Statewide Electric Vehicle Charging Report

Review of Virginia and Washington D.C.

Collection of Major Urban Area Electrification Reports

JUNE 30, 2021

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Introduction

Virginia Clean Cities has recognized the need for electric vehicle infrastructure projection guidance and information dissemination to the Commonwealth and its localities. The objective of this report is to outline the tools and benefits available to the Commonwealth that will allow state and local planners to make informed decisions about initial market scale volumes and locations of electric vehicle charging. Some key tenants of this projection process include preparing for scalable levels of electric vehicle deployment, maximizing the use of electrical energy over petroleum, full utilization of plug-in hybrids and providing service to all people, grounded in equitable access to clean transportation. In this report, prepared in May and June of 2021, we utilized multiple modeling and mapping tools including the publicly accessible EVI-Pro Tool Lite, the MJ-Bradley tool, and the Energy Zones Mapping tool (EZMT), as well as the Alternative Fueling Station Locator, and Plugshare to assess charging across the Commonwealth and develop recommendations. This comprehensive infrastructure projection report for Virginia will also include individual regional reports for Roanoke, Richmond, Virginia Beach, Blacksburg, Harrisonburg, Lynchburg, Williamsburg, Bristol, Fredericksburg, Staunton, Winchester, Washington D.C.

Projections

As a state and nation, we are in the early days of electric vehicle (EV) adoption at 2% adoption in 2021 (*"The State of Electric Vehicle Adoption"*). However, as Federal and State policymakers have expressed their support for EVs and EV infrastructure and many manufactures like GM have announced goals to launch 30 EVs around the world by 2025, localities need to start planning and placing EV infrastructure ("FACT SHEET: The American Jobs Plan" and "GM's Path to an All-Electric Future"). Planning EV infrastructure can seem like a daunting task, but there are many tools that can aid localities in this process. When beginning to place or plan EV infrastructure, vehicle and charger adoption projections can help a state or locality gauge their needs. Here we discuss the statewide charging needs for the Commonwealth of Virginia.

Below is the statewide output from the EVI-Pro tool for Virginia. To support 10% EV ownership, or 733,100 plug-in electric vehicles, the following charging plug quantities are required to meet expected charging demand. This is based off of the EVI Pro Tool Lite.

To support the first 733,100 plug-in electric vehicles, Virginia will need:

91,170 Workplace Level 2 Charging Plugs

57,967 Public Level 2 Charging Plugs

6,485 Public DC Fast Charging Plugs

The EVI-Pro Tool Lite is a simplified version of the Electric Vehicle Projection Tool created by the National Renewable Energy Laboratory (NREL) and the California Electric Commission. The EVI-Pro Tool uses 2016 total vehicle populations and simulations of current driving behaviors among all light-duty vehicles to provide major urban areas with projections of necessary quantities and types of Electric Vehicle Charging Infrastructure (EVSE) in residential, workplace, and public areas under a variety of user-designated scenarios. User-designations include the number of EVs you would like to support, percentage of EV types, and level of support given to PHEVs to operate on their batteries opposed to gasoline.

Two EVI-Pro assumptions were selected to provide a more accurate output those produced by the tools default filters. At default, the model expects plug-in hybrid vehicles to run completely on gas. We believe that this model should anticipate full service or “full support” for plug-in hybrid vehicles to minimize the imported high carbon gasoline, these vehicles could use electricity on a consistent daily basis. The second default is that the tool only allows for modeling between 50% or 100% charging at home. For our calculations, we selected the lower of the two at 50% home changing, however this is still an overestimation. Today, only 40% of Americans and Virginians have access to electricity within 20 feet of where they park at home, meaning that home charging is already overestimated in the current model. An example of the different charging scenarios can be seen below.

