Frederick County Community-wide Electric Vehicle Readiness Plan

December 2023

FREDERICK COUNTY, MARYLAND 1748

SUSTAINABLE FREDERICK COUNTY
DIVISION OF ENERGY AND ENVIRONMENT

Metropolitan Washington Council of Governments

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Jessica Fitzwater
County Executive

FREDERICK COUNTY GOVERNMENT

OFFICE OF THE COUNTY EXECUTIVE

Chelsea Kadish, Chief of Staff

The global climate crisis demands immediate attention and action from all of us. Increasing global temperatures, shifting rainfall patterns, loss of biodiversity, and other ramifications of a changing climate threaten our infrastructure, our economy, our health, and our well-being. We can make a difference, though, by making adaptations to reduce further environmental harm and build resilient communities. The primary and most urgent focus of this work is to reduce greenhouse gas emissions that are fueling climate change.

The Metropolitan Washington Council of Governments performed a community-wide inventory of Frederick County's greenhouse gas emissions (GHG) in 2020, which showed the transportation sector generated approximately 48% of all emissions. Reducing that number will require our transportation systems to evolve from reliance on gas-powered vehicles to electric ones. This Electric Vehicle Readiness Plan (EVRP) serves as a road map for adapting our infrastructure and anticipating the needs of our residents, workforce members, and visitors as we transition to more sustainable technologies.

Our Division of Energy and Environment formed a stakeholder advisory group to help guide the drafting of this plan. The group included representatives of local government agencies, educational institutions, private companies and developers, and advocacy groups. The group offered input and provided feedback on EVRP components, such as EV charging needs, anticipated challenges, and deployment strategies. As we continue to discuss recommendations in this plan, we will strive to address barriers and help identify funding opportunities to make projects more attainable. We will seek additional community input as we move forward, because, like the problem itself, the strategies to address climate change involve everyone.

I am proud that Frederick County Government is demonstrating leadership in response to the global climate crisis. Our staff recently released the Alternative Fuel Vehicles Fleet Transition Plan to reduce the GHG emissions of our own operations through a cost-effective, data-driven, practical approach. This Electric Vehicle Readiness Plan is another example of how we are converting sustainable ideals into pragmatic strategies, sensible policies, well-planned projects, and meaningful actions. This document provides a guiding vision and best practices that Frederick County Government, the private sector, and all our residents can participate in. Working together locally, we can do our part to combat this global issue.

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Acronyms

The following acronyms are used in this report:	
A	Amp
ABA	Architectural Barriers Act
AC	Alternating Current
ADA	Americans with Disabilities Act
ADAAS	Americans with Disabilities Act Accessibility Standards
AFC	Alternative Fuel Corridor
AFDC	Alternative Fuels Data Center
AFV	Alternative Fuel Vehicle
BAU	Business-as-Usual
BEV	Battery Electric Vehicle
BIL	Bipartisan Infrastructure Law
BLAST	Battery Lifetime Analysis and Simulation Tool
BMC	Baltimore Metropolitan Council
BOM	Battery Ownership Model
CAGP	Charge Ahead Grant Program
CARB	California Air Resources Board
CCS	Combined Charging System
CEAP	Climate and Energy Action Plan
CEJST	Climate and Economic Justice Screening Tool
CEMWG	Climate Emergency Mobilization Workgroup
CESA	Clean Energy States Alliance
CRRR	Climate Response and Resilience Report
DAC	Disadvantaged Community
DC	Direct Current
DCFC	Direct Current Fast Charger
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
E85	Ethanol-gasoline blended fuel that contains 51%-83% ethanol
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EV	Electric Vehicle
EVI-Pro	Electric Vehicle Infrastructure Projection Tool
EVSE	Electric Vehicle Supply Equipment
FAQs	Frequently Asked Questions
FCAB	Federal Consortium for Advanced Batteries
FCEV	Fuel Cell Electric Vehicle
FHA	Fair Housing Act
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
HOA	Homeowners Association

The following acronyms are used in this report:	
ICE	Internal Combustion Engine
IEA	International Energy Agency
IIJA	Infrastructure Investment and Jobs Act
IRA	Inflation Reduction Act
kVA	Kilovolt-Amp
kW	Kilowatt
kWh	Kilowatt hour
MAPT	Mid-Atlantic Purchasing Team
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transportation
MEA	Maryland Energy Administration
MVA	Maryland Vehicle Administration
NESCAUM	Northeast States for Coordinated Air Use Management
MOU	Memorandum of Understanding
MWCOG	Metropolitan Washington Council of Governments
NACS	North American Charging Standard
NEVI	National Electric Vehicle Infrastructure
NPRM	Notice of Proposed Rulemaking
NREL	National Renewable Energy Laboratory
OCPI	Open Charge Point Interface
OCPP	Open Charge Point Protocol
PHEV	Plug-In Hybrid Electric Vehicle
PV	Photovoltaic
RMI	Rocky Mountain Institute
STEAP	Screening Tool for Equity Analysis of Projects
SWEEP	Southwest Energy Efficiency Project
USDN	Urban Sustainability Directors Network
V	Volt
V2G	Vehicle-To-Grid
WANADA	Washington Area New Dealers Association
ZEV	Zero-Emission Vehicle
ZEEVIC	Zero Emission Electric Vehicle Infrastructure Council

Executive Summary

The Frederick County Electric Vehicle Readiness Plan (Plan) supports Frederick County's goals to reduce community-wide greenhouse gas (GHG) emissions 50% by 2030 and 100% by 2050.[1] The transportation sector generates 48% of GHG emissions in Frederick County, according to a 2020 Metropolitan Washington Council of Governments (MWCOG) inventory.[2] Increasing the use of electric vehicles (EVs) will help to reduce GHG emissions.

The Plan aligns with other efforts in Frederick County. It incorporates recommendations made by the County Council-created Climate Emergency Mobilization Workgroup (CEMWG), now known as Mobilize Frederick, in its 2021 Climate Response and Resilience Report (CRRR). In addition, in 2022, the County Council approved the then County Executive's program to meet emission reduction goals. The program established the Department of Climate and Energy and directed the department to create a Climate and Energy Action Plan (CEAP) and an Alternative Fuel Vehicle (AFV) Program. These plans address the transportation sector. In addition, community-specific policy recommendations for existing and anticipated use cases and building types are presented in a South Frederick Corridors case study in support of Livable Frederick's draft South Frederick Corridors Plan.

This Plan provides a framework for an evolving network of EV charging infrastructure necessary to sustain EV market growth in the region. It aligns with the State of Maryland's goal to have 300,000 EVs on the road by 2025. With $7.5 billion in federal incentives for EV and charging deployment from the Bipartisan Infrastructure Law (BIL), and more from the Inflation Reduction Act (IRA), this Plan offers insight and recommendations to best position Frederick County to take advantage of these unprecedented EV funding opportunities. The Plan evaluates market and policy conditions, projects the potential demand for regional EV charging infrastructure as EV adoption increases, and outlines implementation strategies needed to accelerate EV charger installations.

Existing and Projected EV Adoption and Charging Demand

As of October 2023, there were 4,710 EVs registered in Frederick County.[3] This number is expected to increase dramatically in the next 10-15 years, with projections ranging from 48,461 to 106,796 EVs by 2035. There are three charger types that would support demand over the next 15 years: Level 1 chargers, Level 2 chargers, and direct current fast chargers (DCFCs), also known as DC fast chargers. Level 1, Level 2, and DC fast chargers vary based on the level of energy output they provide. Level 1 chargers are standard wall outlets that give battery electric vehicles (BEVs) two to five miles of range per one hour of charging, while Level 2 chargers, more commonly installed at residences, give BEVs 10 to 20 miles of range per one hour of charging. DCFCs give BEVs 60 to 80 miles of range per 20 minutes of charging and are more common in publicly accessible spaces.

To support over 48,000 EV drivers, more than 4,000 workplace Level 2 charging ports, 3,000 public Level 2 ports, and 400 DCFC ports will be needed.[4] The potential charging need could go as high as 15,000 workplace

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[1] Frederick County Government. Resolution No. 20-22. Retrieved from: https://frederickcountymd.gov/ArchiveCenter/ViewFile/Item/11819
[2] MWCOG. Metropolitan Washington Community-wide Greenhouse Gas Emissions Inventory Summary. Retrieved from: https://www.mwcog.org/documents/2022/12/27/community-wide-greenhouse-gas-emissions-inventory-summaries-featured-publications-greenhouse-gas/
[3] Maryland Department of Transportation (MDOT)/Maryland Vehicle Administration (MVA). Electric and Plug-in Hybrid Vehicle Registrations by County as of each month end from July 2020 to October 2023. Retrieved from: https://opendata.maryland.gov/Transportation/MDOT-MVA-Electric-and-Plug-in-Hybrid-Vehicle-Regis/qtcv-n3tc
[4] Alternative Fuels Data Center (AFDC). EVI-Pro Lite. Retrieved from: https://afdc.energy.gov/evi-pro-lite

and public Level 2 charging ports and more than 800 DCFC ports. As of November 2023, there are 120 public EV charging ports in Frederick County, though many have restrictions on who can use them and when. Only 48 chargers are fully available to the public in the Frederick County region.[5]

Plan Recommendations and Best Practices

The Plan highlights the importance of ensuring equitable access to EV charging through equitable engagement of historically disadvantaged communities. Low-income and underserved communities are typically exposed to a higher proportion of transportation-related air pollution. EV charging infrastructure can make it easier to encourage EV adoption as a strategy to reduce those impacts. Resources on the following are included:

- Geographic tools to help Frederick County connect communities with targeted funding opportunities.
- Recommendations and best practices for community-centered outreach and engagement.
- Equitable Electric Vehicle Supply Equipment (EVSE)-related policy considerations.

The Plan includes a comprehensive review of supportive policies and implementation strategies to best position Frederick County to take advantage of expected programs and funding opportunities. Recommendations were informed by a Stakeholder Advisory Group which met three times to provide Frederick County with specific insights to guide Plan components and recommendations. A variety of policy actions can be taken to accelerate EV adoption and complement supportive state policies to accelerate the transition to a zero-emission transportation system, including:

- Strengthening EV-ready building codes.
- Developing supportive parking and zoning ordinances.
- Providing a checklist of requirements for EV charger permit applications.
- Developing EV charger incentives.
- Incorporating EV load management strategies.

The Plan also provides additional resources and best practices on a host of issue areas such as:

- EVSE installation, operations, and maintenance.
- Outreach and educational resources.
- Technology considerations.
- Existing and expected funding opportunities.

Next Steps

While this Plan provides a recommended framework for EV charging decision-making, no formal plan for charging infrastructure installations has been made yet. The next steps are for the local jurisdictions, utility companies, and potential site owners and managers to discuss these recommendations, identify which sites have willing hosts, strive to address barriers, refine cost estimates for charging equipment and installation, and seek funding.

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[5] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest

1 Introduction

Climate change poses a threat to health, safety, the environment, and the economy in Frederick County. The number of extreme heat days is expected to rise from 2-3 days per year to an estimated 19-26 days per year by 2050 and 27-62 days by 2090. Rain events will be less frequent and more intense, leading to higher risks of both droughts and flooding. By 2050, temperatures in Frederick County are projected to increase by an annual average maximum temperature of 4.2-5.2 degrees Fahrenheit. The intensity of climate impacts in Frederick County will depend on the extent of greenhouse gas (GHG) reductions in the next few years – both globally and locally.

In Frederick County, the transportation sector generates 48% of GHG emissions, according to a 2020 Metropolitan Washington Council of Governments (MWCOG) inventory.[6] Transportation-related emissions also affect air quality and human health. In the Washington-Arlington-Alexandria, DC-VA-MD-WV urban area, there were 9 days with elevated ozone and 19 days with elevated particulate matter pollution in 2020.[7] Often, the impacts of poor air quality are experienced more by disadvantaged communities.

Vehicle electrification can play a critical role in addressing the threat of climate change and reducing local air pollution in Frederick County. Electric vehicles (EVs) produce zero tailpipe emissions and zero GHG emissions if powered by renewable energy. Beyond emissions reductions, EVs offer several additional benefits to consumers like lower operating and maintenance costs, regenerative braking, emissions testing exemptions, and a quieter and smoother driving experience.

Additionally, new legislation and programs at the federal level will help accelerate EV adoption across the United States. In August 2021, President Biden signed the Executive Order on Strengthening American Leadership in Clean Cars and Trucks.[8] The executive order establishes a goal that 50% of all new passenger cars and light-duty trucks sold are zero-emission vehicles (ZEVs) by 2030. To work towards this goal, federal actions will include setting new emissions standards and fuel economy standards and expanding infrastructure. In December 2021, President Biden released an EV Charging Action Plan that outlines steps that federal agencies are taking to deploy EV infrastructure across the country.[9] Recent legislation such as the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) have outpaced government funds for EV and infrastructure deployment to date by almost 30 times, with the BIL providing at least $7.5 billion in EV investments and the IRA creating new and expanding existing EV and infrastructure tax credits.[10] The CHIPS Act included a number of incentives and programs for semiconductor manufacturing and demonstrated a commitment to building the domestic supply chain for batteries to support the growing EV market and signal a clear commitment to a clean energy future.

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[6] MWCOG. Metropolitan Washington Community-wide Greenhouse Gas Emissions Inventory Summary. Retrieved from: https://www.mwcog.org/documents/2022/12/27/community-wide-greenhouse-gas-emissions-inventory-summaries-featured-publications-greenhouse-gas/

[7] Environment Maryland Research & Policy Center and Maryland PIRG Foundation. Trouble in the Air: Millions of Americans breathed polluted air in 2020. Retrieved from: https://publicinterestnetwork.org/wp-content/uploads/2021/10/MD-Trouble-in-the-Air-Web.pdf

[8] The White House. Executive Order on Strengthening American Leadership in Clean Cars and Trucks. Retrieved from: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/08/05/executive-order-on-strengthening-american-leadership-in-clean-cars-and-trucks/

[9] The White House. FACT SHEET: The Biden-Harris Electric Vehicle Charging Action Plan. Retrieved from: https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/13/fact-sheet-the-biden-harris-electric-vehicle-charging-action-plan/

[10] Burget, Spencer. EV eligible funding in Infrastructure Investment and Jobs Act (IIJA) and IRA represents nearly 30 times the total EV funding awarded by U.S. government to date. Retrieved from: https://www.atlasevhub.com/data_story/3-billion-in-federal-funding-for-evs-to-date/#:~:text=In%20November%202021%20President%20Biden,electric%20vehicle%20(EV)%20adoption%20through

1.1 EV Goals

Vehicle electrification is also a key component of regional goals to tackle climate change. In 2020, MWCOG established a goal to reduce GHG emissions by 50% below 2005 levels by 2030. To do so, by 2030, approximately 34% of light-duty vehicles on the road in the region will need to be EVs.[11]

In 2013, the State of Maryland signed a memorandum of understanding (MOU) to support the deployment of ZEVs through a ZEV Program Implementation Task Force. The Task Force established goals, including having at least 3.3 million ZEVs on the road in the 11 signatory states by 2025.[12] The Task Force has developed action plans – one in 2014 and one in 2018 – which established steps for achieving these goals. The 2018 action plan includes steps such as expanding consumer education and outreach, facilitating investment in charging infrastructure, improving access to ZEV incentives, promoting the electrification of public and private light-duty fleets, and supporting dealerships in promoting ZEV sales.[13] As part of the Task Force, Maryland set goals to have 60,000 ZEVs on the road by 2020 and 300,000 ZEVs on the road by 2025.[14] In 2022, the Climate Solutions Now Act set a target of a 60% reduction by 2031, based on 2006 levels, as well as net-zero emissions by 2045. It requires the state to electrify its fleet of cars by 2031 and light-duty trucks by 2036.

In March 2023, Governor Wes Moore announced Maryland's adoption of the multi-state Advanced Clean Cars II rule, a major step in the state's acceleration to improve air quality and combat the effects of climate change. Maryland is moving quickly to adopt the regulation, which requires manufacturers to continuously increase the share of electric vehicles they sell, reaching 100% of passenger car and light-duty truck sales by 2035.[15]

Additionally, Frederick County set goals to reduce GHG emissions by 25% by 2025 and has already achieved a 43% decrease in community-wide GHG emissions between 2005 and 2020.[16][17] In 2020, the County Council passed a Climate Emergency Resolution that included GHG emission reduction goals of 50% by 2030 and 100% by 2050 community-wide.[18] In 2022, the County Council approved the then County Executive's program to meet emission reduction goals. The program established the Department of Climate and Energy and directed the Department to create a Climate and Energy Action Plan (Phase I for internal operations and Phase II for the community) and an Alternative Fuel Vehicle Program to focus on clean vehicles and EV infrastructure to support the growing number of electric vehicles.

The Climate Emergency Resolution established an ad-hoc Climate Emergency Mobilization Workgroup (CEMWG) to make recommendations to achieve emission reduction goals. CEMWG, now known as Mobilize

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[11] MWCOG. Metropolitan Washington 2030 Climate and Energy Action Plan. Retrieved from: https://www.mwcog.org/documents/2020/11/18/metropolitan-washington-2030-climate-and-energy-action-plan/

[12] Northeast States for Coordinated Air Use Management (NESCAUM). State Zero-Emission Vehicle Programs Memorandum of Understanding. Retrieved from: https://www.nescaum.org/documents/zev-mou-10-governors-signed-20191120.pdf/

[13] NESCAUM. ZEV Action Plan. Retrieved from: https://www.nescaum.org/documents/2018-zev-action-plan.pdf

[14] Maryland Energy Administration (MEA). Tracking Maryland's Zero-Emission Vehicle Activity. Retrieved from: https://news.maryland.gov/mea/2020/09/30/tracking-marylands-zero-emission-vehicle-activity/

[15] The Office of Governor Wes Moore. Governor Moore Announced Maryland Adoption of the Advanced Clean Cars II Rule to Combat the Effects of Climate Change. Retrieved from: https://governor.maryland.gov/news/press/pages/Governor-Moore-Announces-Maryland-Adoption-of-the-Advanced-Clean-Cars-II-Rule-to-Combat-the-Effects-of-Climate-Change.aspx

[16] Frederick County Government. Sustainable Action Plan for County Operations. Retrieved from: https://frederickcountymd.gov/DocumentCenter/View/16111/Sustainable-Action-Plan-for-County-Ops_Final072

[17] MWCOG. Frederick County Community-wide Greenhouse Gas Inventory Summary. Retrieved from: https://www.mwcog.org/documents/2022/12/27/community-wide-greenhouse-gas-emissions-inventory-summaries-featured-publications-greenhouse-gas/

[18] Frederick County Government. Resolution No. 20-22. Retrieved from: https://frederickcountymd.gov/ArchiveCenter/ViewFile/Item/11819

Frederick, created the 2021 Climate Response and Resilience Report (CRRR), which includes several transportation-related recommendations (summarized below).

- Recommendation 4: Adopt building codes that emphasize energy efficiency and climate adaptation.
    - Action items: Incorporate prewiring for EV charging stations into building codes and incentivize adoption.
- Recommendation 13: Transition light and medium duty vehicles to all electric.
    - Action items: Create an education campaign for vehicle electrification; accelerate installations of community-wide EV charging; and launch initiatives to encourage residents to consider electric models as their next personal vehicle.
- Recommendation 38: Climate actions for Frederick area residents, households, and homeowners associations (HOAs).
    - Action items: Adopt no-idle policies and consider EV models for the next vehicle purchased or leased.
- Recommendation 39: Climate actions for Frederick area businesses and institutions.
    - Action items: Adopt no-idle policies and consider EV models for fleet replacements.

There is significant national and regional momentum for electrification. However, there are also barriers. In Frederick County, one of the most pressing barriers is a lack of adequate charging infrastructure. This Plan aims to address those challenges and establish a strategic, coordinated action plan for EV charging infrastructure in line with County GHG emission reduction goals and CRRR recommendations.

2 About EVs and EV Charging

2.1 EV Technology

EVs are vehicles that have an electric motor and a battery and use electricity as a fuel source. Electricity is the only fuel source for battery electric vehicles, which have a chargeable battery. Plug-in hybrid electric vehicles use multiple energy sources. Plug-in hybrid electric vehicles have an internal combustion engine (ICE) as well as an electric motor, which uses electricity stored in a battery. These vehicles are further defined in the sections below.

Battery Electric Vehicles (BEVs): BEVs, also known as all-electric vehicles, operate using only electricity. They use batteries, which are larger than plug-in hybrid electric vehicle batteries, and an electric motor to propel the vehicle. BEV batteries are also charged via a port. BEVs typically have a range of 100 to 350 miles between charges, although some BEVs can go as far as 500 miles on one charge.

Plug-In Hybrid Electric Vehicles (PHEVs): PHEVs use a combination of electricity and fossil fuels to propel the vehicle. They have an electric battery, a 12-volt lead-acid battery, and an internal combustion engine. The driver can charge the two batteries using a port. PHEVs can operate in an electricity-only mode and can typically travel approximately 15 to 60 miles using just electricity.

Zero-Emission Vehicles (ZEVs): ZEVs refer to vehicles with zero tailpipe emissions and includes BEVs and fuel cell electric vehicles (FCEVs).

2.2 Current EV Market

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 United States – nearly double the 308,000 sold in 2020.[19] EV sales in the month of June 2022 represented approximately eight percent of the passenger vehicle market in the US, as seen in the Figure 1.[20] Now there are more than three million EVs on the road and over 135,000 public EV chargers nationwide.[21] Passenger vehicles, also called light-duty vehicles, are vehicles with a maximum gross vehicle weight rating of 8,500 pounds or less.

