent standards for communications across state and utility boundaries. There is also work underway to develop a testing and certification program specifically aimed at the use of IEEE 2030.5 in EVs, much like the common smart inverter profile (CSIP) that was developed in California for the testing and certification of DERs using IEEE 2030.5.

Related to alignment with electric distribution interconnection processes, and plans for the use of renewable energy source to power charging and energy storage:

Energy storage, when co-located with public highway charging infrastructure, could play a role in mitigating peak electricity demand of highway charging stations and ultimately lower the cost of charging for consumers. For example, storage systems could provide an extra burst of electricity stored from the grid if more vehicles charge at a given time than planned, or support the integration of solar canopies installed at charging sites.

Again, supporting extensive and early planning efforts around charging infrastructure and potentially collocated storage and/or solar systems is of the utmost importance. Grid upgrades and energy storage systems, when deployed as integral parts of the operations and functioning of a charging station, should be considered an eligible cost under the grant funding.

[4] Our full response is available on the GridWise Alliance website here.

[5] IEEE Standards Association. *IEEE 2030.5-2018 – IEEE Standard for Smart Energy Profile Application Protocol.* https://standards.ieee.org/standard/2030_5-2018.html

4. The need for publicly available EV charging infrastructure in rural corridors and underserved or disadvantaged communities;

The need of publicly available EV charging infrastructure in rural corridors and underserved or disadvantaged communities is related to the overall equitable transition of the transportation sector to electric. While charging infrastructure in rural corridors is likely to be used less frequently than chargers located in urban areas, it is still critical to providing charging coverage for long-distance travel and improves customer comfort around being able to access a charger when needed.

Our members propose that underserved and disadvantaged communities include some or all of the following community characteristics:

1. Communities with populations that are predominately Black, Indigenous, and Persons of Color (BIPOC)
2. Communities that are predominately low- to moderate-income (LMI)
3. Communities that are predominately renters or residents of multi-unit dwellings (MUDs)
4. Communities that are disproportionally impacted by regional environmental stressors, such as poor air quality
5. Communities with relatively high population but with low EV adoption rates

In addition to defining the above communities, it's also important that the need for publicly available EV charging infrastructure is based upon the local transportation-related characteristics of a given community. In other words, the transportation needs of a community is not necessarily satisfied by the deployment of a single public charging site. Instead, some communities are heavily reliant on alternative modes of transportation, such as public transit, and may require different electric transportation solutions with unique public charging needs. [6]

The electric utility obligation to serve has extended electric service to rural corridors and underserved or disadvantaged communities when traditional return on investment decision-making may not have done so. Given this precedent, and the resulting extensive electric network in place today, utilities could play a meaningful role in making publicly available EV charging infrastructure accessible and ensure equitable distribution.

5. The long-term operation and maintenance of publicly available EV charging infrastructure to avoid stranded assets and protect the investment of public funds in that infrastructure;

The GridWise Alliance outlined three possible business models for EV charging infrastructure ownership in our 2018 whitepaper on EVs.[7] While we don't have an opinion on which model is best, or who should own and operate the infrastructure, we do support allowing utilities to have

[6] For your reference, see the following example of local, equity-focused EV charging infrastructure deployment: A Neighborhood-Based Approach to Equitable E-Mobility.

[7] GridWise Alliance. *EVs – Driving Adoption, Capturing Benefits*. July 2018. https://www.gridwise.org/resource-downloads/GWA_18_EVs-DrivingAdoptionCapturingBenefits_Final.pdf

the opportunity to own EV charging infrastructure as long as they have the interest and it is appropriate. Regardless of who owns the equipment, a well-developed operation and maintenance (O&M) model is critical to avoiding stranded assets and protecting the investment of public funds in EV charging infrastructure. In the subsections below we include details on potential ownership business models and O&M models.

Related to ownership business models

The selection of a particular business model should be situational, though the following tenets should be kept in mind: customer experience, ease of coordination, equity of availability, and speed of execution. These tenets would also point to requiring open standards and interoperability in charging infrastructure, not only for ease of coordination, equity of availability, and customer experience, but also to reduce the possibility of stranded assets. This is something the government should consider as a criterion for receiving funding.