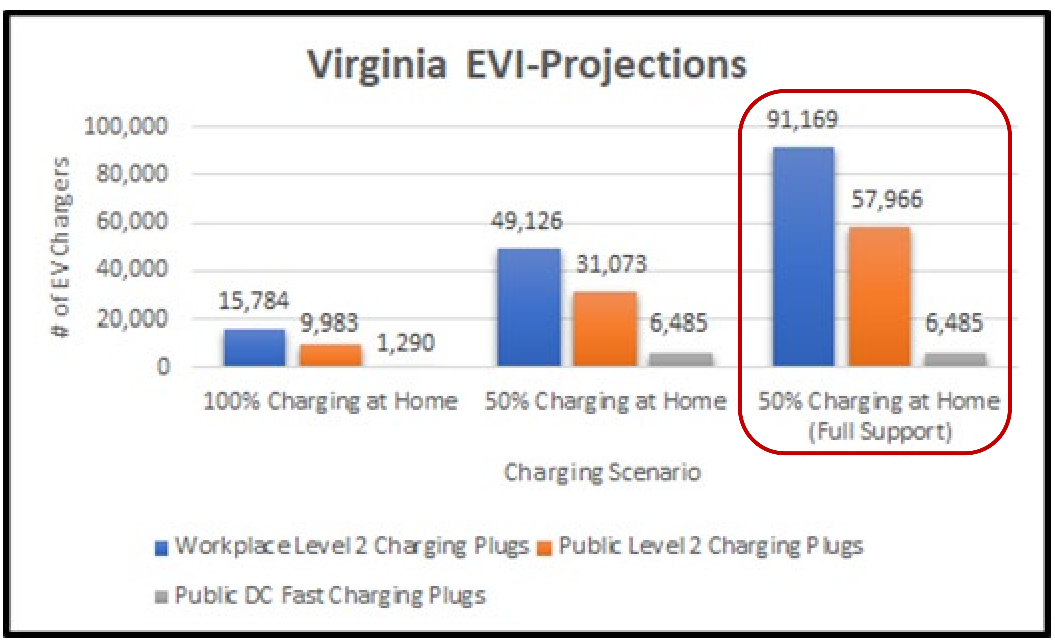

Figure 1 Virginia EVI Charger Projections generated using the EVI Pro Tool Lite

Residential Charging and Accessibility

Residential or home charging plays a large role in EV infrastructure, but it is not as accessible as one might hope or assume. Only 40% of Virginian's have access to an outlet within 20 feet of where they park. This means that at least 60% of the population cannot charge EVs at home. There are many barriers to residential charging including home ownership, parking configuration, and navigating public rights-of-way. In this section, we will outline these issues and examine how two localities make home charging more accessible.

Home ownership plays a large role in home charging access. As of 2019, the owner-occupied housing rate in the Commonwealth was 66.3% ("U.S. Census Bureau QuickFacts"). A large portion of the population lives in rental properties and Multi-Unit Dwellings (MUD). According to an assessment of rental data from the 2018 American Community Survey completed by the Virginia Realtors Association, Multi-family dwellings (MUDs) comprise approximately 56% of rental units in the Commonwealth and townhomes comprise an additional 12% ("Virginia's Renter Population"). These housing types are particularly prone to limited charging access. MUDs without assigned parking can be make it difficult for individuals to install their own parking stations, and MUDs with assigned parking can make it difficult to site public chargers. Town homes often have challenges similar to single-family homes with street parking, where outlets can be accessed but only if they are allowed to cross the public rights-of-way.

Home ownership often increases the likelihood that an individual will have access to home charging, but home owners and renters alike can experience limited access to charging due to street parking. Unlike EV owners with private driveways or garages, street parking EV owners cannot just plug and charge. In many cases, public rights-of-way sit between homes and street parking which prevents EV owners from plugging their vehicles into their own residential electric services. EV owners are not able to safely to stretch their charging cords across the right-of-way for safety and accessibility reasons and few localities have created processes for EV owners to install their own private chargers in the right-of-way. However, there are at least two U.S. cities that have created guidance or pilot programs to begin addressing curbside charging, Seattle, Washington and Berkeley, California.

Concluding in late 2020, the results of the Berkley Residential Curbside Electrical Vehicle (EV) Charging Pilot Program have yet to be published, but some initial successes and challenges have been identified by the city. One of the barriers that arose from the Berkeley Pilot program was cost. Installations ranged from $5,000 to $20,000 including permits, chargers, labor, and materials. However, some of these costs were not related to curbside installations, but rather the costs of cutting curbs to install driveways. As part of the Berkeley Pilot, if a resident was legally able to install a driveway, they were required to do so in place of a curbside installations. As a result, the less expensive curbside installations were only available to those with no other alternatives, which limited access. However, while some high costs in this pilot were due to curb cutting, high planning and permitting fees from the city of Berkeley typically amounting to $2,500 also limited accessibility (Moore and "EV Curbside Pilot").