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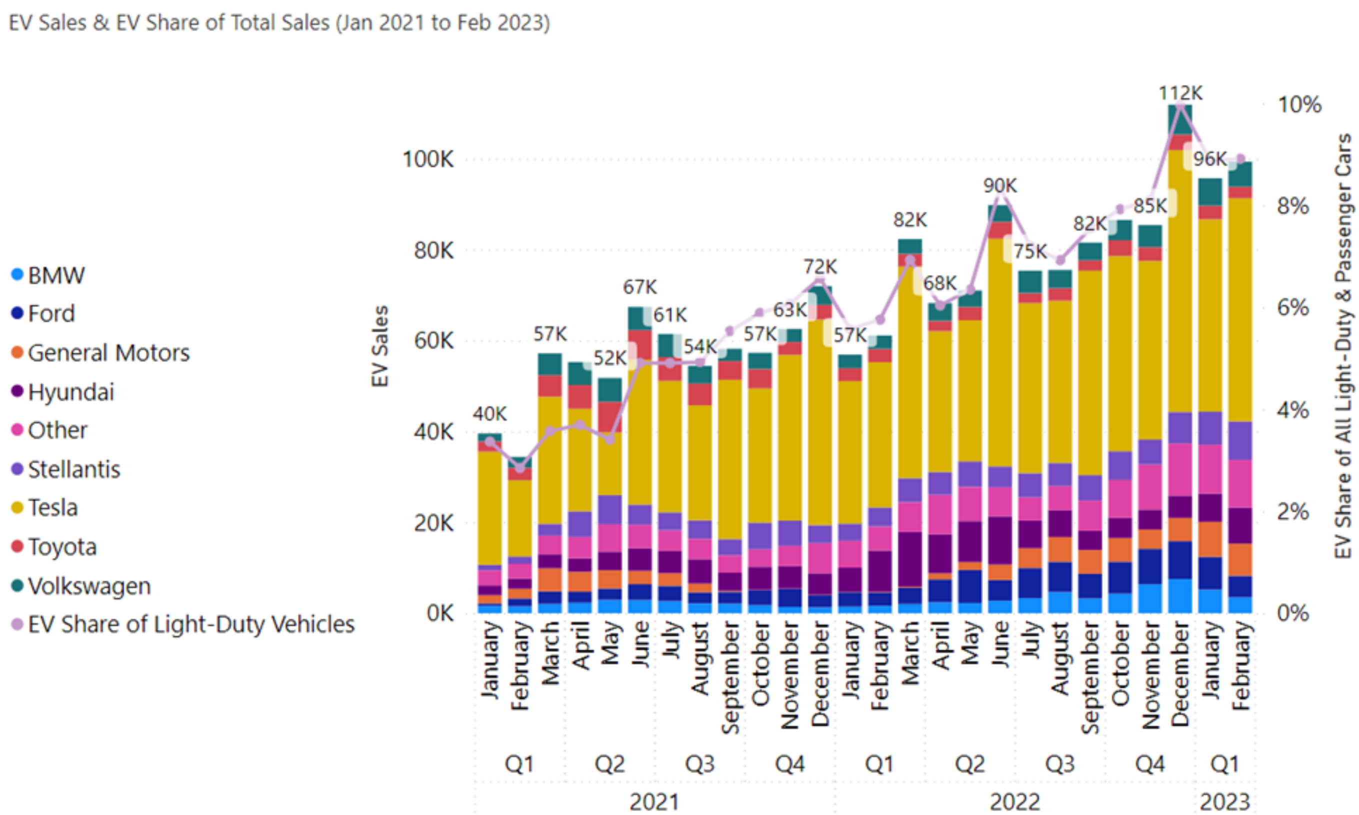
[19] U.S. Department of Energy (DOE). New Plug-in Electric Vehicle Sales in the United States Nearly Doubled from 2020 to 2021. Retrieved from: https://www.energy.gov/energysaver/articles/new-plug-electric-vehicle-sales-united-states-nearly-doubled-2020-2021

[20] Atlas Public Policy. Q2 2022: U.S. EV Market Overview. Retrieved from: https://atlaspolicy.com/wp-content/uploads/2022/12/Q1-and-Q2-2022-EV-Market-Update-for-Clean-Cities-Coalition-1.pdf

[21] White House. Fact Sheet: Biden-Harris Administration Announces New Private and Public Sector Investments for Affordable Electric Vehicles. Retrieved from: https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/17/fact-sheet-biden-harris-administration-announces-new-private-and-public-sector-investments-for-affordable-electric-vehicles/

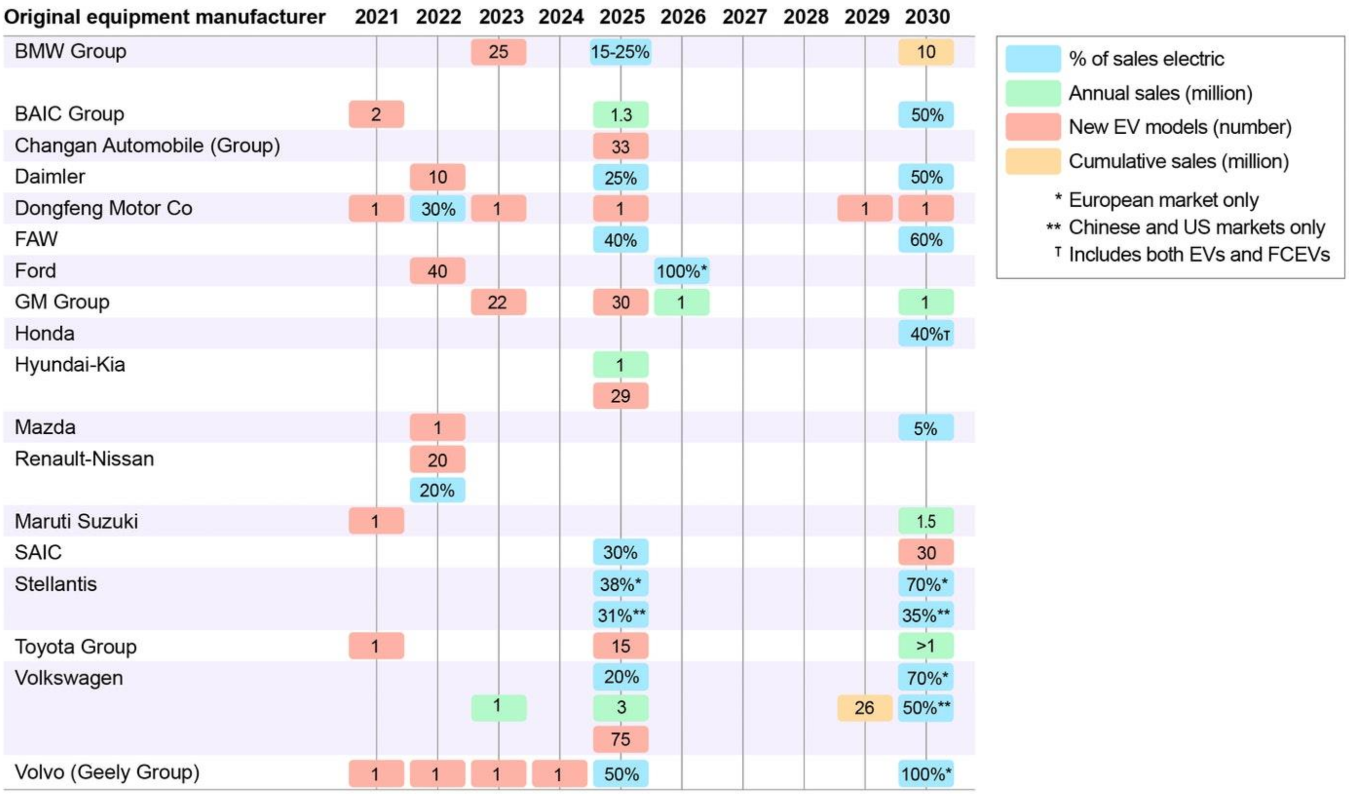
Figure 1: EV Sales and Market Share (January 2021 through February 2023)[22]



EV sales are expected to continue growing throughout the United States as vehicle manufacturers recognize the importance of electrification and take steps towards this transition. The Biden Administration announced a goal to build 500,000 EV charging stations across the country by 2030.[23] Since 2021, companies in the United States have invested around $85 billion in EV manufacturing and sales of EVs have tripled. Major auto manufacturers have made commitments to expand production of EVs. General Motors has pledged to transition to a full electric fleet by 2035. By 2025, Toyota will have 70 electric vehicle models in the market.[24] In 2021, nearly 65 EV models were available in the United States.[25]

[22] Atlas Public Policy. EV Sales and Market Share (January 2021 through February 2023). Retrieved from: https://www.atlasevhub.com/materials/automakers-dashboard/
[23] 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
[24] Motavalli, Jim. Forbes. Every Automaker's EV Plan Through 2035 and Beyond. Retrieved from: https://www.forbes.com/wheels/news/automaker-ev-plans/
[25] International Energy Agency (IEA). Global EV Outlook 2022. Retrieved from: https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-light-duty-vehicles

Figure 2: EV Manufacturer Commitments[26]



2.3 Benefits of EVs

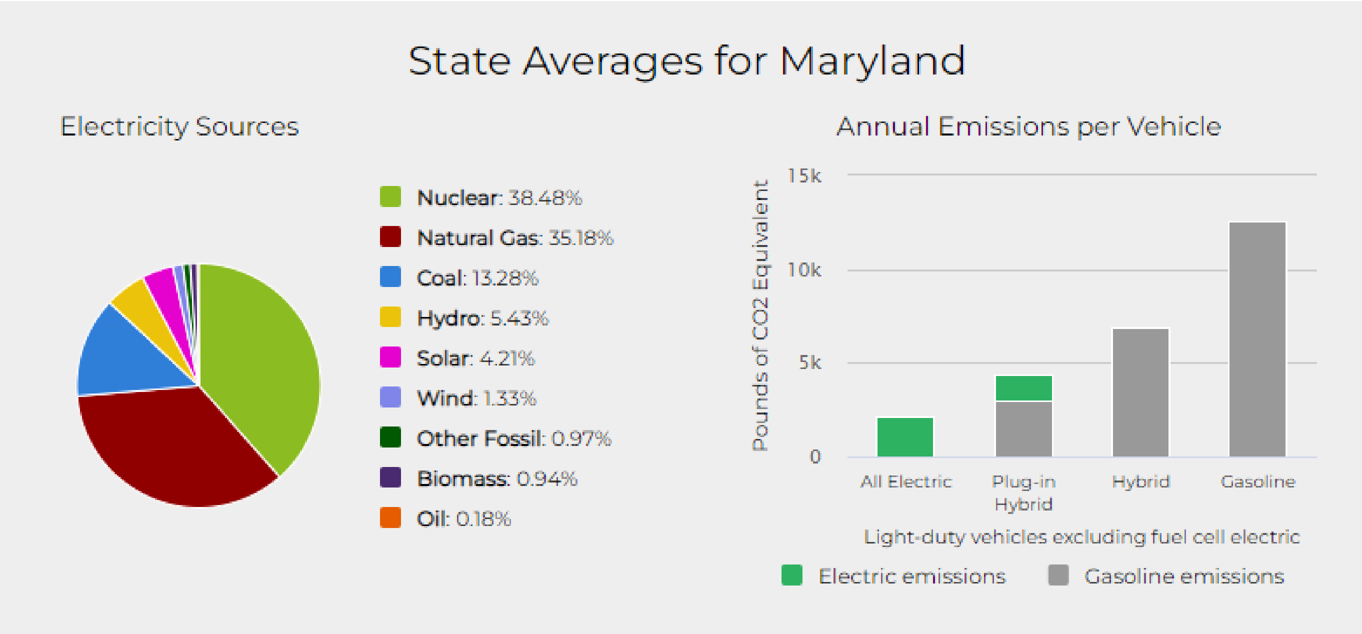
EVs offer a long list of benefits to both individual consumers and a broader set of stakeholders, including government agencies, utilities, and communities.

Environmental benefits of EVs include reduced GHG emissions and improved local air quality. A 2022 study by the University of Michigan and Ford Motor Company found that BEVs and PHEVs have, respectively, approximately 64% and 28% lower cradle-to-grave life cycle emissions than internal combustion engine vehicles.[27] The extent of emissions reductions depend on a number of factors, including vehicle model, electric grid generation mix, and driving and charging patterns.

EVs reduce GHG emissions if powered by renewable sources. Figure 3 shows Maryland's electricity mix, made up of mostly nuclear and natural gas sources on the left-hand side. Comparing the annual emissions from an EV powered by Maryland's electric grid with a gasoline powered car, a gas car emits approximately five times more GHG emissions than an EV.

[26] IEA. Trends and developments in electric vehicle markets. Retrieved from: https://www.iea.org/reports/global-ev-outlook-2021/trends-and-developments-in-electric-vehicle-markets
[27] Woody, Maxwell, et al. The role of pickup truck electrification in the decarbonization of light-duty vehicles. Retrieved from: https://iopscience.iop.org/article/10.1088/1748-9326/ac5142

Figure 3: Maryland Electricity Sources and Emissions[28]



Additionally, EVs produce zero tailpipe emissions[29]. EV adoption can help reduce the levels of nitrogen oxides, volatile organic compounds, fine particle pollution, and sulfur dioxide – pollutants that can have harmful effects on lung and heart health.[30] The American Lung Association estimated the health impacts of a national shift to 100% sales of zero-emission passenger vehicles by 2035 and medium- and heavy-duty trucks by 2040, coupled with renewable electricity, and found that up to 110,000 premature deaths and 2.78 million asthma attacks could be avoided between 2020 and 2050.[31] In Maryland, between 2020 and 2050, health benefits under this scenario could exceed $27 billion.[32]

Although the upfront costs of EVs are typically higher than comparable gas-fueled vehicles, the maintenance and fuel costs are typically lower. In EVs, the design of the powertrain makes it so that oil changes, tune ups, and emissions tests are not required. Over a typical vehicle lifetime, EV drivers save approximately 50% on repair and maintenance costs. EVs are more energy efficient than gas vehicles, and it typically costs less to charge an electric vehicle than to pay for gas. A 2020 Consumer Reports study found that BEV drivers spend approximately 60% less on "fuel" costs than the average gas vehicle in the same class.[33] Fuel costs depend on factors such as efficiency of the EV, regional electricity costs, and driving and charging patterns.

EVs also offer a quieter driving experience and faster acceleration rates. Additionally, EVs can serve as a distributed energy resource. EV batteries can store energy, which allows for bidirectional charging, or energy flow from batteries back to the grid. Vehicle-grid integration uses software and smart data systems to

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[28] Alternative Fuels Data Center (AFDC). Emissions from Electric Vehicles. Retrieved from: https://afdc.energy.gov/vehicles/electric_emissions.html
[29] PHEVs produce zero tailpipe emissions when running on electric-only mode.
[30] American Lung Association. Zeroing In on Health Air. Retrieved from: https://www.lung.org/getmedia/13248145-06f0-4e35-b79b-6dfacfd29a71/zeroing-in-on-healthy-air-report-2022
[31] Ibid.
[32] Ibid.
[33] Consumer Reports. Electric Vehicle Ownership Costs. Retrieved from: https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf

facilitate bidirectional charging. This practice can help manage energy loads for buildings, facilities, the electric grid, and other assets.

2.4 Challenges to EV Adoption

Even with momentum 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 related to the production process and battery disposal.

There is currently a significant price gap between EVs and comparable gas vehicles. In 2022, for instance, consumers could purchase a gas-fueled Hyundai Kona for $22,595 and a Hyundai Kona Electric for $35,295. Gas-fueled Ford F-150s go for $40,960, while the electric Ford F-150 Lightning sells for $54,769.[34] It is worth noting, however, that EV tax credits, cheaper fueling costs, and lower maintenance costs can all reduce the price gap between EVs and gas vehicles.

A lack of sufficient infrastructure remains a barrier to EV adoption. Many current and prospective owners have "range anxiety" – the concern that the battery will run out of power before reaching the destination. This concern is intensified for those who do not have access to a charger at home, which is more common for low-income households and those living in multi-unit dwellings. Coupled with concerns about inadequate charging infrastructure are concerns about the range of EVs in hot and cold weather. For gas vehicles, waste heat produced by the engine helps power the heating system. For EVs, the energy for heating comes entirely from the same battery that propels the vehicle, meaning that the range is reduced when heating systems are on. Additionally, EV battery thermal management systems use energy to keep the battery at an optimal temperature, so the battery uses extra energy on hot and cold days to regulate battery temperature.

Finally, there are sustainability concerns associated with EV manufacturing. EVs require approximately six times more minerals than gas-fueled cars.[35] EV batteries require lithium, cobalt, and other rare earth minerals.

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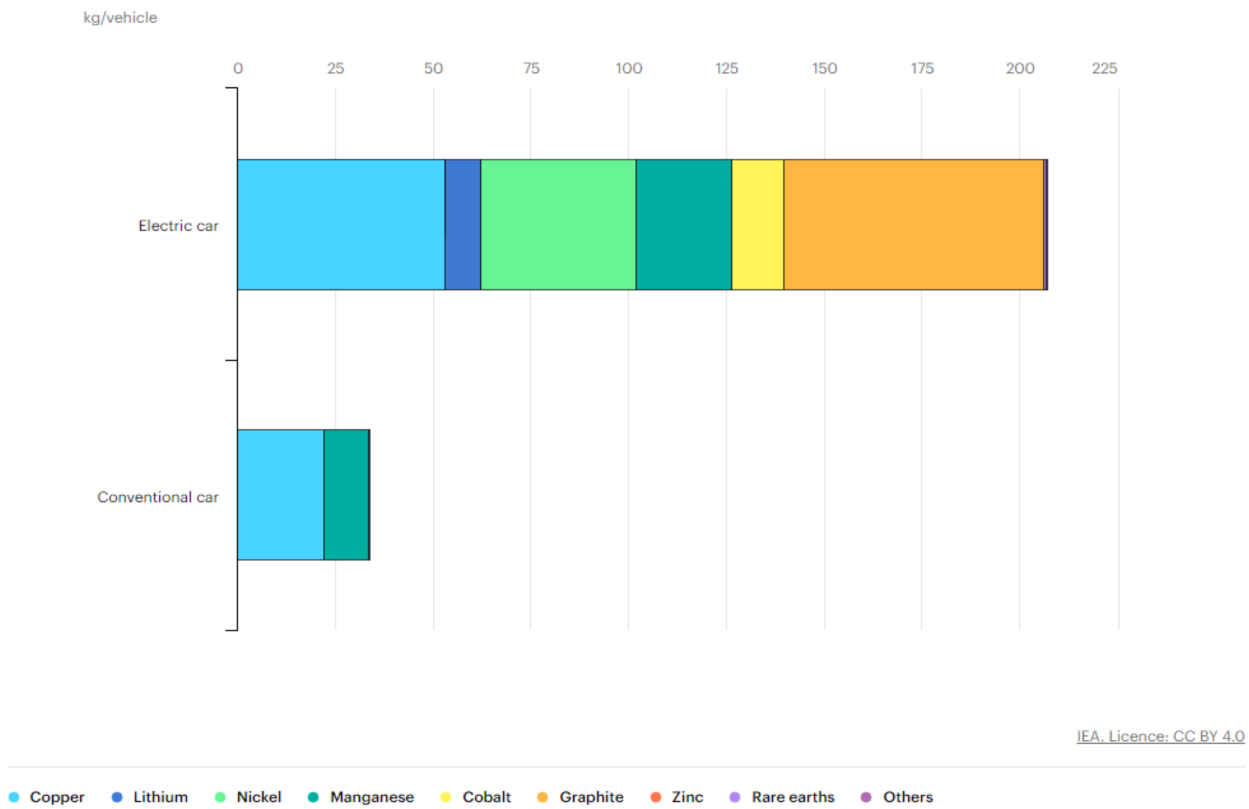
[34] Baldwin, Roberto et al. Car and Driver. EVs vs. Gas: Which Cars are Cheaper to Own. Retrieved from: https://www.caranddriver.com/shopping-advice/a32494027/ev-vs-gas-cheaper-to-own/

[35] van Halm, Isabeau. Mining Technology. Concerns for Mineral Supply Chain Amid Booming EV Sales. Retrieved from: https://www.mining-technology.com/features/concerns-for-mineral-supply-chain-amid-booming-ev-sales/

Figure 4: Minerals in EVs and Conventional Vehicles[36]



The International Energy Agency (IEA) predicts that demand for minerals for EV and battery storage will grow more than 30 times between 2020 and 2050, and that this demand will surpass the expected supply from existing mining projects.[37] Mining processes are often energy intensive. However, research and development efforts are underway to reduce the environmental impacts of mining. The Snow Lake Lithium mine in Canada, for instance, is working towards a carbon neutral process for mining lithium, including by using only 100% renewable energy.[38] Additionally, new processes are being developed to increase the efficiency of battery recycling and reuse. The United States Federal Consortium for Advanced Batteries (FCAB) and several other new initiatives are committing to increasing domestic mineral production and recycling, relying less on minerals extracted from other countries.

2.5 EV Charging Infrastructure

A critical step in boosting the number of electric vehicles in Frederick County will be installing more charging infrastructure. EV charging infrastructure is also known as electric vehicle supply equipment (EVSE).

