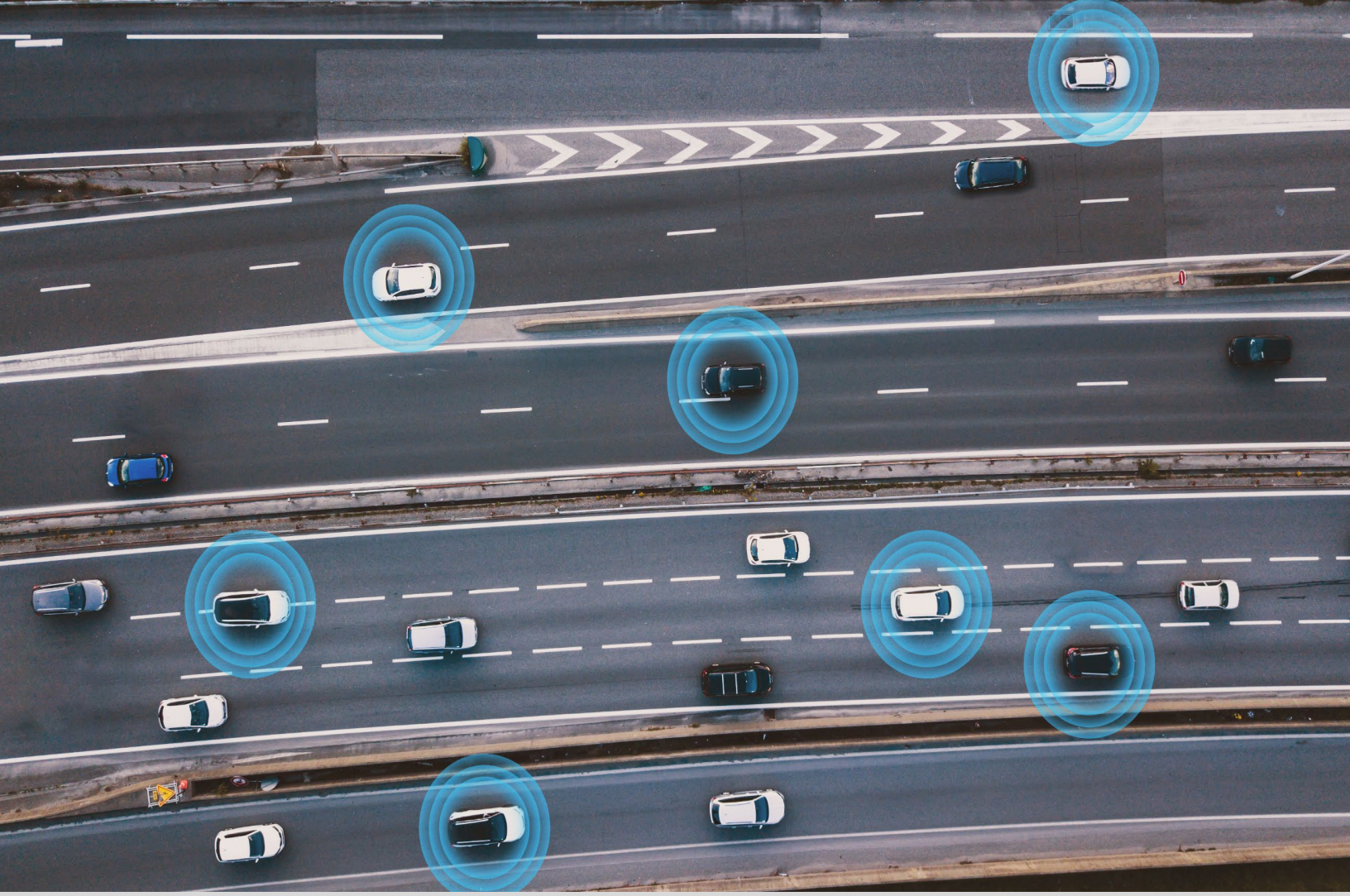

Roanoke Valley-Alleghany Regional Commission Electric Vehicle (EV) Infrastructure Implementation Strategy

September 2024

Roanoke Valley-Alleghany REGIONAL commission

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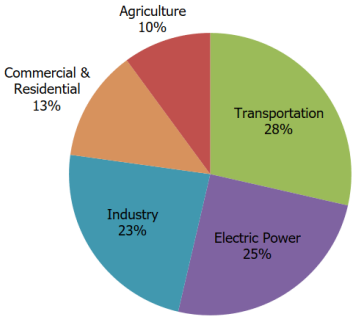
1 Vision and Goals Statement



The transportation sector is the leading contributor to greenhouse gas (GHG) emissions, making up 28% of the nation's emissions according to the U.S. EPA. Electric vehicle (EV) adoption can play a pivotal role in reducing the harmful effects of GHG and tailpipe emissions for Roanoke Valley Alleghany Regional Commission (RVARC) communities. With an unprecedented amount of federal funding available to support EV and charging infrastructure projects, RVARC will explore opportunities, barriers, and best practices to leverage funding opportunities to promote EV adoption and benefit public health across the region.

RVARC's Electric Vehicle Infrastructure Deployment and Implementation Strategy (Strategy) will support the equitable development of a network of reliable, affordable, and publicly accessible Level 2 and direct current fast charging stations for RVARC jurisdictions and citizens, including those in rural and underserved communities. The Strategy will:

- Support RVARC and member jurisdictions identify locations for EV charging station deployments;
- Guide RVARC localities in setting targets for EV readiness and adoption;
- Provide guidance for deployment adaptability that can keep up with technological advancements; and
- Outline best practices for identifying funding opportunities, developing local policies related to EV charging infrastructure, and ensuring infrastructure accessibility through the next several years of the creation of a charging station network creation and its expansion.

2 Public Engagement in Electric Vehicle Planning

EVs make up a small but quickly growing share of vehicle sales in the United States. In 2021, 608,000 EVs were sold in the US, almost doubling the 308,000 EVs sold in 2020.[1] In 2023, EV sales continued to rise, representing 16.3% of total new light-duty vehicle (LDV) sales.[2] EV sales are expected to continue to grow throughout the United States as vehicle manufacturers recognize the importance of electrification. The Biden Administration announced a goal to build 500,000 EV charging stations across the country by 2030.[3] Even with momentum in the EV market and on the local, state, and federal levels, barriers to EV adoption remain, including higher upfront purchase prices, inadequate charging infrastructure, concerns about EV range, and environmental issues in the production process. Public engagement is crucial during early technology adoption to help consumers and key community stakeholders understand the new technology, adopt EVs and associated infrastructure, and support local planning efforts.

Similarly, EV technology and deployment have advanced in recent years, creating opportunities that directly benefit the communities that adopt them. Increasing EV adoption in Roanoke Valley-Alleghany County region will help to improve regional air quality by reducing vehicle emissions, provide economic benefits through lower operating costs and fuel savings, and contribute to the region's energy security.

Public engagement plays a pivotal role in enriching communities' understanding of and familiarity with EVs. Lack of awareness, familiarity, and education are significant barriers to widespread EV adoption, making community outreach a key component to expanding EV adoption and EV infrastructure networks. Through initiatives such as ride and drive events, educational programs highlighting fuel and maintenance cost savings, and increased awareness of incentive programs, can help facilitate EV adoption. Studies show that direct exposure to EVs significantly influences individuals' willingness to explore purchasing or leasing an EV. For instance, following EV showcases organized by the U.S. Department of Energy's (U.S. DOE) Vehicle Technologies Office, there was a notable shift in participant attitudes. Prior to the showcase, 62% expressed openness to considering a PHEV, a figure that increased to 73% post-showcase, emphasizing the importance of such engagement efforts.[4]

As RVARC localities develop and carry out regional EV infrastructure implementation and deployment plan, engaging a diverse set of community members through public engagement strategies such as webinars, surveys, and in-person events will support RVARC members' efforts to create a well-structured and thoughtfully built out regional network of charging stations that both new and experienced EV drivers can confidently use. Through these strategies, community members can provide local context that ensures appropriate charging solutions for the area.

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[1] U.S. DOE. New Plug-in Electric Vehicle Sales in the United States Nearly Doubled from 2020 to 2021. Retrieved from: https://www.energy.gov/energysaver/articles/new-plug-electric-vehicle-sales-united-states-nearly-doubled-2020-2021
[2] U.S. Energy Information Administration. Electric vehicles and hybrids surpass 16% of total 2023 U.S. light-duty vehicle sales. Retrieved from: https://www.eia.gov/todayinenergy/detail.php?id=61344
[3] U.S. DOE. 5 Clean Energy Moments from President Biden's State of the Union Address. Retrieved from: https://www.energy.gov/articles/5-clean-energy-moments-president-bidens-state-union-address
[4] Argonne National Laboratory. Plug-In Electric Vehicle Showcases: Consumer Experience and Acceptance. Retrieved from: https://afdc.energy.gov/files/u/publication/pev_showcases_consumer_experience_acceptance.pdf?68d4fb0388

2.1 Public Perception and Barriers to Electric Vehicle Adoption and Charging Station Deployments

RVARC member jurisdictions should engage with the public to address commonly perceived barriers to EV adoptions. It is important to acknowledge that individuals do face barriers in adopting EVs or using EV charging stations, but the public may not be aware of all the tools and opportunities available to navigate these barriers.

Range anxiety, which refers to the concern that an EV's battery will run out of power before reaching the destination, is one of the largest barriers to individual EV adoption. This is primarily due to a lack of sufficient EV charging stations and is amplified for those without access to charging at home. Residents are more likely to lack access to EV charging stations in low-income households and multi-unit dwellings. Range anxiety is amplified by concerns about battery range during hot and cold weather. EVs use battery thermal management systems to keep the battery at an optimal temperature. More energy is required to maintain the battery temperature during hot and cold days, which reduces the range. Additionally, the engine in conventional gas vehicles produces heat which helps power the heating system in cold weather. For EVs, all the energy to power the heating system comes from the same battery that propels the vehicle thus reducing the range.

Another element of range anxiety is the time needed to charge an EV compared to a conventional vehicle. Depending on the level of charger and the amount of range needed, an EV can take longer to charge than it would for a gas-powered vehicle to fill up. Drivers will need to take charging times into account when trip planning. However, to address this issue, EV charging stations are often strategically located where vehicles are likely to park for extended periods. This includes residential areas, workplaces, transit hubs, and shopping centers.

Range anxiety can be alleviated by increasing deployments of EV charging infrastructure, especially in highly trafficked travel corridors. RVARC localities should make efforts to inform the public of federal, state, and local efforts to install more EV charging stations to reduce these concerns.

Prohibitive purchase prices are a significant obstacle to individual EV adoption as EVs currently have a higher upfront cost than conventional gas vehicles. Due to higher vehicle prices, upfront purchase costs have been a barrier to widespread EV adoption in communities across the country. This upfront cost is often offset by lower fuel and maintenance costs over the vehicle's life cycle, resulting in a lower total cost of ownership. Additionally, EV tax credits are currently available to lower this prohibitive upfront cost and make EVs more accessible to the public. Similarly, current market forecasts suggest that EVs will reach cost parity with internal combustion engines (ICE) vehicles between the 2025 and 2040 model years, which will remove the purchase price barrier for EVs in the future[5]. Public outreach can be leveraged to inform individuals of EV tax credits and cheaper fuel and maintenance costs.

EV charging station availability and uptime is a common public concern preventing EV adoption. In addition to concerns related to a lack of EV charging stations, EV drivers may arrive at a charging station only to find that all the ports are in use or some are out of order. Public engagement provides multiple chances to ease this concern. EV drivers can use websites like the AFDC Station Locator, PlugShare, and other charging

[5] Argonne National Laboratory. Battery Electric and Fuel Cell Vehicles Cost Parity. Retrieved from: https://vms.taps.anl.gov/research-highlights/bev-and-fc-cost-parity/

network platforms to find stations that are available and functional. These resources can show also users the power output of charging stations and allow drivers to plan how long they will need to charge at a location. There is also an opportunity here to seek public input on charging station uptime concerns and where to deploy more charging stations. Charging stations installed in areas with a high projected demand for EV charging are used nearly 90 percent more than chargers outside these areas.[6]

Finally, while EVs offer substantially lower or no tailpipe emissions, there are still concerns related to other **environmental risks** that act as a barrier to public adoption. Because EV battery manufacturing requires copper, lithium, and other rare earth minerals, increased EV adoption will also increase demand for mining processes, which are already energy intensive. EV battery recycling remains a challenge for EV sustainability since the necessary supply chain is not fully developed yet. Public engagement can be an opportunity to highlight the multiple recycling and sustainability initiatives that are both in development and already available.

2.2 Identifying Groups for Outreach and Engagement

To ensure RVARC members addresses EV barriers and properly assesses the region's level of EV readiness, RVARC localities should conduct ongoing outreach and engagement with the public and key community and regional stakeholders. There are several target audiences to consider when developing and implementing education and outreach efforts. RVARC members should consider the following audiences when pursuing EV education and outreach:

- Local government agencies
- Regional planning organizations
- Local and regional business owners
- Electric utilities
- Advocacy groups
- Potential EV charging investors, owners, and site hosts
- Multifamily housing owners/managers
- Commercial building owners/managers
- Universities engaged in EV-related research or fleet electrification
- Vehicle dealerships
- Commercial fleets
- Underserved and low-income communities
- Building developers
- Community-based organizations

Note that the suggested list of stakeholders can be either or both outreach and engagement targets, depending on RVARC members' priorities. Stakeholders will have the opportunity to ask questions about RVARC member jurisdictions' approach to EV infrastructure implementation, provide suggestions for program planning and implementation, and share lessons learned from their previous experience. Many of these groups can also provide valuable input from rural and underserved communities. Key objectives, messages, and tactics will vary as audiences change. RVARC will create and maintain a list of relevant stakeholder groups and contacts for member jurisdictions.

2.2.1 Equity Considerations

Ensuring equitable access to EV charging is an important consideration when planning infrastructure development. Low-income and underserved communities are typically exposed to a higher proportion of environmental hazards and EV charging infrastructure can make it easier to encourage EV adoption as a

[6] Idaho National Laboratory. 2015. How Does Utilization of Non-Residential EVSE Compare Between those Installed in Oregon in Planned versus Unplanned Locations?. Available online at: https://avt.inl.gov/sites/default/files/pdf/EVProj/UtilizationOfNonResEVSEInstallationVsPlan.pdf

strategy to reduce those impacts. RVARC localities should focus on allocating program funds toward the construction of an economical and resilient network of EV charging stations in a manner that engages rural, underserved, and low-income communities and fosters opportunities for minority and disadvantaged businesses to compete in the procurement process such that benefits accrue to these communities.

Additional items should be considered when conducting education and outreach efforts with these groups. Program information and funding opportunities should be widely disseminated to all communities of the Roanoke Valley-Allegheny County region through existing stakeholder networks and public engagement tools. RVARC members should consider and incorporate some of the following outreach activities when connecting with underserved and low-income communities:

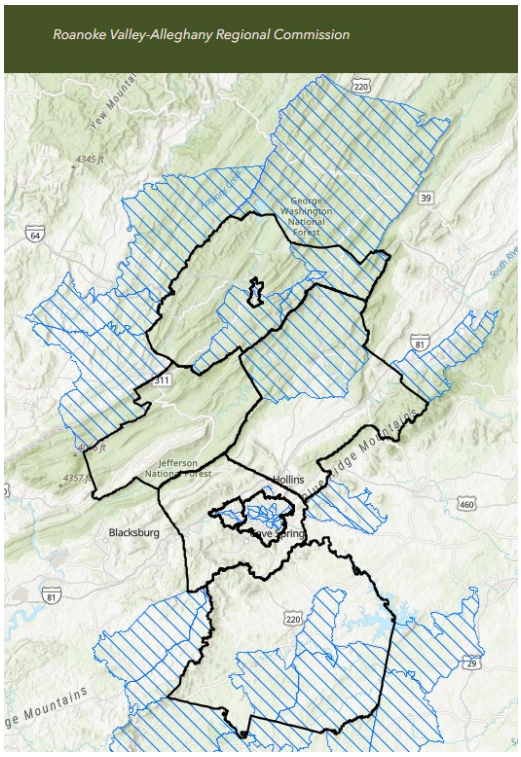
- Translate materials into multiple languages as needed.
- Plan outreach at locations where these community members already meet regularly.
- Educate the audience on why and how EVs and EV charging stations are relevant to them, including benefits such as emissions reduction, improved mobility, and lower cost of ownership.
- Describe federal and state incentives for EV adoption and EV charging station installation, especially those prioritizing investment and programs in disadvantaged or underserved communities.
- Highlight lower cost ways to own and operate an EV and EV charging stations, such as:
    - Purchasing a used EV
    - Participating in an EV carshare or rideshare program, if available
    - Utilizing public EV charging stations
    - Utilizing EV charging stations available in multifamily dwellings
    - Taking advantage of EV and EV charging stations financial incentives provided by the federal government, Virginia, electric utilities, and other entities
- Explain Virginia's "Right-to-Charge" law, which protects tenants that wish to install EV charging stations on property owned by the resident

RVARC localities should leverage ongoing connections of existing partner organizations and seek new partnerships with member governments, relevant state agencies, stakeholder groups, and community organizations to identify disadvantaged communities and plan and implement meaningful public outreach. RVARC member jurisdictions can use climate and equity tools that have been developed by other government entities to help identify disadvantaged communities throughout the engagement process. which include the following:[7]

- EV Charging Justice40 Map: Tool from Argonne National Laboratory providing interactive maps of disadvantaged communities;

[7] U.S. DOE and U.S. DOT have similar but distinct definitions of DACs.

Figure 1. Justice40 Census Tracts in RVARC Area



- Climate and Economic Justice Screening Tool: Mapping tool from the Council on Environmental Quality that uses climate change energy, health, housing, legacy pollution, transportation, water and wastewater and workforce development to identify communities that are overburdened and underserved;
- Screening Tool for Equity Analysis of Projects (STEAP): Mapping tool from the Federal Highway Administration that supports environmental justice screening;
- Low-Income Energy Affordability Data Tool: Tool from the U.S. Department of Energy that provides estimates of low-income and moderate-income household energy data;
- Transportation Equity Analysis: Tools and resources from Argonne National Laboratory that support transportation energy equity analysis; and,
- Virginia EJScreen+: Mapping tool from the Virginia Department of Environmental Quality that increases access to and enhances awareness of environmental justice-related data and information throughout the Commonwealth.

2.3 Best Practices for Public Engagement

There are a variety of outreach and engagement strategies and best practices that local governments can utilize. RVARC may decide to create one or more of the resources mentioned below. These resources would allow the public and other interested parties to obtain information and provide feedback on EV adoption and EV charging station buildout in the region.

Website Development: EV and EV Infrastructure Page

RVARC should develop a webpage to provide the public with background on the EV Infrastructure Deployment Plan, general information on EVs and EV charging stations, and resources related to EV adoption

and EV charging station deployments. The webpage can contain fact sheets, case studies, checklists, and frequently asked questions.

Social Media

RVARC should leverage existing social media platforms to share quick facts and announcements related to EVs as well as upcoming outreach and events. This will allow RVARC to connect with an existing network of community members and stakeholders that are already invested in community activities and development.

Public Surveys

RVARC should host public surveys to solicit public feedback related to EVs, targeting EV and non-EV drivers; urban, rural, and underserved or disadvantaged communities; private businesses with an interest in hosting EV charging stations; and the general public. Public surveys are an excellent opportunity to learn more about the unique barriers to EV and EV charging station adoption in the region, community preferences for infrastructure deployments, and areas that have high demand for charging in both the short- and long-term. Community EV Charging Surveys can include general questions covering travel patterns, vehicle preferences, parking considerations, existing knowledge and experience with EVs, feedback on siting criteria, as well as editable maps where community members can suggest specific charging locations, For specific survey question examples, see Appendix: Example Community Survey Questions.

Public Webinars

RVARC member should host routine public webinars to discuss the EV Infrastructure Deployment Plan and the status of deployment outcomes (e.g., where target areas are for charging stations). A key aspect of these webinars should be a Question-and-Answer session or a method to collect live comments, which gives attendees the opportunity to ask RVARC member jurisdictions' staff questions during the webinar. All webinars or virtual workshops should be recorded and made available online for those who are unable to join. Entities like the Joint Office of Energy and Transportation also host EV and charging-focused webinars. Past recordings and planned webinar topics may serve as a resource to RVARC members to share among staff and with the community and may also provide an initial list of potential topics should members choose to host their own webinar series.

Ride & Drives and Showcase Events

RVARC localities should partner with local dealerships to host ride and drive events to engage with the community and provide individuals with an opportunity to test drive an EV. A ride and drive event can help break down stigmas individuals may have with EVs, especially if they have never driven or ridden in an EV prior to the event. It also gives the community an opportunity to talk in-person with vehicle dealerships and experts about EVs. In addition to ride and drives, RVARC communities can benefit from showcase events where dealerships, local drivers, charging companies, and fleets display their EVs and charging stations, helping to demystify the technologies and provide individuals with hands-on experiences.

Email

RVARC members should designate an EV email for inquiries and comments to which RVARC member jurisdictions' staff respond regularly.