The city of Seattle took a different approach to curbside charging. In response to residents stretching charging cords from their homes across right of ways, the city developed a ramp policy instead of charging fines and removing cords. The policy allows EV owners to stretch their Level 1 chargers across sidewalks and rights-of-way to their vehicles so long as they run their cords under ramps that comply with ADA guidelines approved by the city ("Electric Vehicle Charging Cord Guidance"). While this solution does not allow for any charging options above Level 1, it does allow many more EV owners the opportunity to charge from home.

When extending EVSE to all people, accessibility is key. Personal curbside electric vehicle charging stations or even just curbside receptacles to plug a charger into would at most require minimal drilling or trenching into the sidewalk for very short distances to extend the conduit and connect the pedestal. Excessive fees limit accessibility and overcomplicate what should be a simple installation process. Keeping fees accessible can greatly reduce the costs of these projects and thus extend accessibility to a wider range of households. This is especially applicable when one of the major draws to EVs is the lower fueling costs compared to their gasoline counterparts. We suggest that localities should instate a minor encroachment permitting process for the purposes of residential curbside electric vehicle charging stations where the permitting fees amount to no more than $100 per installation. By creating these processes for accessible street side charging a locality can extend equity while reducing the charging burden that they would need to take on themselves to keep up with demand.

Connecting EV Accessibility: Alternative Fuel Corridors

Connecting localities also extends accessibility and allows EV owners to get more use out of their vehicles. In the U.S., major transportation corridors are labeled as EV Charging Signage Ready or EV Charging Signage Pending to indicate charging availability. To be considered EV Charging Signage Ready, a transportation corridor must meet several requirements. Along the route, there can be no more than 50 miles between stations, the stations must be open to the public and they must be within five miles of a highway exit. Only non-Tesla, DC fast-charging stations are considered in these charger counts as the corridors are meant to provide quick and easy refueling, similar to the role gas stations play for internal combustion engines ("Alternative Fuel Corridors").

As of April 2021, I-81 between the Virginia-West Virginia border and the Virginia-Tennessee border, I-95 between the Virginia- Maryland border and Virginia-North Carolina border, I-64 from Chesapeake to the Virginia-West Virginia border, and I-66 from Washington DC to the Middletown intersection with I-81 have all been designated as EV Signage Ready.