2.5.1 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

[36] IEA. Minerals used in electric cars compared to conventional cars. Retrieved from: https://www.iea.org/data-and-statistics/charts/minerals-used-in-electric-cars-compared-to-conventional-cars
[37] van Halm, Isabeau. Mining Technology. Concerns for Mineral Supply Chain Amid Booming EV Sales. Retrieved from: https://www.mining-technology.com/features/concerns-for-mineral-supply-chain-amid-booming-ev-sales/
[38] Snow Lake Lithium. Retrieved from: https://snowlakelithium.com/

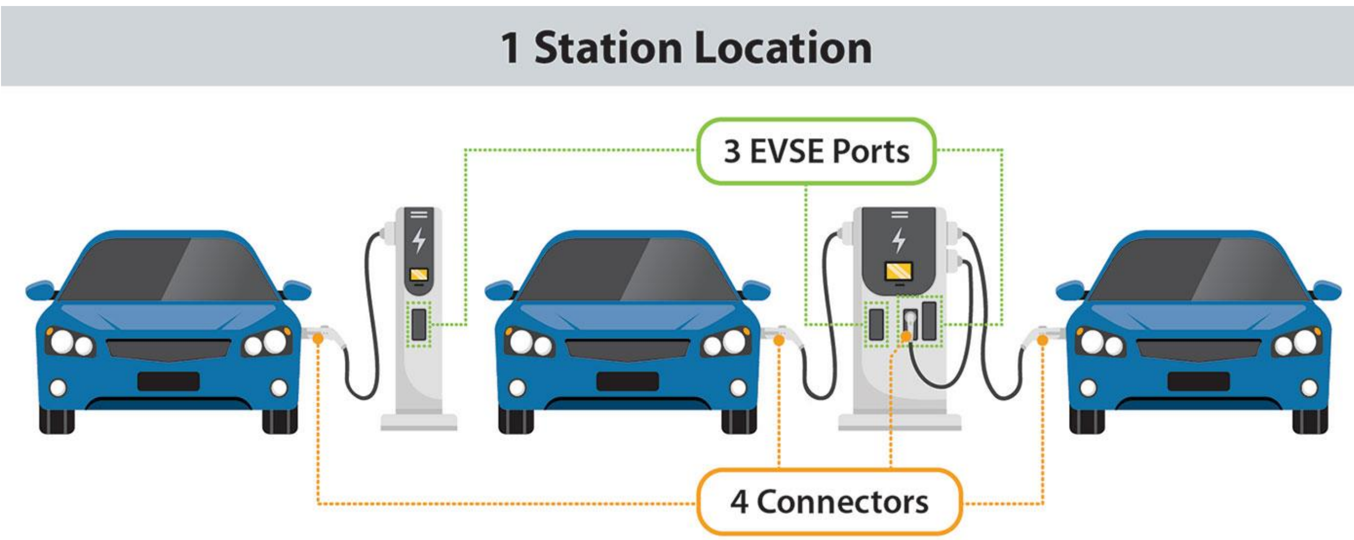
Alternative Fuels Data Center (AFDC) and the Station Locator use the following charging infrastructure definitions:

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.

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 5: EV Charging Station Diagram[39]



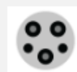
2.5.2 Charging Equipment

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 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).

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

The table below summarizes EVSE types.

Table 1: EVSE Connector Information[40]

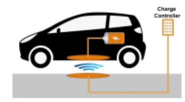
	Level 1	Level 2	DCFC
Description	120-volt (V) alternating current (AC) port, single phase service 12-16 amp (A)	208/240V AC port, single phase service 12-80A	208/480V AC circuit, three-phase service connection 50-200A
Connector Type(s)	 J1772 charge port Standard Wall Outlet	 J1772 charge port	 Combined 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; 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

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.

[40] U.S. DOE. Developing Infrastructure to Charge Plug-In Electric Vehicles. Retrieved from: https://afdc.energy.gov/fuels/electricity_infrastructure.html

- **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 electric vehicles, 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 micromobility 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.

2.6 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.

2.6.1 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 2. Average Range of Site-Level EV Charging Equipment Costs[41,42,43]

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

2.6.2 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 Table 3.

[41] ICF (December 2019). Comparison of Medium- and Heavy-Duty Technologies in California. California Electric Transportation Coalition. Retrieved from: https://www.caletc.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf
[42] U.S. DOE (November 2015). Costs Associated with Non-Residential Electric Vehicle Supply Equipment, Retrieved from: https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf
[43] Nelder, C. & Rogers, E. (December 2019). Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute. Retrieved from: https://rmi.org/wp-content/uploads/2020/01/RMI-EV-Charging-Infrastructure-Costs.pdf

Table 3. Average Charger Installation Costs[44,45,46]

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

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. If a site is overloaded by the addition of 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 4. Average Unit Costs for Service Transformer Upgrades[47,48,49,50]

Unit Size (Kilovolt-Amp)	Cost Estimate		Unit Size (Kilovolt-Amp)	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.

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[44] ICF (December 2019). Comparison of Medium- and Heavy-Duty Technologies in California. Retrieved from: https://www.caletc.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf

[45] U.S. DOE (November 2015). Costs Associated with Non-Residential Electric Vehicle Supply Equipment. Retrieved from: https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

[46] Energy Marketers of America (December 2020). 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

[47] Horowitz, Kelsey. 2019 Distribution System Upgrade Unit Cost Database Current Version. National Renewable Energy Laboratory. Retrieved from: https://data.nrel.gov/submissions/101

[48] Pacific Gas & Electric (March 2023). Unit Cost Guide. Retrieved from: https://www.pge.com/content/dam/pge/docs/about/doing-business-with-pge/unit-cost-guide.pdf

[49] Southern California Edison (March 2021). Unit Cost Guide. Retrieved from: www.sce.com/sites/default/files/inline-files/Attachment_A-Unit%20Cost%20Guide%202021_Final.pdf

[50] San Diego Gas & Electric. Unit Cost Guide (March 2020). Retrieved from: www.sdge.com/sites/default/files/documents/unit.cost_.guide_.3.31.20_R3_EAJ1.pdf

2.6.3 Other Costs

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.[51] For more information on operations and maintenance considerations, see Section 8.2.

[51] AFDC. Charging Infrastructure Operation and Maintenance. Retrieved from: https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html

3 Stakeholder Engagement Process

Throughout the planning process, Frederick County engaged a variety of stakeholders to solicit input and feedback on Plan component topics such as charging station needs, permitting challenges, and outreach strategies. Stakeholders represented local government agencies, educational institutions, private companies and developers, advocacy groups, Fort Detrick, and Frederick Health.

3.1 Stakeholder Recruitment

The Department of Climate and Energy conducted outreach to recruit members from relevant Frederick County Government offices. Then, Climate and Energy staff worked with the Office of Economic Development to identify and contact major employers, housing builders, institutions, and more. The Office of Economic Development also issued an open call via email to the broader business community to indicate interest in EV issues. The Department of Climate and Energy also invited the City of Frederick, Frederick County Public Schools, and Potomac Edison representatives to participate.

3.2 Stakeholder Advisory Group Members

Scott Roxby, *AstraZeneca*
Wayne Davison Sr., *AstraZeneca*
Carol Crockett, *Canam Steel Corporation*
Edwin Steinke, *Canam Steel Corporation*
Jenny Willoughby, *City of Frederick*
Ron Kaltenbaugh, *Electric Vehicle Association of Greater Washington, DC*
Troy Bolyard, *Frederick County Office of Economic Development*
Travis Tracey, *Frederick County Public Schools*
Fred Punturiero, *Frederick County Public Schools*
Jay Welch, *Fort Detrick*
John Bennet, *Fort Detrick*
Don Chory, *Fort Detrick*
John Anzinger, *Frederick Community College*
Mark Mishler, *Frederick County Division of Planning and Permitting*
Suzanne Jacobson, *Frederick Health*
Don Moody, *Frederick Health*
Billy Demory, *Frederick Health*
Paul Borawski, *Frederick Health*
Kevin Buker, *Frederick Health*
Rowela Lascolette*, Hood College*
Denis Supercyznski, *Livable Frederick*
Sam Bollinger, *MK Concrete*
Kim Klabe, *Mount St. Mary's University*
Jeff Simmons, *Mount St. Mary's University*
Maureen Plant, *Mount St. Mary's University*
Mark Zucca, *Potomac Edison*
Laura Rectenwald, *Potomac Edison*
Nick Wade, *Ryan Homes*
Steven Heise, *Ryan Homes*

3.3 Stakeholder Advisory Group Outcomes

Frederick County convened the Stakeholder Advisory Group, which met three times. During each meeting, Frederick County presented findings, collected new ideas, and solicited feedback through anonymous polls and open discussions. Stakeholders shared their specific experiences and questions with regards to EV adoption and EVSE installation, which provided valuable direction for Plan recommendations. Individual meetings were held with stakeholders such as Frederick County Public Schools and Potomac Edison to gain a deeper understanding of existing conditions, challenges, and opportunities. A summary of Stakeholder Advisory Group meetings, issues discussed, and feedback received are presented below.

Table 5: Stakeholder Engagement Meetings

Stakeholder Meeting	Date	Purpose	Feedback
Stakeholder Advisory Group Kick-Off Meeting	June 2, 2022	Introduction of Project Overview of EVs and Charging Infrastructure Discussion Regarding Charging Needs, Barriers, Investment Criteria, Funding, and Outreach Strategies	Suggested general EV charging locations Discussed challenges related to EV parking management and multifamily housing installations
Stakeholder Advisory Group Meeting #2	July 27, 2022	Regional Context and Updates Lessons Learned from EV Charging Installations Policy Review Update Planning and Permitting Process Discussion	Expressed a need for feasibility studies and operational policies Provided feedback on proposed building code recommendations
Stakeholder Advisory Group Meeting #3	September 7, 2022	Infrastructure Update/EV and EVSE Projections Community Outreach Planning Funding Opportunities	Confirmed that charging stations in new developments are a key area of need Prioritized experiential outreach strategies, like ride-and-drives and working with transit

The stakeholders presented a diverse set of needs, EV readiness, and future priorities. EV charging infrastructure needs ranged from having no plans to install stations on company property, to having already installed stations that are overutilized, to needing a more focused planning effort to install new/additional stations, to wanting more stations throughout the county to allow charging beyond the workplace. Employee demographics also varied widely, with some employers seeing travel across county and state lines, some carpooling, some transit, but mostly single occupancy vehicle commuting. Generally, stakeholders expressed an interest in technical support to assess the level of need for EV charging in their area and resources to better understand EVSE-related processes like needs assessments, funding opportunities, procurement considerations, installation requirements, and operational considerations. Stakeholders also highlighted needs specific to their contexts. On policy considerations, educational institutions highlighted a need to clarify how potential EV readiness requirements in building codes would apply to a campus with several buildings and associated parking lots.

4 Existing Conditions in Frederick County

Currently, the Frederick County region has relatively low levels of EV registrations and limited charging infrastructure, although both have been steadily increasing in recent years. This section reviews current conditions in the region.

4.1 EV Registrations

In October 2023, there were more than 4,700 EVs registered in Frederick County.[52] EVs account for 1.77% of the approximate 266,000 total vehicles registered in Frederick County. BEVs make up more than 68% of the EVs in Frederick County, while the remaining 32% are PHEVs.

4.2 Existing Public EV Charging Stations

Data from the U.S. Department of Energy's (DOE) Alternative Fuels Data Center was used to identify, analyze, and map the chargers currently available across the region. According to the Alternative Fuels Data Center, there are 120 charging ports available to the public in Frederick County, with 85 Level 2 ports and 35 DCFC ports.[53] However, many of these ports are not available to all EV drivers. Fourteen of the Level 2 ports and 26 of the DCFC ports are exclusively Tesla chargers.[54] Another 30 Level 2 ports and two DCFC ports are restricted to the public for reasons such as, businesses restrict access to business hours and customers only.

When these stations are accounted for, there are 41 Level 2 ports and seven DCFC ports available to the public in Frederick County. The table below lists the existing chargers in Frederick County. Figure 6, following the table, illustrates the locations of these charging stations.

Table 6: Existing Public EV Charging Stations in Frederick County[55]

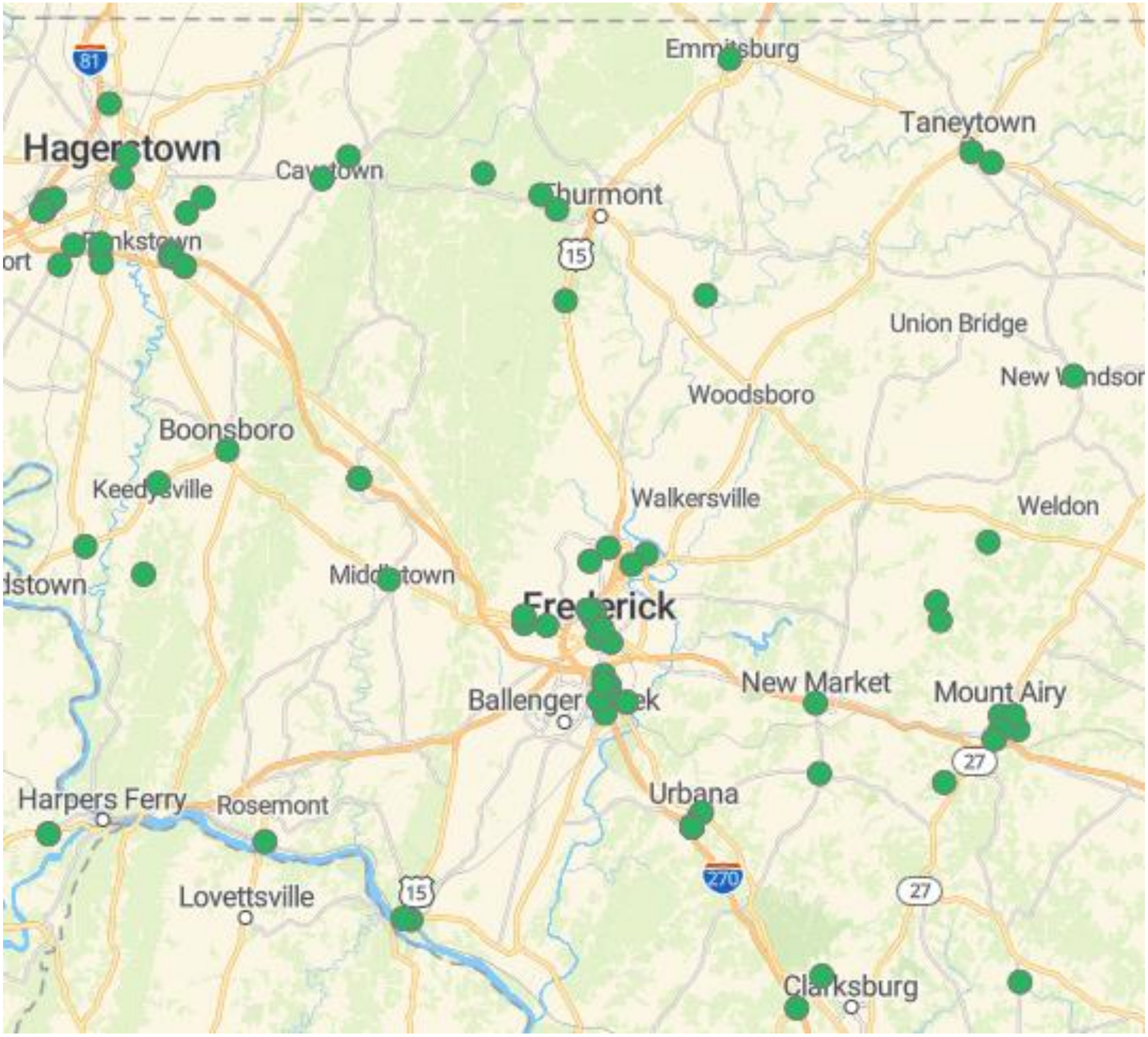
Station Name	Street Address	City	L2 Ports	DCFC Ports	Network
Railroad Square Parking Lot	203 S Maple Ave	Brunswick	2		ChargePoint
Emmitsburg Town Office	300 S Seton Ave	Emmitsburg	4		Non-Networked
DARCARS Toyota of Frederick	5293 Buckeystown Pike	Frederick	2		ChargePoint
Fitzgerald Auto Mall	114 Baughmans Ln	Frederick	2		ChargePoint
Francis Scott Key Mall	5500 Buckeystown Pike	Frederick		10	Tesla

[52] Maryland Department of Transportation (MDOT)/Maryland Vehicle Administration (MVA). Electric and Plug-in Hybrid Vehicle Registrations by County as of each month end from July 2020 to October 2023. Retrieved from: https://opendata.maryland.gov/Transportation/MDOT-MVA-Electric-and-Plug-in-Hybrid-Vehicle-Regis/qtcv-n3tc
[53] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest
[54] 7,500 Tesla supercharger and destination chargers are expected to be accessible to non-Tesla EVs by 2024. Retrieved from: https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/
[55] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest

Station Name	Street Address	City	L2 Ports	DCFC Ports	Network
Frederick Community College	7203 W Sundown Ct	Frederick	2		Blink
Frederick Health Hospital	400 W 7th St	Frederick	5		Non-Networked
Frederick MARC Station	155 B and O Ave	Frederick	2		ChargePoint
Harley Davidson of Frederick	5722 Urbana Pike	Frederick		1	ChargePoint
Keys Station	1405 Key Pkwy	Frederick	2		ChargePoint
Max Kehne Park	1100 W 7th St	Frederick		1	ChargePoint
MOM's Organic Market	5273 Buckeystown Pike	Frederick	2		Blink
Monocacy MARC Station	7800 Genstar St	Frederick	2		ChargePoint
North Market Street Parking Lot	331 N Market St	Frederick	2		ChargePoint
Renn Kerby Mitsubishi	5712 Buckeystown Pike	Frederick	2		Blink
Sheetz	5601 Buckeystown Pike	Frederick		8	Tesla
SpringHill Suites by Marriott	111 Byte Dr	Frederick	4		Blink
Tasker's Chance Park	1175 Key Pkwy	Frederick	2		ChargePoint
The Common Market – 7th Street	927 W 7th St	Frederick	5		Blink
The Common Market – MD 85	5728 Buckeystown Pike Unit B1	Frederick	2		Blink
Walmart	7400 Guilford Dr	Frederick		4	Electrify America
West Patrick Street Garage	140 W Patrick St	Frederick	2		Non-Networked
Younger Nissan	7418 Grove Rd	Frederick	1	1	Non-Networked
Natelli YMCA	3481 Campus Dr	Ijamsville	2		ChargePoint
Elm Street Parking Lot	119 Washington St	Middletown	2		ChargePoint
Wilcom's Inn	11234 Fingerboard Rd	Monrovia	4		Tesla Destination

Station Name	Street Address	City	L2 Ports	DCFC Ports	Network
Black Ankle Vineyards	14463 Black Ankle Rd	Mount Airy	3		Tesla Destination
Linganore Winecellars	13601 Glissans Mill Rd	Mount Airy	2		Blink
			4		Tesla Destination
Myersville Municipal Center	307 Main St	Myersville	2		ChargePoint
Myersville Park and Ride	3002 Ventrie Ct	Myersville	2	2	ChargePoint
New Market Town Hall	40 South Alley	New Market	2		ChargePoint
Point of Rocks MARC Station	4000 Clay St	Point of Rocks	4		ChargePoint
Blue Belly Farms Corporation	9201 Longs Mill Rd	Rocky Ridge	3		Non-Networked
			3		Tesla Destination
Catoctin Mountain Park – Round Meadow	14850 Manahan Rd	Sabillasville	2		Non-Networked
Catoctin Mountain Park – Headquarters	6602 Foxville Rd	Thurmont	1		Non-Networked
Catoctin Mountain Park – Visitor Center	14707 Park Central Rd	Thurmont	2		Non-Networked
Cunningham Falls State Park – Catoctin Furnace	12698 Catoctin Furnace Rd	Thurmont	2		ChargePoint
Royal Farms	9180 Fingerboard Rd	Urbana		8	Tesla

Figure 6: Map of Existing EVSE in the Frederick County Region[56]



[56] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest

5 Projected EV Charging Needs

5.1 Projected EV Adoption

To support Frederick County's GHG emission reduction goals and **CRRR Recommendation 16** to rapidly expand access to EV charging, EV market growth scenarios for Frederick County were completed by utilizing the state goal benchmarks in addition to historical and existing Frederick County EV registrations. Three different vehicle growth scenarios were forecast as part of this study:

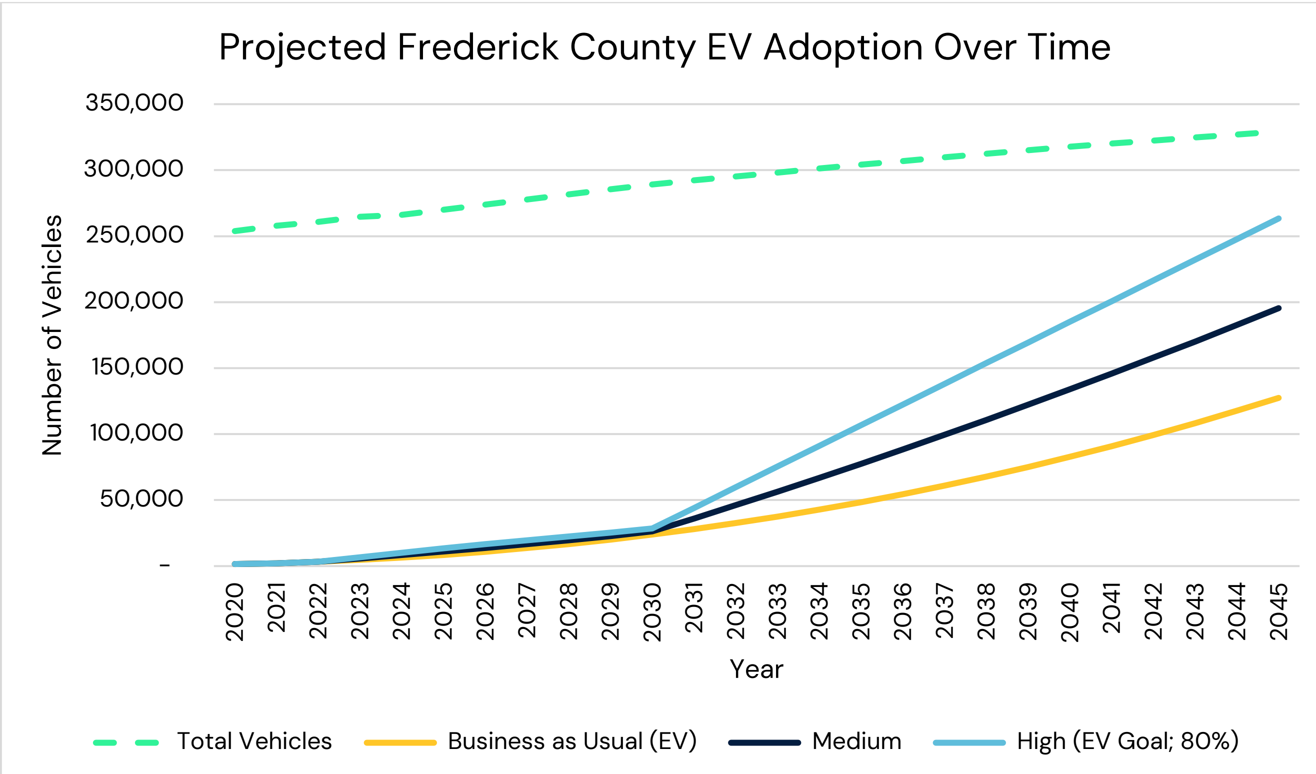
- Business-as-Usual (BAU)/Low Growth: The historical EV growth rate in Frederick County was used to project future EV deployment as a function of projected population growth.[57, 58, 59]
- Medium Growth: An average of the BAU and high growth projection.
- High Growth: The projected ratio of Frederick County to Maryland's population was applied to meet each of the state EV goals that Frederick County would be responsible for in benchmark years 2025 and 2030.[60] Following 2030, projections are extrapolated from an assumed goal of 80% EV registrations out of total vehicle registrations by 2045.