2.4 Promoting Electric Vehicle Readiness in Communities

Community outreach can help demystify EV adoption and EV infrastructure deployment by providing clear process guidance and real-world examples. The following list includes topics that RVARC localities may be interested in discussing during community engagement:

- **The permitting processes:** Local agencies must issue permits to ensure that EV charging station installation is done in a safe and reliable way. However, the permitting process can be long and burdensome. RVARC members can work with communities to collect feedback and streamline permitting and accelerate the installation process.
- **Strengthening building codes:** Communities can amend building codes to accommodate current EV charging needs and to anticipate future increases in demand. Strengthened building codes may include make-ready requirements that guarantee electrical infrastructure is available for future EV charging station deployments at public and residential locations.
- **Parking and zoning bylaws:** Municipalities often require a minimum amount of parking spaces at real estate properties like multi-unit dwellings and office buildings. RVARC members can work with municipalities to ensure that spaces with EV charging equipment are recognized as parking spaces so that developers can install EV charging stations without needing to build more parking spaces.
- **Accessibility and ADA considerations:** It is important that communities plan to accommodate accessibility needs so that EVs and EVSE can be used by all community members. RVARC members can promote accessibility best practices and ADA recommendations to ensure that EV deployment is accessible.
- **EV and EV charging station incentives:** Communities can provide their own incentives to ease the financial burden of EV and EVSE deployment. Local incentives, in addition to state and federal ones, can lower the prohibitive cost barrier of EVs and EVSE installation.

2.5 Resources for Communication and Education

There are a variety of resources available to help RVARC member jurisdictions develop outreach materials for public engagement. Each public engagement piece should focus on a key message related to EVs as part of a suite of engagement materials and efforts that RVARC localities can utilize. Key messages and associated resources for community engagement material development include:

Table 1. Key Outreach Message Examples

Key Outreach Message	Purpose and Resources
EV and EV Charging Station Basics	Oftentimes, the public may have questions about EVs and how to charge the vehicles at home or in public. There are a variety of EV makes and models and EV charging station types, power levels, styles, makes, and models available. Having outreach dedicated to EV basics can help the public feel more comfortable interacting with and adopting the new technology. Resources to help develop outreach and education materials include: • Electricity Vehicles (AFDC, 2024) • How Do All-Electric Cars Work? (AFDC, 2024)

	• How Do Plug-In Hybrid Electric Cars Work? (AFDC, 2024) • EV Charging Stations (AFDC, 2024) • Charging an EV: Everything You Need to Know (Car and Driver, 2022) • At a Glance: EVs (U.S. DOE, 2023) • EV Basics (U.S. DOE, 2023) • Charging Electric Vehicles at Home (AFDC, 2024) • Consumer Reports Buyer Guides (Consumer Reports, 2024) • About Hybrid and Electric Cars (U.S. DOE, 2024)
Vehicle and Infrastructure Costs	Understanding the cost differences between EVs and traditional ICE vehicles and the costs of charging an EV can help both consumers and site hosts feel more comfortable adopting EVs and installing EV charging stations. Resources to help develop outreach and education materials include: • Vehicle Cost Calculator (AFDC, 2024) • Reducing EV Charging Infrastructure Costs (Rocky Mountain Institute, 2019) • Costs Associated with Non-Residential Electric Vehicle Supply Equipment (AFDC, 2015) • The Costs of EV Fast Charging Infrastructure and Economic Benefits to Rapid Scale-Up (EVgo, 2020) • Find and Compare Cars (U.S. DOE, 2024)
Financial Incentives for EVs or EV Charging Stations	Many consumers and vehicle dealerships are unaware of different financial incentives that exist to help offset the cost of purchasing EVs and EV charging stations. Creating materials that summarize financial programs or provide guidance on how to find financial programs can help reduce the cost barrier to EV adoption. The Alternative Fuels Data Center (AFDC) Laws and Incentives Database is a comprehensive resource for all financial and non-financial incentives at the federal and state level for alternative fuels, vehicles, and infrastructure: • Federal Laws and Incentives (AFDC, 2024) • Virginia Laws and Incentives (AFDC, 2024)
Environmental Benefits of EV Adoption	Communicating the environmental and health benefits of EVs can be beneficial in helping communities embrace new technology.

	Resources to help develop outreach and education materials include: • Emissions from Electric Vehicles (AFDC, 2024) • Electric Vehicle Benefits and Considerations (AFDC, 2024) • Zeroing In on Healthy Air (American Lung Association, 2022)
Range Anxiety and EVs in Rural Communities	Community members that do not own or regularly interact with EVs may be unaware of existing charging infrastructure, which can result in range anxiety. Understanding the public charging infrastructure network and charging solutions for rural communities can help prospective EV owners feel comfortable purchasing a vehicle. Resources to help develop outreach and education materials include: • Alternative Fueling Station Locator (AFDC, 2024) • EV Challenges and Evolving Solutions for Rural Communities (U.S. DOT, 2022) • Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure (U.S. DOT, 2023)
Benefits of EV Infrastructure Deployment	For local businesses and prospective site hosts, understanding how EV charging stations can positively impact their business can help them feel comfortable making the investment in charging infrastructure. Resources to help develop outreach and education materials include: • Estimating the Economic Impact of Electric Vehicle Charging Stations (Argonne National Laboratory, 2022) • How to Earn Revenue with EV Charging at Retail Locations (Charge Point, 2022)

2.6 Private Sector Engagement

In addition to community members and public entities, RVARC localities should engage private entities to ensure that the EV deployment process is coordinated across all sectors. Commercial entities will need to sell, purchase, maintain, and operate EVs and EV charging stations and manage properties with EV charging stations. Informative outreach can be highly valuable, since private organizations may not be well-versed in EVs, EV charging stations, available financial incentives, and applicable laws and regulations. Engaging the private sector can also allow entities to be proactive about EV charging needs and lower some publicly perceived barriers such as EV charger availability and range anxiety. RVARC will create and maintain a private sector contact list for RVARC members.

Charging companies may wish to build or operate EV charging stations in the Roanoke Valley-Alleghany region and should be made aware of RVARC member jurisdictions' plans to increase EV charging station deployments. This can be an opportunity for charging networks that already operate in the region to expand

their businesses and ensure that they are prepared for expansion, while contributing to RVARC's larger EV network development efforts.

Car dealerships and auto repair shops will need to be prepared for increased EV adoption. Not only will dealerships be able to increase their stock of EVs to make them more available, but dealerships can also play an important role in promoting EVs to potential customers and addressing common misconceptions. Additionally, auto repair shops will need to be equipped to do maintenance work on EVs, whether this means procuring more EV-specific parts or certifying employees to be able to work on EVs.

Electric utilities are one of the most important stakeholders to engage, as they ensure that EV charging stations receive reliable and continuous service. Utilities will also need to plan for increased load on the electric grid, so it is important that they know where EV charging stations deployments are expected to be installed and upgrade the grid as needed.

Shopping centers or other public areas with high parking demand are also key private sector stakeholders. Public EV charging stations will be needed for residents without access to charging equipment at home. This frequently includes residents of multi-unit dwellings, low-income individuals, and individuals without access to private off-street or garage parking. Installing EV charging stations at high traffic areas, such as frequently visited shopping centers, alleviates public concern about EV charging station availability. Installing EV chargers in shopping centers may also attract new customers and provide an economic boost to businesses.

Multifamily housing groups provide residential parking to tenants and will need to be ready to accommodate increased EV adoption and demand for EV charging in their buildings. New and existing buildings will need to add EV parking spots or EV-ready parking spots to enable residents to charge at home. Planning for EV charging needs early on allows multifamily housing groups to adjust smoothly to EV adoption and mitigates publicly perceived barriers to EVs. Additionally, EV charging factors into the electric needs of multi-unit dwellings and will need to be accounted for in the planning process.

3 Stakeholder Engagement in Electric Vehicle Infrastructure Planning

Throughout the implementation process, RVARC members will engage a variety of stakeholders to solicit input and feedback on charging station deployment topics such as siting and design considerations, community and stakeholder needs, permitting challenges, financial incentive opportunities, policy issues and opportunities, and outreach strategies. To effectively support residents in the growing EV market, communities must prioritize inclusivity among various stakeholders. Stakeholder engagement is a critical component of the implementation process and can provide insight into the following:

- Barriers to EV adoption (e.g., range anxiety, lack of EV availability at dealerships, charging station uptime, charging deserts, etc.)
- Strategies to advance EV adoption and support stakeholders during the implementation and deployment process (e.g., providing incentives for EV ownership and charging station installations, increasing consumer education and outreach, and connecting stakeholders with appropriate contacts and government resources, etc.)
- Actions to implement strategies (e.g., lowering the cost of EV ownership, increasing outreach to dealers, expanding utility capacity in targeted deployment areas, etc.)
- Criteria to measure progress of implementation process (e.g., costs, equity, scalability, policy changes, number of chargers deployed and uptime metrics, etc.)

As part of the outreach effort to external stakeholders, Working Group members can leverage their knowledge of the local communities to provide information about key entities in and unique characteristics of the Roanoke Valley-Alleghany region. A wide range of stakeholders within three main categories–Government, Industry, and Community–are identified below with the goal of having a diverse group to maximize the benefits of community wide planning.

3.1 Stakeholder Identification and Recruitment

Including a variety of stakeholders in the EV planning process will allow RVARC to anticipate and preemptively mitigate barriers and build trust among key local and regional groups vital to EV infrastructure deployment. Each stakeholder group can offer perspectives unique to their area of focus, allowing RVARC's EV infrastructure planning process to meet the needs of every member of the community. RVARC should consider the following groups to recruit as stakeholders:

- **City and regional planning authorities** can provide more detailed insight on where EV chargers will be the most needed and utilized. They can also provide insight into building codes, permitting requirements, and other local infrastructure considerations.
- **Utilities** can provide insight on grid capabilities as well and where they plan to implement grid modifications and upgrades. Utilities are a key stakeholder group to engage to ensure that EV infrastructure in the Roanoke Valley-Alleghany Region receives reliable service both in the short- and long-term.
- **Advocacy and community groups** can identify equity concerns and outcomes the public hopes to see from EV and EV infrastructure deployment.
- **Charging companies** often assess the EV charging needs of towns, cities, and regions and can help RVARC determine where faster or slower charging is needed. However, due to potential conflicts of

interest, private charging companies may be better suited as regular Working Group attendees rather than Working Group members.

- **State agencies** can provide expertise on state-specific concerns regarding EV and EV infrastructure deployment. Some agencies, for example VDOT, likely have experience installing EV infrastructure and can share lessons learned as well as state plans for EV infrastructure buildout. State agencies may also be able to provide funding and incentives for EV deployment.
- **Educational institutions** can promote interest and provide workforce training necessary for EV adoption. Universities, especially, can implement research programs related to solving EV adoption challenges.
- **Interest groups** have experience advocating for EVs and can assist RVARC in appealing EV and EV infrastructure deployment to the public.
- **Dealerships** can provide insight into what the average consumer is seeking when purchasing a vehicle and identify public barriers to EV adoption.

Understanding that RVARC engages a number of these stakeholders through existing and planned Committees, RVARC will remain open to opportunities to incorporate EV and EV charging discussions and activities in either existing Committees interested in expanding their scope to include EVs or in a new Committee or Working Group focused on EV and charging issues.

3.2 Recommendations and Considerations for Working Group Members

RVARC should consider constructing a working group from the stakeholder groups listed below. While some stakeholder groups are strongly recommended, including others is at RVARC's discretion. Specific entities are identified in the table, but beyond RVARC's member jurisdictions, RVARC does not need to include all of the stakeholder groups or identified entities.

RVARC Member Jurisdictions (Recommended)

- City of Convington
- Alleghany County
- Town of Cliton Forge
- Craig County
- Botetourt County
- Town of Vinton
- City of Roanoke
- Roanoke County
- City of Salem
- Town of Rocky Mount
- Franklin County

RVARC should identify the best point of contact within member jurisdictions. These contacts might be in a jurisdiction's Public Works Department, Planning Commission, Community Development

Government Entities (Recommended)

- RVARC Transportation Department
- Roanoke Valley Transportation Planning Organization
- Virginia Clean Cities
- Virginia Department of Transportation
- Virginia Planning and Budget Department

Educational Institutions

- Automotive Analysis and Repair Department at Virginia Western Community College
- Virginia Tech Apprenticeship Program

Interest Groups

- Renewable Energy and Electric Vehicle Association
- Solar United Neighbors
- Sierra Club Roanoke Chapter

Department, Planning and Zoning Department, or other departments.

Utility Representatives (Recommended)

- Dominion Energy
- Craig-Botetourt Electric Cooperative
- Appalachian Power
- City of Salem Municipal Electric Utility

Community and Advocacy Groups

- Council of Community Services
- Roanoke Regional Chamber
- Roanoke Regional Home Builders Association
- Roanoke Regional Partnership
- The Advancement Foundation
- United Way of Roanoke Valley

Charging Companies

- Blink
- Greenspot
- Beam
- ChargePoint
- Electrify America
- EV Connect
- EVgo
- FLO
- OpConnect
- Rivian
- Shell Recharge
- Tesla

RVARC should consider inviting representatives from charging companies in the area. Having a representative from one or multiple companies can provide valuable insight to the planning and deployment process

Dealerships

- Virginia Automobile Dealers Association
- Berglund Automotive

Faith Groups

- Unitarian Universalist Church of Roanoke Green Team
- Second Presbyterian Church
- Roanoke Area Interfaith Stewards of the Earth (RAISE)

RVARC may also choose to only select certain stakeholder groups for inclusion in the Working Group but may regularly invite other groups identified in this coordination plan to participate in meetings and provide feedback. Groups that may be better as regular attendees include charging companies, community and advocacy groups, faith groups, educational institutions, and dealerships. Working group meetings do not need to be private and can be open to the public and other stakeholders.

3.3 Guidance on Working Group Meetings

The Working Group should focus on targeted topics and initiatives that will help ensure that goals stay aligned. RVARC should consider organizing the Working Group's activities around the following target areas:

- EV infrastructure deployments
- EV policies and incentives
- EV education and awareness

When creating the Working Group, RVARC should designate a working group "chair", or an individual dedicated to running and managing working group meetings and operations. The chair should be a representative of the region's efforts and not an individual representing an entity with strong, specific interests. The chair should likely be someone from within RVARC, a regional planning commission, or similar.

The Working Group should meet regularly at times that are convenient for all members. At its onset, the Working Group should meet monthly to establish relationships, set goals, and begin coordinating activities for implementing and deploying a regional EV charging network. Once the Working Group is fully operational, meeting frequency can decrease to bi-monthly or quarterly.

The Working Group should develop common metrics to track and report progress on EV infrastructure deployments at the local and regional level. It is recommended that the group attend regular meetings and contribute to the overall implementation of the EV infrastructure implementation and deployment plan.

3.4 Guidance on Working Group Goals and Outcomes

RVARC Working Group can focus on a range of EV and EV charging station related topics, such as:

- Set or evaluate EV adoption and EV charging station deployment goals. RVARC members can develop jurisdiction-specific goals as part of broader health and climate initiatives.
- Share technology best practices. RVARC can invite EV experts to learn more about opportunities and potential barriers to EV adoption and EV infrastructure deployment. Learnings can also be leveraged in educational materials and community engagement activities.
- Crowdsource community feedback and needs. Members can highlight real-world questions from the community and collectively brainstorm solutions and share case studies.
- Identify potential site hosts. Working group members can further focus on identifying and engaging subsets of potential EV charging station site hosts (i.e., publicly available EV chargers, sites accessible to disadvantaged communities, properties eligible for federal funding, etc.).
- Share lessons learned on supportive policies, codes, and permitting practices. Local policies, codes, and permitting processes can greatly affect an EV driver and EV charging station site host's user experience. Inaccessible information, complicated instructions, and long approval timelines can dissuade constituents from considering EVs. By clarifying and/or simplifying local requirements, constituents may be more open to EV adoption.
- Develop joint educational materials. Members can collaborate on EV and EV charging station-related educational flyers, factsheets, social media posts, events, and more. Joint educational materials can leverage RVARC member resources to reach the broader community.

3.4.1 Tracking Working Group Outcomes

The Working Group has the ability to monitor progress by establishing both long-term goals and interim targets. If the Working Group decides to concentrate on any of the previously mentioned topics, it should define specific targets for each one. These targets should include interim milestones along with their respective deadlines. As an initial step, the Working Group should review and discuss the final version of this plan to foster the development of local implementation strategies.

4 Deployment Strategy

4.1 Electric Vehicle Charging Infrastructure Overview

A critical step in boosting the number of EVs in the Roanoke Valley-Alleghany region will be installing more charging infrastructure. EV charging infrastructure is also known as electric vehicle supply equipment (EVSE).

4.1.1 Charging Infrastructure Terminology

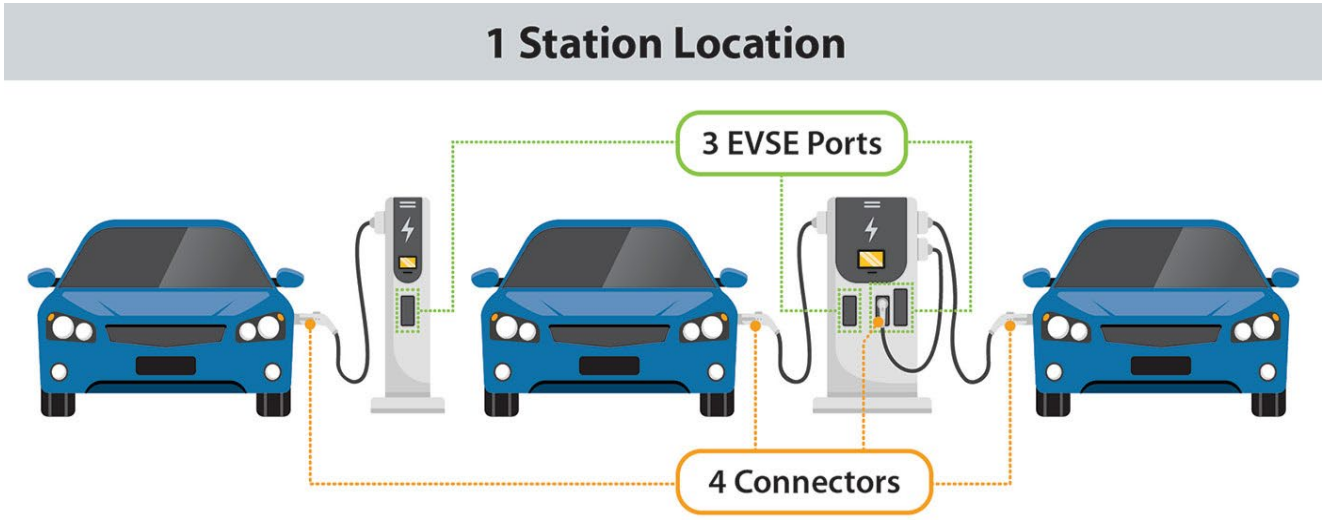
The charging infrastructure industry has aligned with a common standard called the Open Charge Point Interface (OCPI) protocol with this hierarchy for charging stations: location, EVSE port, and connector. The Department of Energy's Alternative Fuels Data Center (AFDC) and the Station Locator use the following charging infrastructure definitions:

Station Location: A station location is a site with one or more EVSE ports at the same address. Examples include a parking garage or a mall parking lot.

EVSE Port: An EVSE port provides power to charge only one vehicle at a time even though it may have multiple connectors. The unit that houses EVSE ports is sometimes called a charging post, which can have one or more EVSE ports. An EV charging station can have either single- or dual-port configurations.

Connector: A connector is what is plugged into a vehicle to charge it. Multiple connectors and connector types (such as CHAdeMO and Combined Charging System/CCS) can be available on one EVSE port, but only one vehicle will charge at a time. Connectors are sometimes called plugs.

Figure 2. EV Charging Station Diagram[8]



4.1.2 Charging Equipment

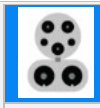
EVSE are characterized by the maximum amount of power they can deliver to an EV battery. Level 1 chargers are standard 120-volt wall outlets. These chargers give EVs two to five miles of range per hour of charging. Due to this relatively slow rate, Level 1 charging is most common in residential settings where regular overnight charging is possible. Level 2 chargers use 240-volt service. These chargers give EVs 10 to 20 miles of range

[8] AFDC. Developing Infrastructure to Charge Electric Vehicles. Retrieved from: https://afdc.energy.gov/fuels/electricity_infrastructure.html

per hour and are most suitable for residential and workplace locations where charging for at least 4 hours at a time is feasible. Direct Current Fast Chargers (DCFCs) give 60 to 80 miles of range per 20 minutes of charging. DCFCs are useful in publicly accessible spaces where parking dwell times may be short. When choosing a type of charging station best suited for a fleet or location, the type of EV the charging station is meant or most likely to serve should also be taken into consideration. EVs range in their battery capacity (kWh) and their intake of power will depend on the charger's power level (kW). How quickly or slowly an EV can charge its battery will depend on how large the battery is (kWh) and how powerful the charger is (kW).

The table below summarizes EVSE types.

Table 2. EVSE Type and Connector Information[9]

	Level 1	Level 2	DCFC		
Description	120-volt (V) alternating current (AC) port, single phase service 12-16 amp (A)	208/240V AC port, single phase service 12-80A	208/480/1,000V AC circuit, three-phase service connection 50-500A		
Connector Type(s)	 J1772 charge port Standard Wall Outlet	 J1772 charge port	 Combined Charging System (CCS)	 CHAdeMO	 Tesla
Typical Use Cases	Light-duty EVs; residential, workplace	Light and medium-duty EVs; residential, workplace, public charging, fleets	Light, medium, and heavy-duty EVs; public charging, fleets		
Typical Charge Time (for light-duty EVs, varies based on battery size)	2-5-miles/1 hour of charging PHEVs can be fully charged in 2-7 hours; battery electric vehicles (BEVs) in 14-20+ hours.	10-20 miles/1 hour of charging PHEVs can be fully charged in 1-3 hours; BEVs in 4-8 hours.	60-80-miles/20 min of charging BEVs can be fully charged in 30-60 minutes.		
Limitations	Lower power delivery lengthens charging time	Requires additional infrastructure and wiring	Can only be used by EVs currently, depending on vehicle capabilities. Higher upfront and operation costs.		