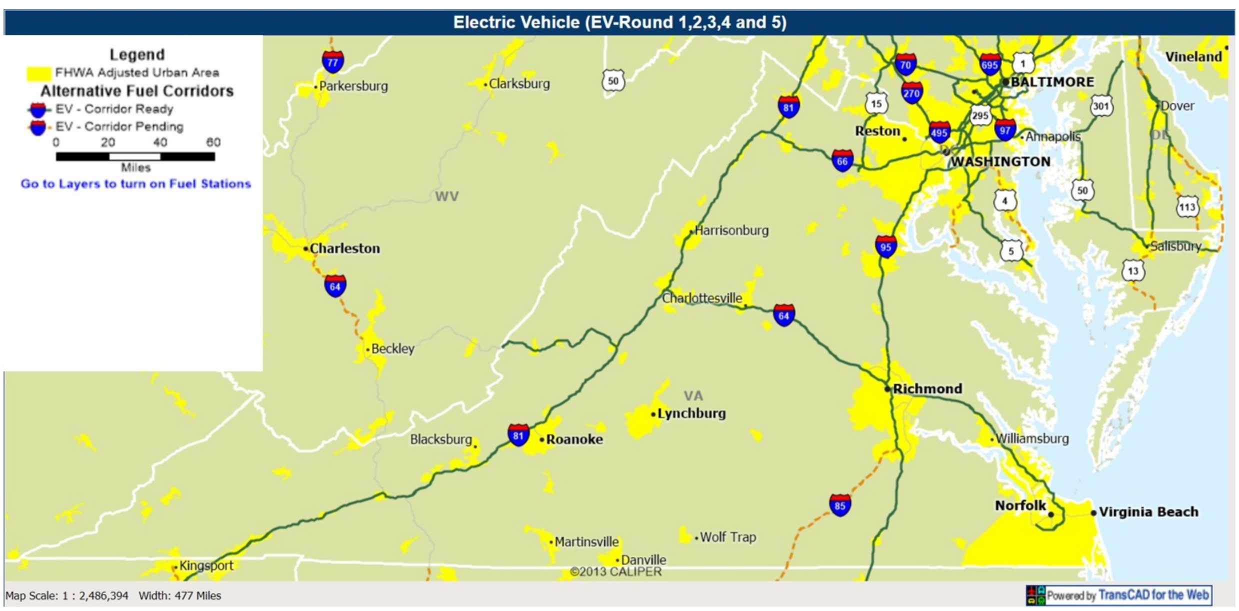

Figure 2 Electric Vehicle Alternative Fuel Corridor Designations Rounds 1-5 from the Federal Highway Administration

Free Chargers and Their Locations

Free chargers are a vital asset to consider when extending charging to all people. There are many non-networked charging stations in the Commonwealth, meaning that the stations are unable to charge a fee and track usage. These chargers, when publicly accessible, can also be referred to as free chargers. It's important to identify where these stations are to increase accessibility and further encourage EV adoption. While these chargers can help increase EV adoption, they can also still bring in income. The chargers themselves may not be generating money, but the time customers spend in an establishment waiting for their vehicle to charge will.

The maps below display two overlays, free non-Tesla chargers and chargers in the Commonwealth that are accessible for a fee. In these maps, blue icons represent publicly accessible free charging stations and black icons represent chargers that are publicly accessible for a fee. The interactive version of this map can be found on the Virginia Clean Cities website station locations section.

EV Charging Stations- Publicly Accessible for Free

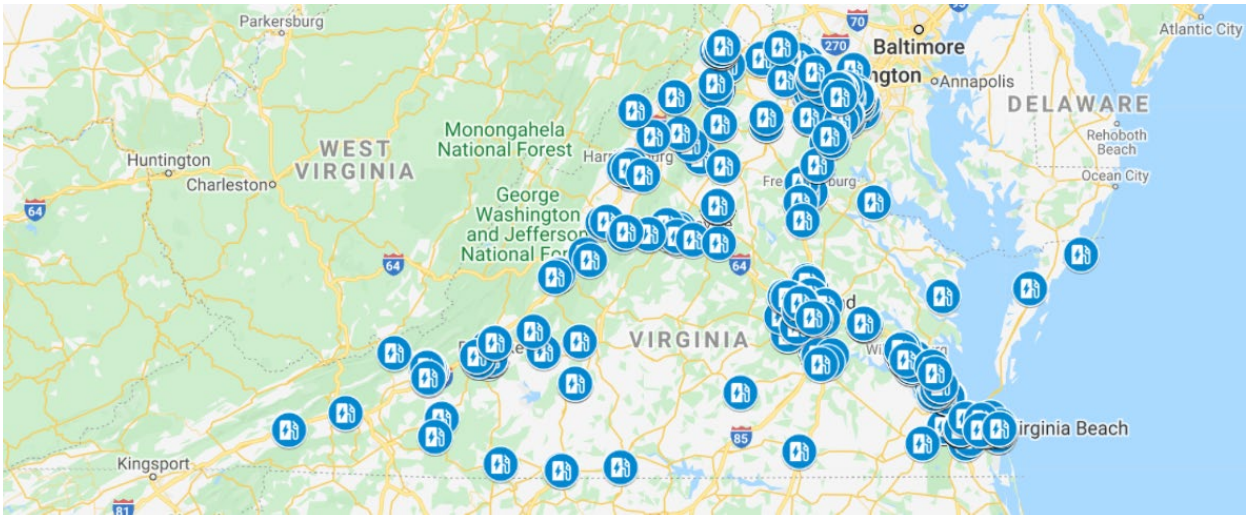

Figure 3 Map of publicly accessible Free EV Charging Stations in Virginia. The blue icons indicate free non-Tesla chargers. Based on charger data from the U.S. Department of Energy's Alternative Fuels Data Center Station Locator from June 2021, map generated in Google My Maps.