Table 7: Projected Frederick County EV Registrations by Benchmark Years

Year	2025	2030	2035	2040	2045
Business As Usual	8,523	23,991	48,461	82,866	127,450
Medium	11,035	26,238	77,629	133,986	195,433
High (ZEV Goal; 80%)	13,548	28,486	106,796	185,106	263,416
Total Vehicle Registrations	270,085	289,275	304,190	317,870	329,270

[57] MDOT/MVA. Electric and Plug-in Hybrid Vehicle Registrations by County as of each month end from July 2020 to September 2022. Retrieved from: https://opendata.maryland.gov/Transportation/MDOT-MVA-Electric-and-Plug-in-Hybrid-Vehicle-Regis/qtcv-n3tc
[58] MVA. Vehicle Registration by County for FY2010 to FY2021. Retrieved from: https://opendata.maryland.gov/Transportation/MVA-VEHICLE-REGISTRATION-by-COUNTY-FY-2010-to-FY-2/kqkd-4fx8
[59] MWCOG. Round 9.2 Cooperative Forecasting Summary Tables. Retrieved from: https://www.mwcog.org/documents/2021/12/02/cooperative-forecasts-employment-population-and-household-forecasts-by-transportation-analysis-zone-cooperative-forecast-demographics-housing-population/
[60] Maryland Department of the Environment (MDE). Zero Emission Vehicles. Retrieved from: https://mde.maryland.gov/programs/air/mobilesources/pages/zev.aspx#:~:text=Maryland%20has%20a%20goal%20of,needed%20to%20sustain%20this%20goal

Figure 7: Projected Frederick County EV Registrations Over Time



5.2 Projected Charging Needs

The U.S. Department of Energy's Electric Vehicle Infrastructure Projection Tool (EVI-Pro Lite) was used to project the amount of public and workplace charging need for current and projected EVs in Frederick County. EVSE infrastructure needs are evaluated by Level 2 workplace, Level 2 public, and DCFC.[61]

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 default assumptions were used for Frederick County's EVSE needs assessment:

- Vehicle mix:
  - PHEV: 20-mile electric range: 15%.
  - PHEV: 50-mile electric range: 35%.
  - BEV: 100-mile electric range: 15%.
  - BEV: 250-mile electric range: 35%.
- Full support provided for PHEVs.
- Percent of drivers with access to home charging: 75%.

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

The inputs above are 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 for drivers that may not be able to install home charging to meet anticipated charging demand.

The results from the Frederick County EV projection scenarios were applied to benchmark years 2025, 2030, 2035, 2040, and 2045 to determine the number of EVs deployed in the Frederick County region.[62]

EVSE assessment results for Frederick County 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:

- Single Family Home Charging Ports
  - Level 1
  - Level 2
- Shared Private Charging Ports
  - Multi-Unit Dwelling Level 1
  - Multi-Unit Dwelling Level 2
  - Private Workplace Level 2
- 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+

[62] 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.

Table 8: Projected EVSE Needs by Benchmark Year

			2025	2030	2035	2040	2045
Business As Usual (BAU)	EVSE Needs (port count)	Single Family	6,066	16,705	34,490	58,977	88,749
		Shared Private	479	1,220	2,729	4,661	6,479
		Public Level 2	617	1,546	3,508	6,003	8,214
		Public DCFC	37	77	211	362	406
		Total	**7,200**	**19,548**	**40,938**	**70,003**	**103,848**
	EVs to Support		8,523	23,991	48,461	82,866	127,450
Medium	EVSE Needs (port count)	Single Family	7,854	18,270	55,249	93,299	136,084
		Shared Private	621	1,334	4,369	6,813	9,933
		Public Level 2	799	1,690	5,620	8,633	12,591
		Public DCFC	48	80	340	429	623
		Total	**9,323**	**21,374**	**65,578**	**109,174**	**159,231**
	EVs to Support		11,035	26,238	77,629	133,986	195,433
High (State ZEV Goal)	EVSE Needs (port count)	Single Family	9,434	19,836	76,008	128,893	183,423
		Shared Private	689	1,448	6,014	9,409	13,395
		Public Level 2	873	1,835	7,735	11,926	16,969
		Public DCFC	43	91	467	590	842
		Total	**11,039**	**23,210**	**90,224**	**150,818**	**214,629**
	EVs to Support		13,548	28,486	106,796	185,106	263,416

With 120 existing publicly accessible charging ports in Frederick County, 85 Level 2 ports and 35 DCFC ports, Frederick County is projected to need almost ten times the existing number of public charging infrastructure by 2025. 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 Workplace Level 2 charging is not easily accessible. It is important to note that residential charging and workplace charging are key to address charging demand since the vast majority of EV drivers primarily charge either at home or at work. Single Family and Shared Private (multi-unit dwelling and workplace) charging projections are included in the table above, although data on existing and planned private EVSE installations within Frederick County may be difficult to collect. Further outreach and engagement are required to better understand the current state of existing residential and workplace charging availability. For educational resources for workplace charging, see Section 8.3.4.

5.3 Siting Best Practices

Adequate charging infrastructure must be planned for and installed across Frederick County 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. Frederick County priorities for public EV charging sites are listed below.

- **Transportation Hubs**
  - Potomac Edison has installed Level 2 charging stations at several *MARC stations*. *Transit Connector* stops should also be considered as potential EVSE sites, especially those that

overlap with other highly trafficked locations. Examples include *Frederick Community College, Frederick Towne Mall, Brunswick Crossing, Spring Ridge Shopping Center*, etc.

- Community Sites
    - *Frederick County Public Libraries* are spread across nine municipalities and already provide amenities like bathrooms. *Town halls* and *community centers* should also be considered.
- 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 *public schools*, *local colleges and universities*, *hospitals*, *shopping centers*, *hotels*, *movie theaters*, etc.
- Public Lands
    - EV charging stations at local *parks*, *plazas*, and *recreational centers* promote EV adoption and greater use of green spaces. Examples include *Catoctin Mountain Park*, *Cunningham Falls State Park*, and the *Chesapeake & Ohio Canal National Historical Park*.[63]
- Tourist Destinations

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. The County can also leverage existing relationships with employers to encourage adoption of workplace charging and better understand how much workplace charging is already available. Recommendations in both Section 7 and Section 8 would serve interested site hosts as they install, operate, and maintain EV charging infrastructure.

Prioritizing potential site locations can depend on a range of factors. Best practices for Frederick County 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 local utility to evaluate whether there is sufficient existing capacity to support EV charging infrastructure or if infrastructure upgrades are needed. See Section 8.1.3 for more information on how to engage your utility.

[63] Frederick County would provide feedback to stakeholders in charge of property management at such green spaces like the National Park Service.

- **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. See Section 6 for more information.
- **Near Multifamily Housing**
  - The majority of 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 power availability and construction costs.

Within Frederick County, there are both public and private opportunities to expand the EV charging network. As was shown in Figure 6 (map), existing EV charging infrastructure is spread across Frederick County with a high concentration in the City of Frederick. The County can leverage information on the above criteria, in addition to any community-specific needs, to fill gaps in the region's charging network. In conversations with the Stakeholder Advisory Group, EV charging needs at new and existing multifamily housing, public sites that can serve garage orphans,[64] and workplace charging require further outreach to better understand and mitigate barriers to adoption.

[64] "Garage orphans" are EV drivers that do not have access to a driveway or garage where they could install a private EV charging station.

6 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 transportation-related air pollution, like particulate matter and volatile organic compounds, and EV charging infrastructure can make it easier to encourage EV adoption as a strategy to reduce those impacts.

6.1 Identifying and Engaging Disadvantaged Communities

The approach provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy[65] can help incorporate equity and justice considerations in Frederick's future clean energy investments:

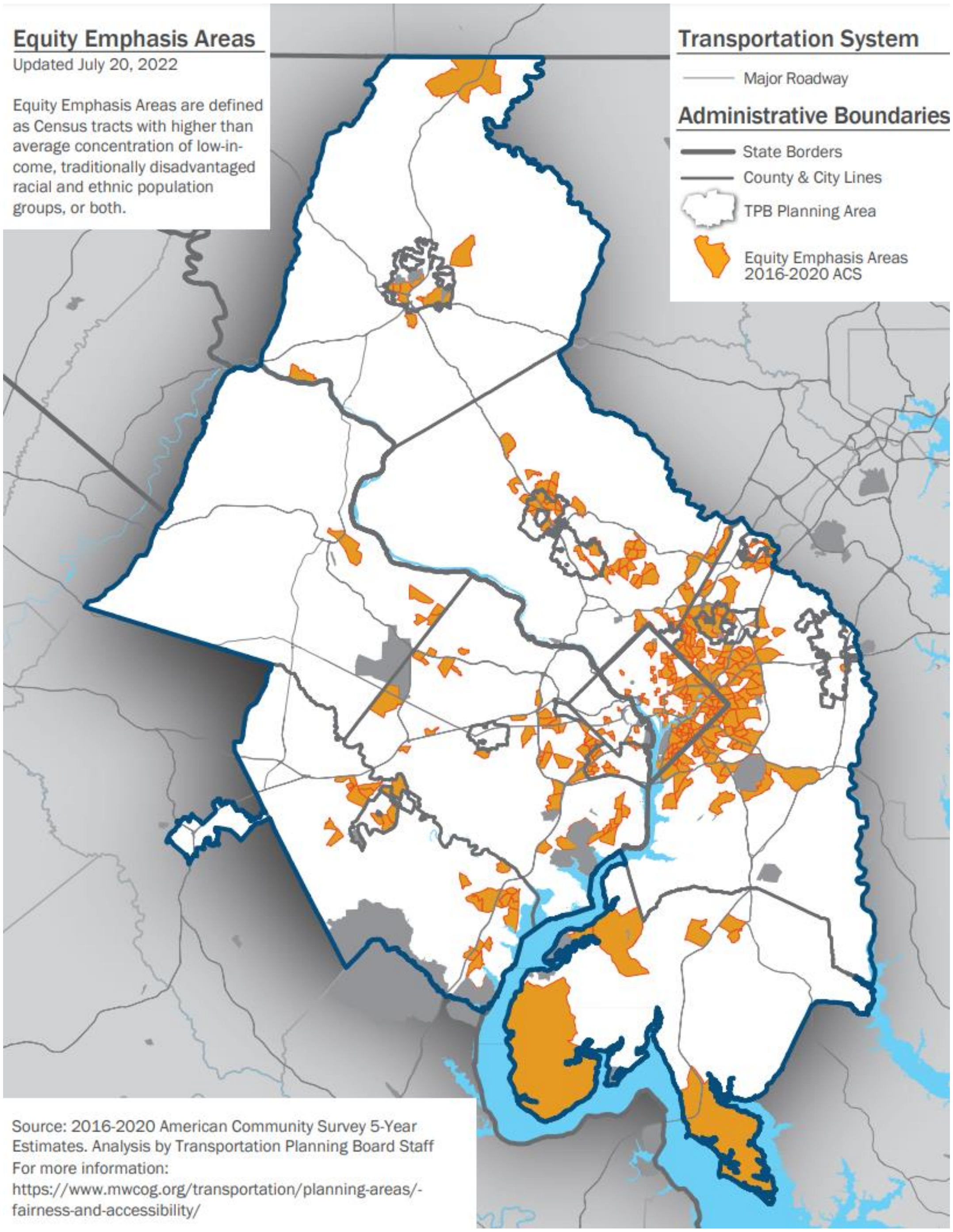
1. Identify the factors that have and continue to contribute to inequality and the existence of underrepresented communities. Use a series of tools to guide and measure disadvantaged community status.
2. Enhance the institutional and cultural factors that can foster the capabilities of communities. Use strategies and policies, such as funds and compensation, to alleviate damage or subsidize technology adoption and civil society organizations (NGOs) communities can draw on.
3. Co-develop adaptive and inclusive governance and policy systems. For example, collaborating with communities to design programs that increase their opportunities to access jobs, schools, and good quality energy services.
4. Evaluate using metrics to monitor performance and determine whether the goals of the program are being addressed.

Localized data can help identify disadvantaged communities.

- MWCOG Equity Emphasis Areas: MWCOG and the National Capital Region Transportation Planning Board provides census tract-level data on concentrations of low-income and/or minority populations.

[65] NREL. Energy Justice: Key Concepts and Metrics Relevant to EERE Transportation Projects. Retrieved from: https://www.nrel.gov/docs/fy21osti/80206.pdf

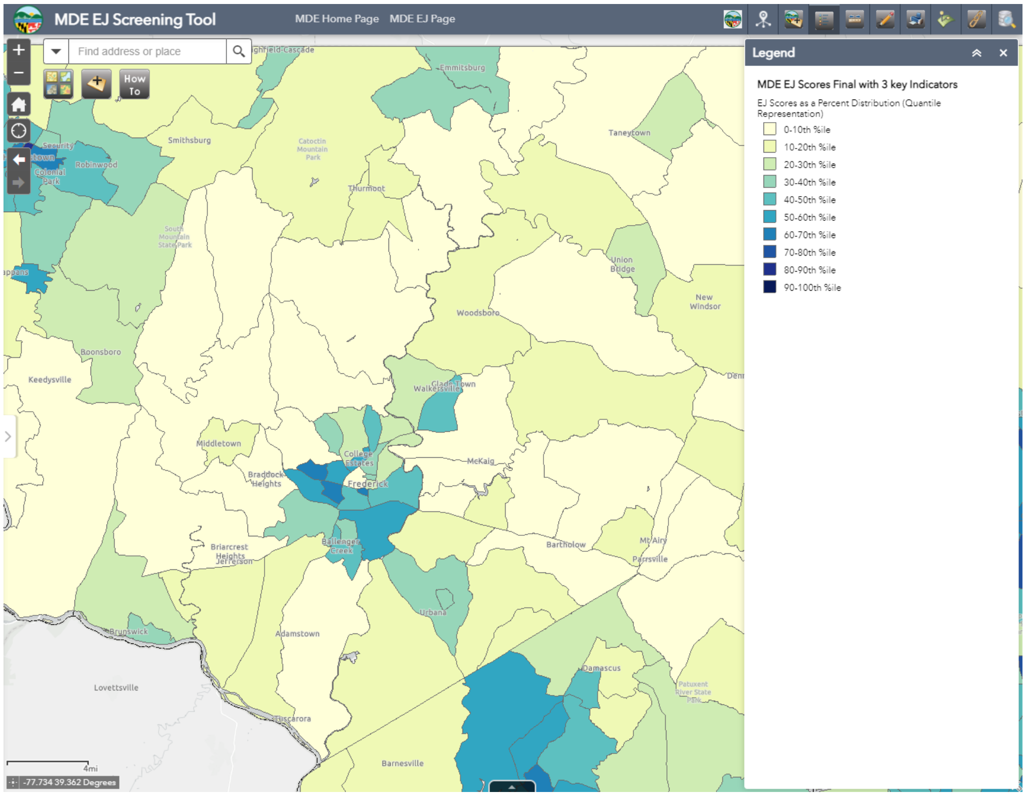
Figure 8: MWCOG Equity Emphasis Areas 2022[66]



- [Maryland Environmental Justice Screen Tool](#): Maryland mapping tool that includes a data on a range of socioeconomic factors, environmental effects, sensitive populations, and pollution burden exposure metrics.

[66] MWCOG. Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis. Retrieved from: https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/

Figure 9: Census Tract and Frederick County Environmental Justice[67]



There is also an increased federal emphasis on equitable engagement and outcomes, several national-level climate and equity tools have been developed to help identify disadvantaged communities (DACs)[68], listed below.

- Climate and Economic Justice Screening Tool (CEJST): The White House Council on Environmental Quality (CEQ) provides interactive maps of disadvantaged communities established by Justice40 Interim Guidance.
- Screening Tool for Equity Analysis of Projects (STEAP): The Federal Highway Administration (FHWA) provides mapping tools that supports environmental justice screening.
- Low-Income Energy Affordability Data Tool: The U.S. Department of Energy developed a tool that provides estimates of low-income and moderate-income household energy data.
- Energy Zones Mapping Tool: Mapping tool from Argonne National Laboratory to identify potential energy resource areas and energy corridors in the United States.
- Social Vulnerability Index: The U.S. Center for Disease Control provides maps of 16 census variables to help local officials identify communities that may need support before, during, or after disasters.
- Transportation Equity Analysis: Tools and resources from Argonne National Laboratory that support transportation energy equity analysis.

[67] Maryland Department of the Environment (MDE). MDE EJ Screening Tool. Retrieved from: https://mdewin64.mde.state.md.us/EJ/
[68] It is important to note that the U.S. Department of Energy and Department of Transportation have created similar but distinct definitions of DACs, which may affect tool outcomes.

Evolving federal environmental justice tools and designations may become requirements for future federal funding and should be tracked. Additional resources also include a Rural EV Toolkit from the U.S. Department of Transportation to assist rural stakeholders with planning for EV charging infrastructure.[69]

It is important to design charging infrastructure projects alongside a diverse set of community members, which provides local context to ensure appropriate charging solutions for the area. For example, a high-density urban area with multifamily housing might benefit from Level 2 curbside charging, while a more rural community may not have on-street parking and would benefit instead from centralized fast charging.

6.2 Outreach to Disadvantaged Community Audiences

Directly engaging communities to understand their specific transportation needs is critical to developing appropriate solutions. The County should work with trusted partners within communities that can help collect information and contextualize responses. With their input, communities and the County can collaboratively develop solutions that directly address community concerns and maximize investments to best serve drivers that may have a harder time accessing charging infrastructure. Examples of potential barriers are listed below:

- Greater financial need to purchase or lease any vehicle, including an EV or EVSE.
- Live and/or work in inconvenient areas (i.e., further from transportation hubs or city centers, no private parking, live in multifamily housing, no parking at their homes, grid constrained, etc.).
- Do not own the property they reside on (renters).
- Lack of a phone or sufficient data to connect with a charging network/payment system.
- Lack of a credit card.
- Educational barriers to information like financial incentives, lifestyle changes, user instructions, etc.
- Language barriers for charging station instructions.
- Difficulties applying commuting subsidies (e.g., gas card) to charging stations.

Additional items should be considered when communicating with these groups to conduct education and outreach efforts. Consider the following when conducting efforts with such groups:

- Translate materials into multiple languages as needed.
- Engage with vendors to translate sales materials.
- Plan outreach at locations where these groups already meet.
- Connect with community-based organizations and community leaders to disseminate information about EVs and EVSE.
- Educate the audience on why and how the topic of EVs and EVSE is relevant to them, including topics such as emissions benefits, improved mobility, and cost of ownership benefits.
- Describe state incentives for EV purchasing and EVSE installation that are targeted towards low-income communities.
- Highlight less costly ways to own, operate, or ride an EV and access EVSE, such as:
    - Purchasing a used EV.
    - Participating in an EV carshare or rideshare program where available.
    - Utilizing public EVSE.
    - Utilizing EVSE available in multi-unit dwellings.
    - Taking advantage of EVSE purchase incentives from utilities and other entities.

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[69] U.S. Department of Transportation (DOT). Rural EV Toolkit. Retrieved from: https://www.transportation.gov/rural/ev/toolkit

6.3 Equitable Policy Considerations

Beyond equitable planning, engagement, and siting, there are some additional topics that may also pose barriers to disadvantaged communities and their access to EV infrastructure. Examples include considerations for disabled EV drivers and riders, EV drivers with restricted access to parking, and potential EV drivers with limited financial resources. More information on accessibility and garage orphans is provided in Section 7.

6.3.1 Targeted Incentives

Many jurisdictions will lower barriers to EV adoption and charging infrastructure specifically for disadvantaged communities (DACs) by offering targeted incentives. Examples of innovative policies and programs from the Northeast States for Coordinated Air Use Management (NESCAUM) are summarized below. [70]

- Rebates for used EVs: Used EVs are an attractive option for DACs as they have lower upfront costs and still offer fuel and maintenance benefits like new EVs. Refer to manufacturer websites for information on vehicle and battery warranties for used vehicles.
- Separate or larger incentives for DACs (can include incentives for multi-unit dwellings). While rebates for EVs and EV charging infrastructure are widespread, DACs often need additional help to afford the upfront cost of switching. Targeted or larger incentives can help meet the differential in need for these communities.
- Targeted outreach and materials to increase EV awareness: DACs may not be aware of EV incentives available to help make the switch to EVs and may even need general information on EVs and charging infrastructure. Providing information and resources can support EV adoption in these communities.