[9]AFDC. Developing Infrastructure to Charge Plug-In Electric Vehicles. Retrieved from: https://afdc.energy.gov/fuels/electricity_infrastructure.html

There are also several types of chargers:

- **Plug-in**: Plug-in chargers are by far the most common type of EVSE. Plug-in chargers have a charging box, cable, and connector. The connector plugs into the port of a PHEV or BEV. Different mounting styles allow plug-in chargers to be used in different settings, including the home, workplace, and public charging areas.
- **Overhead**: Overhead chargers are often used for transit bus routes and other contexts in which fast opportunity charging is required. A pantograph lowers the charger from an overhead position onto a connection point located on top of the vehicle.

- **Inductive**: This charging type is also known as wireless charging and involves a charging pad installed in the ground. Vehicles can charge by positioning over the pad.

- **Catenary**: With this type of charging, overhead lines contact a pantograph on top of the vehicle. Catenary charging is more common for electric rail and streetcars, although its use for heavy-duty electric trucks has been studied.

While the focus of this plan is on EVs, it is worth noting that the other forms of battery-powered mobility are growing in popularity. Electric scooters and electric bicycles (e-bikes) can typically be plugged into a wall outlet with an AC/DC converter. However, publicly accessible charging stations for micro mobility can help expand the range of these modes and make them more accessible to people living in multi-unit dwellings and other contexts where at-home charging is not as feasible.

4.1.3 Charging Infrastructure Costs

The costs of EV infrastructure are important factors in planning for EV expansion. Beyond charging equipment, costs may include equipment costs, installation costs, and utility upgrade costs.

4.1.3.1 Equipment Costs

The costs of the EVSE vary based on the type and strength of the charging equipment. Average cost ranges for each type of charger are shown in the table below.

Table 3. Average Range of Site-Level EV Charging Equipment Costs [10,11,12]

Item	Minimum Cost Estimate	Maximum Cost Estimate
Level 2 Charger, per port	$400 (Residential), $2,500 (Commercial)	$6,500
DCFC (50 kW)	$20,000	$35,800
DCFC (150 kW)	$75,600	$100,000
DCFC (350 kW)	$128,000	$150,000

[10] ICF. Comparison of Medium- and Heavy-Duty Technologies in California. California Electric Transportation Coalition. Retrieved from: https://caletc.com/wp-content/uploads/2024/04/ICF-Truck-Report_Final_December-2019.pdf
[11] U.S. DOE. Costs Associated with Non-Residential Electric Vehicle Supply Equipment, Retrieved from: https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf
[12] Nelder, C. & Rogers, E.. Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute. Retrieved from: https://rmi.org/wp-content/uploads/2020/01/RMI-EV-Charging-Infrastructure-Costs.pdf

4.1.3.2 Installation Costs

Sometimes, site upgrades are needed to enable EVSE installation. Installation costs are heavily dependent on local site locations. Average installation costs are shown in the table below.

Table 4. Average Charger Installation Costs [13,14,15]

Charger Type	Minimum Cost Estimate	Maximum Cost Estimate
Level 2 Charger	$600 (Residential L2 Charger)	$6,500 (Commercial L2 Charger)
DCFC	$20,000	$94,000

4.1.3.3 Additional Cost Considerations

Other costs may include adding networking and communication capabilities and soft costs such as permitting processes and fees. Additionally, there are ongoing charger operation and maintenance costs associated with EVSE ownership. Maintenance may include cable management and storage, regular parts checks, and cleaning equipment. Charging stations may also need occasional repairs. Costs will vary based on warranty pricing, general wear and tear, and more, charging station owners should estimate average annual maintenance costs of up to $400. It is important to establish whether the site host, charging network, or installer is responsible for maintenance costs. Maintenance contracts should include a response time, time for given repair, and an overall uptime requirement.[16]

4.2 Existing Conditions

The Roanoke Valley-Alleghany region has a growing number of EV registrations and limited public charging infrastructure, although adoption and installation rates have been increasing over the past few years. This section outlines the current conditions in the region.

4.2.1 EV Registrations

As of 2022, there were 757 EVs registered in the Roanoke Valley-Alleghany region.[17] EVs accounted for approximately 0.2% of all vehicles registered in the region.

4.2.2 Existing Public EV Charging Stations

Data from the U.S. Department of Energy's AFDC Station Locator was used to identify, analyze, and map the chargers currently available across the region. According to the AFDC, there are 61 charging ports available to the public in the Roanoke Valley-Alleghany region, with 34 Level 2 ports and 22 DCFC ports.[18] However, many of these ports are not available to all EV drivers, such as proprietary Tesla and Rivian EV chargers. Five of the Level 2 ports and five of the DCFC ports are exclusively Rivian chargers. However, it is important to note that

[13] ICF. Comparison of Medium- and Heavy-Duty Technologies in California. Retrieved from: https://caletc.com/wp-content/uploads/2024/04/ICF-Truck-Report_Final_December-2019.pdf
[14] U.S. DOE. Costs Associated with Non-Residential Electric Vehicle Supply Equipment. Retrieved from: https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf
[15] Energy Marketers of America. Utility Investments and Consumer Costs of Electric Vehicle Charging Infrastructure. Retrieved from: https://www.energymarketersofamerica.org/ema_today/attachments/Energy_Marketers_of_America_Study-Utility_Infrastructure_for_EVs.pdf
[16] AFDC. Charging Infrastructure Operation and Maintenance. Retrieved from: https://afdc.energy.gov/fuels/electricity-infrastructure-maintenance-and-operation
[17] Atlas Public Policy. State EV Registration Data. Retrieved from: https://www.atlasevhub.com/materials/state-ev-registration-data/#data
[18] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest

Rivian announced that it will open its private charging network to all EVs in late 2024.[19] While Tesla also plans on opening up their network of Superchargers later in 2024, Superchargers are also omitted from this list since there are no Tesla chargers open to other EVs in Virginia as of June 2024.[20] Additionally, another three Level 2 ports and one DCFC port are restricted to the public for limited hours. When these stations are accounted for, there are 26 Level 2 ports and 16 DCFC ports available to the public in the Roanoke Valley-Alleghany region. The table below lists the existing charging stations in the Roanoke Valley-Alleghany region. The figures that follow the table illustrate the locations of these charging stations.

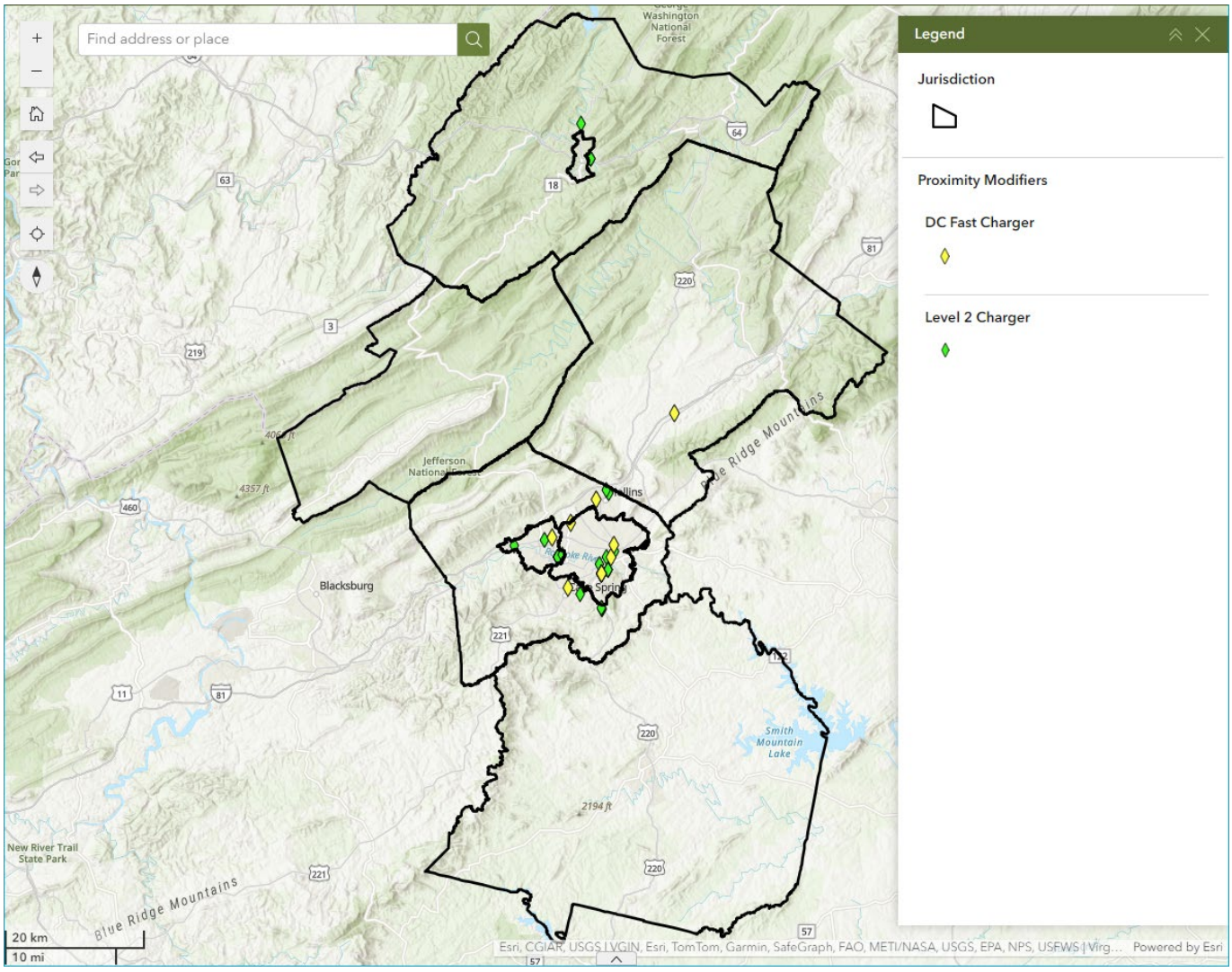
Table 5. Existing Public EV Charging Stations in the Roanoke Valley-Alleghany Region

Station Name	Street Address	City	Level 2 Ports	DCFC Ports	Network
Berglund INFINITI of Roanoke	5000 Franklin Road SW	Roanoke	1		ChargePoint Network
Mercedes-Benz of Roanoke	5000 Franklin Road SW	Roanoke	2		ChargePoint Network
Volvo Cars of Roanoke	5000 Franklin Road SW	Roanoke	2		ChargePoint Network
Windy Hill Key Parking	5400 Bernard Drive	Roanoke	2		EV Connect
Cave Spring Corners	3971 Brambleton Avenue	Roanoke		4	EVgo Network
6 Riverside Circle	6 Riverside Circle	Roanoke	6		ChargePoint Network
The River House	806 Wasena Avenue SW	Roanoke	1		Non-Networked
City of Roanoke	102 Market Street SE	Roanoke		1	Non-Networked
Virginia Museum of Transportation	303 Norfolk Avenue SW	Roanoke	1		Blink Network
Salem Veterans Affairs Medical Center	1970 Roanoke Boulevard	Salem	1		ChargePoint Network
Berglund Chevrolet Buick	1824 Williamson Road	Roanoke		2	EV Connect
El Rodeo Mexican Restaurant	2032 W Main Street	Salem	2		Non-Networked
Berglund Ford Mazda	834 E Main Street	Salem	3		Non-Networked
Hart Motor Co.	1341 East Main Street	Salem		1	EV Connect
Sheetz	2703 Peters Creek Road NW	Roanoke		4	EVgo Network
Hollins U - Dara	8003 Fishburn Drive	Hollins	1		Blink Network

[19] Electrify News. Rivian Opening Its Own Charging Network to All EVs. Retrieved from, https://electrifynews.com/news/ev-chargers/rivian-announces-a-next-gen-charging-network-prototype-open-to-all-evs/
[20] Tesla. Supercharger Interactive Map. Retrieved from: https://www.tesla.com/findus

Station Name	Street Address	City	Level 2 Ports	DCFC Ports	Network
Hollins U - West 1 & 2	8295 Keystone Lane	Hollins	2		Blink Network
Brughs Mill Country Store	345 Brughs Mill Road	Fincastle		4	Electrify America
Covington Honda Nissan	1915 Hot Springs Road	Covington	2		Blink Network
TOTAL			26	16	

Figure 3. Existing Public EV Charging Stations in the Roanoke Valley-Alleghany Region[21]



[21] Please see the RVARC EV Siting Parcel Review and select the DC Fast Charger and Level 2 Charger proximity modifiers to see existing station locations.

4.3 Future EV Charging Needs

4.3.1 EV Adoption Projections

EV market growth scenarios for the region were completed by utilizing the state goal benchmarks in addition to historical and existing estimated EV registrations. Three different vehicle growth scenarios were forecast as part of this study:

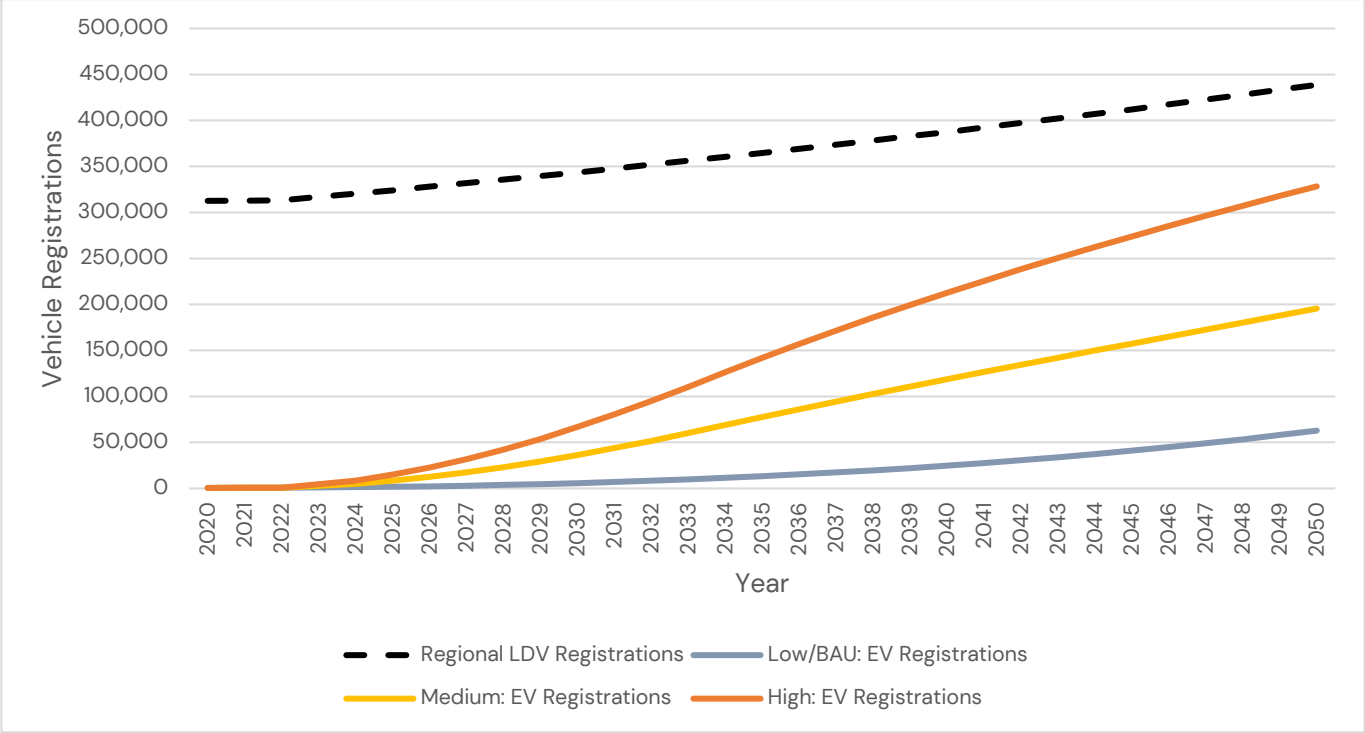
- Business-as-Usual (BAU)/Low Growth: The historical EV growth rate in the Roanoke Valley-Alleghany region was used to project future EV deployment as a function of projected population growth.[22]
    - Due to the lack of local-level EV registration data, current and historical EV registrations were calculated using regional-level registration data and proportional population data.[23]
- Medium Growth: An average of the BAU and high growth projection.
- High Growth: The projected ratio of the Roanoke Valley-Alleghany region's EV registrations to light-duty vehicle registrations was applied to meet the state's ZEV sales goal that the region would be responsible for starting in 2024 onwards.[24] Following 2023, EV registration projections are extrapolated from the state goal of 22% ZEV sales starting in 2024 and increasing to 100% ZEV sales starting in 2034.

Table 6. Projected EV Registrations by Benchmark Years

Year	2023	2030	2040	2050
Business-as-Usual	980	5,783	24,752	62,811
Medium	2,770	36,249	118,751	195,580
High (State ZEV Goal)	4,560	66,715	212,749	328,349

[22] Atlas Public Policy. State EV Registration Data. Retrieved from: https://www.atlasevhub.com/materials/state-ev-registration-data/
[23] University of Virginia. Virginia Population Estimates. Retrieved from: https://www.coopercenter.org/virginia-population-estimates
[24] AFDC. Laws and Incentives database. Retrieved from: https://afdc.energy.gov/laws/12561

Figure 4. Projected EV Registrations Over Time



4.3.2 EV Charging Infrastructure

The U.S. Department of Energy's Electric Vehicle Infrastructure Projection Tool (EVI-Pro Lite) was used to project the amount of private and public charging needed for current and projected EVs for the RVARC region. EV charging infrastructure, or EVSE, needs are evaluated by Public Level 2 and Public DCFC.[25]

The EVI-Pro Lite tool uses a set of variables to determine the amount of EVSE infrastructure needed to support EVs, including:

- Number of EVs that need support
- Vehicle mix of PHEVs and BEVs
- Support provided for PHEVs
- Percentage of drivers with access to home charging

The following EVI-Pro Lite assumptions were used for the regional EVSE needs assessment:

- Vehicle mix
  - PEV Sedans: 35%
  - PEV C/SUVs: 39%
  - PEV Pickups: 21%
  - PEV Vans: 5%
  - PHEV Share of PEVs: 35%
- Full support provided for PHEVs

[25] AFDC. EVI-Pro Lite Tool. Retrieved from: https://afdc.energy.gov/evi-pro-lite

- Percent of drivers with access to home charging: 75%[26]

The inputs above were all default assumptions from EVI-Pro Lite, except for support provided for PHEVs and the percentage of drivers with access to home charging. EVI-Pro Lite assumes partial support for PHEVs and that 98% of EV drivers have access to home charging. This analysis assumes full support for PHEVs and that 75% of EV drivers have access to home charging to ensure sufficient support to meet anticipated charging demand. The results from the Roanoke Valley-Alleghany region EV projection scenarios were applied to benchmark years 2030, 2035, 2040, 2045, and 2050 to determine the number of EVs deployed in the region.[27]

EVSE assessment results for the Roanoke Valley-Alleghany region are shown in the table below. EVSE needs are listed in terms of number of ports by EVSE type, EV growth scenario, and benchmark year. EVI-Pro Lite includes more information on charging needs broken down into the following subcategories.

- Public Level 2
  - Retail
  - Recreation Center
  - Healthcare Facility
  - Education Facility
  - Community Center
  - Transportation Facility
  - Neighborhood
  - Office
- Public DCFC
  - Retail – 150 kW, 250 kW, and 350 kW+
  - Recreation Center – 150 kW, 250 kW, and 350 kW+

Table 7. Projected EVSE Needs by Benchmark Years

Projection Scenarios			2030	2035	2040	2045	2050
Low/Business-As-Usual	EV Charging Needs (port count)	Public Level 2	391	852	1,495	2,354	3,612
		Public DCFC	32	53	77	104	161
		Total (port count)	423	905	1,572	2,458	3,773
	EVs to Support		5,783	13,246	24,752	40,997	62,811
Medium	EV Charging Needs (port count)	Public Level 2	2,082	4,460	6,048	8,020	10,034
		Public DCFC	93	195	219	288	361
		Total (port count)	2,175	4,655	6,267	8,308	10,395
	EVs to Support		36,249	77,643	118,751	157,478	195,580

[26] This assumption is based on NREL's 2021 projections that in an optimistic scenario of 100% light-duty vehicle electrification, 25% of EVs would not have access to home charging. Ge, Yanbo, et al. There's No Place Like Home: Residential Parking, Electrical Access, and Implications for the Future of Electric Vehicle Charging Infrastructure. Retrieved from: https://www.nrel.gov/docs/fy22osti/81065.pdf.