Model 1: Make-ready. The make-ready model involves utility participation beyond traditional demarcation of service at the meter but does not include utility ownership of the charger itself. While the utility still locates, designs, builds, maintains, owns, and operates the infrastructure up to the meter, it also goes beyond the meter and locates, designs, builds, maintains, owns, and operates infrastructure connecting the meter to the charger without owning the charger itself.

Make-ready work produces a nearly-complete "stub" site that can be quickly interconnected with a customer or third-party charging station, streamlining the charger interconnection process. The infrastructure between the meter and charger can represent a large portion of charging station project costs,[8] so the utility can lower the barrier for third-party charging station development by actively preparing a site for an EV charger.

Although the utility would not own the electric vehicle charger under the make-ready model, it could have control over the siting of some chargers. By identifying prime locations for its make-ready work, the utility can anticipate expansions to the EV charging network, can help provide opportunities for a wider base of customers to have access to chargers, can look to avoid areas with immediate grid constraints, and can prepare the distribution system to accommodate increased EV charging demands.

Model 2: Charger leasing. Under a charger leasing business model, the utility or third-party owns a collection of EV charging stations which it leases to consumers. The utility or third-party retains ownership, performs maintenance, and other responsibilities beyond the consumer meter and up to the charger, but both the consumer and the charging station owner can have a role in the charger operation. The leasing model could make either the owner or the consumer responsible for installing and maintaining the charger.

This model could be desirable to consumers who are dissuaded from EV ownership by risks brought on by charging infrastructure ownership such as the potential installation and maintenance costs, the lifetime of a charger, or charger financing. A leasing program would

[8] Allen, Paul, et al., "Utility Investment in Electric Vehicle Charging Infrastructure: Key Regulatory Considerations," M.J. Bradley & Associates and Georgetown Climate Center, November 2017, p. 10.

utilize utility and third-party expertise and create more opportunities for consumer-focused interactions.

Additionally, a leasing program could help protect against obsolescence. As charging technology or the sophistication of newly manufactured electric vehicles advances, charging stations used in some settings (e.g., public DCFCs) may no longer be competitive or compatible with a new charging technology, but nonetheless might function well for, and could be deployed to, other applications or target markets (e.g., home charging, where the total charge time is less critical).

Model 3: Public charging station owner and operator. By installing, owning, operating, and maintaining the charger, utilities and state entities could serve a valuable role in "filling gaps" in the charging infrastructure network. A utility-owned network can serve to complement and accelerate efforts to grow existing EV networks and provide equitable access. Privately-owned charging stations need not be superseded or pushed aside by utility involvement as an owner/operator. Utilities can complement the existing third-party marketplace by providing charging options to state and local governments across the entire utility service area, including underserved communities and other consumers that may be overlooked by existing models. EV adoption can expand to the benefit of all customers and to the ultimate benefit of third parties as this expansion will enable growth in EVs among populations that would not have otherwise purchased an EV and who would now use third-party charging locations as well. An example of such business model is the EVolve NY DCFC network in New York, which is owned by the New York Power Authority and operated by private network operators. EVolve NY is currently the largest public DCFC network in the State of New York.

Related to ongoing O&M of EV charging infrastructure

For a public charging network to be effective at removing barriers to electrification, the chargers themselves must be reliable. Programs, owners, and operators should be required to submit well-developed operations and maintenance plans that demonstrate the ability to maintain reliable operation of their chargers over a multi-year period, including the ability to service chargers within a reasonable timeframe. These plans should include service level agreements (SLAs) backed by the manufacturers of that charging equipment. Maintenance, operations, and service plans should be set up for the useful life of the charger and should include close coordination with charging manufacturers.

A well-developed operations and maintenance model could include a number of features, including, but not limited to, the following. These features could be performed in-house by the owner or operator or via service level agreements or contracts with third-party providers.