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[70] NESCAUM. Examples of Innovative Policies and Programs. Retrieved from: https://www.nescaum.org/documents/expanding-equitable-access-to-ev-mobility-examples_9-21-20.pdf

7 Policy Overview and Recommendations

This section reviews EV charging infrastructure policies, requirements, and regulations in Frederick County, 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 Frederick County. The County can accelerate EV adoption and complement supportive state policies to accelerate the transition to a zero-emission transportation system by:

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

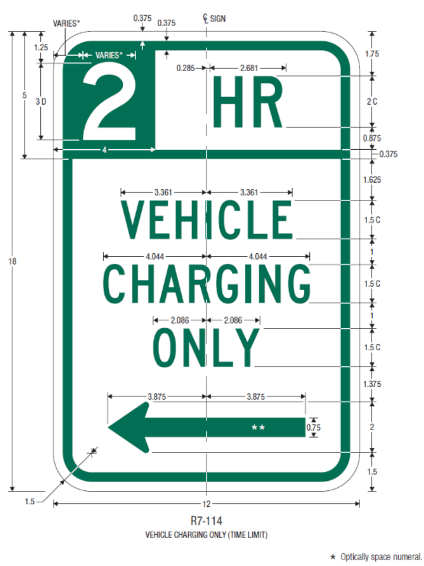
7.1 Parking and Zoning Bylaws

Local jurisdictions can improve driver confidence and increase the number of EV charger installations by instituting supportive parking and zoning bylaws. Consumers are more likely to consider purchasing an EV if they have access to publicly available charging stations or EV-ready infrastructure at or near their residence.[71] This is increasingly important for residents of multi-unit dwellings, who require greater access to off-street charging infrastructure. While most EV drivers charge at home, about half of Americans do not have access to dedicated off-street parking spaces that are EV-capable.[72] 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. Currently, the Frederick County Code of Ordinances has requirements for the number of total parking spaces and dimensions of parking spaces but does not include any EV-specific parking or zoning bylaws.[73]

7.1.1 Current Policies

In 2022, Maryland passed the **EV Parking Space Regulation**, effective October 1, 2022, which resulted in the following changes:

- Individuals may not stop, stand, or park a vehicle in a designated EV charging space unless it is an EV that is actively charging. Violators may be subject to a fine of $100.
- EV charging spaces must have signage that indicates the charging space is only for EV charging, day or time restrictions, states maximum violation fine, and is consistent with design and placement specifications in the Manual on Uniform Traffic Control Devices for Streets and Highways (draft example shown to right, courtesy of the Zero Emission Electric Vehicle Infrastructure Council (ZEEVIC)).
- EV charging spaces count toward the total minimum parking space requirements for zoning and parking laws.



[71] Singer, Mark. 2020. *Plug-In Electric Vehicle Showcases: Consumer Experience and Acceptance*. National Renewable Energy Laboratory. NREL/TP-5400-75707. Retrieved from: https://www.nrel.gov/docs/fy20osti/75707.pdf

[72] Southwest Energy Efficiency Project (SWEEP). *EV Infrastructure Building Codes: Adoption Toolkit*. Retrieved from: https://swenergy.org/transportation/electric-vehicles/building-codes

[73] Frederick County, Maryland Code of Ordinances § 1-19-6.220. Parking Space Requirements and Dimensions. Retrieved from: https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-34450

Maryland has also passed **EV Charging Station Policies for Associations** which prohibits homeowners associations or condominium associations from restricting the installation or use of an EV charging station in a homeowner's dedicated parking space.[74] 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. For more information and case studies on EV charging projects in homeowner associations and multifamily housing, please see Maryland EV's Local Resources page.

7.1.2 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 EV car sharing.[75]

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.[76]

"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. Some examples are listed below.

- Montgomery County 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.[77]
- 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.[78] 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.[79]
- In 2014, the City of Seattle conducted research on how to mitigate barriers to charging for garage orphans.[80] Their findings recommended the two following strategies: after-hours access to private

[74] AFDC. Electric Vehicle (EV) Charging Station Policies for Associations. Retrieved from: https://afdc.energy.gov/laws/12624
[75] 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
[76] City of Oakland. Electric Vehicle Requirements in New Construction. Retrieved from: https://www.oaklandca.gov/resources/electric-vehicle-requirements-in-new-construction
[77] Montgomery County, MD – Department of Permitting Services. Residential Electric Vehicles (EV) Charging Permitting Guidelines. Retrieved from: https://www.montgomerycountymd.gov/DPS/Resources/Files/RCI/EV Charging Stations in the ROW.pdf
[78] District Department of Transportation. EV Charging Station Program. Retrieved from: https://ddot.dc.gov/page/electric-vehicle-charging-station-program
[79] 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
[80] Seattle Office of Sustainability & Environment (October 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

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.

7.1.3 Policy Recommendations

Local jurisdictions can enact regulations that codify legal certainty and improve efficiency of EV charging station deployment. Establishing beneficial codes increases the likelihood that future developments will accommodate the needs of EV charging service providers, site hosts, and EV drivers. Frederick County can amend parking regulations in a way that:

- Supports EV building codes (see Section 7.2).
- Incorporates accessible best practices and/or future requirements. Monitor federal announcements for new recommendations or requirements on accessible EVSE parking spaces (see Section 7.4).
    - Provide U.S. Access Board accessible EV charging parking space recommendations to relevant or interested parties in the interim.

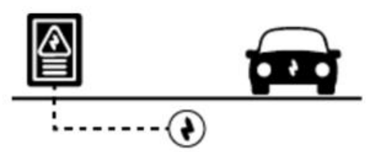
7.2 Building Codes

CRRR Recommendation 4 includes adopting building codes that encourage prewiring for EV charging stations, which decreases the cost of charging station installations. Building code provisions, 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". Figure 10 provides an overview of the differences between these terms.

Figure 10: Building Code Definitions[81]

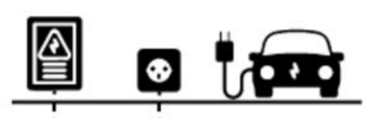
EV-Capable Parking Space: Electrical Panel Capacity & Conduit

- 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.



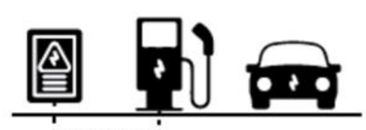
EV-Ready Parking Space: Install full circuit

- 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.



[81] City of Sacramento. Electric Vehicle Infrastructure Requirements in CALGreen Building Code. Retrieved from: http://www.cityofsacramento.org/-/media/Corporate/Files/CDD/Building/Sacramento-Streamline/EV-Infrastructure-Reqs-in-CALGreen-Building-Code_April-2020.pdf?la=en

One goal of enacting these EV building codes is to lower the installation costs for EV chargers. Installing EV infrastructure during new construction can be substantially less expensive than installing EV infrastructure during retrofits. The Southwest Energy Efficiency Project (SWEEP) estimates that costs can be four to six times higher when installing EV infrastructure during 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.

7.2.1 Current State and Local Policies

Effective March 15, 2022, the Frederick County **Residential Construction EV Charging Ordinance** requires all newly built single family detached houses, along with townhouses and duplexes having an on-lot parking area, to install the following for a minimum of one dedicated parking space:

- An electrical panel with sufficient capacity and space to support a minimum 240-volt/40 amp branch circuit for Level 2 charging for at least one vehicle at the garage, carport, parking pad, or on lot parking area;
- The installation of raceways to support an EV charging outlet terminating at a junction box at the parking space; and
- Permanent and visible labels stating "Reserved for EV-Raceway" at the service panel and "Reserved for EV Charging Outlet" at the termination point or junction box at the parking space.[82]

In addition, Maryland's **EV Charging Station New Construction Requirement** mandates that builders must provide buyers the option to include a Level 2 EV charging station or electric prewiring to support a Level 2 EV charging station in all new homes which include a garage, carport, or driveway. The builder must provide buyers with notice of EV charging station make-ready options and information about all available rebate programs for EV charging station purchase and installation.[83]

7.2.2 Leading Jurisdictions

SWEEP has compiled examples of jurisdictions that have adopted EV infrastructure building codes, with references to specific codes included on their website.[84] In an effort to expand opportunities for EV charging in multifamily buildings, states and localities have amended their building codes to require EV charging station installations or make-ready EV parking spaces. Examples of EV charging station building standards for multifamily buildings include:

- San Jose, California: New residential construction must provide EV charging station compatible infrastructure to facilitate current and future EV use. New multifamily buildings must have 10% of total parking spaces designated as EV charging stations parking spaces, 20% may be EV-ready, and 70% may be EV-capable. New hotels and motels are required to have 10% of parking spaces designated for

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[82] Frederick County, MD: Code of Ordinances. *Electric Vehicle Charging; Residential Construction.* Retrieved from: https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-1360#JD_1-6-23
[83] AFDC. Electric Vehicle (EV) Charging Station New Construction Requirement. Retrieved from: https://afdc.energy.gov/laws/12622
[84] SWEEP. EV Infrastructure Building Codes: Adoption Toolkit. Retrieved from: https://www.swenergy.org/transportation/electric-vehicles/building-codes#who

EV charging and 50% may be EV-capable. All new non-residential facilities may have 10% of parking spaces and 40% may be EV-capable.[85]

- Fremont, California: Residential and non-residential new construction projects and additions where additional parking spaces are provided must include EV-ready parking spaces equipped with the electrical raceway, wiring, and electrical circuit. Single family residential projects must provide one EV- ready parking space per each dwelling unit, and multifamily residential projects of three units or more and all non-residential projects must provide EV-ready spaces for 10% of the total number of new parking spaces. All EV-ready parking spaces must be equipped with an EV charging unit.[86]
- Fort Collins, Colorado: 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.[87]

CALGreen, the State of California's green building code, has established minimum requirements for EV-capable infrastructure in new buildings. The requirements don't require the installation of EV chargers but 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% or 20%.[88]

7.2.3 Recommendations

Supportive building codes are a valuable tool for reducing overall costs and timelines associated with the deployment of EV charging infrastructure. Recommended steps for the County include:

- Implement County regulations that require baseline levels of EV readiness for additional residential building types not covered by the 2022 Zoning Ordinance and EV building code updates. Current EV building codes apply to single family homes, townhouses, and duplexes. Building types to consider for expansion include multifamily dwellings and multifamily group developments. Consider regulations that require baseline levels of EV readiness for new developments that are differentiated by building type.
    - Engage stakeholders like educational institutions to understand whether additional guidance or policy options should be considered in different cases.

[85] City of San Jose. Ordinance No. 30311. Retrieved from: https://www.sanjoseca.gov/home/showdocument?id=44078

[86] City of Fremont. Green Building: Electric Vehicle Readiness. Retrieved from: https://www.fremont.gov/about/sustainability/green-building

[87] City of Fort Collins, Colorado. Fort Collins Municipal Code Section §5-27-2.3604. Retrieved from: 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

[88] 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

- Example Text: Fort Collins, CO

City of Fort Collins Occupancy Classification for EV Charging Infrastructure	EV-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%

- Consider EV requirements for existing buildings undergoing significant renovations.
    - Example Text: Denver, CO Code Amendment Proposal[89]
        - Level 3 Alteration: Alterations where the work area exceeds 50% of the original building area or more than 10 parking spaces are substantially modified.
        - The building shall be provided with electric vehicle charging in accordance with this section and the National Electrical Code (NFPA 70). When parking spaces are added or modified without an increase in building size or a Level 3 Alteration, only the new parking spaces are subject to this requirement.

7.3 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.

[89] Denver Community Planning and Development. 2018 IECC Code Amendment Proposal. Retrieved from: https://drive.google.com/file/d/1mcJSpvXRuSOV-5pry2FWaZoas67S244X/view

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.

7.3.1 Current Local Policies

Electrical equipment installations for light, heat, or power, such as that required for installation of EV charging stations, requires an electrical permit from Frederick County.[90] Applications are required to be submitted to the County's Department of Permits and Inspections before the wiring can begin for an EV charging station. The location must be shown on an approved plan.

The County permitting process currently aligns with most EVSE permitting best practices, like creating a streamlined approval process and publishing an estimated processing time. The County currently has a 2-step permitting application process. First, the location must be chosen on an approved site plan. Site plans may either be for an original development or an amended site plan for an existing development. Once site plans are submitted or approved, multifamily housing, off-lot installations, and commercial non-residential sites may need additional building permits. Residential EV charging installations typically only require electrical permits. The Division of Planning and Permitting lists the expected processing time for an electrical permit as one or two days from the day the application is made and the fee is paid.[91]

While Frederick County offers expedited permitting through its Expedited Permit & Inspection Certificate, EV charging stations are currently not an eligible project.

The installation of EV charging stations in Frederick County may require additional review if the desired project location is on the Register of Historic Places.[92] The Frederick County Historic Preservation Commission reviews exterior changes to a County Register property, which would include EV charging stations, to ensure the proposed changes minimally impact the historic character of the property. Historic preservation laws require state and federal government agencies to consider the effects of their state or federally funded projects on National Register or eligible historic and archaeological resources through a consultation process known as Section 106 review.[93] Local agencies may submit projects for review to the Maryland Historical Trust.

The City of Frederick has a separate electrical permitting process from the County, which eligible EV charging stations need approval for prior to installing.[94] If the proposed property is in a historic area, Historic Preservation Commission or staff-level historic preservation approval is required before an electrical permit is secured.[95]

7.3.2 Leading Jurisdictions

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

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[90] Frederick County, Maryland Code of Ordinances § 1-7-61. Retrieved from: https://codelibrary.amlegal.com/codes/frederickcounty/latest/frederickco_md/0-0-0-2152
[91] Frederick County, MD. Electrical Permits. Retrieved from: https://www.frederickcountymd.gov/8002/Electrical-Permits
[92] Frederick County. Register of Historic Places. Retrieved from: https://frederickcountymd.gov/DocumentCenter/View/334292/County-Register-List-April-2022?bidId=
[93] Maryland Department of Planning. Section 106 Review Process. Retrieved from: https://mht.maryland.gov/projectreview_section106.shtml
[94] City of Frederick. Permits & Applications. Retrieved from: https://www.cityoffrederickmd.gov/902/Permits-Application-Center
[95] City of Frederick. Historic Preservation. Retrieved from: https://www.cityoffrederickmd.gov/225/Historic-Preservation

- Prince George's County's Guidelines for Permitting EV Charging Stations provides an overview of the inspection certification form, step-by-step instructions, and sample list of electrical code considerations for Level 1, Level 2, and DCFC systems.[96]
- Montgomery County has websites devoted to the permitting and inspection processes for both residential EV charging stations[97] and commercial EV charging stations[98]. Each website directs users to the respective EV charging policies, FAQs, and a step-by-step Process Guide for permitting and inspection.
- Baltimore County has a website devoted to EV charging station permitting, which provides an overview of guidelines for location, installation, and operation of EV charging stations, and a step-by-step guide to the application process.[99]

California's *Permitting Electric Vehicle Charging Stations: Best Practices* provides additional information and best practices for EV charger permitting (examples below).[100]

- 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
- 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.[101]

7.3.3 Recommendations

Frederick County's two-step permitting process is more streamlined than many other jurisdictions which will help support timely deployment of EV charging stations. Additional updates to the permitting processes in Frederick County could help to accelerate the safe and efficient deployment of EV charging infrastructure. The following are recommended steps the County could take to update their permitting procedures:

- Create a transparent checklist of all necessary requirements for EV charger permit applications and post the checklist in an easily accessible online location

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[96] Prince George's County – Department of Permitting, Inspections, and Enforcement. Guidelines for Permitting Electric Vehicle Charging Stations. Retrieved from: https://www.princegeorgescountymd.gov/DocumentCenter/View/35392/DPIE-Guidelines-for-Permitting-Electric-Vehicle-Charging-Stations-PDF

[97] Montgomery County – Department of Permitting Services. Residential EV Charging Station: Permit and Inspection Process. Retrieved from: https://www.montgomerycountymd.gov/DPS/Process/rci/residential-EV-charging.html

[98] Montgomery County – Department of Permitting Services. Commercial EV Charging: Permit and Inspection Process. Retrieved from: https://www.montgomerycountymd.gov/DPS/Process/combuild/commercial-ev-charging.html

[99] Baltimore County Government. Electric Vehicle (EV) Charging Station Permit. Retrieved from: https://www.baltimorecountymd.gov/departments/pai/application/electric-vehicle-charging-station

[100] 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/

[101] New York State Energy Research and Development Authority. 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

- 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

7.4 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, non-residential 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.[102] 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.[103]

7.4.1 Current Local Policies

Select site hosts created **informal accessibility guidance** for EV parking spaces in Frederick County after receiving user feedback that there is a universal accessibility issue with most of the existing EV infrastructure. The relevant site hosts then redesigned select public Level 2 and DCFC installations, to include an aisle between the EV spaces. Informal accessibility guidance used for some local Level 2 and DCFC installations are included below.

Level 2

- Request minimum of 21' in width;
    - Two 8' spaces with a 5' aisle in between.
- Place the station within the aisle, up against the curb or the far back of the space.
- Install foundation at grade with the parking spaces.
- Install two bollards on either side of the unit, at least 36" apart.
- Require lot to be concrete or asphalt. If not, consider installing a pad for charging area. This would be a minimum of 21' width x 19' depth or 400 square feet.

DCFC with Level 2

- Install foundation at grade with the parking spaces.
- Install two bollards on either side of the units, at least 36" apart.
- Require lot to be concrete or asphalt. If not, consider installing a pad for charging area. This would be a minimum of 37' width x 19' depth or 700 square feet.

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

[103] 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

7.4.2 Leading Jurisdiction

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.[104]

7.4.3 Recommendation

While there are no existing accessibility requirements for EV parking spaces, several federal agencies have begun evaluating EV charging station requirements as several sizeable federal funding programs for EV charging stations begin distributing funds. However, the County should require that new stations intended for public use meet the requirements of Section 302 and Subsections 502.1 – 502.5 of the Americans with Disabilities Act Accessibility Standards (ADAAS) with regard to size, surfacing, etc. for parking spaces to ensure equal access to charging facilities. Referencing these sections incorporates requirements for even, durable, non-slip surfacing that does not exceed a 1:48 slope threshold in any direction. Should the County adopt design standards for these facilities, the location of the charging equipment will also be a factor to consider because of implications it could have for accessible routes and the ability of persons with mobility impairments to park, plug-in, and access adjacent facilities. Concerning accessible signage, whether accessible EV parking spaces should be reserved solely for eligible EV drivers or accessible to all EV or accessible needs drivers needs to be determined. The County should monitor federal reviews and rulemakings related to the ADA, ABA, and FHA for updated guidance on recommendations or requirements for accessible EV parking spaces and related signage.

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

8 Implementation Strategies

8.1 Installation Considerations

Planning for EV charging infrastructure investment necessitates consideration of a variety of factors, including the following:

- The type (e.g., light-, medium-, and heavy-duty) and number of EVs to be deployed now and into the future.
- The number of chargers needed now and into the future.
- The required power level of each charger.
- Deployment timelines for EVs and charger installation, including time needed to complete site-level make-ready infrastructure and distribution grid upgrades.

EV charging infrastructure is available with multiple interfaces to the vehicle, a range of power capacities, and several auxiliary components to choose from. The right combination of charging infrastructure and equipment will depend on the level of EVs to be powered, typical EV daily operating profiles, the number of EVs needing power, and site location.

8.1.1 Public versus Private EV Chargers

One of the first factors that entities should consider when planning to deploy EV charging infrastructure is whether the charger will be used in a private or public setting. The optimal type of EV charging infrastructure will depend on whether the charger is available to the public, to a private fleet, or to a semi-private shared set of fleet vehicles. Public chargers are often made available to commuters and non-work travelers who may need to charge because they 1) do not have their own home charger, or 2) need to charge their battery on long trips or in situations in which their battery is significantly depleted. At this point in time, public chargers are expected to charge mostly light-duty vehicles (i.e., passenger vehicles), and they can be either Level 2 chargers or DCFCs, depending on the anticipated needs of drivers. As described in Section 2, DCFCs are more expensive to install but offer significantly faster charging rates than Level 2 chargers. Public Level 2 chargers are less costly to install and are better suited in locations where EV drivers are expected to spend several hours, and therefore can allow their EV to stay connected to the charger for longer.

Private chargers can be installed in a number of locations, including at vehicle fleet facilities or depots, at shared charging lots, or on public corridors that are commonly traveled by one or more fleets that own the charger. Most commonly, private chargers are installed in fleet facilities, and the power and design requirements of those chargers will vary depending on the type of EVs to be charged and how the EVs are operated on a day-to-day basis.

See Table 6 for a list of the 120 publicly available EV chargers in Frederick County.

8.1.2 Engage With Utility

Coordination and collaboration with local utilities is an important component of ensuring successful deployment of EV infrastructure. In Frederick County, Potomac Edison supplies energy to most of the region while the Town of Thurmont owns and operates the Town of Thurmont Municipal Light Company.