[27] As it is structured, EVI-Pro Lite will only be able to project EVSE needs for scenarios in which the EVs make up less than 10% of projected light duty vehicles for the area. In order to model EVSE needs for higher proportions of EVs, projected EV registration values were divided by 10 for a "small scale" projection input into EVI-Pro Lite. EVI-Pro Lite's projected "small scale" EVSE figures were then multiplied by 10 for a "full-scale projection" of EVSE needs. This type of adjustment is commonly done when the EVI-Pro Lite tool is used for local government EV infrastructure planning studies.

Projection Scenarios			2030	2035	2040	2045	2050
High (State ZEV Goal)	EV Charging Needs (port count)	Public Level 2	3,837	7,233	10,916	14,325	17,384
		Public DCFC	170	261	391	499	632
		Total (port count)	4,007	7,494	11,307	14,824	18,016
	EVs to Support		66,715	142,040	212,749	273,959	328,349

With 42 existing publicly accessible charging ports in the Roanoke Valley-Alleghany region, 26 Level 2 ports and 16 DCFC ports, the region is projected to need over ten times the existing number of charging infrastructure by 2030. However, it is important to note that these are conservative projections based on 1) the assumption that only 75% of drivers will have access to home charging increases projected demand for charging, and 2) data on shared private charging, either multifamily or workplace charging, is not easily accessible. Further outreach and engagement are required to better understand the current state of existing shared private charging availability.

4.4 Siting Best Practices

Adequate charging infrastructure must be planned for and installed across member jurisdictions to allow EVs to be as attractive as conventional vehicles. An EVSE site host is a landowner or occupant on which an EV charging station is installed. Member jurisdiction priorities for public EV charging sites are listed below.

- **Transportation Hubs**
  - Parking lots and structures nearby *Valley Metro* and *Smart Way* bus stops should be considered as potential EVSE sites, especially those that overlap with other highly trafficked locations. Examples include *3rd Street Station, Roanoke-Blacksburg Regional Airport, Downtown Salem, Roanoke Memorial Hospital*, *Roanoke Amtrak Station*, etc.
- **Community Sites**
  - *Community sites such as public libraries, town halls, and community centers* are spread across member jurisdictions and already provide amenities like bathrooms.
- **Businesses and Institutions**
  - Siting EV infrastructure at high-traffic destinations like *schools*, *hospitals*, *gas stations, grocery stores, restaurants,* and *shopping centers* with existing parking capacity are easily accessible to drivers. Charging stations at already frequented businesses and institutions allow drivers to incorporate charging into their existing driving patterns. Examples include p*ublic schools*, *local colleges and universities*, *hospitals*, *shopping centers*, *hotels*, *movie theaters*, etc.
- **Public Lands**
  - EV charging stations at local *parks*, *plazas*, *recreational centers* promote EV adoption and greater use of green spaces. Examples include *George Washington National Forest, the Blue Ridge Parkway, and Jefferson National Forest*.
- **Tourist Destinations**
  - Tourist destinations can experience higher traffic and longer dwell times, making them suitable locations for EV charging stations. Examples include the *Virginia Museum of Transportation, Taubman Museum of Art, and Mill Mountain Zoo*.

The location of public chargers will affect usage, and therefore their cost-effectiveness and ability to provide a return on investment. High-traffic public properties like public libraries, government buildings, local parks, and more can utilize parking capacity to increase access to EV charging infrastructure. Partners with diverse locations (i.e., schools, retail businesses, etc.) should be identified and engaged as potential site hosts as well.

Member jurisdictions can also leverage existing relationships with employers to encourage adoption of workplace charging and better understand how much workplace charging is already available.

Prioritizing potential site locations can depend on a range of factors. Best practices for member jurisdictions to consider are listed below:

- **Traffic Patterns**
  - Siting an EV charging station in a highly trafficked area will increase utilization and maximize station owner investments.
- **Dwell Time**
  - How long a driver spends at any given location will contribute to the duration of the charging session. For example, charging stations located near highways should consider DCFC, as drivers may only intend to make a quick stop. Most other destinations where drivers may park for hours at a time, like shopping centers and workplaces, should consider installing Level 2 chargers.
- **Electrical Capacity**
  - Contact your (Appalachian Power, Dominion Power, Craig-Botetourt Electric Cooperative, etc.) local utility to evaluate whether there is sufficient existing capacity to support EV charging infrastructure or if infrastructure upgrades are needed.
- **Parking Capacity**
  - Ensuring that there is sufficient parking capacity before dedicating EV-specific parking spaces mitigates potential tension between EV and gas car drivers over parking designations.
- **Existing EV infrastructure**
  - Siting new EV infrastructure to fill gaps in the regional charging network is important to build drivers' confidence in being able to charge their vehicle no matter where they are in the region and minimize potential "range anxiety".
  - Resource: AFDC Station Locator
- **Proximity to Public Transportation and Travel Corridors**
  - Maximize public investments in shared mobility by siting EVSE near bus or train stations. Siting EVSE by highly trafficked travel corridors reduces range anxiety for drivers that drive along such corridors,
- **Areas or locations with underserved communities to ensure regional charging networks are equitably distributed**
  - Disadvantaged communities vary significantly by region and can be identified through a range of criteria (historical health and environmental impacts, lack of resilient infrastructure and investment, low-income, etc.). There are a variety of local, regional, and federal datasets on environmental justice communities.
- **Near Multifamily Housing**
  - Most EV drivers charge at home or at work, but barriers to installing EV charging at multifamily housing makes it difficult for residents to consider an EV as their next vehicle. By siting public charging nearby, there would be increased access to EV charging for all residents of nearby multifamily housing developments. These sites are more likely to have higher utilization, as drivers may use nearby public stations are a replacement for at-home charging.
- **Amenities**
  - Access to typical amenities like bathrooms and food should be considered. Sufficient lighting to alleviate safety concerns with charging overnight is another best practice.

Some other important factors to consider include the power availability, proximity to amenities such as bathrooms and food, and construction costs.

Within the Roanoke Valley-Alleghany Region, there are both public and private opportunities to expand the EV charging network. Existing EV charging infrastructure is spread across the Region with a higher concentration in the cities of Salem and Roanoke. Member jurisdictions can leverage information on the above criteria, in addition to any community-specific needs, to fill gaps in the region's charging network.

4.4.1 Equity Considerations

Ensuring equitable access to EV charging is an important consideration when planning infrastructure development. Low-income and underserved communities are typically exposed to a higher proportion of environmental hazards and EV charging infrastructure can make it easier to encourage EV adoption as a strategy to reduce those impacts. RVARC localities should focus on allocating program funds toward the construction of an economical and resilient network of EV charging stations in a manner that engages rural, underserved, and low-income communities and fosters opportunities for minority and disadvantaged businesses to compete in the procurement process such that benefits accrue to these communities.

Additional items should be considered when conducting education and outreach efforts with these groups. Program information and funding opportunities should be widely disseminated to all communities of the Roanoke Valley-Alleghany County region through existing stakeholder networks and public engagement tools. RVARC members should consider and incorporate some of the following outreach activities when connecting with underserved and low-income communities:

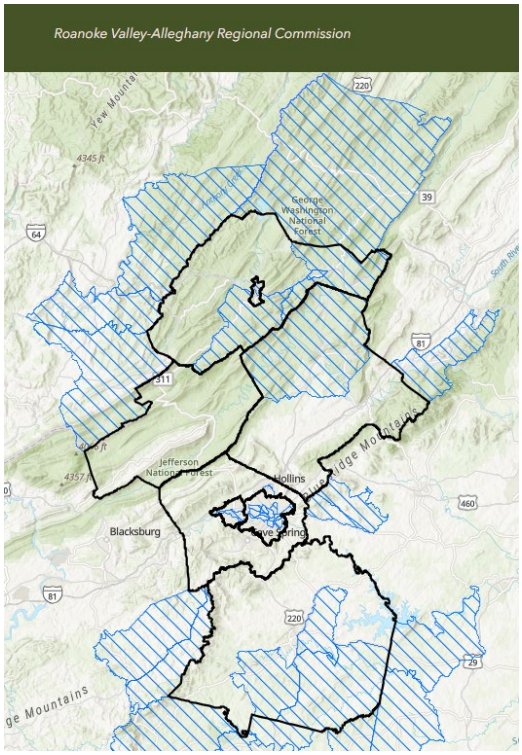
- Translate materials into multiple languages as needed.
- Plan outreach at locations where these community members already meet regularly.
- Educate the audience on why and how EVs and EV charging stations are relevant to them, including benefits such as emissions reduction, improved mobility, and lower cost of ownership.
- Describe federal and state incentives for EV adoption and EV charging station installation, especially those prioritizing investment and programs in disadvantaged or underserved communities.
- Highlight lower cost ways to own and operate an EV and EV charging stations, such as:
    - Purchasing a used EV
    - Participating in an EV carshare or rideshare program, if available
    - Utilizing public EV charging stations
    - Utilizing EV charging stations available in multifamily dwellings
    - Taking advantage of EV and EV charging stations financial incentives provided by the federal government, Virginia, electric utilities, and other entities
- Explain Virginia's "Right-to-Charge" law, which protects tenants that wish to install EV charging stations on property owned by the resident

RVARC localities should leverage ongoing connections of existing partner organizations and seek new partnerships with member governments, relevant state agencies, stakeholder groups, and community organizations to identify disadvantaged communities and plan and implement meaningful public outreach. RVARC member jurisdictions can use climate and equity tools that have been developed by other government

entities to help identify disadvantaged communities throughout the engagement process. which include the following:[28]

- EV Charging Justice40 Map: Tool from Argonne National Laboratory providing interactive maps of disadvantaged communities;

Figure 5: Justice40 Census Tracts in RVARC Area



- Climate and Economic Justice Screening Tool: Mapping tool from the Council on Environmental Quality that uses climate change energy, health, housing, legacy pollution, transportation, water and wastewater and workforce development to identify communities that are overburdened and underserved;
- Screening Tool for Equity Analysis of Projects (STEAP): Mapping tool from the Federal Highway Administration that supports environmental justice screening;
- Low-Income Energy Affordability Data Tool: Tool from the U.S. Department of Energy that provides estimates of low-income and moderate-income household energy data;
- Transportation Equity Analysis: Tools and resources from Argonne National Laboratory that support transportation energy equity analysis; and,
- Virginia EJScreen+: Mapping tool from the Virginia Department of Environmental Quality that increases access to and enhances awareness of environmental justice-related data and information throughout the Commonwealth.

[28] U.S. Department of Energy and Transportation have similar but distinct definitions of DACs.

4.5 Regional Siting Analysis

ICF has developed an approach to EV charging station siting analyses to identify and recommend locations to deploy publicly accessible light-duty EV charging stations.[29] Building off ICF's existing EV charger GIS mapping analysis methodology, the development of these recommendations follows a three-stage process. This process aims to identify sites with a high probability for charging demand. Such sites will likely receive higher utilization, leading to a better and faster return on investment for those charging stations. Each step of the process will also account for scenarios that focus on equitable outcomes when prioritizing site locations.

The output of this analysis is intended to provide local jurisdictions and planning agencies with guidance and recommendations on optimal locations for EV charging station deployments; it is not meant to be prescriptive. Using this map output in conjunction with EV projections will allow jurisdictions to estimate the number of chargers needed to support the current and future EV market as well as key locations for deploying the infrastructure in order to build out a comprehensive charging network that accounts for regional demand. RVARC and its local jurisdictions should use this study in conjunction with local knowledge to determine the best path forward for charging infrastructure deployments.

4.5.1 Step 1: Census Block Group Trip Data Scoring Methodology

The first step in the EV charging station siting analysis is a census block group (CBG) trip screening. Each CBG in the region will be scored based on certain trip characteristics that end within that CBG. The primary purpose of this step in the analysis is to identify CBGs with the highest number of trips and which CBGs have the most trips with characteristics of interest. CBGs with more trips are assumed to be areas that will have higher charging demand. CBG scores are based on the following metrics and trip characteristics:

- Trip Purpose – Number of non-home-based trips[30]
- Trip Length – Number of long-distance trips (≥20 miles)
- Dwelling time[31] 30 to 60 minutes (shorter trips that indicate drivers would prioritizing direct current fast chargers (DCFC))
- Dwelling time 60 to 120 minutes (medium-distance trips that indicate drivers may prioritize either DCFC or Level 2 (L2) chargers)
- Dwelling time >120 minutes (longer trips where drivers leave their cars for multiple hours, indicating drivers may prioritize L2 chargers)
- Income of the trip taker (> median income)
- Income of the trip taker (< median income)
- Trips originating from multi-family housing (MFH)
- Trips originating from environmental justice (EJ) communities[32]

Each CBG is scored based on the percentage of regional trips it receives meeting the criteria, normalized on a scale of 0 to 1, and then assigned a percentile rank. The final score is derived through assigning a weight to the

[29] Both Level 2 and Direct Current Fast Chargers
[30] This metric encompasses both work commutes and shopping trips. Scenarios were then built around additional metrics like dwelling time or equity prioritization, rather than trip types.
[31] Dwelling time indicates how long a driver leaves their vehicle at a destination. Shorter dwell times are likely associated with grocery trips, whereas longer dwell times might be associated with work or outdoor recreational activities. A longer vehicle dwell time indicates that a L2 charger is more appropriate than a DCFC for that trip.
[32] EJ communities are defined as those located in Justice40 areas.

metrics of interest, calculating the sum product of the characteristics, and assigning distributed scores of 1 to 6 throughout all CBGs in the regional study area.[33]

For example, a CBG with many non-home-based trips should receive a higher score since it is more likely that there will be a need for a public EV charging infrastructure within that CBG. A CBG with a higher number of long-distance trips is also more likely in need of charging stations because drivers will be farther from home and require public charging. Similarly, expanded use of the dwelling time characteristics can be used as a means of prioritizing L2 versus DCFC at priority locations.

ICF developed three scenarios for Step 1. ICF's three proposed scenarios are below:

Table 8. Siting Analysis Scenario Descriptions

Scenario	Scenario Priority	Scenario Description
A	Prioritizing L2 chargers with high utilization	Trips taken by drivers with high incomes and that have dwell times of > 120 minutes are prioritized.
B	Prioritizing DCFCs with high utilization	Longer trips with shorter dwell times taken by drivers with high incomes are prioritized. DCFCs are prioritized by focusing on drivers taking longer trips with shorter dwell times that would need to charge more rapidly.
C	Prioritizing L2 chargers with equity focus	Trips originating from EJ communities and that have dwell times of > 120 minutes are prioritized.

4.5.2 Step 2: High Priority Parcel Analysis

After all CBGs had been scored, the analysis advanced to a more granular assessment. Step 2 involved prioritizing individual parcels for siting within CBGs based on certain parcel-level characteristics. Many parcels were initially excluded from public charging recommendations based on use type (e.g., single-family housing, railways, utility-owned, etc.) or emphasized based on ownership and ease of construction.[34]

Score modifiers, or certain characteristics that are considered priorities for charging station deployment, were incorporated during Step 2 and applied to analyzed parcels to ensure specific factors (e.g., equity, proximity to existing charging stations, etc.) are considered during the scoring process. Parcel-level characteristics can include the following as score modifiers:

- **Distance to existing charging stations**. Locations that are close to existing chargers may have less demand. Similarly, these areas already have existing infrastructure and likely will not be as high of a priority as locations without existing infrastructure. This results in a score reduction based on a function of the number of chargers and trips to that CBG.
- **Distance to MFH**. Residents of MFH typically lack access to home charging and will likely rely more heavily on public infrastructure to meet charging needs versus individuals that live in single-family homes.

[33] Even if a trip metric is not weighted, it was still considered in the analysis, just without any additional weighting or emphasis.
[34] Examples of parcels that were excluded from the analysis include railways, utility-owned parcels, single-family housing, agricultural, and commercial/industrial.

- **Distance to highway on-ramp or off-ramp**. Sites located near highway ramps are likely to attract EV drivers who are making longer trips, typically needing DCFC.
- **Location in or near an EJ community**. This ensures the benefits of EVs are spread equitably in the region. Providing access to charging infrastructure in EJ communities can help remove barriers to EV adoption.
- **Distance to public transportation connections**. The distance from potential sites to the nearest public transportation or park-and-ride locations helps determine which sites will be most useful in enabling more sustainable first and last miles of multimodal trips. Charging locations near transit and park-and-ride locations could benefit EV ride-sharing companies or commuters that use a combination of personal vehicles and mass transit.
- **Distance to outdoor recreation access points.** The distance from potential sites to trailheads and other outdoor recreation access points is a unique consideration for the RVARC region. Outdoor recreation serves an important role in RVARC, both for residents and tourists. Providing access to charging infrastructure near these locations can help improve accessibility for individuals looking to enjoy the region's natural attractions.
- **Distance to public libraries.** This ensures the benefits of EVs are available at publicly accessible and popular locations within communities.

Proximity scoring modifiers used in the analysis include[35]:

- Park-and-ride location within 1/4 mile
- Level 2 charging within 1/2 mile
- DC Fast charging within 1/2 mile
- Outdoor recreation access points within 1/4 mile
- Multifamily housing within 1/4 mile
- Justice40 area with 1/4 mile
- Public libraries within 1/4 mile
- Travel demand is estimated based on the number of non-home-based trips at the CBG scale for three scenarios

These factors were assessed with GIS software and compiled to modify the demand score. The score for each parcel was calculated by summing a parcel's opportunity charging score (CBG score) and the total score for the parcel-level analysis factors.

[35] Final proximity score modifiers used in this analysis have been determined based on data availability in RVARC jurisdictions and the region.

4.5.3 Siting Analysis Results

The RVARC EV charging station siting analysis produced two parcel-level maps. Within the maps, parcels are scored based on Step 1 (CBG trip data) and Step 2 (proximity score modifiers) to get their charging station suitability score. The results of the analysis for all three scenarios, outlined in Step 1 of the Methodology, are displayed by priority and percentile scores. High priority parcels for deployment are red, and low priority parcels for deployment are blue. To access the interactive map, please visit the RVARC EV Siting Parcel Review and toggle on the relevant layers.