- Scheduled and risk-based preventative maintenance
- 24/7/365 customer call center to receive service calls
- 24/7/365 connectivity and monitoring of the operations of each charger
- Service ticketing and procedure to ensure service and operational issues are addressed in a reasonable timeframe
- Service level agreements backed by charging manufacturers

- Sufficient technicians trained to work on the make and model of each charger they operate in each region in which they operate
- Detailed documentation and procedures to troubleshoot and repair chargers
- Sufficient local inventory of spare parts and logistics infrastructure
- Sufficient safety protocols that incorporate advanced hazard identification methods and controls to keep field personnel and the public safe when servicing assets
- Leveraging technologies such as artificial intelligence, machine learning, or sensors to optimize uptime and performance

The need for qualified EV charging technicians who have been trained and certified to service particular charger makes and models is extremely important particularly because the current pool of such technicians is limited. As the Department works to encourage and support the training and certification of new technicians it should keep three important principles in mind.

(1) Qualified Technicians. As noted above, EV chargers are not just electrical equipment. While electricians are needed as part of an installation team, commissioning, service, and maintenance are often performed by certified technicians with a different skillset including electronic parts repair, maintenance and replacement and software troubleshooting and upgrades and applications engineers.
(2) Chargers Vary by Manufacturer. While there are common principles among different EV chargers, the architecture of chargers varies by manufacturer, while manufacturer- and model- specific training and certification is needed to properly service a charger.
(3) Geographic Diversity. EV chargers are located across the country, some of which are in remote locations. All regions of the US should have access to quality training.

6. Existing private, national, State, Local, Tribal, and territorial government EV charging infrastructure programs and incentives;

Today, numerous state and local governments are individually pursuing policies that support the rapid expansion of EV adoption amongst their residents and businesses. However, many potential new vehicle purchasers regularly travel outside their home city or state and have grown accustomed to ubiquitous internal combustion engine (ICE) fueling infrastructure and a seamless experience at a gas station, regardless of its location or ‘brand.’ For instance, though much attention has been paid to charging along major interstate highways, such as I-95 on the Atlantic Coast or I-5 in the Pacific Northwest, consumer confidence in the convenience of EVs to meet non-daily, but routine mid- and long-range travel needs are also impacted by the availability of charging on secondary routes which may cross municipal and state lines.

State and local boundaries in the EV experience must be broken down by regional cooperative and complementary efforts addressing EV charging infrastructure availability and marketing. Coordination in EV infrastructure planning amongst government agencies and the utility industry will help to alleviate consumer concerns about charging availability. Bipartisan efforts between states including the National Electric Highway Coalition, REV West, Drive Change Drive

Electric, Southeastern EV Readiness, Charge Up Midwest, and the West Coast Electric Highway are coordinating investments in EV programs and charging infrastructure to maximize their benefits and enabling EV travel across state borders.

Multi-jurisdictional planning and coordination is needed to ensure that regional travel routes are properly resourced with charging infrastructure that allows for a seamless consumer experience. Additionally, efforts are needed to improve permitting process, whether in its streamlining and standardization or in developing best practices for permitting. Properly prioritizing the development of charging infrastructure and considering barriers will help support expanding EV use.

Building out a national EV charging infrastructure network is going to require significant investment beyond the funds appropriated in the Infrastructure Investment and Jobs Act. Federal funding should both encourage new infrastructure development and complement existing regional partnerships and programs in place or under consideration. Allocating new funding to state agencies that have demonstrated success and have the appropriate authorization to spend money on EV charging infrastructure is important.

7. *Fostering enhanced, coordinated, public-private or private investment in EV charging infrastructure;*

The GridWise Alliance supports the following considerations to help with fostering enhanced, coordinated investment:

- Make procurement guidelines associated with the upcoming grants at both the federal and state level flexible for use in multiple arrangements, for example in public-private partnerships that seek to develop infrastructure or for sole-source charging equipment to ensure compatibility with existing charging networks;
- Require state DOTs to host stakeholder meetings and collect input regarding plans for how the federal funding will be used in the state. Stakeholders should include, but not be limited to, utilities, municipalities, other pertinent state agencies, members of the community, representatives of disadvantaged or underserved communities, regional public transportation authorities, transportation network companies, truck or hauling industry associations, retailers, and other businesses;
- Allow flexibility in building different charging models, however, in all cases, owners and operators should have to provide a portion of the costs, rather than the Federal government covering it 100%;
- Require some reporting mechanism whereby stakeholders within each state are regularly informed of where and how investments are being made, including project status and completion; and
- Simplify payment processing for consumers in the area (e.g. one RFID card instead of many).