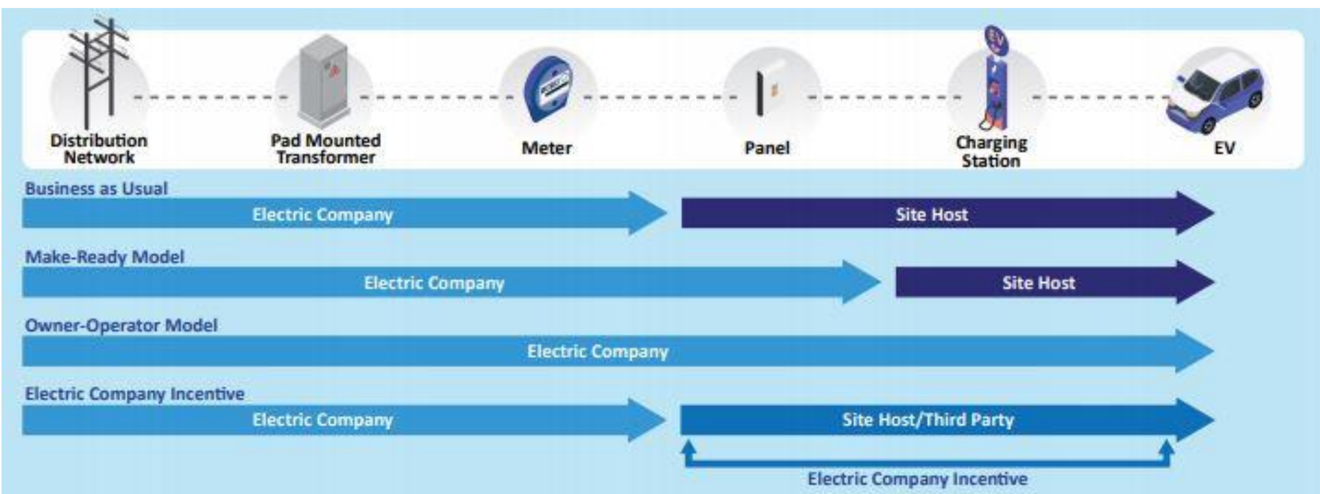
Determining local electricity rates is important to understanding the total cost of ownership. Electricity rates are important factors in planning EVSE deployment. Potomac Edison is the primary electric utility company in the Frederick region. Potomac Edison's rates for public EV charging stations range from $0.21 to $0.25 per kWh for Level 2 and $0.31 to $0.34 per kWh for DCFCs. Scheduled rates are market-based, updated on a quarterly basis, and may vary based upon siting location.[105] Potomac Edison provides EV Driven rebates to residential customers and customers who are owners of multi-unit dwellings. Off-peak credits are also available to residential customers who charge during off-peak hours.

Evaluating electrical supply needs to support EV charging infrastructure at those locations is an important next step in EV charging station site evaluation. As Frederick County identifies EV charging station locations, the process may involve working with Potomac Edison, the Town of Thurmont Municipal Light Company, and any other utilities to conduct site assessments which evaluate whether there is sufficient electrical capacity to serve the expected increase in load.[106] Utilities could also take an observed increase in demand and incorporate future load into their plans to invest in grid resources and distribution upgrades.

8.1.3 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.

Figure 11: Electric Vehicle Charging Infrastructure Ownership Models[107]



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.

[105] Potomac Edison. Tariff for Furnishing Electricity. Retrieved from: https://www.firstenergycorp.com/content/dam/customer/Customer%20Choice/Files/maryland/tariffs/PotomacEdisonRetailTariff.pdf
[106] Potomac Edison has indicated that Phase 3 constraints are particularly crucial to EVSE deployment in the region.
[107] Electric Power Research Institute (August 2019). 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

For Frederick County stakeholders, the list of infrastructure ownership options includes the following:

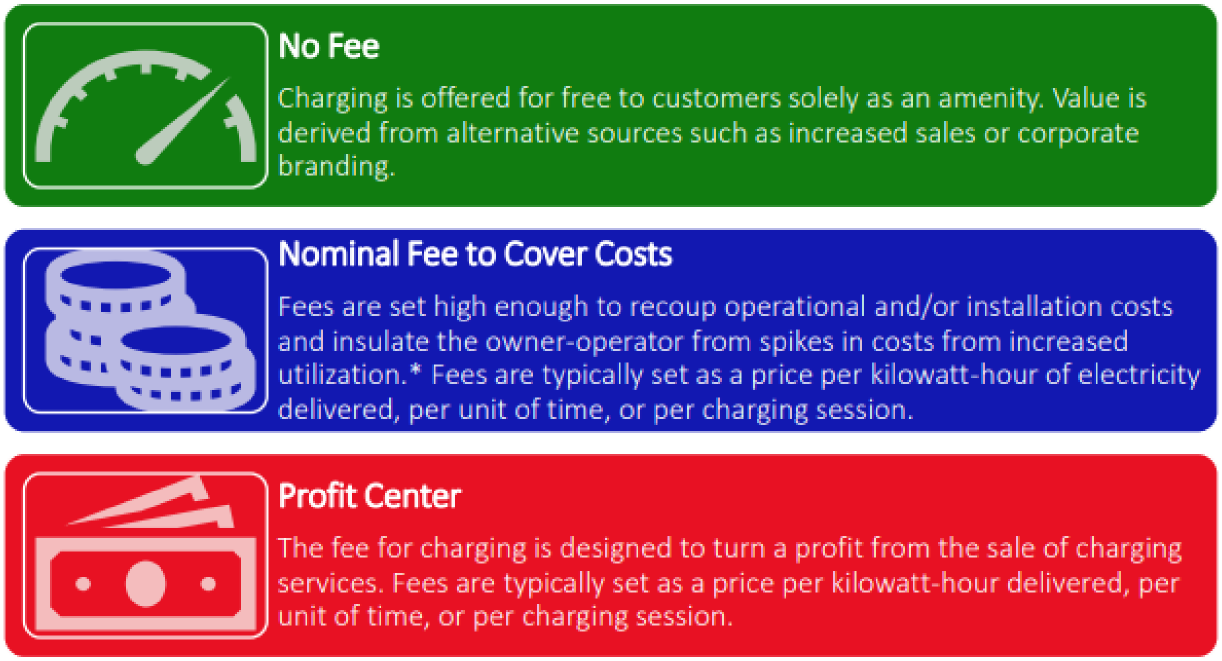
- **Site-Host Owner-Operator:** In this model, the entity hosting the charging stations also own the charging stations. This model gives the site host complete control of the station and allows them to keep all revenues, but also places the most risk on the host, including risks associated with maintenance, 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 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.

8.1.3.1 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 in Figure 12.

Figure 12: Fee Categories[108]



** 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.*

8.1.4 Types of EVs that Chargers Will Service

EV types vary in the amount of energy capacity for their respective electric battery type. Batteries on EVs range in capacity (kWh), and those deploying EV charging infrastructure will need to understand the battery capacity of the vehicles expected to use the chargers, as that will impact how powerful chargers need to be. Another important consideration is whether the EVs will spend significant portions of the battery's energy capacity on auxiliary power requirements.

Consider a fleet of electric refuse trucks as an example. Refuse trucks often have hydraulic systems to run packing cycles used to compress garbage tossed into the hopper, and these systems draw energy from the same battery as the motor, leading to more energy consumption and therefore more energy to return to the battery when charging. 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).

In addition to understanding battery sizes and power needs, those deploying charging equipment should also take note of what type of charging port the deployed EVs contain. Most EVs are designed with a plug-in charging port, but other forms of charging exist as well, as described in Section 2. Overhead charging involves the use of a pantograph that lowers from an overhead position onto a connection point located on the top of the vehicle. Inductive (wireless) charging entails a charging pad to be installed in the ground and the EV

[108] 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

positioning itself over top of the pad to initiate a charge. While the plug-in charging style is most common, it itself also comes with multiple connector types.

Additionally, EVSE is categorized into alternating current (AC) and direct current (DC) chargers. AC power is the type of power that comes directly from the grid. Batteries for electronic devices, including EVs, can only store power as DC, so plugs for electronic devices such as phones have converters that convert AC power to DC.

The difference between AC charging and DC charging is whether the AC power is converted to DC power inside or outside of the EV. Most EVs convert AC to DC inside of the car and then direct that power into the battery. Therefore, most EVs and chargers use AC power. DC chargers, on the other hand, convert the power inside of the charger itself, so DC power is fed directly to the car battery.[109]

In North America, the SAE J1772 Type 1 connector is the standard AC charger used. Aside from Tesla, EVs sold in North America use the SAE J1772 for both Level 1 and Level 2 charging. Tesla provides adapter cables to connect to J1772s. For DC fast chargers, the Combined Charging System (CCS) is the standard in North America; most EV manufacturers use this connector in North America. CCS combines the J1772 charger with high-speed charging pins. However, Nissan and Mitsubishi, automakers based in Japan, use the Japanese standard, CHAdeMO. Tesla produces their own DC fast chargers, called Superchargers, accessible only to Tesla drivers.[110] In May 2023, Ford, GM, and Rivian announced that they will be adopting the Tesla plug standards, also called the North American Charging Standard (NACS).[111] This may have implications as charging providers and customers make decisions on whether to adopt CCS or NACS moving forward. Projects applying for federal funding require CCS connectors, but the County should monitor which standards are required for other jurisdictions' projects and funding programs.

Figure 13: Types of EV Charger Connector Standards

	AC	AC + DC	DC
SAE J1772	 **SAE J1772 AC** Charging rate: up to 20 kW Supply voltage: 120/240 V/208 V Supply amperage: up to 80 A	 **Combined Charging System (CCS Type 1)** Charging rate: up to 20 kW (AC) or 350 kW (DC) Supply voltage: 480V Supply amperage: up to 500A	 **Combined Charging System (CCS Type 1)** Charging rate: up to 350 kW (DC) Supply voltage: 480 V Supply amperage: up to 500 A
SAE J3068	 **SAE J3068 AC_6** Charging rate: up to 33 kW Supply voltage: 208-480V 3P Supply amperage: up to 160 A	 **SAE J3068 AC_6/DC_8** Charging rate: up to 33 kW (AC) or 200 kW (DC) Supply voltage: 208-480 V 3P Supply amperage: up to 160 A (AC) or 200 A (DC)	 **SAE J3068 DC_8** Charging rate: up to 200 kW (DC) Supply voltage: 480 V 3P Supply amperage: up to 200 A (DC)
CHAdeMO	N/A	N/A	 **CHAdeMO** Charging rate: up to 400 kW (DC) Supply voltage: 208-480 V 3P Supply amperage: up to 500 A

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[109] Wallbox. EV Charging Current: What's the Difference Between AC and DC? Retrieved from: https://wallbox.com/en_catalog/faqs-difference-ac-dc

[110] Enel X. The Different EV Charging Connector Types. Retrieved from: https://evcharging.enelx.com/resources/blog/552-ev-charging-connector-types#:~:text=North%20American%20EV%20Plug%20Standards,2%20(240%20volt)%20charging

[111] Roy, Abhirup. "Rivian to adopt Tesla's charging standard in EVs and chargers" Reuters. Retrieved from: https://www.reuters.com/business/autos-transportation/ev-maker-rivian-adopt-teslas-charging-standard-2023-06-20/

8.1.5 Number of EVs Estimated to be Deployed

While the type of EV (and its corresponding battery capacity) will determine how much energy is needed to return to the vehicle battery in each charging session, the number of EVs expected to be serviced by the charger will affect the aggregate power demand required. When planning to deploy charging infrastructure for fleets, Frederick County stakeholders should take stock of the total number of EVs expected to use the facility and how that might change over time. In general, higher amounts of EV deployment will require higher amounts of power demand, possibly triggering the need for upgrades to utility-owned distribution grid equipment such as service transformers and conductors. For instance, Frederick County Government will experience higher power demand once it begins adopting EVs, which may require upgrades. Deploying more EVs in a single fleet will also make the coordination of charging activity more complex, and fleets in this position are likely to benefit from managed charging systems. Frederick County region stakeholders should examine the extent of EV deployment as it can inform the following strategies to optimize charging infrastructure deployment:

- Vehicle-to-charger ratio: Depending on how much energy the EVs consume on a daily basis, fleets may be able to reduce the number of chargers deployed if they could stagger charging across their fleet. A 2:1 vehicle-to-charger ratio might assume that each vehicle will charge every other day, for example (assuming the use of Level 2 chargers; the ratio of vehicles to chargers could be higher for DCFCs).
- Managed charging: Managed charging systems use software to coordinate charging activity across a fleet of EVs such that energy consumption is optimized and charging costs are minimized. In general, the more EVs deployed the greater the case becomes for managed charging.

For public chargers, Frederick County stakeholders should consider the expected throughput of EV drivers that may use the chargers. For example, a high traffic charging station that consists of five dual-port DCFCs (with ten total charging ports) will require more power from a utility than a station with only a single dual-port DCFC or a station with five dual-port Level 2 chargers.

8.1.6 Daily Driving and Operating Patterns of EVs

The way that vehicles drive on a daily basis will affect not only the amount of energy that needs to be charged into the vehicles' batteries, but also where charging infrastructure is best suited, what type of chargers are most suitable, and what other equipment may be needed to enable EV operations. For public chargers, stakeholders should seek to understand the travel patterns among drivers, including vehicle throughput and vehicle dwell time at those locations. For fleet charging, stakeholders should analyze the current operations of existing vehicles to understand the following items, assuming that EVs will replace existing fleet vehicles and operate on the same or similar routes: daily miles traveled, route patterns, where parked overnight, and the type of activities that vehicles are completing on route.

8.1.7 Location of EV Charging Infrastructure

The location of EV charging infrastructure is another important consideration that can affect what type of charger equipment is optimal and how powerful the chargers should be. For fleets, overnight charging at a central depot is generally the most optimal and cost-effective approach, but other arrangements may be necessary depending on a number of factors discussed above. For example, a transit bus traveling on long routes may require an on-route opportunity charger to ensure that the bus can complete the route without fully depleting the battery.

For public chargers, location will affect usage, and therefore their cost-effectiveness and ability to provide a return on investment. In general, optimal locations for public Level 2 EV chargers are those with high vehicle throughput and long vehicle dwell time. Locations that fit these criteria include MARC stations, parks, retail shopping centers, shopping malls, parking structures, and movie theaters. DCFCs are best suited in locations with high vehicle throughput but short vehicle dwell times, such as cafes and rest areas. Section 5 discusses high priority locations for new charging stations in the Frederick County region.

On the Federal level, funding is being directed to help strategically build out a national network of EV infrastructure, allowing travelers to access EV charging stations along national highway system corridors. FHWA designates a national network of alternative fuel corridors (AFCs) to focus development of alternative fueling infrastructure. In Maryland, there are currently 23 EV AFCs. Three of these corridors – I-70, I-270, and US-15 – run through Frederick County.[112] These designated corridors can help bring in funding from the National Electric Vehicle Infrastructure (NEVI) Formula Program.

8.2 Operations and Maintenance Considerations

8.2.1 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 (RMI), a research non-profit focused on sustainability.

Table 9: Range of EVSE Miscellaneous Equipment and Services Costs[113]

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

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

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[112] Zero Emission Electric Vehicle Infrastructure Council (ZEEVIC). EV Story Map. Retrieved from: https://maryland.maps.arcgis.com/apps/MapSeries/index.html?appid=f8c9dce0e3a8438caf8e53b71079834f

[113] Nelder, C. & Rogers, E. (December 2019). Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute. Retrieved from: https://rmi.org/wp-content/uploads/2020/01/RMI-EV-Charging-Infrastructure-Costs.pdf

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.

8.2.2 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.[114] 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. The County should 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.[115]

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.[116] 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.

8.2.3 Monitor 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 utilization data to site hosts. Frederick County 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.

8.3 Education, Outreach, and Marketing

Education and outreach are critical components to the successful deployment and utilization of EVSE. Such efforts should be tailored to each situation; the messaging, communication channels, and other outreach strategies should be tailored to the audience and goals. This section provides general guidance on education

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[114] Federal Highway Administration (FHWA)/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

[115] Federal Register. 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

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

and outreach strategies that can be used by local governments and other regional actors to educate and promote EV infrastructure deployment throughout the Frederick County region.

8.3.1 Key Messages to Communicate About EVSE

Messages meant to educate audiences about EVSE and promote its deployment should focus on current and expected future demand for EV charging, describing the types of EVSE and in which settings each are appropriate, the business case for deploying EVSE, available incentives, and indirect benefits of deploying EVSE (e.g., retail stores may see an increase in the time that shoppers spend in the store while their EVs are charging). While the messages that should be communicated through education and outreach efforts will vary depending on the audience, the following is a list of key messages to consider. The Stakeholder Advisory Group highlighted a need to build awareness on current market demand for EVs and associated demand for EV charging and information on the cost of charging infrastructure and incentives.

8.3.1.1 Communicating about Incentives and Resources for EVs and EVSE

While there are significant upfront costs associated with EVs and EVSE, there are also programs available to reduce those costs, as well as financial benefits associated with EVSE deployment. The table below shows incentives available in Frederick County.

Table 10: Private EV and EVSE Incentives[117]

Program	Eligible Entity	Incentive
Federal EV Tax Credit	EV Purchasers	Vehicles that meet critical mineral requirements are eligible for $3,750 tax credit, and vehicles that meet battery component requirements are eligible for a $3,750 tax credit. Vehicles meeting both the critical mineral and the battery component requirements are eligible for a total tax credit of up to $7,500.
Federal Used EV Tax Credit	Used EV Purchasers	A tax credit of up to $4,000 for the purchase of a used EV or FCEV. Eligible vehicles must be of a model year at least two years prior to the year of purchase and may not have a purchase price above $25,000.
Federal EVSE Tax Credit	Fueling Property Owners	Fueling equipment for natural gas, propane, hydrogen, electricity, E85, or diesel fuel blends, is eligible for a tax credit of 30% of the cost or 6% in the case of property subject to depreciation, not to exceed $100,000.
State EV and Fuel Cell EV Tax Credit	EV and FCEV purchasers	EV and FCEV purchasers may apply for an excise tax credit of up to $3,000

[117] AFDC. Maryland Alternative Fuel Laws and Incentives. https://afdc.energy.gov/laws/all?state=MD

Program	Eligible Entity	Incentive
MEA EVSE Rebate Program	Residential and Commercial Entities	Provides funding assistance for 40% of costs incurred acquiring and/or installing qualified EV charging stations (Max rebate amounts: $700 residential, $4,000 commercial)
MDE/MEA Electric Corridors Grant Program	Businesses	Provides funding through the VW Mitigation Program (over $3.68M) to install Level 2 electric vehicle stations and Level 3 electric vehicle DC Fast Charging stations throughout Maryland
Potomac Edison's EV Driven Program	Residential Customers and Multi-Unit Dwelling Property Owners	Rebates – $300 for residential customers and up to $20,000 – for multi-unit dwelling property owners for the purchase and installation of a Level 2 EV charging station
Potomac Edison's EV Driven Off-Peak Rewards Program	Potomac Edison Customers	Customers can earn 2 cents per kilowatt-hour for charging during off-peak hours
Potomac Edison's Public Charging Stations Program	Government Customers	Potomac Edison is installing and operating 59 Level 2 or DC fast charging stations on government property at no cost to the government sites

Additional resources like the AFDC's Vehicle Cost Calculator and Consumer Reports Buyer Guides may help consumers learn more about available EV models that fit their driving patterns. For more information about funding opportunities, see Section 10.

Communications can include information about incentives programs available in the Frederick County region to support EVSE deployment and operations, as well as information on the range of average costs associated with EVSE deployment, operations, and maintenance. Resources on average costs include:

- Costs Associated with Non-Residential Electric Vehicle Supply Equipment, U.S. DOE (2015)
- Reducing EV Charging Infrastructure Costs, RMI (2019)
- The Costs of EV Fast Charging Infrastructure and Economic Benefits to Rapid Scale-Up, EVgo (2020)

Beyond incentive programs, many additional resources are available to support potential EV and EVSE owners, site hosts, and operators. Messaging can include these resources, such as those listed below:

- Maryland EV: The state provides Maryland-specific EV information and links to additional resources
- The Electric Vehicle Association of Greater Washington, DC (EVADC): Local EV non-profit with educational resources on EV and EVSE costs and incentives
- Maryland Clean Cities Coalition: Clean Cities coalitions are located throughout the country to assist with projects related to alternative fuel vehicles and infrastructure. The State of Maryland Clean Cities works with stakeholders across the region

8.3.1.2 Conveying the Benefits of EVSE Deployment

To engage potential site hosts, it is important to demonstrate that demand for EVs and EV charging is growing. The Stakeholder Advisory Group confirmed that providing a "reality check" on the current market demand for EVs and EV charging due to increasingly ambitious manufacturer commitments and federal programs is critical. Coupling messaging about significant government programs dedicated to supporting the EV market with information on supportive policies and available resources can help illustrate the shift to EVs in the transportation sector. Providing information on the potential benefits associated with installing EV charging stations may further encourage interested parties to proceed with deployment. The table below lists messaging options and resources.

Table 11: Key Messages on the Benefits of EVSE Deployment

Message	Resource
Businesses may open **new revenue streams** through EV charging.	How to Earn Revenue with EV Charging at Retail Locations, ChargePoint (2022)
EV infrastructure is an amenity that can help spur economic growth. EVSE can help owners of **multi-unit dwellings attract new residents** and can help restaurants, retail shops, and other businesses attract new customers.	Estimating the Economic Impact of Electric Vehicle Charging Stations, Argonne National Laboratory (2022) Electric Vehicle Charging for Multifamily Housing, AFDC (2022)
Widespread EVSE deployment will help make EV ownership more **accessible to low-income residents and those living in multi-unit dwellings**. These residents may not be able to charge at home or in their buildings because of a lack of EVSE in their parking garage or use of off-street parking.	Equity Considerations in EV Infrastructure Planning, U.S. DOT (2022)
Widespread deployment of EVSE helps make charging stations more ubiquitous, **reducing range anxiety** and encouraging and enabling the adoption and use of EVs.	EV Challenges and Evolving Solutions for Rural Communities, U.S. DOT (2022)
Load management systems can help reduce the financial impact of EV charging on site owners.	What Is Vehicle-to-Grid Technology and How Does It Work?, EV Connect (2020)
With zero tailpipe emissions, **EVs have positive impacts on air quality** and thus yield health benefits. EV adoption can help reduce the levels of nitrogen oxides, volatile organic compounds, fine particle pollution, and sulfur dioxide – pollutants that can have harmful effects on lung and heart health.	Zeroing In on Healthy Air, American Lung Association (2022)
EVs help reduce greenhouse gas emissions with lower carbon dioxide emissions compared to other vehicles.	Emissions from Electric Vehicles, AFDC (2022)

8.3.1.3 Demystifying the Process

Communications can also discuss how EV infrastructure works, making the processes clearer and easier to understand. Key points include:

- EVSE is customizable; designs can be tailored to each site owner's needs. There are a variety of EVSE types, power levels, styles, makes, and models commercially available.
- Early planning and development for future EVSE deployment – for example, installing circuitry and enabling infrastructure in parking garages of new buildings in anticipation of future EVSE deployment can be less costly than retrofitting parking spaces after the building has been constructed.
- Residents who wish to install EV charging stations in their parking spaces cannot be prohibited by homeowner associations or condominium associations from the installation or use of an EV charging station in a homeowner's dedicated parking space.[118]

8.3.2 Target Audiences to Consider for Education and Outreach Efforts

Education and outreach should be conducted for all relevant and necessary audiences. Importantly, key objectives, messages, and tactics will vary as audiences change. The following is a list of audiences to consider when pursuing education and outreach related to EVSE deployment.