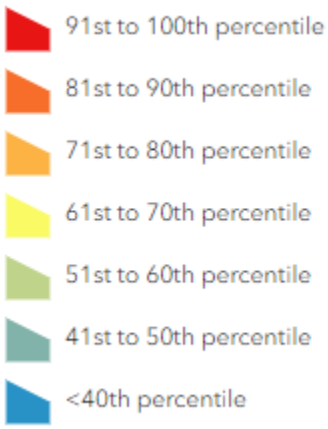


Figure 6. High Utilization Level 2 Priority Scenario, Normalized by Jurisdiction

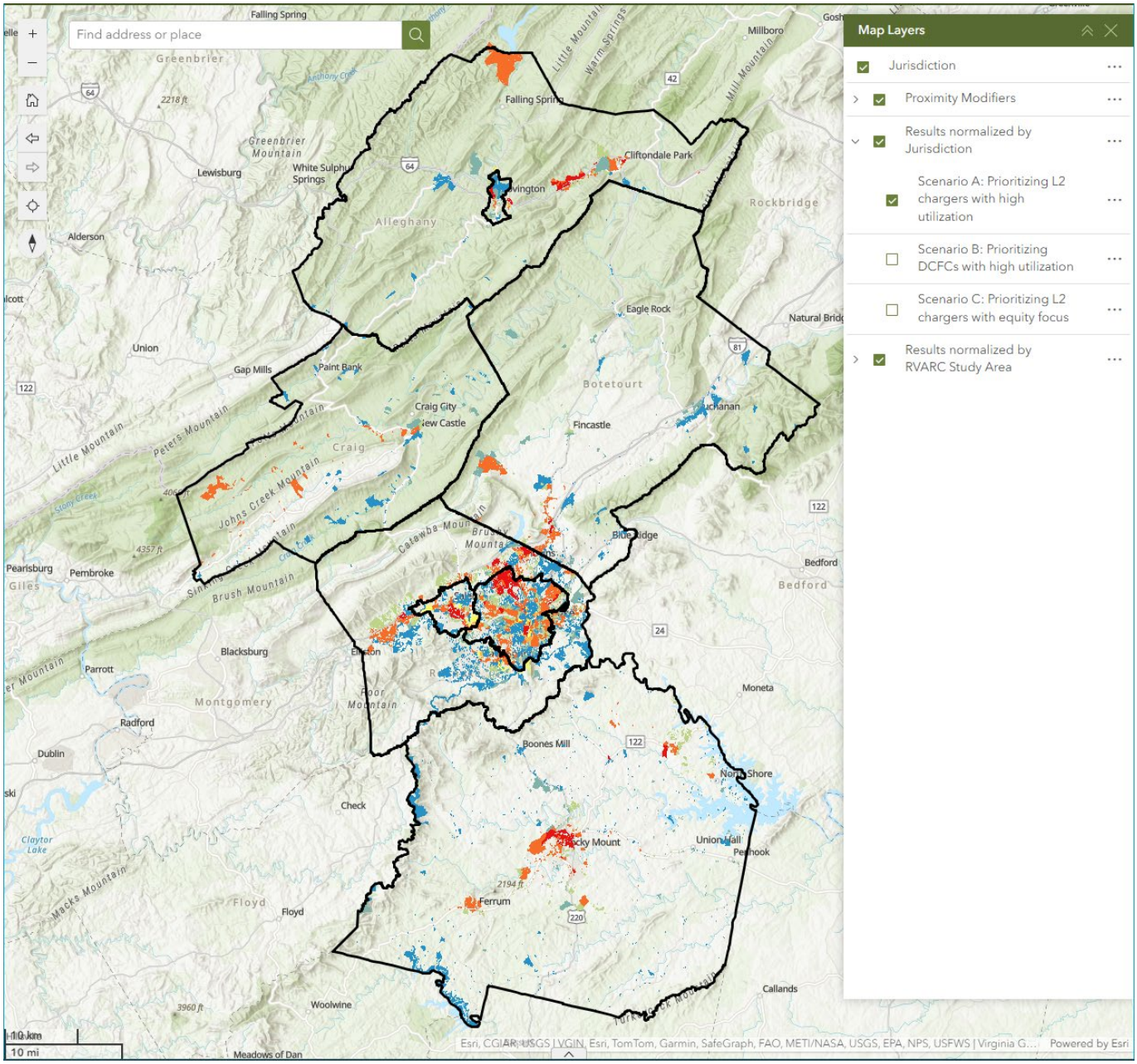


Figure 7. High Utilization DCFC Priority Scenario, Normalized by Jurisdiction

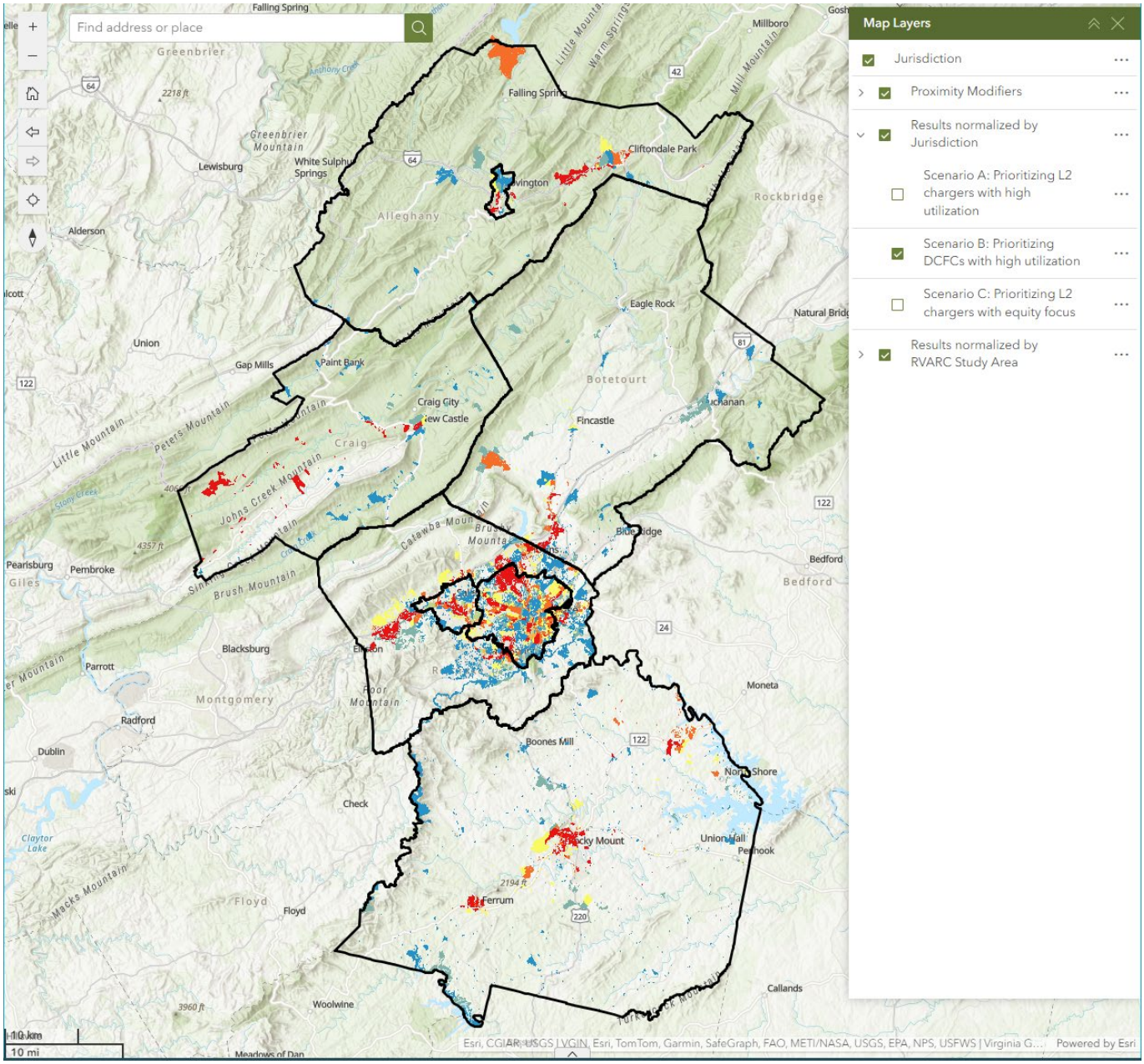
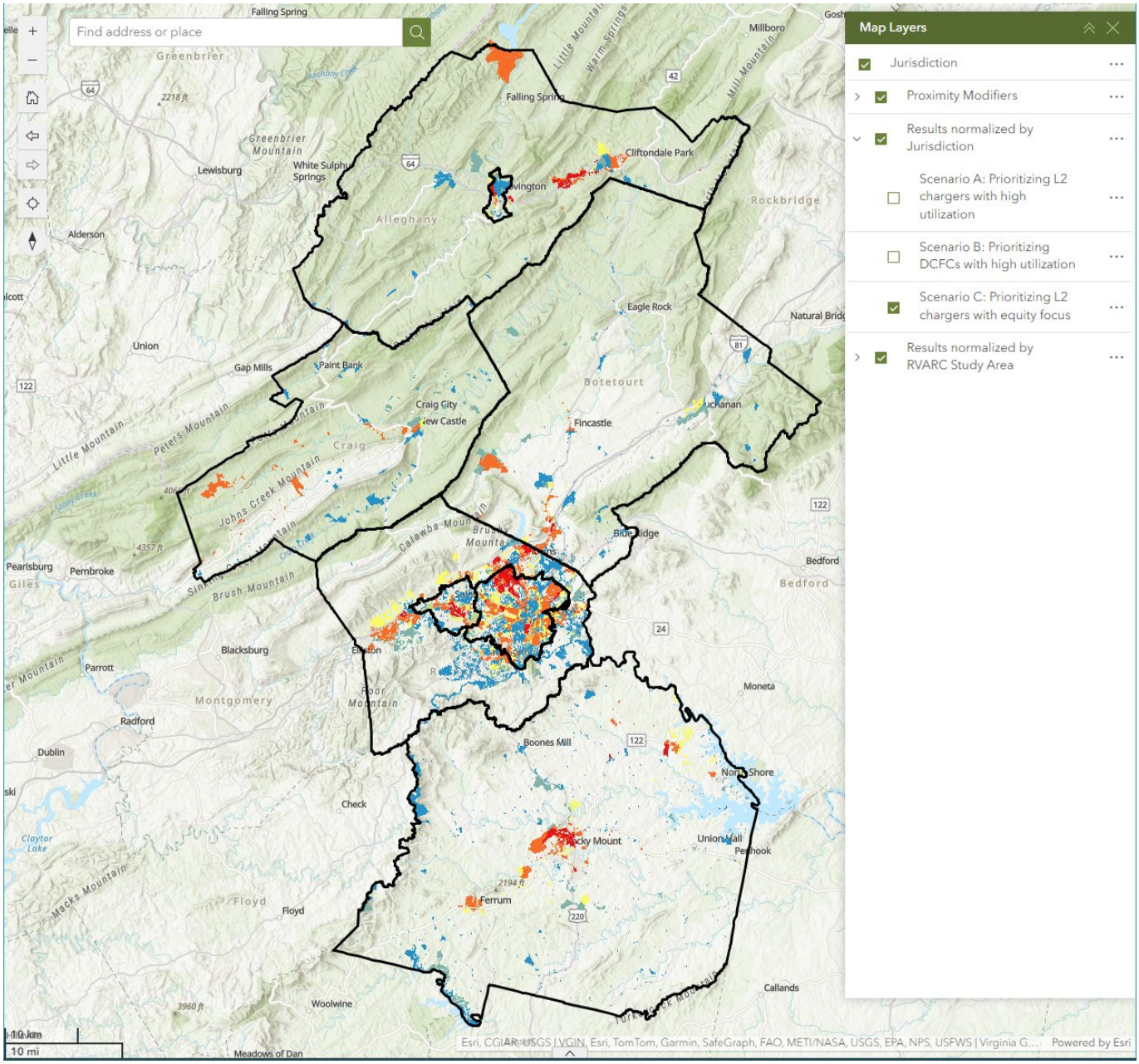


Figure 8. Level 2 with Equity Priority Scenario, Normalized by Jurisdiction



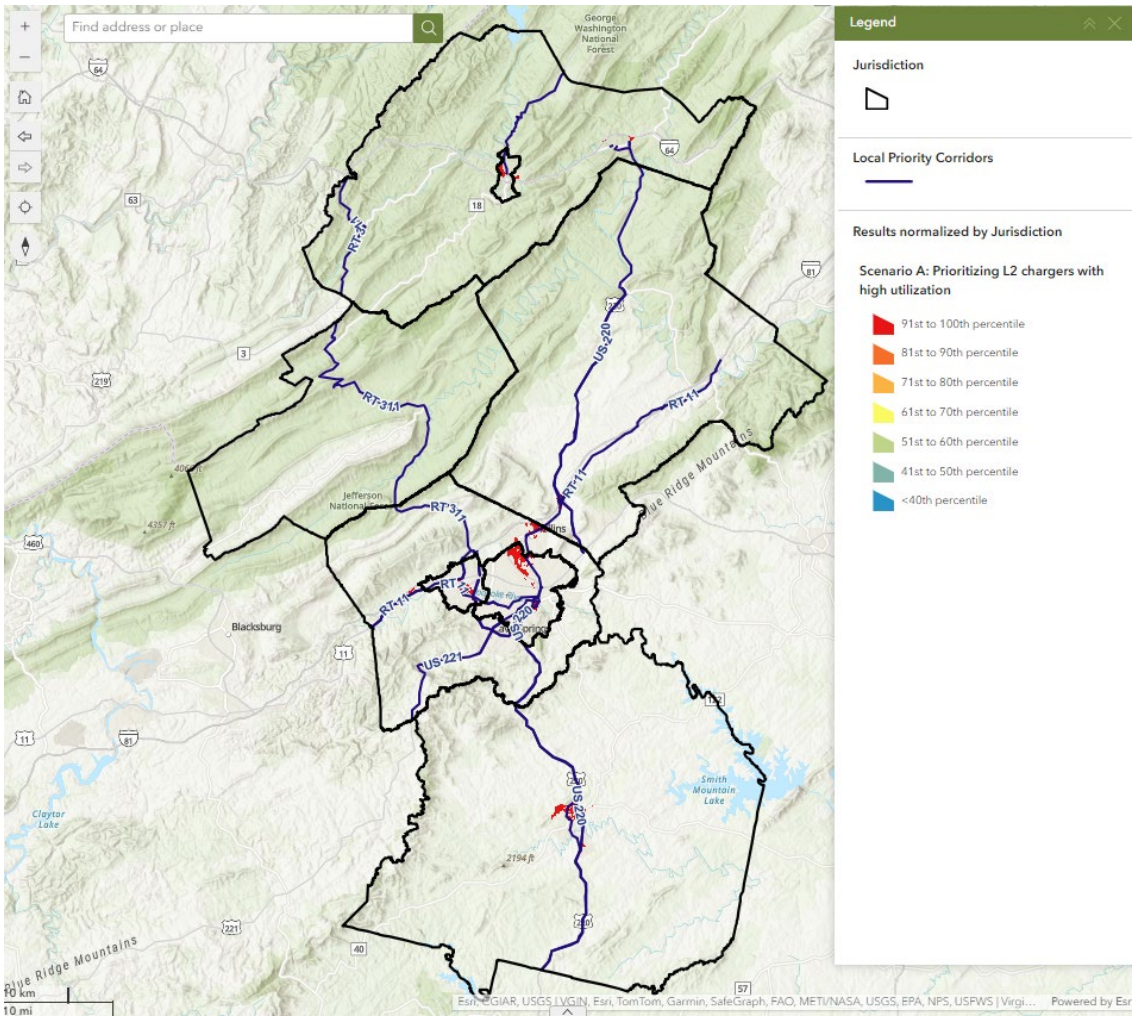
Note that parcel scores may not change dramatically between scenarios; certain parcels score high or low no matter what, based on the data. For example, some high scoring parcels will remain high scoring across scenarios because they receive the majority of trips and are located near proximity modifiers. Grey areas indicate areas that were excluded from the analysis.

4.5.4 Local Priority Corridors

Based on this analysis, the region may choose to focus EV charging investments along local corridors in the next phase of implementation. Siting EV charging infrastructure nearby local corridors can provide crucial charging access to strengthen the regional EV charging network and reduce range anxiety for EV drivers as they travel within and through the region. Many high-scoring parcels are located nearby priority local corridors, which are:

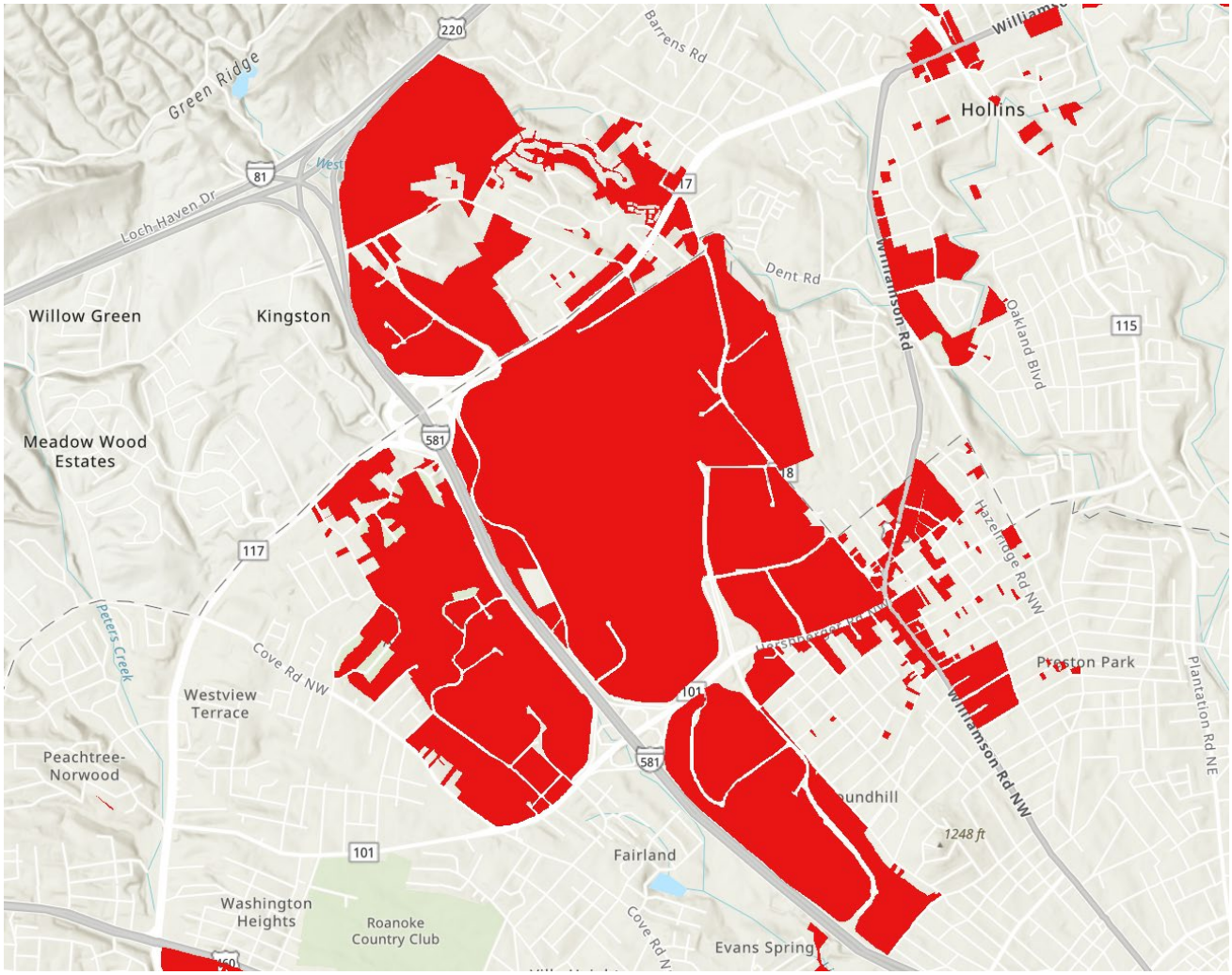
- US 220
- US 221
- RT 11
- RT 311
- RT 419

Figure 9. High Scoring Parcels Along Local Priority Corridors



As shown in **Figure 10**, the area along US 220 near the Roanoke Blacksburg Regional Airport and Valley View Mall has been identified as a high-priority location for DCFC stations, with several large parcels falling within the top ten percentile of the high utilization scenario that prioritizes DC fast charging. Members of RVARC may consider this, and similarly identified, areas for potential DCFC site locations. DC fast chargers are recommended for highway and short-term destination charging since EVs may only stop and charge for shorter periods of time compared to charging at home or at work.

Figure 10. High Utilization DCFC Priority Scenario, Top Ten Percentile Parcels Along US 220



Note that identified local priority corridors do not overlap with federally-recognized Alternative Fuel Corridors (AFCs), since the Virginia Department of Transportation (VDOT) has and will continue to focus federal National Electric Vehicle Infrastructure (NEVI) Formula Program investments along AFCs. For more information on VDOT's NEVI plans, see **Federal Funding Opportunities**.

Members should work with local staff to analyze and leverage jurisdictional results for future EVSE network planning and stakeholder engagement. The siting analysis can provide useful insights on potential site hosts to engage, more specific locations to include when applying for funding opportunities, and more.

4.6 Utility Engagement and Grid Capacity Considerations

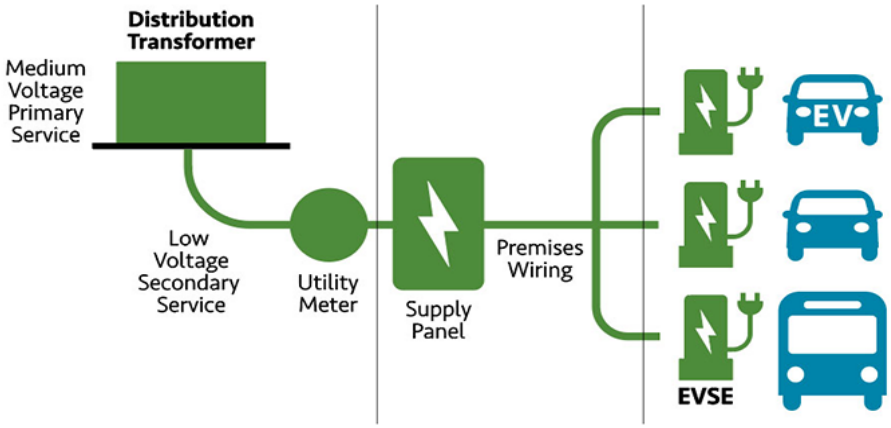
Coordination and collaboration with local utilities is an important component of ensuring successful deployment of EV infrastructure. Determining local electricity rates is important to understanding the total cost of ownership. Electricity rates are important factors in planning EVSE deployment.

Evaluating electrical supply needs to support EV charging infrastructure at those locations is an important next step in EV charging station site evaluation. As the Roanoke Valley-Alleghany region identifies EV charging station locations, the process may involve working with Appalachian Power, Dominion Power, Craig-Botetourt Electric Cooperative, and any other utilities to conduct site assessments which evaluate whether there is sufficient electrical capacity to serve the expected increase in load. Utilities could also take an observed increase in demand and incorporate future load into their plans to invest in grid resources and distribution upgrades.

4.6.1 Utility Upgrade Costs

Electric utilities may need to upgrade their distribution grid infrastructure to enable EVSE operations. This process often involves upgrading transformers and conductors at EVSE sites. The figure below provides a simplified illustration of the process of delivering power to EVSE.

Figure 11. Utility and Customer EV Infrastructure Equipment[36]



	UTILITY SERVICE	PREMISES WIRING	EVSE
1. Traditional	Electric Company	Customer	
2. Make Ready	Electric Company		Customer
3. EVSE Only	Electric Company	Customer	Elecric Company
4. Full Ownership	Electric Company		

[36] U.S. DOT. EV Infrastructure Project Planning Checklist. Retrieved from: https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-planning/project-planning-checklist

If a site does not have enough capacity to deliver power for an EV charger, the service transformer would need to be upgraded. When grid upgrades are requested as part of a specific customer project, the customer is typically responsible for the associated cost. The table below shows average unit costs for service transformer upgrades, based on average estimates from the National Renewable Energy Laboratory's (NREL) unit cost database and unit cost guides from California's three major investor-owned utilities.

Table 9. Average Unit Costs for Service Transformer Upgrades [37,38,39,40]

Unit Size	Cost Estimate		Unit Size	Cost Estimate
Transformer (25 kVA)	$3,853		Transformer (500 kVA)	$55,300
Transformer (50 kVA)	$4,178		Transformer (750 kVA)	$64,100
Transformer (75 kVA)	$5,249		Transformer (1000 kVA)	$93,933
Transformer (100 kVA)	$6,057		Transformer (1500 kVA)	$106,450
Transformer (150 kVA)	$45,100		Transformer (2500 kVA)	$164,550
Transformer (300 kVA)	$45,600			

Utility feeder lines that serve areas of a city may not have sufficient capacity to add new EVSE, especially DC fast chargers. Upgrades to utility feeder lines have widely varying costs, so it is not possible to provide a "rule-of-thumb" range.