8. Meeting current and anticipated market demands for EV charging infrastructure, including with regard to power levels and charging speed, and minimizing the time to charge current and anticipated vehicles;

Due to the variance in EV charging infrastructure needs from state to state, this decision should be left up to the states and relevant stakeholders who have better insight into their customer base, where charging is located, what kind of charging might be needed, and other relevant state policies that may be in effect.

There are three main categories of EV charging system infrastructure: (1) infrastructure up to meter, (2) infrastructure connecting the meter to the charger, and (3) the charger itself. Business models for public charging infrastructure can largely be differentiated by who owns and operates each of these three categories of EV charging infrastructure.

The infrastructure up to the charging meter includes not only the familiar distribution assets that deliver power to the owner of the charging infrastructure, but also a local mounted transformer that the EV infrastructure owner may need to deliver the appropriate voltage for vehicle charging. This equipment, as well as the EV charging infrastructure meter, all fall within the traditional domain of utility-owned and operated assets.

In between the meter and the charger are paneling and trenched or bored conduit and cable. This infrastructure has, to date, largely been the responsibility of the owner and operator of the charger, but it could be developed and owned by the utility under a more ‘make-ready’ model, which reduces installation cost and complexity for the site host and third-party charging operator.

The EV charger itself represents the last piece of equipment in this chain. It connects the vehicle to the electric system and delivers the charge that replenishes the EV battery. Several categories of EV chargers are available that differ by power, charge time, and use case (Table 1).

Table 1. Charger Classes and Characteristics

Charge Level	Rated Power	Charging Time	Use Case
AC Level 2 (L2)	7kW to 19kW	4 to 10 hours	Residential, Workplace, Commercial Buildings, Last-mile Fleet
DC Fast Charging	50kW to 90kW	30 to 90 minutes	Retail, Shopping Malls, Restaurants
DC Fast Charging	90kW to 180kW	15 to 45 minutes	Convenience Stores, Fueling Stations, Travel Plazas, Commercial Fleets
DC High Power	150kW to 350kW	10 to 30 minutes	Fueling Stations, Travel Plazas, Truck Stops

Other considerations in this area include:

- **Maintaining a cost share component.** While there should be flexibility allowed in building, owning, and operating different charging infrastructure models, in all cases, owners and operators should have to provide a portion of the costs, as opposed to the federal government covering 100% of costs. State and local governments should not be allowed to waive or subsidize the cost-share requirement. Cost-share components provide an incentive for owners and operators to deliver high-quality charging experiences while also fostering self-sustaining business models. Public charging infrastructure is not "set it and forget it" and requires significant resources to operate and maintain. Requiring cost-share encourages owners and operators to develop well-structured business and operational models for delivering reliable and customer focused charging services.

- **Encouraging data sharing among states and utilities.** Oftentimes, data is not readily available or is too costly to obtain, prohibiting necessary analysis to conduct distribution planning around electric vehicles and public charging. This is true even for some utilities who cannot access data on EV adoption within their own service territory, including data on vehicle adoption rates, vehicle sales, vehicle registrations and types, or other important local EV market indicators. Thus, it is important to encourage data sharing and collaboration between utilities and state agencies to support EV infrastructure planning.

9. Any other factors, as determined by the Secretary.

We suggest the following be considered:

Ensuring cybersecurity and integrity of EV charging infrastructure is of paramount importance, with two main areas of concern: 1) securing user physical safety and personal information and 2) protecting operational integrity and connected infrastructure. While charging technology and cybersecurity systems to protect them are evolving quickly, there are some foundational cybersecurity principles and techniques that public charging infrastructure should adopt, including the following:

1. **"Boot Security.".** Boot security uses embedded manufacturer approved and authenticated hardware devices to authenticate operating system software when an EV charger is "booted" up. If the operating system at the boot stage is not authenticated, the charger will stop the malicious operating system from loading or making changes to the charger.
2. **Secure "over the air updates**." Secure methods to update software on deployed chargers should be available such as "over the air updates" or updates that can be issued remotely. When the software components on an EV charger are updated, there should be protections in place to authenticate the software update before the update is accepted and implemented. This mitigates the risk of malicious software being loaded onto a device.
3. **Secure customer information**. EV chargers may store sensitive data such as personally identifiable information or payment information. This sensitive data should be protected and there are a variety of means to do that including, but not limited to, encryption, role-based access, and limiting the amount of such information locally stored on an EV charger.
4. **Secure communication.** EV chargers can communicate sensitive data to a Central System on the cloud for their operation and to offer charging services for the EV drivers. The link between the chargers and this Central System must be sufficiently secured to ensure authenticity, confidentiality, and integrity of the data exchanged. This mitigates the risk of a man-in-the-middle attack.