- Residents, distinguishing between Renters and Homeowners
- Multifamily Housing Stakeholders
- Homeowners Associations
- Building Owners/Managers
- Building Developers
- Business Owners
- Car Dealerships
- Sports and Entertainment Venue Owners
- Public and Private Vehicle Fleet Owners or Operators
- Community-based Organizations representing low-income residents, seniors, disadvantaged communities, rural communities, and other underserved groups
- Tourist Destinations
- Schools
- Utilities
- Environmental and Sustainability Groups
- Local and Regional Government Agencies and Offices
- Frederick County Chamber of Commerce
- Frederick County Planning Commission

The Stakeholder Advisory Group identified multi-unit housing developers and owners were a key target audience due to unique challenges with installing charging infrastructure and the magnitude of the benefit to residents to have access to home charging. Frederick County has already begun outreach and engagement to County and City agencies and offices, multi-unit housing stakeholders, schools, utilities, and large employers through the Stakeholder Advisory Group and will continue to expand engagement as EV planning and coordination progresses.

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[118] See Section 7.1.1 for further details.

8.3.3 Channels and Tactics for EVSE Education and Outreach

A variety of channels and tactics exist to conduct education and outreach efforts, including the following:

- Websites, including those belonging to both government agencies and utilities
- Social media
- Direct training and technical assistance
- Webinars and workshops
- Education and outreach materials, such as fact sheets, case studies, checklists, and frequently asked questions (FAQs)
- Direct engagement at existing meetings (e.g., community meetings, board meetings)
- Physical showcases
- Recognition programs
- EV "ride-and-drive" events and EVSE demonstrations

The Stakeholder Advisory Group recommended EV "ride-and-drive" events and EVSE demonstrations and webinars and workshops as the most effective outreach methods to engage audiences on the benefits of EVs and EVSE adoption.[119]

8.3.4 Resources for Workplace Charging

Engaging employers to provide workplace charging will be key to meet growing demand for EV charging. There are a range of existing resources and case studies, listed in the table below.

Table 12: Resources for Workplace Charging

Resource	Description
EMPOWER	An outreach and education project that provides resources and support for workplace charging efforts.
AFDC Workplace Charging Overview	Provides resources on how employers can evaluate, plan, install, and manage workplace charging programs.
Clean Cities Coalition Workplace Charging Toolkit	Shares examples of workplace charging outreach and events
Connecticut Workplace Charging	State of Connecticut created a publicly accessible site on workplace charging directed to employers
How-to Guide: Starting an electric vehicle workplace charging program	City of Boston guide employers and site hosts in assessing whether their organization should offer workplace charging, considerations for program management, important steps for implementation, and ideas for ongoing outreach.

8.3.5 Resources for Multifamily Housing

The Stakeholder Advisory Group highlighted challenges to siting EV charging at multifamily housing properties. The Department of Climate and Energy conducted additional outreach to multifamily housing building and property managers and collected feedback listed below.

[119] Local partners like EVADC have experience with organizing ride-and-drives.

- Logistics – Technical assistance to understand, guide, and track the process related to siting considerations, funding opportunities, individual and total cost estimates, procurement, installation requirements, operation considerations, and more.
- Resident Interest – Difficult to establish resident interest in EV charging as an amenity due to 1) a lack of direct communication on EV charging, and 2) many drivers may wait to purchase or lease an EV until charging is made available.
- Cost – Lack of resources detailing installation, permitting, maintenance, and other costs related to EV charging for multifamily housing. Noted a general need for resources and technical assistance.

The State of Maryland has collected EV resources on the MD EV webpage, with specific resources for HOAs and multifamily housing.[120] The AFDC has a webpage that provides information on EV charging for multifamily housing and includes survey templates, how-to guides, and case studies.

8.4 Update Priorities: Planning to Meet Future Infrastructure Needs

On a periodic basis, Frederick 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.

8.4.1 Tracking EV Registrations and EVSE Installations

EV registration and sales data can inform stakeholders of the trends in EV adoption within Frederick County at various levels of granularity. County-level EV registration data is available from the Maryland Department of Transportation (MDOT)/Maryland Vehicle Administration (MVA) Electric and Plug-in Hybrid Vehicle Registration dataset, which includes the total number of electric and plug-in hybrid vehicles with active Maryland 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.[121] 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.

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

[120] Maryland EV. Local EV Programs. Retrieved from: https://marylandev.org/local_ev_resources/#hoa-resources
[121] Data offered by IHS Markit or Experian are available for purchase.

9 Technology Considerations

9.1 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 photovoltaic (PV) systems due to higher construction costs associated with the mounting apparatus for the solar panels.[86] 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.[87] Overall project costs will impacted by numerous factors, including utility rates, project financing structures, and available incentive programs.

The Maryland Energy Administration (MEA) provides funding for solar canopy installations through the Solar Canopy and Dual Use Technology Grant Program, which supports the installation of solar systems that provide multiple uses for land and water. While solar canopies over parking lots and waterborne solar installations are specifically included, applicants can propose other dual use opportunities for consideration.[88]

9.1.1 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 batteries that can be moved to different parking locations based 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.
- 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 for the fleet:

- 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 fleet-use only.

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

9.2 Streetlight-Mounted EVSE Infrastructure

The use of streetlights, which may be owned by Potomac Edison, as EV charging stations is an emerging technology that aims to increase access to EV charging options. Streetlight poles can be modified to include Level 1 and Level 2 charging infrastructure, providing EVSE infrastructure in public locations without the physical footprint needed to install a new charging station. Publicly accessible EVSE requires users to pay for the supplied electricity and associated data services, typically at a per kilowatt-hour rate. Certain charging stations may also have a plug-in fee associated with each charging event. Additional fees for parking and the usage of charging equipment may apply depending on the local authority. A variety of membership options are offered by EV charging station companies which allow subscribers to pay reduced rates per kWh after paying a monthly or yearly subscription fee. This variance in equipment standards can become an issue for local governments who want to centrally manage a set of charging stations from different manufacturers. If Frederick County were to test streetlight charging from different manufacturers, the EVSE should all be capable of taking a credit card payment.

The costs associated with installation and operation of electric vehicle charging infrastructure vary depending on the number and type of chargers installed. The main cost drivers for the hardware itself are the power of the unit (in kW), whether the charger requires a pedestal, and whether it is networked with communication or payment gathering capability. Level 2 charger hardware at installation ranges from $938-$1,182 per charger (non-networked), $2,793-$3,127 (networked). In addition to the hardware itself, EV chargers have associated installation costs including labor, materials, permits, taxes, and utility upgrades. For Level 2 chargers, these costs can range from $2,000-$3,000 depending on the number of chargers installed per site (more chargers generally leads to a lower cost-per-charger) [122] In addition to equipment and installation costs, EVSE owners also incur costs associated with data (from $84-$240/year per charger) , network service (from $200-$240 per year per charger) and maintenance contracts (starting at $575 per charger per year) ensure the long term operability of equipment.[123]

Integrating EVSE with existing street lighting infrastructure requires additional costs and specific coordination with the local electric utility. Conduit and wire would need to be run to the EVSE, which would be mounted to existing or new streetlight poles. Depending on the location and installation type there may be costs associated with metering, switchgear, or service panel. Nearly all existing EVSE mounted to street lighting poles are Level 2 chargers and equipment manufacturers have a variety of options for pole mounted EVSE installations. The total installation scope of work may be completed by the local electricity utility depending on the ownership structure. Who pays for installations and operations will likely depend on long term ownership.

As a part of the Los Angeles Green New Deal and the city's sustainability plan, the Los Angeles Bureau of Street Lighting began installing EV charging stations by attaching existing units to street lighting poles. The city used Level 2 chargers that accept credit cards payments and do not have membership models. The installation of EV charging stations was carried out in conjunction with the conversion of LA's streetlights to energy efficient LEDs. Rates for charging typically cost around $1 or $2 per hour, but parking in those charging spots is free. According to the BSL website, 284 streetlight charging stations have been installed so far.[124]

Kansas City started their Streetlight Charging in the Kansas City Right-of-Way in 2018. The city is aiming to install EV charging infrastructure on the streetlight system to demonstrate and test benefits of curbside charging at on-street parking locations. The project prioritizes equitable distribution of charging opportunities and working alongside the Kansas City community. Funding for the project was awarded through a competitively funded opportunity offered by the U.S. Department of Energy.[125]

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[122] Nicholas, Michael. Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas. Retrieved from: https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf

[123] Nelder, C. & Rogers, E. (December 2019). Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute. Retrieved from: https://rmi.org/wp-content/uploads/2020/01/RMI-EV-Charging-Infrastructure-Costs.pdf

[124] Davies, Alex. LA's Using Energy Savings From LED Streetlights to Charge Electric Vehicles. Retrieved from: https://www.wired.com/2016/06/las-using-energy-savings-led-streetlights-charge-electric-vehicles/

[125] Metropolitan Energy Center. Streetlight Charging in the Kansas City Right-of-Way. Retrieved from: https://metroenergy.org/programs/current-projects/streetlight-ev-charging/

9.3 Battery Swaps

Some of the major challenges facing more widespread adoption of electric vehicles include high upfront costs of lithium-ion batteries, battery-limited vehicle range, and concerns over the high costs of battery replacements. One emerging solution to these challenges is battery swapping. In this scenario, drivers could purchase battery-powered electric vehicles without a battery, avoiding the high upfront cost while a service provider would supply batteries in exchange for a subscription fee.[126]

The U.S Department of Energy's NREL is currently exploring ways to reduce EV ownership expenses and improve vehicle utility, including battery swapping. Specifically, NREL is developing a Battery Ownership Model (BOM) to determine the cost of owning an EV more accurately. The BOM is yet to become public, but the Battery Lifetime Analysis and Simulation Tool Suite (BLAST) can be used to evaluate lifetime battery costs and conduct simple analysis of performance factors.

9.4 Vehicle-To-Grid

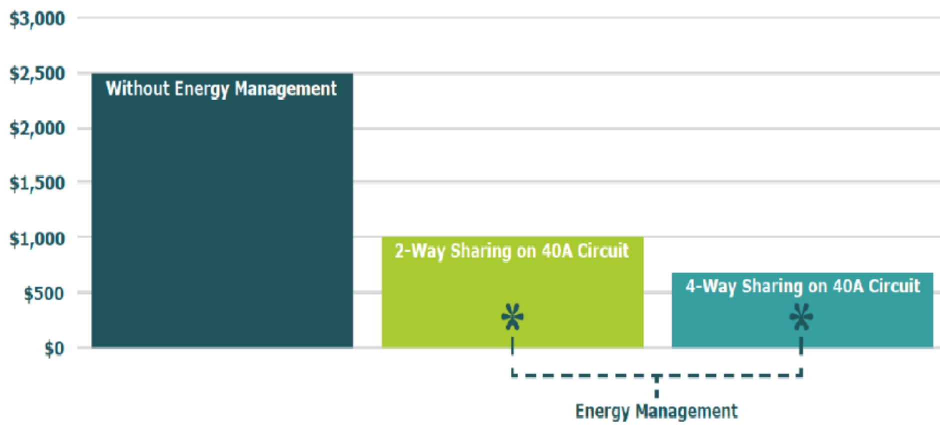
Vehicle-to-grid (V2G) is an emerging, smart charging technology that allows EV batteries to give electricity back to the grid, allowing car batteries to both power EVs and provide backup storage for the electrical grid. This push-and-pull of power uses bidirectional charging to move power between the vehicle and the grid through the battery. Power from V2G can be used to power homes and even larger buildings, making it a great source of backup energy. For V2G to work, charging stations must have software that allows the station to communicate with the electrical grid and evaluate the grid's electricity demand at any given time. However, this technology is still in development with few bidirectional chargers available and few studies. Because V2G is a still-nascent technology and requires EVSE technology more complex than a regular smart EVSE, they are also more expensive.

9.5 Power Sharing

Frederick County 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.

[126] Neubauer, Jeremy S. and Ahmad Pesaran. A Techno-Economic Analysis of BEV Service Providers Offering Battery Swapping Services. Retrieved from: https://www.nrel.gov/docs/fy13osti/58608.pdf

Figure 14: Cost Savings from Energy Management Strategies[127]



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.

9.6 Burying Power Lines

One important cost consideration for the installation of EV infrastructure is the burying of power lines, also known as trenching. Burying power lines is one of the largest costs for public outdoor charging sites at about $200 per linear foot and can add thousands of dollars to project costs. In one proposed budget at a California corridor project, of the $129,000 allocated to materials and miscellaneous, 17.8% was dedicated to trenching. Frederick County stakeholders need to carefully plan the location for charging infrastructure due to the high installation cost of trenching and laying conduit. Stakeholders must consider the distance between chargers and the nearest utility interconnection point to avoid high costs. The most cost-effective way to install charging infrastructure and conduit is during construction, reducing the costs for retrofitting.

9.7 Interoperability

Frederick County stakeholders can futureproof their charging infrastructure by designing it to be as interoperable as possible. The Electric Power Research Institute (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."[128] 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:

- 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

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[127] Banwell, Peter, et al. Cracking the Code to EV Readiness in New Buildings. Retrieved from: https://aceee2022.conferencespot.org/event-data/pdf/catalyst_activity_32614/catalyst_activity_paper_20220810191640949_d45c4936_026b_4e52_a292_5b2c0a346985

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

providers have signed agreements with each other to enable e-roaming, and Frederick 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, Frederick 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: Frederick County 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. Frederick stakeholders should also consider deploying networked public chargers, which will be necessary if a fee is to be charged for charging activity.

10 Funding Opportunities

There are several incentive and funding programs for EV infrastructure development that range from federal, state, and local opportunities. The MWCOG EV Clearinghouse and the Urban Sustainability Directors Network (USDN) Funding Opportunities website are regularly updated with EV-specific resources and opportunities.

10.1 Federal Funding Opportunities

Multiple federal funding opportunities are available for Frederick County stakeholders to utilize. Some of these funding opportunities already have dedicated funding allocated to Maryland, such as the National Electric Vehicle Infrastructure Formula Program or the Carbon Reduction Program, while other opportunities have more varied award ranges. The table below highlights potential federal funding opportunities to consider.

Table 13: Federal EVSE Incentives

Funding Agency	Program	Range of Awards	Program Description
U.S. Joint Office of Energy and Transportation	National Electric Vehicle Infrastructure (NEVI) Formula Program	Funding of up to 80% of project costs with $62,818,576 allocated to Maryland for FY 2022-2026	The Bipartisan Infrastructure Law (BIL) created the NEVI Formula Program to distribute $5 billion to State DOTs for EV charging station investments along alternative fuel corridors (AFCs). The program is also meant to establish an interconnected network to facilitate data collection, access, and reliability.
U.S. Department of Transportation (DOT)	Alternative Fuel Corridor Grants	Varies	The U.S. DOT must establish a competitive grant program to strategically deploy publicly accessible electric vehicle charging and hydrogen, propane, and natural gas fueling infrastructure along designated DOT Federal Highway Administration AFCs. The grant will provide funding for designated Corridor-Pending AFCs to install infrastructure to convert to Corridor-Ready AFCs, and for Corridor-Ready AFCs to install alternative fuel infrastructure to provide station redundancy and meet higher demand. Eligible entities include states, metropolitan planning organizations, local governments, political subdivisions, and tribal governments.
U.S. DOT	Community Alternative Fuel Infrastructure Grants	Funding of up to 80% of project costs will be available for both development phase planning activities and the acquisition and installation of charging or	The U.S. DOT shall establish a competitive grant program to fill gaps in publicly accessible electric vehicle 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

Funding Agency	Program	Range of Awards	Program Description
		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. Eligible entities include states, metropolitan planning organizations, local governments, political subdivisions, and tribal governments.
U.S. DOT	Carbon Reduction Program	Estimated 5-year total funding for Maryland of $94,377,768	The U.S. DOT must establish a carbon reduction formula program for states to reduce transportation emissions. Eligible state funding activities include truck stop electrification, diesel engine retrofits, vehicle-to-infrastructure communications equipment, public transportation, port electrification, and deployment of alternative fuel vehicles, including charging or fueling infrastructure and the purchase or lease of zero-emission vehicles. Funding can also be used to support the development of state carbon reduction strategies, in consultation with designated metropolitan planning organizations.
U.S. Department of Energy (DOE)	Public School Energy Program	Pending program guidance	The U.S. DOE must establish for local educational agencies competitive grant program for energy improvements upgrades, including installation of alternative fuel vehicle (AFV) fueling or charging infrastructure on school grounds and purchase or lease AFVs. AFV fueling or charging infrastructure can be exclusively for the school fleet or students, or open to the public. Eligible AFVs include school buses and school fleet vehicles.
U.S. Environmental Protection Agency (EPA)	Clean School Bus Program	The EPA may award up to 100% of the cost of the replacement bus, charging equipment, or fueling infrastructure	This program provides funding to eligible applicants for the replacement of existing school buses with clean, alternative fuel school buses or zero-emission school buses.
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. The Discretionary Grant Program for Charging and Fueling Infrastructure will be the most significant direct opportunity for Frederick County. This grant program will allocate $2.5 billion into two different funding opportunities: one for alternative fuel infrastructure along corridors and one for alternative fuel infrastructure in communities. The corridors through Frederick County include I-70, I-270, and US-15. The community grants will offer an opportunity for Frederick County 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, will apply to all Title 23 funded EV charging programs. For many other federal programs, the County 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 County can work with the state and school district to strengthen 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.[129] [130] [131]

10.2 State and Local Funding

10.2.1 Maryland Funding

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

Table 14: Available State EVSE Incentives

Funding Agency	Program	Range of Awards	Program Description
Maryland Energy Administration (MEA)	EVSE Rebate Program	50% of the costs, up to $700, per residential EVSE and 50% of the costs, up to $5,000, per business/government entity EVSE	This program offers a rebate to individuals, businesses, or state or local government entities for the costs of acquiring and installing qualified EV charging stations. Program will reopen in FY25 (July 1, 2024).
MEA	Smart Energy Communities	$6,000 per EVSE, up to $75,000 per project	This program is designed to support local governments as they voluntarily adopt sustainable, long-term energy policies that lead to reduced energy usage, cost savings, and additional opportunities for renewable energy development.
MEA	Public Facility Solar Grant Program	Anticipated program budget of $700,000	This program provides grant funding to state, county, or municipal government entities to support the planning and installation of solar

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

Funding Agency	Program	Range of Awards	Program Description
			arrays on existing infrastructure of public facilities.
Maryland Department of the Environment (MDE)/MEA	Charge Ahead Grant Program (CAGP) and EV Workplace Charging Grant	Over $3.68M to install Level 2 electric vehicle stations and Level 3 electric vehicle DC Fast charging stations EV Workplace Charging grants are available for up to $4,500 per Level 2 EV charger and $600,000 per applicant	This program offers grants for EV charging stations for private businesses and public entities. Funding is available through the Volkswagen Mitigation Program. Through CAGP, MDE offers grants for the installation of EV charging stations at workplaces. CAGP funding is available for costs directly attributable to the design, installation, and operation of eligible workplace EV charging stations. Eligible entities include non-profits, private companies, and government agencies.
MDE/MEA	Electric Vehicle Corridors Grant Program	Grants of up to 80% of installation costs	This program offers businesses grants for the installation of direct current fast charging (DCFC) stations along Federal Highway Administration designated alternative fuel corridors. Funding is available through the Volkswagen Mitigation Program and is for up to $150,000 per DCFC station and $600,000 per applicant.
Potomac Edison	EVSE Rebate	$300 rebate	This rebate allows residential and multifamily customers to receive a $300 rebate for purchasing and installing eligible Level 2 charging stations.
MEA	Alternative Fuel Vehicle (AFV) Grants	Varies - can cover up to 100% of costs. Grant amounts range from $5,000-$150,000.	The Clean Fuels Incentive Program (CFIP) provides grants to fleets for the purchase of new AFVs. Grant award amounts vary and may cover up to 100% of the incremental AFV cost. The maximum grant award per vehicles varies based on AFV technology and vehicles class.
MEA	Clean Energy Grants	Varies based on project type	The Maryland Smart Energy Communities (MSEC) program offers local governments grants for transportation-related projects, including the purchase of new EVs or alternative fuel vehicles and the installation of EV charging stations.

Frederick County is well-positioned to leverage parking capacity on County-owned property to increase access to EV charging infrastructure. Several state and local programs provide funding to support such efforts like the MEA EVSE Rebate and Clean Energy Grants. The County should incorporate ongoing EV planning and community engagement into EVSE siting for these programs. Programs like the EV Workplace Charging Grant Program and Potomac Edison's EVSE Rebate for multifamily housing target key audiences identified by the Stakeholder Advisory Group. The County has an opportunity to play a coordinating role by connecting community partners with available information and resources on targeted EVSE incentives.

10.2.2 Local Purchasing Programs

In addition to federal and state funding, a few local programs provide coordination opportunities with potential for EVSE funding. The table below highlights four options.