EV Charging Stations- Publicly Accessible for a Fee

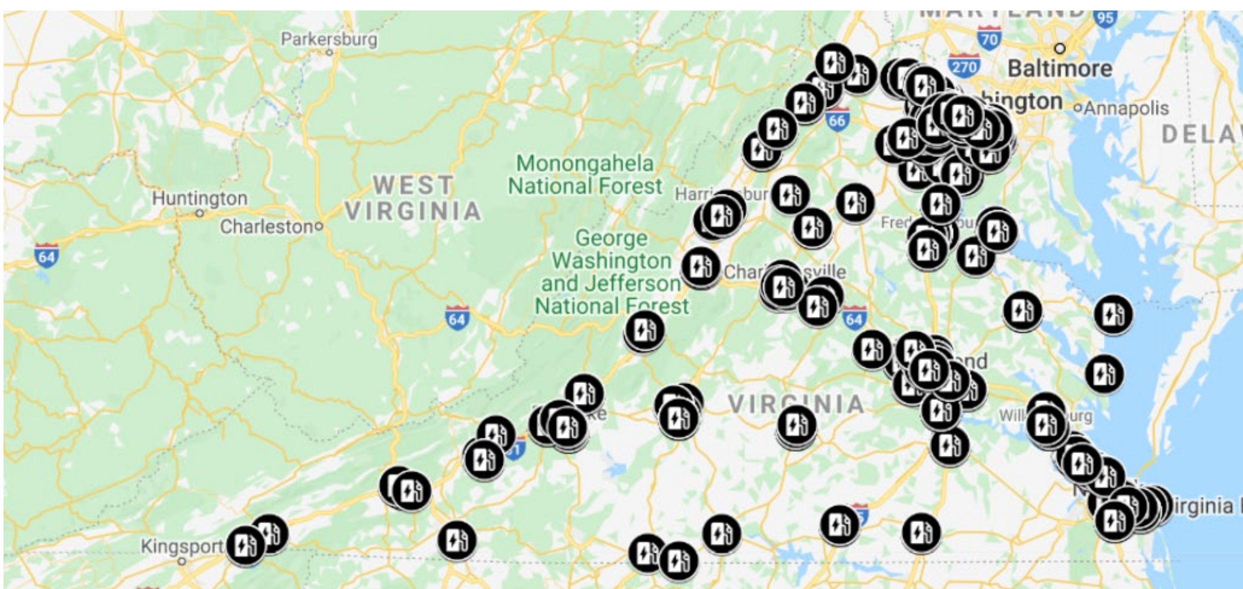

Figure 4 Map of EV chargers in Virginia that are publicly accessible for a fee. Based on charger data from the U.S. Department of Energy's Alternative Fuels Data Center Station Locator from June 2021, map generated in Google My Maps.

Speeds of Charging

In addition to where chargers will go, it is also important to consider what type of charger will be installed and how it will be used. There are three major charger types and their price, charging speeds, and usage varies. The three types, Level 1, Level 2, and DC Fast Charging (DCFC) charging capabilities are outlined below, though standards advance and charging speed may also be limited by the vehicle.

Charger Type	Alternating or Direct Current	Amperage	Voltage	Power	Range per Hour of Charging
Level 1	Alternating	12-16 Amps	120 Volts	1.3-1.9 kiloWatts	2-5 miles
Level 2	Alternating	Up to 80 Amps	208-240 Volts	Up to 19.2 kiloWatts	10-20 miles
DC Fast Charging	Direct	Up to 200 Amps	208-600 Volts	50-150 kiloWatts	60-80 miles

While DCFC is the fastest of the charging options, it is limited by equipment cost, and high speeds are not necessary in every situation. DCFC can be great in instances such as along highway routes where quick top-ups are needed, but one of the great things about EV charging is that it can be done over longer periods of time at less expensive rates. Take for instance a charger in a movie theater parking lot, where we would expect the average costumer to spend about three hours inside of the establishment. In this case, many vehicles could top up their battery using a high-powered Level 2 charger. A DCFC in this instance would be able to charge the car battery quicker, but with the customer inside enjoying their movie, they would not be able to move the vehicle for other drivers to charge, meaning that DCFC would actually be a less efficient option. It is important to match charging with parking dwell times.