There are a variety of hardware and software techniques for mitigating risks of malicious actors gaining access to public charging infrastructure and information. We encourage close coordination with the Department of Energy, the National Laboratories, and industry in setting minimum cybersecurity standards for EV charging infrastructure.

Charging and Fueling Infrastructure Program

10. Please provide examples of best practices relating to project development of EV charging infrastructure and hydrogen, propane, and natural gas fueling infrastructure at the State, Tribal, and local levels.

The GridWise Alliance provides the following examples for consideration relating to development of EV charging infrastructure:

Load Forecasting and Infrastructure Planning

- California Electric Transportation Coalition (CalETC). Fleet EV Load Grid Planning. Develop a 2020-2050 EV adoption forecast in California and perform EV charging needs forecasting to provide CalETC with an understanding of approximate locations for EV charging infrastructure development based on projected adoption of EVs through 2050, along with typical site configurations.
- Hawaiian Electric Company. Electric Vehicle Critical Backbone Study: Planning Methodology. A report that summarizes recent analysis by Hawaiian utilities to better understand how the global EV market transition will manifest for their customers by forecasting the need for EV charging infrastructure in the Companies' territories in 2025 and 2030.
- Drive Electric Tennessee (DET) Consortium. Electric Vehicle Charging Needs Assessment. A strategic assessment for public PEV charging infrastructure in the state of Tennessee with a primary objective to illuminate tracks for public infrastructure rollout to meet DET's Shared Vision and Mission articulated in the 2019 Roadmap.
- Transportation Electrification Activator. www.sustainabilityactivator.com. The TE Activator is founded by organizations committed to advancing transportation electrification for the benefit of all Arizonans. We aspire to electrify transportation in a manner that optimizes community benefits, maximizes investment efficiency, and achieves transformative results. Our focus is on cross-industry collaborative action aimed towards a region with clean air, accessible electric transportation options, and robust electric vehicle infrastructure.

Pilots & Infrastructure Deployment Projects

- California Energy Commission. California Electric Vehicle Incentive Project. A public charging infrastructure project with $164 million in state funding and another $39 million from local partners.

- Pacific Gas & Electric. Charge Ready Program. A three-year program to install up to 7,500 Level 2 electric vehicle (EV) chargers at multi-unit dwelling and workplaces
- Southern California Edison. Charge Ready Program. Assists business and property owners with deploying the infrastructure and equipment necessary to support EV charging stations at their multi-family buildings, public sector, or business locations.
- Monterey Bay Air Resources District. Plug-in Monterey Bay EV Infrastructure Program. The funding of alternative fuel and electrical infrastructure projects solicited and selected through a competitive bid process.
- Colorado Energy Office. Fast-Charging Electric Vehicle Corridors Project. The Colorado Energy Office (CEO) fast-charging electric vehicle corridors project comprises high-speed charging stations at 34 locations across the state developed in partnership with ChargePoint and site hosts such as local governments, utilities and private companies.
- The State of Colorado. ChargeAhead grant program. Grants are available for EVs and community-based Level 2 and Level 3 charging stations. Program objectives include improving air quality, encouraging deployment of EVs across the state and supporting implementation of the Colorado Electric Vehicle Plan 2020.
- Dominion Energy Virginia. Smart Charging Infrastructure Pilot. The Smart Charging Infrastructure Pilot (or "SCIP") Program supports electric vehicle (EV) adoption in Virginia and will inform the design of managed charging programs and other EV customer offerings in the future. The SCIP Program provides rebates for qualifying EV charging stations, charging infrastructure and installation, commonly referred to as "make-ready," and network fees.