Table 15: Local EVSE Funding Opportunities

Funding Agency	Program	Range of Awards	Program Description
Multiple agencies	Mid-Atlantic Purchasing Team (MAPT)	-	MWCOG and the Baltimore Metropolitan Council (BMC) are partners in the development of MAPT, which provides additional opportunities to participate in cooperative purchases and to ride on the contracts of these jurisdictions. Frederick County can leverage MAPT to purchase commodities and services through economies of scale and reduce administrative costs. Frederick County can make recommendations for commodities, such as EVs or AFVs, and volunteer to serve as a lead jurisdiction.
U.S. Department of Energy	Clean Cities	-	Clean Cities coalitions are located throughout the country to assist with projects related to alternative fuel vehicles and infrastructure. The State of Maryland Clean Cities works with stakeholders in the region. There are funding opportunities through Clean Cities that can be found here. Agencies interested in Clean Cities funding can work with their Clean Cities coalition to navigate the process.
Washington Area New Dealers Association (WANADA)	WANADA	-	WANADA promotes retail automobile businesses in the Washington Metropolitan area.
Cooperative purchasing	Capital Area Solar Switch	Discounts vary	This program leverages bulk purchasing power to make installing rooftop solar panels, battery storage, and electric vehicle charging stations more affordable.

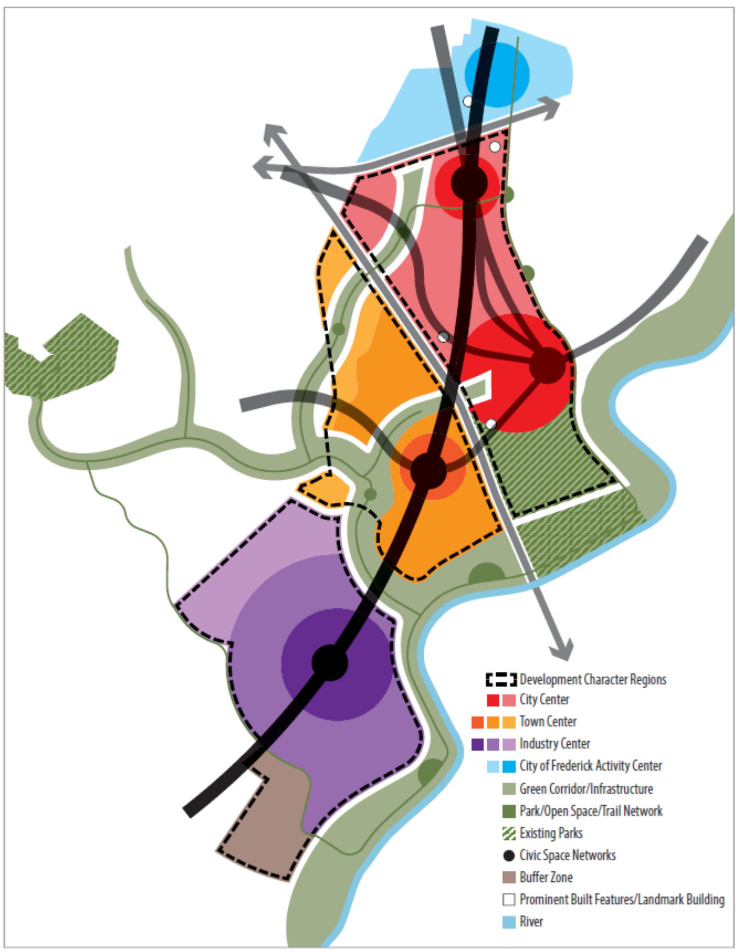
Lessons learned from past and existing solar purchasing efforts can be considered for EVSE deployment. For example, the Solar United Neighbors Solar and EVSE Co-op Model expanded to include EV charging after observed interest in both technologies from residents. In a similar way, the County has also facilitated solar bulk purchases which selected specifications and vendors for solar purchases for entities that chose to participate in bulk purchases.

The County should also monitor MAPT to learn from other jurisdictions on topics like charging infrastructure specifications, Request for Proposal details, and more. There may also be opportunities for cooperative purchasing through MAPT.

11 Case Study: South Frederick Corridors EV Plan

In December 2022, Livable Frederick released a draft version of the South Frederick Corridors Plan[132] which examines the economic center composed of existing commercial and industrial land to the south of Frederick City along Urbana Pike (MD 355) and Buckeystown Pike (MD 85), and constitutes 20% of the county's jobs, 15% of the county's business establishments, and 15% of the county's total wages.[133] Among the many factors involved in developing the South Frederick Corridors Plan are goals related to reinforcing and creating economic strengths and assets, supporting existing business and industries, and fostering innovation and opportunity. The draft plan highlights three imperatives: workforce attraction, environmental responsibility, and regional competitiveness. The figure below shows Livable Frederick's vision for the South Frederick Corridor's redevelopment characterized by a red area to the northeast of I-270 (City Center), an orange area to the southwest of I-270 (Town Center), and a purple area south of Ballenger Creek (Industry Center), each outlined in black dashed lines.

Figure 15: South Frederick Corridors Design Vision Concept Diagram



[132] Livable Frederick. The South Frederick Corridors Plan. Retrieved from: https://www.frederickcountymd.gov/8141/South-Frederick-Corridors-Plan#:~:text=The%20South%20Frederick%20Corridors%20Plan%20is%20the%20a%20second%20planning,Our%20Health%2C%20and%20Our%20Community

[133] U.S. Bureau of Labor Statistics. Mid-Atlantic Information Office. Retrieved from: https://www.bls.gov/regions/mid-atlantic/maryland.htm#tab-1

With traffic from two major highways feeding into the South Frederick Corridors as a commercial and workplace destination, the area is a prime location for increased investment in EV charging infrastructure. Combined with Livable Frederick's redevelopment planning efforts, planning for EV infrastructure investments as well allows developers to lower costs in comparison to retrofits for installations and attract residents, businesses, and customers with the added amenity.

Livable Frederick proposes a new form-based zoning designation to better facilitate mixed-use development, with **Plan Adoption and Oversight Action Item 2** identifying a need to integrate form-based code into Frederick County's Ordinances.

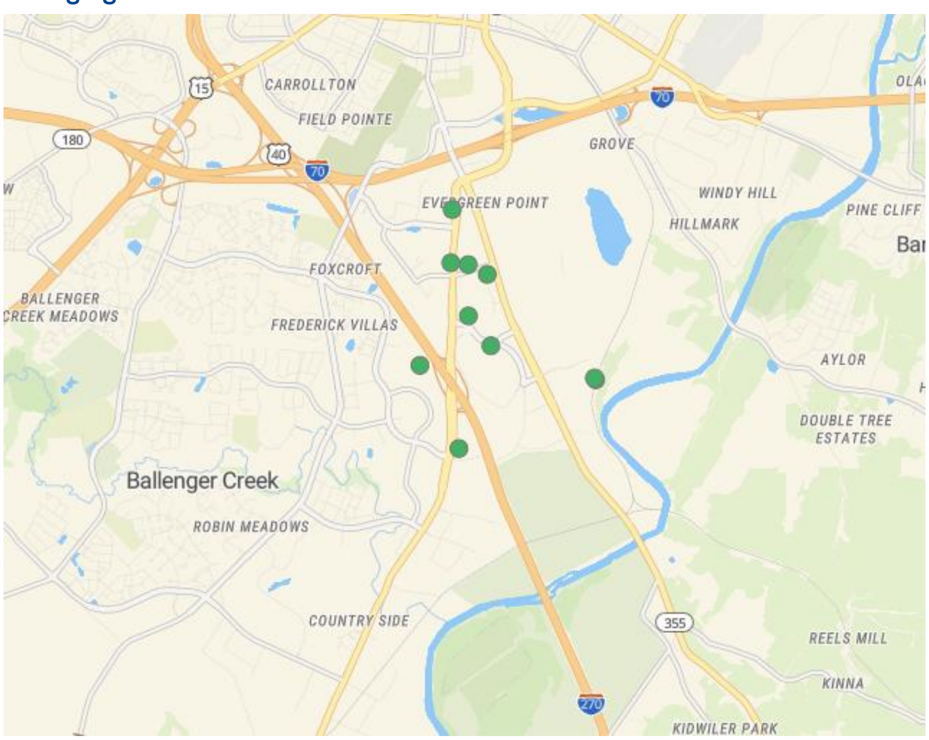
General Policy Recommendation: It will be imperative to update codes to include new form-based building types in any existing or planned EV building codes (see Section 7.2). Increased capacity for EV charging infrastructure at these new developments will help ensure that EV charging demand is met as the South Frederick Corridor transitions.

Additionally, the County should continue coordination with the City of Frederick as they examine their policies to support EV adoption and EVSE installations. City policy interests highlighted in the Stakeholder Advisory Group were EVSE permitting in historical districts, specifications for ADA compliant EV parking spaces, and charging solutions for garage orphans.

11.1 Existing Sites

Currently, there are 35 existing publicly accessible EV charging ports in the South Frederick Corridors across ten different charging sites. Of the 35 charging ports, there are 11 Level 2 and 24 DC charging ports, including 18 Tesla fast chargers.

Figure 16: Existing Charging Sites in South Frederick Corridor[134]



[134] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest

Table 16: Existing Charging Ports in South Frederick Corridor[135]

Station Name	Street Address	City	L2 Ports	DCFC Ports	Network
DARCARS Toyota of Frederick	5293 Buckeystown Pike	Frederick	2		ChargePoint
Francis Scott Key Mall	5500 Buckeystown Pike	Frederick		10	Tesla
Harley Davidson of Frederick	5722 Urbana Pike	Frederick		1	ChargePoint
MOM's Organic Market	5273 Buckeystown Pike	Frederick	2		Blink
Monocacy MARC Station	7800 Genstar St	Frederick	2		ChargePoint
Renn Kerby Mitsubishi	5712 Buckeystown Pike	Frederick	2		Blink
Sheetz	5601 Buckeystown Pike	Frederick		8	Tesla
The Common Market – MD 85	5728 Buckeystown Pike Unit B1	Frederick	2		Blink
Walmart	7400 Guilford Dr	Frederick		4	Electrify America
Younger Nissan	7418 Grove Rd	Frederick	1	1	Non-Networked

11.2 Future Site Location Priorities

Livable Frederick's draft plan includes **Facilities and Services Action Item 4** to develop an initial framework for EV charging for the South Frederick Corridors region. The County should leverage EV Readiness Plan findings and recommendations to coordinate planning and inform an EV charging framework specific to South Frederick Corridors.

The County should also coordinate with Livable Frederick on EV-related outreach and engagement efforts and potential funding opportunities. Based on conversations with Livable Frederick, who engage community members and developers throughout their plan development process, the following EVSE siting priorities were identified:

- New mixed-use buildings.
- Multifamily housing.
- Public lands, such as parks and plazas.
- Businesses, especially local shopping centers.

[135] AFDC. Alternative Fueling Station Locator. Retrieved from: https://afdc.energy.gov/stations/#/find/nearest

- Transportation hubs, such as MARC stations.

The recommended focus for future EVSE investments is on residential areas and employment centers, existing and planned, to best support the community. Livable Frederick should coordinate with developers to understand where upcoming EVSE investments are being made, like investments from the Maryland ZEVIP (within 1 mile of Alternative Fuel Corridors, which include I-70 and I-270) where most of the South Frederick Corridors is designated as "highest need" area.

There is an opportunity to engage the builder community to develop and provide education materials on EVSE installation, maintenance, benefits, and incentives. Educational materials can be targeted to different groups depending on which programs they are eligible for. More information on funding opportunities is provided in the following sections.

Building owners and developers should engage Potomac Edison early in the planning process to ensure adequate capacity for planned EV infrastructure, and to better understand future investments in grid infrastructure. This information may help locate which areas may have the most capacity for additional EV charging infrastructure.

General Planning Recommendations

- Coordinate with expected EVSE investments to ensure installations are distributed in line with community needs.
- Work with builders to develop and distribute education materials on installation, maintenance processes, and site host benefits.
- Highlight the importance of engaging Potomac Edison early to evaluate whether there is sufficient electrical capacity to serve an EV charging station at the potential site location.

11.2.1 New Mixed-Use Buildings

For mixed-use building developments, installing EV charging in conjunction with new construction efforts can significantly lower costs compared to retrofitting existing buildings, while supporting the transition to sustainable transportation modes and improving local air quality. The per-port cost of an EV-Ready space in commercial construction averages $1,500-3,000 in labor and materials, whereas the cost to retrofit a similar legacy parking spot may cost an additional $5,000.[136] By offering EV charging as a building amenity, building owners can reap the benefits of (1) an additional revenue stream from charging fees and (2) potential increases in dwell time leading to increased patronage of local businesses.

Recommendations:

- **Policy:** Ensure that new building types from changes to zoning or code are incorporated into EV parking policies and regulations.
- **Funding:** Coordinate with developers to leverage available federal tax credits and EVSE rebates from Potomac Edison for either public locations or multifamily housing in addition to upcoming federal or state funds.
- **Technical:** Depending on the anticipated users of charging stations located at mixed use developments, different levels of EV charging are recommended. Level 2 EV charging stations are

[136] Minezaki, Tim, et al. Electric Vehicle Infrastructure Cost Analysis Report for Peninsula Clean Energy (PCE) & Silicon Valley Clean Energy (SVCE). Retrieved from: https://www.peninsulacleanenergy.com/wp-content/uploads/2020/08/PCE_SCVE-EV-Infrastructure-Cost-Analysis-Report-2019.11.05.pdf

recommended for residential and workplace charging locations while DC fast charging stations are recommended for commercial/customer-facing parking. In mixed use buildings, where customers and residents may require access to charging, developers may want to consider a mix of both Level 2 and DC fast charging stations.

11.2.2 Multifamily Housing

Siting EV charging at Multifamily Housing developments is critical to support EV adoption. Multifamily residents are unable to install their own charging stations and would rely upon public or workplace charging options if their Multifamily residence does not offer EV charging as an amenity.

Recommendation:

- **Funding:** Coordinate with Potomac Edison on the Multifamily EVSE Rebate Program for financial support for EV charging station installations.
- **Technical:** Since residents would be the primary users of charging infrastructure in Multifamily housing residences, Level 2 charging stations are recommended. This is due to residents being able to park, and therefore charge, their vehicles over longer periods of time. If residents are designated parking spots, install Level 2 charging stations in spaces that are open to all residents and preferably close to centralized access points.

11.2.3 Public Parks and Plazas

The South Frederick Corridors Plan proposes several new green corridors, public parks, and plazas in all three development sectors, with a higher proportion of proposed public spaces in the City and Town Centers than the Industry Center.

Recommendation: If planned green corridors, public parks, and plazas will have associated parking lots, coordinate with development teams to install EV infrastructure during initial site construction work to minimize costs, disruption, and potential retrofits. It will be critical to identify the relevant local, state, or federal agency associated with the public space and the associated parking lots to coordinate EVSE related needs. Note that cost benefits of coordinating construction timelines for general development and EV charging station installations only apply to public spaces that require redevelopment. If EV charging stations were to be installed at existing public locations, there are less opportunities to share costs unless there are significant retrofits planned concurrently. There may also be opportunities to coordinate with electric fleet vehicles assigned to local parks that can utilize publicly available EV charging overnight.

- **Funding:** Take advantage of available federal tax credits and EVSE rebates from Potomac Edison for public locations, if applicable, in addition to upcoming federal or state funds. Depending on the procurement agency, there may be public funds available for EVSE procurement.
- **Technical:** Level 2 charging stations are recommended since users are likely to spend extended periods of time utilizing public spaces. Ensure that EVSE specifications meet potential government procurement guidelines.

11.2.4 Businesses

Local businesses can install charging stations to offer to their employees as a benefit, to customers as an amenity, or both. By offering EV charging, businesses may see an additional benefit of longer dwell times for customers, like shopping centers, movie theaters, and more. As a site host, businesses can also leverage the additional revenue stream that the EV charging stations can generate from associated fees.

Recommendation:

- **Funding:** Take advantage of available federal tax credits and EVSE rebates from Potomac Edison for public locations, if applicable, in addition to upcoming federal or state funds.
- **Technical:** Different levels of charging are recommended for different charging use cases. Level 2 EV charging stations are recommended for workplace charging locations while DC fast charging stations are recommended for commercial/customer-facing parking.

11.2.5 Transportation Hubs

As seen in Table 16, two Level 2 charging stations have been installed at the nearest MARC station, Monocacy Station, on Genstar Drive. Since the MARC station is the primary transportation hub in this area, there is potential to install additional EV charging capacity. Utilization of existing chargers at this site location can help determine whether there is demand for additional EV chargers and the magnitude of charging demand.

Recommendation:

- **Funding:** Take advantage of available federal tax credits and EVSE rebates from Potomac Edison for public locations, if applicable, in addition to upcoming federal or state funds.
- **Technical:** Level 2 EV charging stations are recommended since drivers are most likely parking over longer periods of time to take MARC trains to further destinations.

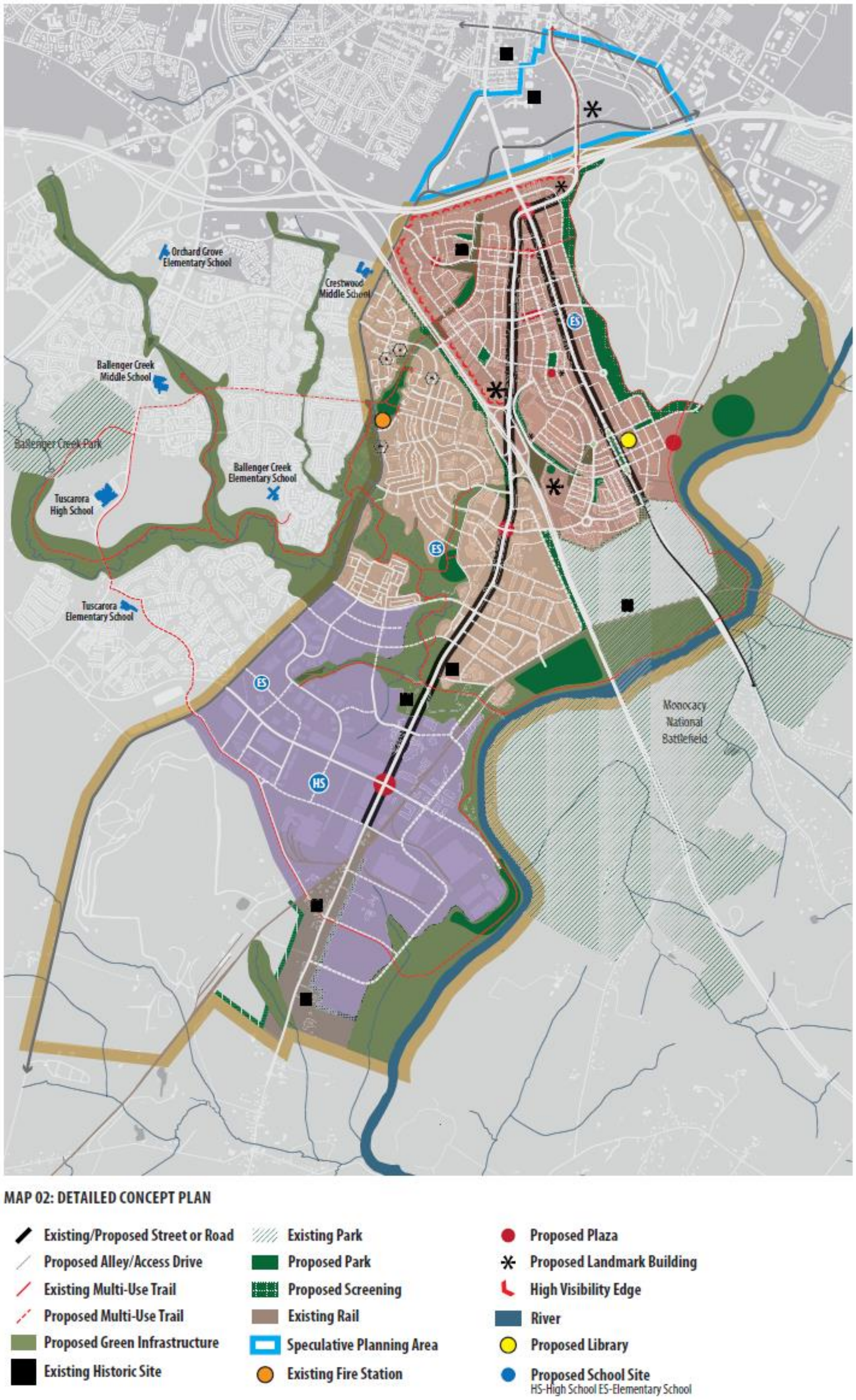
11.2.6 Single Family Homes

Installing at-home EV charging may also be an option to residents of single family homes or townhomes, and is a significant resource to meet personal charging needs. However, both the City and County have found that many residents are "garage orphans" or do not have access to a garage with designated parking or a driveway where they could install personal EV charging. Please refer to the earlier section on garage orphans for potential policy solutions.

Recommendation:

- **Funding:** Take advantage of available federal tax credits and EVSE rebates from Potomac Edison.
- **Technical:** Level 2 EV charging stations are recommended since drivers are most likely parking and charge at their homes overnight.

Figure 17: South Frederick Corridors Concept Plan Map[137]



[137] Livable Frederick. The South Frederick Corridors Plan. Retrieved from: https://www.frederickcountymd.gov/8141/South-Frederick-Corridors-Plan#:~:text=The%20South%20Frederick%20Corridors%20Plan%20is%20the%20a%20second%20planning,Our%20Health%2C%20and%20Our%20Community

12 Next Steps

This Community-wide Electric Vehicle Readiness Plan outlines existing conditions, provides recommendations, and shares best practices to guide decision-making related to EV charging policies, permitting, siting, installation, use cases, stakeholder outreach and education, and existing and upcoming funding opportunities. The Plan builds upon Frederick County's ongoing sustainability work to support Frederick County, State of Maryland, and federal emissions reduction and EV adoption goals.

The Stakeholder Advisory Group and County staff highlighted a few prioritized areas of need, which include:

- Engage multifamily housing developments and building managers.
- Share resources and technical assistance, particularly for EV charging procurement and installations
- Create a transparent checklist of all necessary requirements for EV charger permit applications and post the checklist in an easily accessible online location.
- Incorporate accessibility considerations in EV charging RFPs.

Implementation of this Plan will require continuous collaboration across divisions and the community as well as education and outreach to create robust solutions tailored to Frederick County's local context and community needs.

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