4.7 Supply Chain Considerations

Potential global supply chain and EV backlogs may lead to long periods of time between vehicle down payment or purchase and fleets receiving their vehicle order, and could present a near-term barrier for RVARC member jurisdictions. Possible delays associated with production and delivery of vehicles and necessary charging station components could slow deployment across the region. To circumvent as many complications as possible, member jurisdictions should focus on ordering critical components and vehicles promptly and stay in touch with vehicle and EVSE suppliers. Ordering and purchasing equipment as soon as possible will also decrease the likelihood of inflated costs impacting project plans and budgets. Coincidentally, member jurisdictions should take advantage of this anticipated delay to expedite the required permitting for EVSE and prepare "shovel-ready" projects, allowing for faster installation once equipment is received.

[37] Horowitz, Kelsey. 2019 Distribution System Upgrade Unit Cost Database Current Version. National Renewable Energy Laboratory. Retrieved from: https://data.nrel.gov/submissions/101
[38] PG&E Unit Cost Guide. Retrieved from: https://www.caiso.com/documents/pge2022finalperunitcostguide.xlsx
[39] SCE Unit Cost Guide. Retrieved from: www.sce.com/sites/default/files/inline-files/Attachment_A-Unit%20Cost%20Guide%202021_Final.pdf
[40] SDG&E Unit Cost Guide. Retrieved from: www.sdge.com/sites/default/files/documents/unit.cost_.guide_.3.31.20_R3_EAJ1.pdf

5 Implementation Plan

This section reviews EV charging infrastructure policies, requirements, and regulations in the Roanoke Valley-Alleghany Region, describes relevant policies from other jurisdictions, and makes recommendations for policies that can help lower barriers to and incentivize deployment of EV charging infrastructure in member jurisdictions. Member jurisdictions can accelerate EV adoption and complement supportive state policies to accelerate the transition to a zero-emission transportation system by:

- Strengthening EV-ready building codes
- Enacting supportive parking and zoning bylaws
- Increasing access to permitting information for EV charging equipment
- Monitoring updates to accessible design recommendations for EV parking spaces and signage

5.1 Zoning and Building Codes

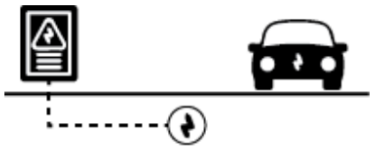
5.1.1 EV Readiness

EV readiness zoning ordinances or building codes, at both the state and local level, can require a minimum number or percentage of parking spaces for new residential or commercial construction to be "EV-Capable", "EV-Ready" or "EV-Installed". The figure below provides an overview of these terms.

Figure 12. Building Code Definitions[41]

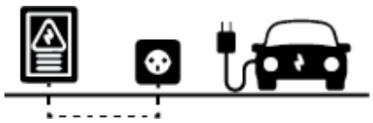
EV-Capable Parking Space: Electrical Panel Capacity & Conduit

- Install panel capacity and conduit (raceway) to accommodate the future build-out of EV charging with 208/240 V, 40-amp circuits.
- Rationale: Provide hard-to-retrofit elements during new construction while minimizing up-front cost.



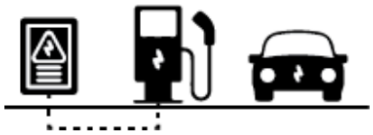
EV-Ready Parking Space: Install full circuit

- Full circuit installations include 208/240V, 40-amp panel capacity, raceway, wiring, receptacle, and overprotection devices similar to a dryer circuit.
- Rationale: Full circuits are plug-and-play ready and minimize total costs and additional barriers to installing Electric Vehicle Supply Equipment (EVSE).



EV-Installed: Install EV Charging Station (also known as Electric Vehicle Supply Equipment or EVSE).

- Install charging stations during new construction.
- Rationale: Provide a visible signal that building supports EV charging and reduce future EV charger installation costs to zero.



One goal of enacting requirements for EV charging parking spaces is to lower the installation costs for EV chargers. Installing EV infrastructure in new developments along with larger construction efforts can be substantially less expensive than installing EV infrastructure as a retrofit. The Southwest Energy Efficiency Project (SWEEP) estimates that costs can be four to six times higher when installing EV infrastructure during

[41] SWEEP. SWEEP guide to EV infrastructure building codes: Retrieved from: https://www.swenergy.org/ev-infrastructure-building-codes/

retrofits as opposed to during initial construction. An existing site's configuration and electrical capacity play a significant role in the range of cost differences and can have the effect of discouraging potential site hosts from installing EV chargers. The California Air Resources Board (CARB) estimates that approximately $8,000 can be avoided by installing an individual Level 2 charger during new construction. For locations with multiple Level 2 chargers, $7,000 per parking space can be avoided.[42] EV readiness in new construction paired with energy management strategies can increase estimated cost savings.

5.1.1.1 Case Study: California

CALGreen, the State of California's green building code, has established minimum requirements for EV-capable infrastructure in new buildings. While installations of EV chargers are not required, the codes are designed to avoid costs of retrofits and simplify future EV charging installations by requiring baseline levels of EV charging readiness. Local jurisdictions can also adopt CALGreen's two-tiered voluntary reach codes, which require minimum EV-capable parking requirements for multi-unit dwellings at 15 percent or 20 percent.[43]

5.1.1.2 Case Study: Fort Collins, CO

In Fort Collins, new construction or renovations where more than 50% of the building area is changing are required to include EV-Capable, Ready, or Installed parking spaces. All new buildings or buildings undergoing a primary or partial change of occupancy shall provide EV parking spaces based on the minimum number of parking spaces. The percentage of required EV capable, ready, and installed parking spaces vary depending on occupancy classification as shown below.[44]

[42] CARB. EV Charging Infrastructure Non-residential Building Codes. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2020-08/CARB_Technical_Analysis_EV_Charging_Nonresidential_CALGreen_2019_2020_Intervening_Code.pdf
[43] California Governor's Office of Business and Economic Development. EV Charging Station Permitting Guidebook. Retrieved from: https://businessportal.ca.gov/wp-content/uploads/2019/07/GoBIZ-EVCharging-Guidebook.pdf
[44] City of Fort Collins, Colorado. Fort Collins Municipal Code Section 5-27-2.3604: https://library.municode.com/CO/fort_collins/codes/municipal_code?nodeId=CH5BUBURE_ARTVIHOST_DIV2REHOST_SDAGE_S5-236DEhttps://library.municode.com/co/fort_collins/codes/municipal_code?nodeId=CH5BUBURE_ARTIIBU_DIV2BUCOST_S5-27AMDE2021INBUCO

Figure 13. Fort Collins EV Readiness Requirements for New Buildings by Occupancy Classification

City of Fort Collins Occupancy Classification for EV Charging Infrastructure	EVSE - installed	EV - Ready	EV - capable
Tier 1			
Residential	10%	20%	40%
Affordable housing	Minimum of 1 space	15%	20%
Tier 2			
Mercantile	5%	15%	20%
Assembly	5%	15%	20%
Institutional	5%	15%	20%
Business	5%	15%	20%
Educational	5%	15%	20%
Factory	5%	15%	20%
Tier 3			
High hazard	1%	5%	15%
Storage	1%	5%	15%
Utility and misc. group	1%	5%	15%

5.1.2 Accessibility

The Americans with Disabilities Act (ADA) Title III prohibits discrimination on the basis of disability in the activities of places of public accommodations (businesses that are generally open to the public, such as restaurants, movie theaters, schools, day care facilities, recreation facilities, and doctors' offices) and requires newly constructed or altered places of public accommodation—as well as commercial facilities (privately owned, nonresidential facilities such as factories, warehouses, or office buildings)—to comply with the ADA Standards.

However, ADA and the Architectural Barriers Act (ABA) do not currently include any specific accessibility requirements for EV parking spaces, although design recommendations as well as other considerations such as accessible communications features have been released by the U.S. Access Board.[45] The Fair Housing Act (FHA) also requires covered facilities to have public and common use areas that are readily accessible and usable by people with disabilities but does not specify requirements for EV parking spaces.[46]

[45] U.S. Access Board. Design Recommendations for Accessible EV Charging Stations. Retrieved from: https://www.access-board.gov/tad/ev/

[46] U.S. Department of Housing and Urban Development. Housing Discrimination Under the Fair Housing Act. Retrieved from: https://www.hud.gov/program_offices/fair_housing_equal_opp/fair_housing_act_overview

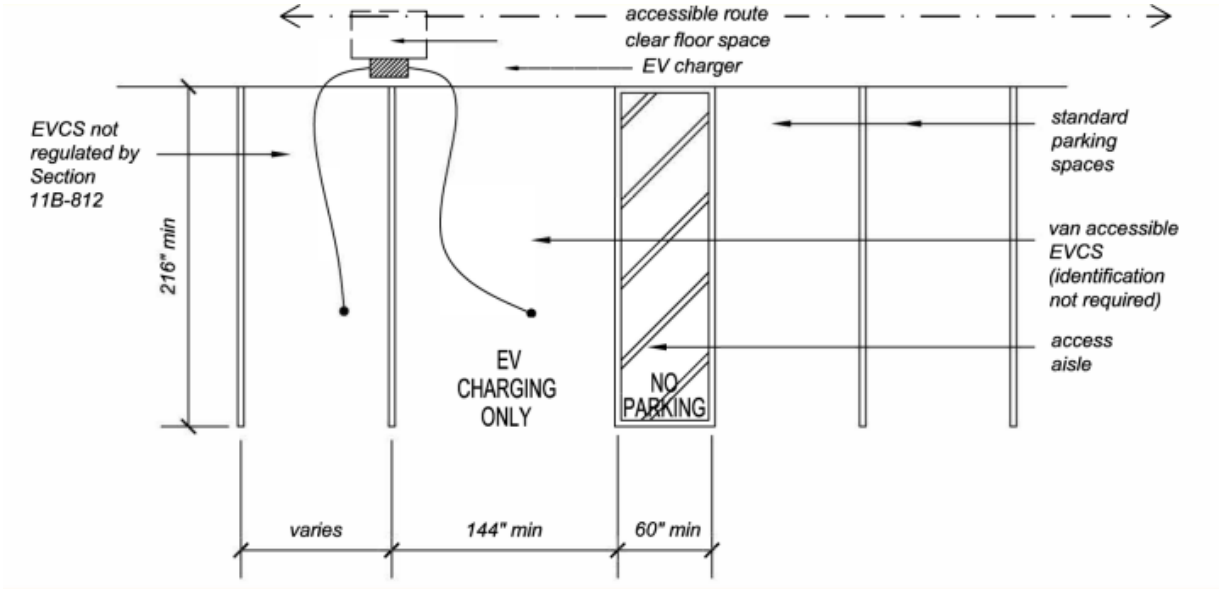
While the RVARC region lacks official policies regarding accessibility for EV parking spaces, the Virginia Clean Cities and Communities coalition created **informal accessibility guidance** for EV charging in Virginia.[47] Informal accessibility guidance is included below.

- Ensure adequate space to move a wheelchair or other equipment in and out of the vehicle.
- Place operable parts of EV chargers within unobstructed reach from a wheelchair.
- Include space for turning around a wheelchair near the charging equipment and inlet of the vehicle.
- Place the station on an accessible path near the parking destination.

5.1.2.1 Case Study: California

The California Building Code requires that EV parking spaces, in specific cases, be accessible. There are four types of accessible EV parking spaces that must be accommodated in specific situations including van accessible, standard accessible, ambulatory, and drive-up. Accessibility requirements only apply to new construction and significant renovations. Examples of compliant accessible EV parking spaces are given in a California Department of General Services presentation on EV charging stations (shown below).[48]

Figure 14. California Accessible EV Charging Parking Space Diagram



5.1.3 Zoning and Building Code Recommendations

RVARC member jurisdictions can support the development of a robust regional EV charging network by assessing their existing zoning and building codes for EV readiness best practices. Members should:

- Evaluate existing zoning ordinances and building codes for existing EV readiness provisions.
- If EV readiness provisions are not included, propose zoning amendments that require baseline levels of EV readiness (EV-Capable, Ready, and/or Installed) for new buildings.

[47] Electric Vehicle Charging for Persons with Disabilities, 2012, https://www.vacleancities.org/wp-content/uploads/EV-Charging-ADA-Version-1.0s.pdf

[48] California Department of General Services. Electric Vehicle Charging Stations: https://scag.ca.gov/sites/main/files/file-attachments/tt031020_californiaevcsaccessibilityregulations.pdf?1605821849

  - Consider zoning amendments that require baseline levels of EV readiness for new developments that are differentiated by building type.[49] Consider who and how to engage stakeholders to gather input on levels of EV readiness for different building types.
  - Consider EV readiness requirements for existing buildings undergoing significant renovations or use changes.
  - Ensure that EVSE retrofit spaces still count toward parking minimums.
  - Consider a parking study to improve land use/transportation efficiency in placement requirements of EVSE.
- Monitor federal announcements for new recommendations or requirements on accessible EVSE parking spaces.
- Provide U.S. Access Board accessible EV charging parking space recommendations to relevant or interested parties in the interim.
- Encourage property owners to consider installing accessible EVSE parking spaces concurrently with ADA parking space updates.

5.2 Parking and Signage Bylaws

Local jurisdictions can improve driver confidence and increase the number of EV charger installations by instituting supportive parking and signage bylaws. Consumers are more likely to consider purchasing an EV if they have access to publicly available charging stations or EV-ready infrastructure on or near their residence.[50] This is increasingly important for residents of multi-unit dwellings, who require greater access to off-street charging infrastructure. Cities and states can improve access to stations through right to charge laws and by allowing EV chargers to be installed in the public right-of-way, such as curbside locations.

Some jurisdictions have instituted **anti-idling policies** in an effort to ensure that EV parking spaces are reserved for actively charging vehicles. The State of Virginia passed an EV Parking Space Regulation[51] which prohibits any vehicle that is not actively charging from parking in a designated EV charging parking space. The penalty for violation is up to $25, with the ability for local governments to add-on another $25 for a maximum possible penalty of $50. Penalties can only be imposed when parking spaces reserved for EV charging display a sign with the following language, "PENALTY, UP TO $25." In the event that proper signage is not posted, penalties cannot be brought against inactive vehicles parked in EV parking spaces.

Virginia has also passed the **Right-to-Charge** law which prohibits homeowner associations or condominium associations from restricting the installation or use of an EV charging station in a homeowner's dedicated parking space.[52] Associations may put reasonable restrictions on EV charging stations, but the association must treat EV charging station installations in the same manner as any unit architectural modification. Residents are required to comply with all relevant building codes and safety standards and engage a licensed EV charging station contractor. The residential EV charging station owner is responsible for the cost of the installation, operation, maintenance, repair, insurance, removal, or replacement of the station, as well as any resulting damage to the EV charging station or surrounding area. Condominium associations could prohibit EV

[49] Fort Collins EV readiness requirements only applied to residential and certain commercial building types initially. After observing the benefits of these requirements, the City expanded requirements to more building types and created baseline with community input.
[50] Singer, Mark. Plug-In Electric Vehicle Showcases: Consumer Experience and Acceptance. National Renewable Energy Laboratory. Retrieved from: https://www.nrel.gov/docs/fy20osti/75707.pdf.
[51] AFDC. Electric Vehicle (EV) Parking Space Regulation. Retrieved from: https://afdc.energy.gov/laws/12893
[52] AFDC. Electric Vehicle (EV) Charging Station Policies for Associations. Retrieved from: https://afdc.energy.gov/laws/12407

charging installations only in situations where installations are not technically feasible or if it poses engineering or safety risks.

5.2.1 Leading Jurisdictions

Cities can modify **parking ordinances** to encourage EV car sharing by reducing parking requirements when EV car sharing is used on site. The City of Santa Monica allows building developers to reduce their parking requirement by two spaces for every space designated for car sharing.[53]

Some local municipalities have adopted strategies to increase the capacity to add additional EV parking spaces at multi-unit dwellings. The City of Oakland requires an electrical panel capacity capable of supporting charging for 20% of spaces at both new multi-unit dwellings with three or more units and non-residential buildings.[54]

"Garage orphans" are EV drivers that do not have access to a driveway or garage where they could install a private EV charging station. Garage orphans have become a growing issue across the country and various jurisdictions have been testing tailored solutions to provide charging to these residents. Local jurisdictions have developed a range of **curbside charging programs** to meet the needs of EV drivers without access to private parking. Some examples are listed below.

- Montgomery County, MD has released Residential EV Charging Permitting Guidelines, where they have created a separate permitting process to allow residents to install EVSE in the public right-of-way.[55]
- Washington, DC created a public space permit which allows EV charging station vendors to install dual-port Level 2 or DC fast charging stations in eligible curbside locations, including residential blocks and business corridors.[56] Individuals may not apply for this permit. In cases of residents extending electrical cords across the sidewalk to provide a level 1 charge for an EV, the District released guidance for covering cords to safely accommodate residents' charging needs.[57]
- In 2014, the City of Seattle conducted research on how to mitigate barriers to charging for garage orphans.[58] Their findings recommended the two following strategies: after-hours access to private lots and after-hours access to institutional properties. While there is an opportunity to utilize otherwise vacant lots with EV charging infrastructure overnight, whether lot owners would be willing to make EV charging infrastructure accessible outside of business hours will require further discussion.

5.2.2 Policy Recommendations

Local jurisdictions should evaluate their parking and signage bylaws to:

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[53] Santa Monica, California, Municipal Code. Article 9, Planning and Zoning, 9.28.180 Reduction of Required Parking. Retrieved from: www.qcode.us/codes/santamonica/view.php?topic=9-3-9_28-9_28_180

[54] City of Oakland. Electric Vehicle Requirements in New Construction. Retrieved from: https://www.oaklandca.gov/resources/electric-vehicle-requirements-in-new-construction

[55] Montgomery County. Residential EV Charging Permitting Guidelines. Retrieved from: https://www.montgomerycountymd.gov/DPS/Resources/Files/RCI/EV Charging Stations in the ROW.pdf

[56] The District Department of Transportation. EV Charging Station Program. Retrieved from: https://ddot.dc.gov/page/electric-vehicle-charging-station-program

[57] The District Department of Transportation. EV Charging Guidance. Retrieved from: https://ddot.dc.gov/sites/default/files/dc/sites/ddot/Admin%20Issuance%20EV%20Charging%20Guidance.pdf

[58] Seattle Office of Sustainability & Environment. 2014. Removing Barriers to Electric Vehicle Adoption by Increasing Access to Charging Infrastructure. Retrieved from: https://www.seattle.gov/Documents/Departments/OSE/FINAL%20REPORT_Removing%20Barriers%20to%20EV%20Adoption_TO%20POST.pdf

- Understand whether there is a need to establish supportive EV parking or signage policies.
- Clarify relevant EV parking and signage policies for staff and community members.
- Identify opportunities to propose or pilot EV parking and signage policies.

5.3 Permitting

Permit applications for EV charging installations are generally reviewed to ensure compliance with building, electrical, accessibility, and fire safety regulations. It is common for municipalities around the country to require these permit applications to be submitted by station developers, site hosts, or contractors prior to beginning construction on a project. Jurisdictions may also require EV charging stations to comply with public safety, structural, and engineering review processes. Failure of an application to satisfy a local jurisdiction's compliance standards will likely result in an application being returned to the submitter with a request for revisions. This process of submission, review, and revision can continue until the application meets all required standards.

While permits are designed to ensure the safety and reliability of EV chargers, a lengthy permitting cycle can discourage those wishing to install EV charging stations. Implementing a streamlined permitting process can greatly cut back on the project time and costs associated with installation.

5.3.1 Leading Jurisdictions

Several counties in Virginia have created dedicated resources to make it easier for installers or site owners to understand the process for EV charger permitting.

- The City of Alexandria's *Guide to Installing Electric Vehicle Chargers in Alexandria* provides a permitting checklist for both residential and commercial Level 1 and Level 2 charging stations. The guide provides information on the permitting portal, how to request an inspector, and FAQs.[59]
- Fairfax County has a website devoted to the permitting and inspection processes for both residential EV charging stations and commercial EV charging stations. The website provides information on fees and documents needed, inspections, and a step-by-step guide for permitting.[60]
- Prince William County has websites devoted to the permitting and inspection process for both residential EV charging stations and commercial EV charging stations. Each website directs users to the respective EV charging policies, ad a step-by-step guide for permitting.[61] [62]

California's *Permitting Electric Vehicle Charging Stations: Best Practices* provides additional information and best practices for EV charger permitting (examples below).[63]

- An expedited, streamlined permitting process for EV charging stations, including Level 2 and DCFC
- A checklist of all requirements needed for expedited review posted on a County website

[59] City of Alexandria. Guide to Installing Electric Vehicle Chargers in Alexandria. Retrieved from: https://www.alexandriava.gov/sites/default/files/2023-11/Alexandria%20EVSE%20Checklist%20and%20FAQ-v1.5.pdf
[60] Fairfax County. Electric Vehicle Charging Station Permits. Retrieved from: https://www.fairfaxcounty.gov/landdevelopment/electric-vehicle-charging-stations
[61] Prince William County. Residential Electric Vehicle (EV) Charging Stations. Retrieved from: https://www.pwcva.gov/department/building-development-division/residential-EV-charging-stations
[62] Prince William County. Commercial Electric Vehicle (EV) Charging Stations. Retrieved from: https://www.pwcva.gov/department/building-development-division/commercial-ev-charging-stations
[63] California Governor's Office of Business and Economic Development. Permitting Electric Vehicle Charging Stations: Best Practices. Retrieved from: https://business.ca.gov/industries/zero-emission-vehicles/plug-in-readiness/permitting-electric-vehicle-charging-stations-best-practices/

- Permit applications that meet checklist requirements will be approved through non-discretionary permit (or similar)
- Electronic signatures accepted
- The permitting office commits to issuing one complete written correction notice detailing all deficiencies in an incomplete application and any additional information needed to be eligible for expedited permit issuance.