Additionally, it is important to consider that in many cases public infrastructure is to support and extend EV range, not to fully charge every EV battery every day. Your average internal combustion engine (ICE) vehicle owner doesn't top off their tank with gas at gasoline retailers every day and EV owners with access to home charging can top off at home.

Workplace charging

Outside of the home, work is the place where vehicles spend the majority of their time. For an electric vehicle owner, this large time frame is a great opportunity to plug in their car and increase their daily commuting range. This not only serves as a convenience and benefit to employees but having an electric vehicle charger can encourage potential plug-in electric vehicle owners to make the switch to an electric vehicle. Employers who offer workplace charging can enjoy the following benefits:

- Corporate Leadership- Taking this step towards furthering the electric vehicle infrastructure through the adoption of advanced technology can demonstrate corporate leadership and innovation.
- Sustainability- Electric vehicle charging can help contribute to the LEED Certification of a building, reduce indirect emissions, and overall enhance corporate sustainability efforts. Each EV charger is a LEED point.

- Employee Incentive- The installation of an electric vehicle charger can serve as a valuable employee benefit by reducing the cost of commuting and increasing driving range

Looking back at the EVI-Pro output for Virginia, there is a high demand (91,170 level 2 charging plugs) for workplace charging. Workplace charging stations are excellent alternatives for EV owners who may not be able to charge at home, in particular those who live in a Multi-Unit Dwelling with limited charging access. As with all charging sites, choosing the right charger type is important. If a workplace requires employees to work in an office all day, Level 2 chargers would be adequate, however if a workplace requires employees to drive routes and make brief stops at their facility a DCFC charger would work better for its speed. Once demand is understood, planning for partial or full EVSE support can commence.

Maximizing Electricity and Minimizing Petroleum

But, why EVs? A major reason for the Commonwealth to make the transition from internal combustion engines to electric vehicles is their fuel and the emissions they create. According to the Energy Information Administration, in 2019 and 2018 respectively, the transportation industry was responsible for 32.2% of the Commonwealth's energy consumption and 47% of its CO_2 emissions ("Virginia - State Energy Profile Overview" and "State Carbon Dioxide Emissions Data").

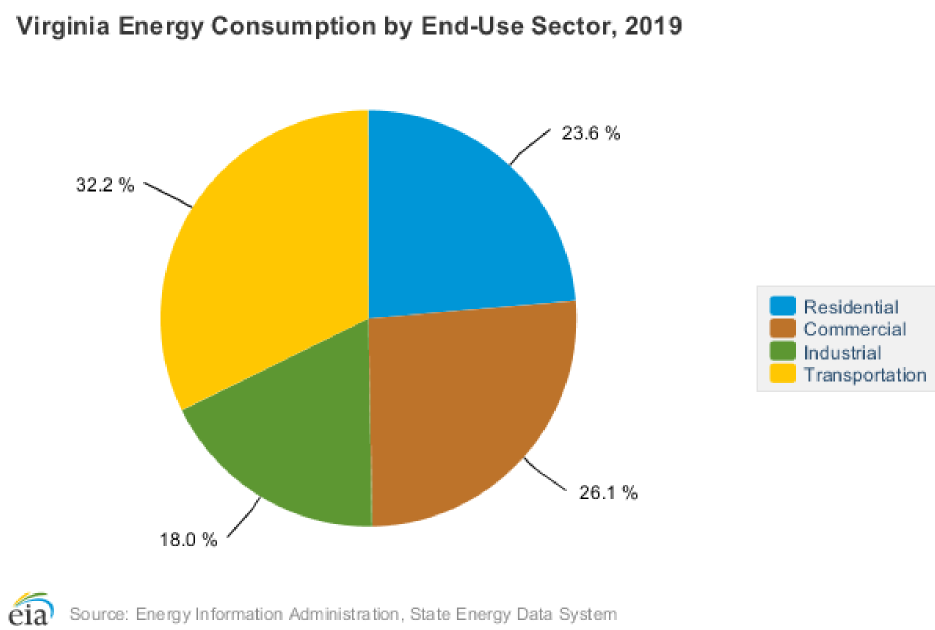

Figure 5 Virginia Energy Consumption by End-Use Sector, 2019, Energy Information Administration

To further contextualize the impact of petroleum, Virginia consumes more petroleum per capita than nearly two-thirds of the other states in the nation and almost three-fourths of the other U.S. states overall. Of this consumption, the transportation sector is responsible for close to 90% of the petroleum used in Virginia with about two-thirds being gasoline consumption. ("Virginia - State Energy Profile Analysis").