Finally, New York's *DC Fast Charger Streamlined Permitting Guidebook for Local Governments* provides an overview of DCFC permitting challenges in New York and administrative and technical best practices for both permit applicants and permitting authorities. The Guidebook includes tools such as model ordinances and a sample permit application.[64]

5.3.2 Recommendations

RVARC member jurisdictions should work with staff to better understand the complete permitting and inspection process for various EV charging station projects, along with associated costs. With a complete picture of their own EVSE permitting process, members can:

- Identify opportunities to optimize the amount of required information included in applications, combine concurrent permitting processes (i.e., electrical and stormwater) to create a comprehensive and streamlined EVSE permitting review process.
- Better understand the total associated costs for EVSE permit applications and inspections.
- Establish clear review and response timelines to support EVSE planning efforts.
- Create a separate page dedicated solely to residential and commercial EV charging station permitting processes.
- Create an FAQ page regarding EV charging stations including information such as financial assistance, curbside charging, publicly accessible charging, charging restrictions, etc. and post the information in an easily accessible online location.
- Consider including EV charging station installations as a category eligible for expedited review.
- Publish guidance for EVSE permits in historic areas.
- Track and share EVSE installations with internal planning and sustainability teams to aid EVSE planning initiatives.

5.4 Technical Best Practices

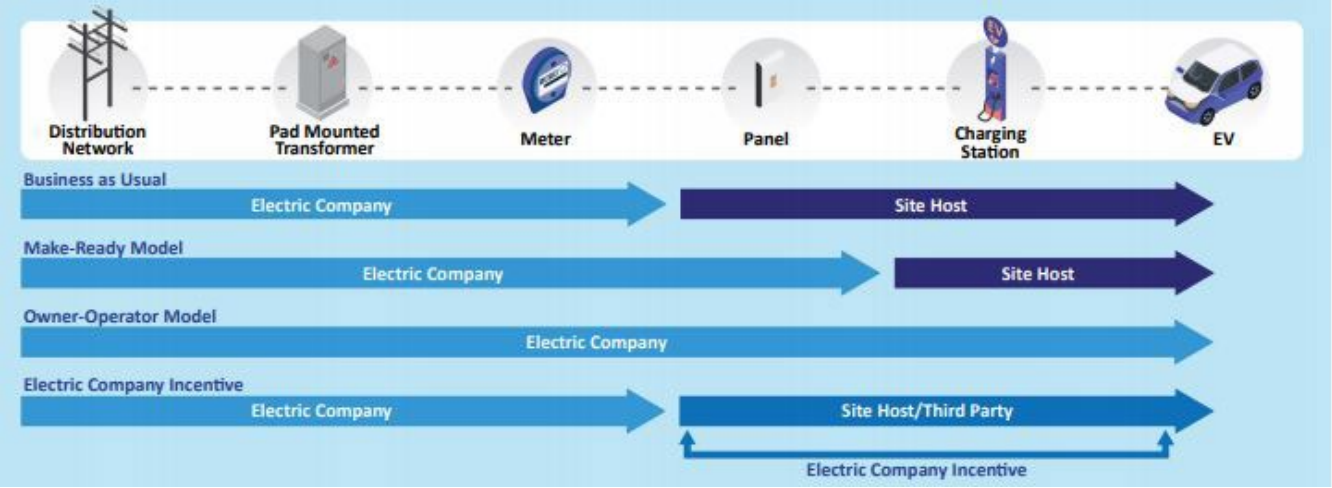
5.4.1 Operations and Maintenance Considerations

5.4.1.1 Ownership Models

Several charging station business and ownership models are available to entities interested in developing charging infrastructure. Understanding ownership models starts with understanding the various components that are part of the broader charging system. The figure below from the Electric Power Research Institute (EPRI) shows four types of EV charging infrastructure ownership models from the perspective of an electric utility.

[64] New York State Energy Research and Development Authority (NYSERDA). DC Fast Charger Streamlined Permitting Guidebook for Local Governments. Retrieved from: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Clean-Energy-Siting/DC-Fast-Charger-Guidebook.pdf

Figure 15. Electric Vehicle Charging Infrastructure Ownership Models[65]



The four types of infrastructure ownership models illustrated above are a business-as-usual model, the make-ready model, the owner-operator model, and the electric company incentive model. The difference between ownership models is found in which party owns and operates site-level charger equipment, including the panel and the charging station itself. Naturally, utilities will own electric transmission and distribution infrastructure, but virtually any entity can own and operate site-level EVSE. For RVARC stakeholders, the list of infrastructure ownership options includes the following:

- **Site-Host Owner-Operator:** In this model, the entity hosting the charging stations also own the charging stations. This model gives the site host complete control of the station and allows them to keep all revenues, but also places the most risk on the host, including risks associated with maintenance, obsolescence, and low charger utilization.
- **Utility Ownership:** In this model, the electric utility would own the charging station. The utility may lease the chargers to the site host or develop its own sites and charging network. For non-utility entities that lease chargers, risks associated with maintenance and charger obsolescence are reduced, but risk of low charger utilization still remains.
- **Third-Party Ownership:** In this model, a site host may partner with a third-party to handle a portion or all of the ownership, operation, maintenance, and billing responsibilities for the charging stations. There is flexibility in this approach as the two parties may agree to the terms, roles, and responsibilities of their choosing. This approach includes partnerships with EV service providers, which is common.
- **Infrastructure-as-a-Service/Charging-as-a-Service:** Infrastructure-as-a-Service is a business model in which a third-party covers all capital expense associated with charging infrastructure development, owns the equipment, and then effectively leases it to a site host under a service agreement that may also include assistance with operations and maintenance. This approach can be beneficial for entities that seek to reduce or minimize the upfront capital cost of charging infrastructure development. The Infrastructure-as-a-Service provider would effectively convert the capital cost of infrastructure development to an operating cost and pass those costs on to the site host via a monthly fee with the

[65] Electric Power Research Institute. (2019, August). Interoperability of Public Electric Vehicle Charging Infrastructure. Retrieved from: https://www.eei.org/-/media/Project/EEI/Documents/Issues-and-Policy/Electric-Transportation/Final-Joint-Interoperability-Paper.pdf

addition of a service charge. This approach may be more costly to site hosts in the long run due to service fees but may still be attractive depending on the value that the site hosts places on reduced upfront costs.

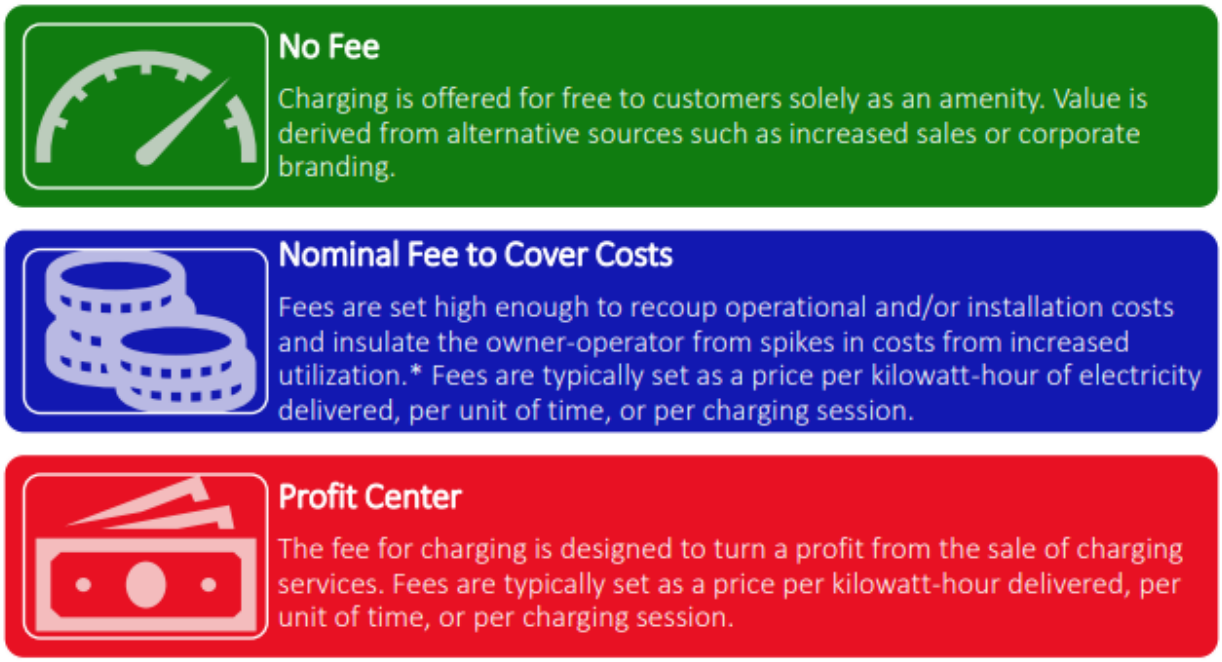
Site hosts should evaluate available ownership models based on operational and management control preferences, vendor and partnership options, and total cost of ownership considerations.

5.4.1.2 Fee Pricing for EV Chargers

An advantage of being a Site-Host Owner-Operator is control over pricing and consistency and optimization of customer experience. This control comes at the price of total responsibility for station operational and maintenance costs, coordination with utilities, and having detailed knowledge of electricity rate. Knowledge of electricity rate structures can be particularly important if the charging infrastructure is connected to the site host's existing electricity meter. In such cases, also known as operating "behind the meter," balancing the optimal pricing structure with the existing electricity demand can become complicated. If owner-operators site charging stations in unfavorable markets or pursue fee structures that negatively impact utilization or dwell time, then the costs of operating stations can outweigh the benefits. Alternatively, well-sited charging stations have the potential to bring significant financial benefits to the owner-operator.

When choosing a fee structure, owner-operators have a range of options though typically fees fall into one of three categories listed below.

Figure 16. Fee Categories[66]



** Depending on electric utility rate structures and collective electricity use of charging stations, station owners can incur expensive fees from utilities for exceeding set levels of electricity use in a given period known as demand charges. This is particularly true for charging stations which are "behind the meter" and are part of the power demands of the retail facility as opposed to stations that have a separate meter.*

5.4.1.3 Service Fees

Charging stations incur one time service costs as well as ongoing operating costs, including data and network contracts with EV charging providers, credit card readers, and charging cable costs. These cost estimates shown in the table below, including costs for data contracts, network contracts, credit card readers, cables, and permitting, are sourced from a 2019 report produced by the Rocky Mountain Institute, a research non-profit focused on sustainability.

Table 10. Range of EVSE Miscellaneous Equipment and Services Costs[67]

Item	Minimum Cost Estimate	Maximum Cost Estimate
Data Contract	$84/year/EVSE	$240/year/EVSE
Network Contract	$200/year/EVSE	$250/year/EVSE
Credit Card Reader	$325/unit	$1000/unit
Cable Cost	$1,500/unit	$3,500/unit

[66] Atlas Public Policy. Public EV Charging Business Models for Retail Site Hosts. Retrieved from: https://atlaspolicy.com/wp-content/uploads/2020/04/Public-EV-Charging-Business-Models-for-Retail-Site-Hosts.pdf
[67] Nelder, C. & Rogers, E.. Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute. Retrieved from: https://rmi.org/wp-content/uploads/2020/01/RMI-EV-Charging-Infrastructure-Costs.pdf

Generally, non-networked (not remotely accessible) Level 1 and Level 2 chargers require very little maintenance, while networked chargers will require slightly more as they have more components with the potential to malfunction or fail. Non-networked Level 1 stations may only need periodic replacement of the electric outlet into which the unit is installed. Non-networked Level 2 chargers will need to be regularly cleaned, and any accessible parts will need to be examined for regular wear and tear periodically. Networked Level 2 stations may experience more maintenance, but nearly all common issues can be addressed by a trained electrician. This may include replacement of the charge cord due to damage or vandalism, periodic troubleshooting, manual system resets, and replacement of the charger at the end of its useful life (an average of 10 years). However, networked chargers have the added benefit of being able to charge user fees and monitor usage. DCFCs will require continual upkeep because they have advanced parts such as filters and cooling systems. Organizations are advised to establish a maintenance service agreement or program with the charger manufacturer before installation. Participating in an extended warranty program may also be advisable, especially for public assets that are more exposed to accidental damage and vandalism.

5.4.1.4 Uptime Requirements

According to the U.S. Federal Highway Administration (FHWA) and Department of Transportation's (DOT) draft Notice of Proposed Rulemaking (NPRM) for the NEVI requirements for EV charging infrastructure investments, uptime is calculated for the time when a charger's hardware and software are both online and available for use, or in use, and the charging port successfully dispenses electricity as expected.[68] While uptime requirements are not currently widespread, it has become an emerging policy priority as programs look to ensure reliability as investments in EV charging infrastructure increase. While there are no existing uptime requirements for EV charging infrastructure, several federal agencies have begun evaluating such requirements as several sizeable federal funding programs for EV charging stations begin distributing funds. We recommend that the County monitor federal and state-level activities related to EV infrastructure minimum standards for updated guidance on uptime requirements.

FHWA and DOT's final rule for the NEVI Formula Program established a 97% uptime requirement as a minimum standard for all EV chargers funded through the program.[69]

Similarly, California passed legislation in 2022 directing the California Energy Commission and the California Public Utilities Commission to create uptime recordkeeping and report standards for EV charging stations purchased through a state incentive program or rate payer charges by January 2024.[70] Both the federal draft NPRM and California's legislative direction to create and enforce uptime minimum standards signals its growing importance to the successful implementation of growing EV infrastructure networks.

5.4.1.5 Station Utilization

Some charging operators add more stations to a charging site once the site begins to reach 50% utilization. Doing so means that the stations will remain available for drivers to use at least half the time, preventing lines and waiting for charging, which could discourage further adoption of EVs. Network providers can report

[68] Federal Highway Administration and U.S. DOT. National Electric Vehicle Infrastructure Formula Program Noticed of Proposed Rulemaking Request for Comments. Retrieved from: https://www.federalregister.gov/documents/2022/06/22/2022-12704/national-electric-vehicle-infrastructure-formula-program

[69] Federal Highway Administration and U.S. DOT. National Electric Vehicle Infrastructure Standards and Requirements. Retrieved from: https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements

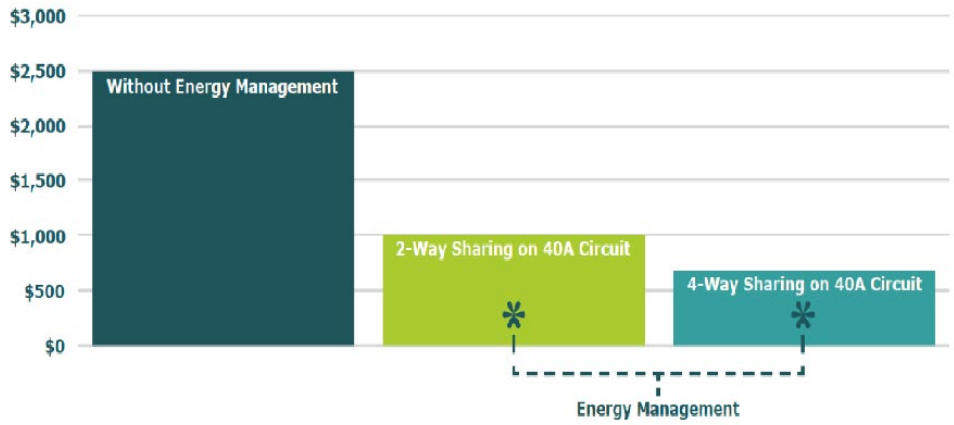
[70] AFDC. Electric Vehicle (EV) Charging Station Uptime Reporting Standards. Retrieved from: https://afdc.energy.gov/laws/13085

utilization data to site hosts. RVARC region site hosts, governments, utilities, and other stakeholders should periodically meet to identify public sites that are reaching high utilization rates and consider adding capacity at those sites as part of the process to update region-wide priorities for charging deployment.

5.4.2 Power Sharing

RVARC member jurisdictions can also facilitate EV-ready parking cost-effectively by allowing power sharing through EV charging management systems. Networked charging systems can facilitate load sharing across branch circuits, share electrical panels, service monitoring, and associated control of EV charging. Networked charging stations can share power so that all cars can be charged more optimally without exceeding a site's electrical capacity. One of the main advantages of power sharing is the reduced cost. The cost (per parking spot) of installing EV charging with power sharing can reduce costs by up to 75% as seen below.

Figure 17. Cost Savings from Energy Management Strategies[71]



One limitation to power sharing is the diminished charging capacity if there are too many EV chargers on a single circuit, which could result in lengthy charging sessions. This can be avoided by providing a maximum limit on load sharing across branch circuits, but this can be challenging for electrical engineers and code officials.

5.4.3 Interoperability

RVARC region stakeholders can futureproof their charging infrastructure by designing it to be as interoperable as possible. EPRI defines interoperability as "the compatibility of key system components – vehicles, charging stations, charging networks, and the grid – and the software systems that support them, allowing all components to work seamlessly and effectively."[72] Interoperability of EV charging stations is a work in progress. There are several connector types and several major charging network providers, and the communications protocols and billing processes in the industry are not standard for charging stations or network providers. Despite the interoperability issues, stakeholders can maximize charger interoperability in a few ways:

[71] McEwen, Brendan. "EV-Ready" Requirements for New Buildings: A Best Practice Guide for BC Local Governments. Retrieved from: https://www.peninsulacleanenergy.com/wp-content/uploads/2021/09/BC-Province-Canada-EV-Ready-Requirements-for-New-Buildings-Final.pdf

[72] Electric Power Research Institute. Interoperability of Public Electric Vehicle Charging Infrastructure, Retrieved from: www.eei.org/issuesandpolicy/electrictransportation/Documents/Final%20Joint%20Interoperability%20Paper.pdf

- E-roaming: E-roaming is the concept in which EV drivers can charge at public chargers from any owner or operator without the need for multiple subscriptions or contracts. Some EV service providers have signed agreements with each other to enable e-roaming, and RVARC stakeholders can help enable this option for EV drivers by working with service providers that pursue e-roaming partnerships.
- Open networking: Networked charging stations must communicate with their networks to track usage data, process billing, and carry out other key functions. Often, EV service providers will have proprietary network protocols which can lead station owners to be locked-in to a single provider for the life of their charging station(s). One solution to this problem is the Open Charge Point Protocol (OCPP), which is an open networking and communications protocol which is already used in Europe and is growing in acceptance across the United States. An open protocol approach may enable charging station owners to switch between network providers without needing to purchase new charging stations, and vice versa. OCPP is not currently recognized as a standard by any national or international standards body, and therefore it does not necessarily guarantee interoperability between various charging stations and networks, but it is a step toward interoperability. To the extent possible, RVARC stakeholders may be able to improve interoperability between charging stations and networks by encouraging that OCPP be used by network providers they partner with.
- Physical charging interface: RVARC stakeholders should coordinate to ensure consistency in the type of charger connectors being deployed at charging stations in the region. Stakeholders should agree to use a common set of connectors at all chargers in the region to ensure standardization and consistency. SAE J-1772 is commonly used for Level 1 and 2 charging, but there are three major DC charging connector standards available today: SAE Combo (also known as Combined Charging System or CCS), CHAdeMO, and Tesla Supercharger. The CCS standard is used by the most vehicle manufacturers; CHAdeMO is used by Nissan and Mitsubishi; Tesla Supercharger is the proprietary connector for the Tesla, and it requires an adaptor to be compatible with an SAE CCS charger.
- Vehicle-grid: V2X capabilities (vehicle-to-grid, vehicle-to-building, vehicle-to-load, vehicle-to-X) are becoming increasingly more common as the EV market develops. For private fleet charging operations, stakeholders should deploy chargers that have at least smart charging capabilities, otherwise known as managed charging or V1G. Smart charging refers to a system in which EVs, EVSE, and operators share data to monitor and manage the EVSE and their output, therefore optimizing energy consumption. Deploying chargers with V2G capabilities may make less sense for public chargers, but it is potentially very valuable for fleet charging, and stakeholders should consider deploying chargers with bidirectional energy transfer capabilities for fleet applications. With bidirectional energy transfer capabilities (V2X), a fleet of EVs can be aggregated to support the grid during critical and peak events and emergencies, or another external piece of infrastructure such as building's local power system. RVARC stakeholders should also consider deploying networked public chargers, which will be necessary if a fee is to be charged for charging activity.

5.5 Data Collection Considerations

On a periodic basis, Roanoke Valley-Alleghany region stakeholders (including site hosts, governments, utilities, employers, and community organizations) should revisit site prioritization for future deployments. This review should include an update of existing sites, plans for new sites, and the utilization of existing sites (if available). This periodic update will enable a review of future priorities for new sites and expansion of existing sites. Information from this section can then be used for the next iteration of site development and charger deployment.

5.5.1 Tracking EV Registrations and EVSE Installations

EV registration and sales data can inform stakeholders of the trends in EV adoption within the Roanoke Valley-Alleghany region at various levels of granularity. County-level EV registration data is available from the Atlas Public Policy State EV Registration Data page, which includes the total number of electric and plug-in hybrid vehicles with active Virginia registrations. More detailed EV registration data can be purchased from firms such as IHS Markit or Experian at various levels of granularity, including state-level, county-level, and zip code-level.[73]

To monitor EVSE deployment, the Alternative Fueling Station Locator provides an up-to-date map and listing of all alternative fuel stations across the United States. The tool provides the following data for EV charging stations:

- Number of stations within a defined radius
- Number of charging outlets within a defined radius
- Ability to specify charger types (Level 1, Level 2, DCFC, etc.)
- Ability to specify connector types
- Ability to specify charging network provider
- Whether the stations are public or private
- Whether the stations are available, planned or temporarily unavailable
- What type of owner the stations has (private, federal government, state government, joint)
- What types of payment the station accepts

EV Battery Safety Trainings

RVARC members should also coordinate with local first responders to ensure they have the resources to appropriately respond to EV-related emergencies. The AFDC's EV Safety Training Resources for First and Second Responders webpage has links to helpful response guides and reference documents.

The Alternative Fueling Station Locator is a valuable tool to understand how many charging stations already exist in the Roanoke Valley-Alleghany region, how many are planned, and other associated information.

5.6 Training and Installation Considerations

As regional EV adoption grows, members and stakeholders should identify certified electricians to support EVSE installations. The NEVI Final Rule[74] requires that all electricians installing, operating, or maintaining EV supply equipment have a certification from the Electric Vehicle Infrastructure Training Program (EVITP) or graduation or a continuing education certificate from a registered apprenticeship program.

EVITP is a non-profit partnership of EV stakeholders, including automakers, utilities, EV charging station manufacturers, energy storage device manufacturers, electrical inspectors, electrical contractors, electrical workers, and first responders. The training includes site assessment, load calculations, National Electric Code, jobsite safety, personal protection equipment, and other installation and maintenance best practices. Training is available online for all states and provides up-skilling for state licensed or certified electricians. In states

[73] Data offered by IHS Markit or Experian are available for purchase.
[74] Federal Highway Administration and U.S. DOT. National Electric Vehicle Infrastructure Standards and Requirements. Retrieved from: https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements

that do not license or certify electricians, the participant must provide documentation of a minimum of 8,000 hours of hands-on electrical construction experience.

Should partners be interested in additional workforce training resources, see the list below.

- National Alternative Fuels Training Consortium (NAFTC): NAFTC's EV Automotive Technician Training covers powertrains for different types of EVs. It explains motor-generator operation, testing, and diagnostic equipment. It details EV direct current and alternating current converters in the various high and low voltage electrical systems in EVs.
- AFV Educate: AFV Educate is a global technology and training organization specialized in alternative fuel vehicle training for first responders, second responders, and automotive technicians and offer a course specific to EV and hybrid electric vehicles.
- Federal Energy Management Program (FEMP): FEMP's fleet management training courses that offers training for EV technology, EVSE power and installation requirements, EV site assessments, and EV site operations.
- Department of Energy (DOE): DOE's EV Training website.
- Clean Tech Institute: The Clean Tech Institute's Certified EV Technician Training Program provides training for EV repair and maintenance.

5.7 Resiliency Considerations

Members may be interested in supporting EVSE back up power generation. Aside from resiliency, modular distributed energy resources (DERs) such as battery energy storage systems (BESS) and solar photovoltaics (PV) can play a role in reducing EV charging costs by providing energy and capacity services for EV charging sites. However, the benefit of installing such DERs is dependent on several factors, including but not limited to location, cost, and the utilization rate of the chargers. Sites that demonstrate ideal criteria and potential for high utilization will experience increased benefits.

5.7.1 Solar-Powered EVSE Infrastructure

Pairing solar canopies with EV charging can maximize land use for space-constrained locations and provide shade and weather protection for vehicles and equipment. However, total system costs may be higher compared to ground-mount or roof-mounted (PV) systems due to higher construction costs associated with the mounting apparatus for the solar panels.[75] A 2016 study by the Clean Energy States Alliance (CESA) estimated the cost of racking systems for solar canopies to be two to four times more expensive than those used for rooftop PV.[76] Overall project costs may be impacted by several factors, such as utility rates, project financing structures, and available funding opportunities.

5.7.2 Off-Grid Charging

Off-grid charging is a developing area within the EV charging space. Generally, most EV charging stations are tied to the grid to ensure a plentiful and consistent power supply. There are some companies that are developing portable solar charging stations with BESS that can be moved to different parking locations based

[75] NREL. 2021. "Maximizing Solar and Transportation Synergies." Retrieved from: https://www.nrel.gov/docs/fy21osti/80779.pdf.
[76] Clean Energy States Alliance (CESA). 2016. "Vermont Solar Cost Study: A Report on Photovoltaic System Cost and Performance Differences Based on Design and Siting Factors." Retrieved from: https://www.cesa.org/wp-content/uploads/Vermont-Solar-Cost-Study.pdf.

on demand. The goal behind portable, off-grid charging is to be able to provide more flexibility in charging infrastructure rather than, or in addition to, developing stationary stations that require detailed siting plans and high construction costs. However, this technology is still developing and may not offer the county fleet the support necessary to successfully operate a transitioning fleet without many existing grid-connected EVSE. Primary concerns related to off-grid solar charging include:

- Loss of solar power collected during periods when vehicle and charging station batteries are full;
- Inability to accommodate fluctuations in demand; and
- Loss of potential power availability and functionality during winter months due to low sun exposure.

There are some instances where off-grid charging may be a better option:

- If the cost to develop a grid-connected Level 2 EVSE is prohibitively high, an off-grid charger may be able to provide power at a lower cost.
- Locations that have smaller, predictable charging demand and are for specific use cases, like fleet charging.

Before purchasing an off-grid EV charging station, the site host should complete a detailed siting assessment to understand charging needs and costs. From there, the decision can be made whether to pursue alternatives.

5.8 Funding Opportunities

5.8.1 Federal Funding Opportunities

Multiple funding opportunities are available for Virginia and the Roanoke Valley-Alleghany region to utilize. Some of these funding opportunities already have dedicated funding allocated to Virginia, such as the National Electric Vehicle Infrastructure (NEVI) Formula Program, while other opportunities have more varied award ranges. The table below highlights Federal funding opportunities for publicly accessible EV charging infrastructure.

Table 11. Federal Funding Opportunities

Funding Agency	Program	Eligible Entities	Program Description
U.S. Joint Office of Energy and Transportation	NEVI Formula Program	State departments of transportations (DOT).	The Bipartisan Infrastructure Law created the NEVI Formula Program to distribute $5 billion to State DOTs for EV charging station investments along alternative fuel vehicle (AFV) corridors. The program is also meant to establish an interconnected network to facilitate data collection, access, and reliability.
U.S. Internal Revenue Service	Alternative Fuel Infrastructure Tax Credit	Alternative fuel infrastructure operators, businesses, personal vehicle owners or	The U.S. Internal Revenue Service Alternative Fuel Vehicle Refueling Property Credit provides funding for qualified AFV fueling property

Funding Agency	Program	Eligible Entities	Program Description
		drivers. Tax exempt entities, including state, local, and tribal governments may be eligible.	installed in a population census tract that is a low-income community or not an urban area.
U.S. DOT	Community Alternative Fuel Infrastructure Grants	States, metropolitan planning organizations, local governments, political subdivisions, and tribal governments.	The U.S. DOT Community Alternative Fuel Infrastructure Grants program was established to fill gaps in publicly accessible EV charging and hydrogen, propane, and natural gas fueling infrastructure in community locations, such as a parking facilities, public schools, public parks, or along public roads. DOT must prioritize projects that expand access to charging and alternative fueling infrastructure within rural areas, low- and moderate-income neighborhoods, and communities with limited parking space or a high ratio of multi-unit dwellings to single-family homes.
U.S. DOT	Freight Efficiency and ZEV Infrastructure Grants	States and local governments, metropolitan planning organizations that serve urbanized areas with a population of more than 200,000 individuals, political subdivisions, port authorities, and tribal governments.	The U.S. DOT's Infrastructure for Rebuilding America grant program provides federal financial assistance to eligible transportation infrastructure projects that address climate change and environmental justice impacts, among other key objectives. Eligible projects include, but are not limited to, developing zero-emission vehicle infrastructure, and supporting the installation of EV charging stations along the National Highways System.

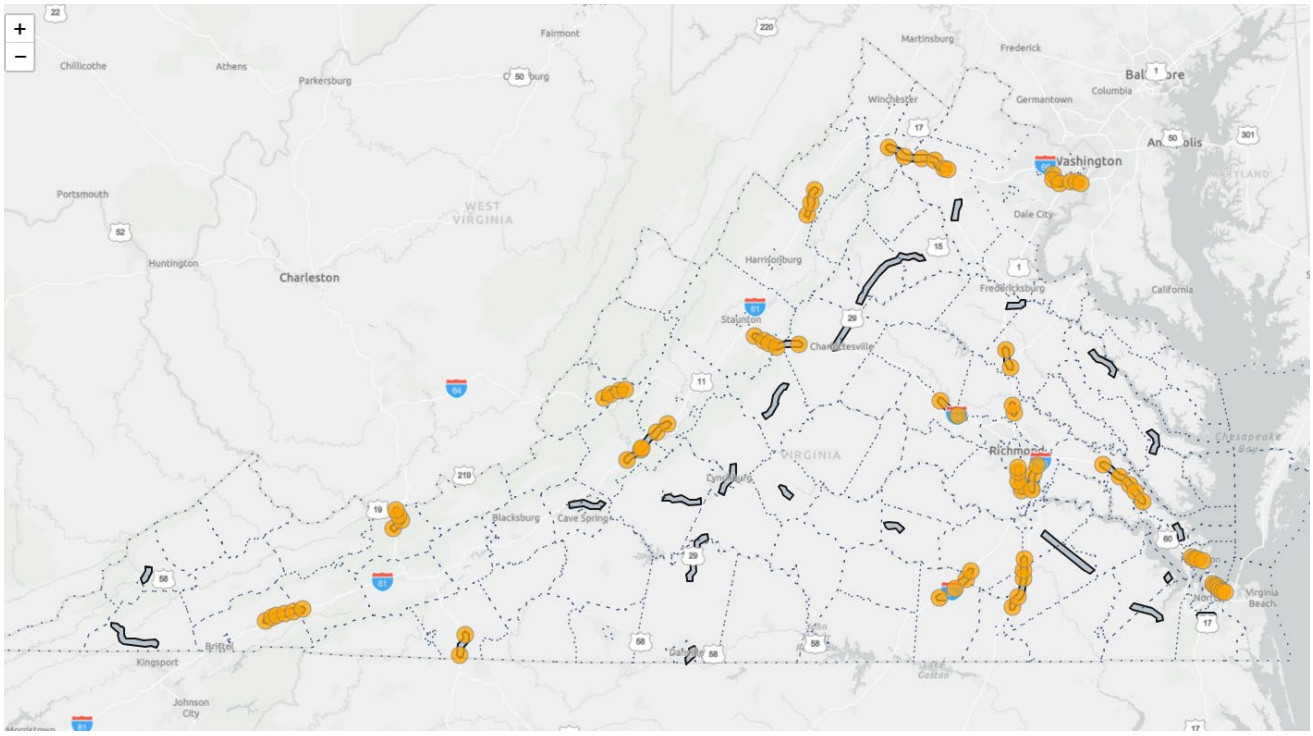
Funding Agency	Program	Eligible Entities	Program Description
U.S. DOT	Resilient Surface Transportation Grants	State, local, and tribal, governments, metropolitan planning organizations, special purpose districts or public authorities with a transportation functions, a Federal land management agency that applies jointly with a State or group of States, and a multi-State or multi-jurisdictional group of entities.	The U.S. DOT FHWA established the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation Discretionary Grant Program to provide funding for projects that improve the resilience of the surface transportation system through support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk costal infrastructure.
U.S. DOT	Congestion Mitigation and Air Quality (CMAQ) Improvement Program	State DOTs, local governments, and transit agencies.	The U.S. DOT CMAQ Program provides funding for projects and programs that help meet the requirements of the Clean Air Act by reducing mobile source emissions and regional congestion on transportation networks.
U.S. DOT	EV Charging and Reliability Grants	State DOTs and local governments.	The U.S. DOT's Federal Highway Administration EV Charger Reliability and Accessibility Accelerator offers funding for the repair and replacement of existing, non-operational publicly accessible Level 2 and direct current fast charging stations.
U.S. DOT	ZEV Infrastructure and Advanced Vehicle Grants	State, local, tribal, and U.S. territories' governments, including transit agencies, port authorities, metropolitan planning	The U.S. DOT's Rebuilding American Infrastructure with Sustainability and Equity grant program provides federal financial assistance to eligible surface transportation infrastructure projects.

Funding Agency	Program	Eligible Entities	Program Description
		organizations, and other political subdivisions of state or local governments.	
U.S. Department of Energy (DOE)	Transportation Energy Efficiency Grants	U.S. territories, state, local, and tribal governments.	The U.S. DOE offers grants through the Energy Efficiency and Conservation Block Grant Program to reduce energy use and fossil fuel emissions, and to improve energy efficiency in transportation.
USDA	Rural Development Enterprise EV Charging Station Grants	State, local, and tribal governments, and non-profit organizations primarily serving rural areas.	The USDA's Rural Business Development Grants Program provides enterprise grants for rural transportation improvement projects and the acquisition and development of buildings, equipment, access for streets and roads, and parking areas.
Multiple agencies	EV Infrastructure Funding and Financing for Rural Areas	Varies	Various rural focused funding opportunities are available. This Rural EV Infrastructure Funding Matrix includes a comprehensive list of relevant Federal programs.

For relevant timelines, Build.gov should be checked regularly for the most up-to-date information. Note that there are additional funding opportunities available for fleets and specific entities that were not included due to the scope of this Plan. The Discretionary Grant Program for Charging and Fueling Infrastructure will be the most significant direct opportunity for RVARC members. This grant program will allocate $2.5 billion into two different funding opportunities: one for alternative fuel infrastructure along Alternative Fuel Corridors (AFCs) and one for alternative fuel infrastructure in communities.

VDOT released the NEVI Phase 1-B Request on May 2nd, and applications are due by July 10, 2024. VDOT guidance also included an interactive map, shown below, of Phase 1-B target areas. Phase 1-B Target Areas in RVARC jurisdictions include sections of US-460, I-64, and I-81.

Figure 18. Virginia NEVI Phase 1-B Target Areas[77]



VDOT also notes that:

- Interstate Highway Target Area mapping has not changed for Phase 1-B. Sites within a mile of identified exits off the Interstate AFCs may be proposed.
- Entrances to proposed Sites in Target Areas along state highways (US-17, US-23, US-29, and US-460) must be between the hard start/stop intersections as indicated by the blunted ends of the Target Area polygons.

For questions on the Phase 1-B Target Area mapping, please email nevi@vdot.virginia.gov.

Separately, the community grants will offer an opportunity for the region to receive funding to build EV charging stations on public roads, parking facilities, and at public buildings, schools, and parks. Rural areas, low- and moderate-income neighborhoods, and communities with low ratios of private parking and high ratios of multifamily housing will be prioritized for funding. Minimum standards and requirements for EV charging infrastructure, as outlined in the NEVI Formula Program Final Rule from February 2023,[78] will apply to all Title 23 funded EV charging programs. For many other federal programs, the region has an opportunity to play a coordinating role. There are funding programs available to the state or partners like schools that can still enhance the regional charging network. The region can work with the state and school district to strengthen

[77] VDOT. Virginia Electric Vehicle Infrastructure Deployment Interactive Map. Retrieved from: https://tmp-map.s3.amazonaws.com/vdot/va-ev-stations-phase1B.html

[78] Federal Highway Administration and U.S. DOT. National Electric Vehicle Infrastructure Standards and Requirements. Retrieved from: https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements

applications for funding and to ensure that EVSE investments best serve the community. The federal government now offers tax credits for new EVs, used EVs, and EV charging infrastructure.[79] [80] [81]

5.8.2 State and Local Funding Opportunities

There are a range of state funding opportunities available to utilize, with many coming from Dominion Energy. The opportunities range from smaller personal rebates to larger grants. The table below highlights state and local funding opportunities in Virginia.

Table 12. State and Local Funding Opportunities

Funding Agency	Program	Eligible Entities	Program Description
Virginia Department of Energy	EV Charging Station Deployment Grants	Businesses or government-industry partnerships.	The Virginia Department of Energy EV Charging Station Deployment Grants program offers grants of up to $400,000 to private businesses and public-private partnerships for the installation of EV charging stations in rural or underserved communities.
Virginia Clean Cities	Rural Reimagined	Local governments	U.S. DOE funding is facilitated by Clean Cities Coalitions in 5 Appalachian states, including Virginia, to support EV test drives and EV charging installations.
Dominion Energy	Commercial EV Charging Station Rebate	Dominion Energy commercial or industrial customers in Virginia.	Dominion Energy offers commercial and industrial customers a rebate for up to 50% of the cost to install Level 2 EV chargers through the Commercial Level 2 Charging Program.

[79] AFDC. Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Tax Credit. Retrieved from: https://afdc.energy.gov/laws/409
[80] AFDC. Pre-Owned Electric Vehicle (EV) and Fuel Cell Electric Vehicle (FCEV) Tax Credit. Retrieved from: https://afdc.energy.gov/laws/13038
[81] AFDC. Alternative Fuel Infrastructure Tax Credit. Retrieved from: https://afdc.energy.gov/laws/10513

Funding Agency	Program	Eligible Entities	Program Description
Dominion Energy	Fleet EV Charging Station Rebate	Dominion Energy commercial or industrial customers in Virginia.	Dominion Energy offers to install and maintain EV chargers for commercial fleets.

RVARC members should also focus on the deployment of EV charging stations in residential settings to best support the community. Utility incentives can be used in tandem with federal, state, and local incentives to lower the cost of installation and equipment costs. For example, the Dominion Energy Residential EV Charging Program and the Danville Utilities Residential EV Charging Station Rebate assist residential customers with the upfront costs of deploying EV charging stations.

Additionally, RVARC members should work with the Virginia Clean Cities and Communities Coalition for assistance in identifying additional incentives. Clean Cities and Communities coalitions are located throughout the country to assist with projects related to alternative fuel vehicles and infrastructure. There are funding opportunities through the Clean Cities and Communities network that can be found here. Additionally, Virginia Clean Cities may be aware of privately available incentives.

6 List of Terminology

A	Amps
ABA	Architectural Barriers Act
AC	Alternating Current
ADA	Americans with Disabilities Act
AFCs	Alternative Fuel Corridors
AFDC	Alternative Fuels Data Center
BAU	Business-as-Usual
BESS	Battery Energy Storage Systems
BEV	Battery Electric Vehicle
CARB	California Air Resources Board
CBG	Census Block Group
CCS	Combined Charging System
CESA	Clean Energy States Alliance
CMAQ	Congestion Mitigation and Air Quality Improvement Program
DC	Direct Current
DCFC	Direct Current Fast Chargers
DERs	Distributed Energy Resources
EJ	Environmental Justice
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
EV	Electric Vehicle
EVI-Pro Lite	Electric Vehicle Infrastructure Projection Tool
EVITP	Electric Vehicle Infrastructure Training Program
EVSE	Electric Vehicle Supply Equipment
FEMP	Federal Energy Management Program
FHA	Fair Housing Act
FHWA	Federal Highway Administration

GHG	Greenhouse Gas
ICE	Internal Combustion Engine
kVa	kilovolt-ampere
kW	kilowatt
kWh	kilowatt-hour
L2	Level 2
LDV	Light-Duty Vehicle
MFH	Multi-Family Housing
NAFTA	National Alternative Fuels Training Consortium
NEVI	National Electric Vehicle Infrastructure Formula Program
NPRM	Notice of Proposed Rulemaking
NREL	National Renewable Energy Laboratory
OCPI	Open Charge Point Interface
OCPP	Open Charge Point Protocol
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PV	Photovoltaics
RAISE	Roanoke Area Interfaith Stewards of the Earth
RVARC	Roanoke Valley-Alleghany Regional Commission
STEAP	Screening Tool for Equity Analysis of Projects.
SWEEP	Southwest Energy Efficiency Project
U.S. DOE	United States Department of Energy
U.S. DOT	United States Department of Transportation
V	Volt
V2X	Vehicle-to-Everything
VDOT	Virginia Department of Transportation
ZEV	Zero-Emission Vehicle

7 Appendix: Example Community Survey Questions

The example community survey questions below are a high-level sample of the types of questions RVARC members may be interested in asking community members and does not represent an exhaustive list of potential survey questions.

1. What best describes your residence? What parking is available at your residence?
2. Rank the main factors you consider when deciding on a vehicle to purchase or lease.
3. Have you considered purchasing or leasing an EV?
4. Would you have access to an EV charger at your residence?
5. Are there obstacles to charging?
6. Rank criteria that [RVARC member] should prioritize for public EV charging locations.
7. For property owners and managers – what are the biggest barriers to installing public charging stations on your property?
8. For property or fleet managers - what concerns need to be met to enable your fleet to move towards fully electric options?