For all of the energy the Commonwealth consumes through the use of petroleum, virtually zero percent is produced in Virginia (*"Oil and petroleum products explained"*). With only two small crude oil production sites and zero refineries, Virginia receives all of its petroleum through the Colonial Pipeline originating in Texas, the Plantation Pipeline originating in Louisiana and Missouri and foreign petroleum products that arrive at Virginia's ports from overseas ("Virginia - State Energy Profile Analysis*"*).

On the other hand, a large portion of the electricity consumed in Virginia is generated in the state. As described in the below chart, Virginia's sources for energy generation as of 2019 had less than 1% produced by oil and less than 4% by coal. The largest contributors to the Commonwealth's energy mix are natural gas and nuclear, which are largely produced in state ("Alternative Fuels Data Center: Emissions from Hybrid and Plug-In Electric Vehicles"). All of the nuclear energy consumed in Virginia is produced in the Commonwealth and a sixth of the natural gas consumed is produced in the state ("Virginia - State Energy Profile Analysis").

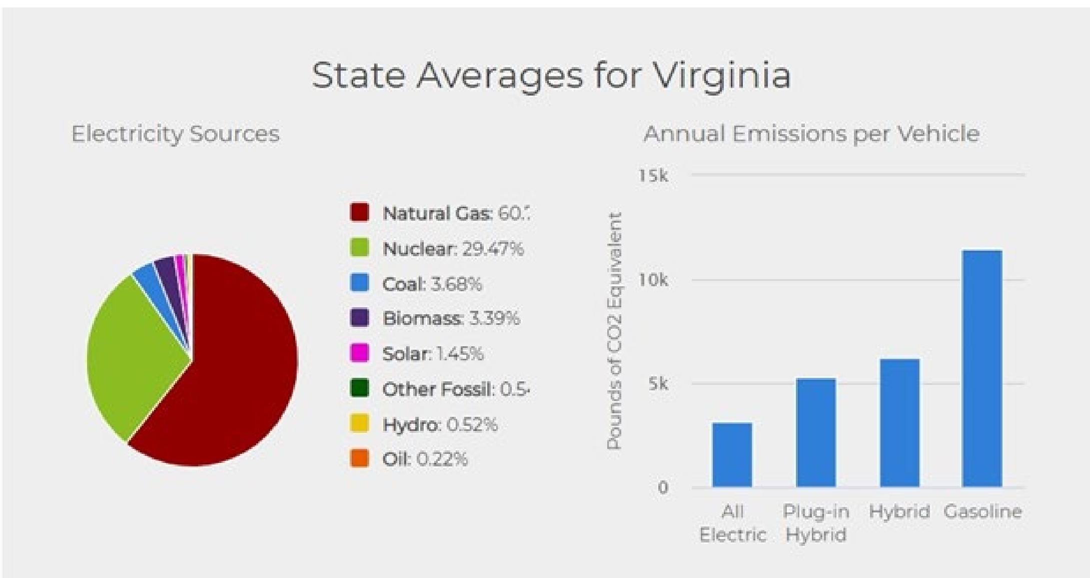

Figure 6 State Emissions Averages for Virginia from the Alternative Fuels Data Center

As demonstrated in the above chart, the CO_2 emissions produced by electric vehicles powered in Virginia is less than a third of those power by petroleum. Additionally, transportation emissions for electric vehicles will also continue to decrease after the purchase date as the grid increases its portfolio of renewables. Virginia is rapidly closing coal fired power plants, with the last expected to close by the end of 2024 ("Governor Northam Signs Clean Energy Legislation*"*). The Commonwealth also has a goal to be 100% carbon free by 2050 ("Virginia's Progress Towards a Cleaner Electric Grid". As demonstrated in the below figure from the Virginia Department of Mines Minerals and Energy and the Virginia Clean Economy Act, Dominion Energy and Appalachian Power's renewable portfolios are expected to make steady increases towards 100% renewable energy in 2050. This transformation of the grid would also decrease EV CO_2 emissions to zero over time.

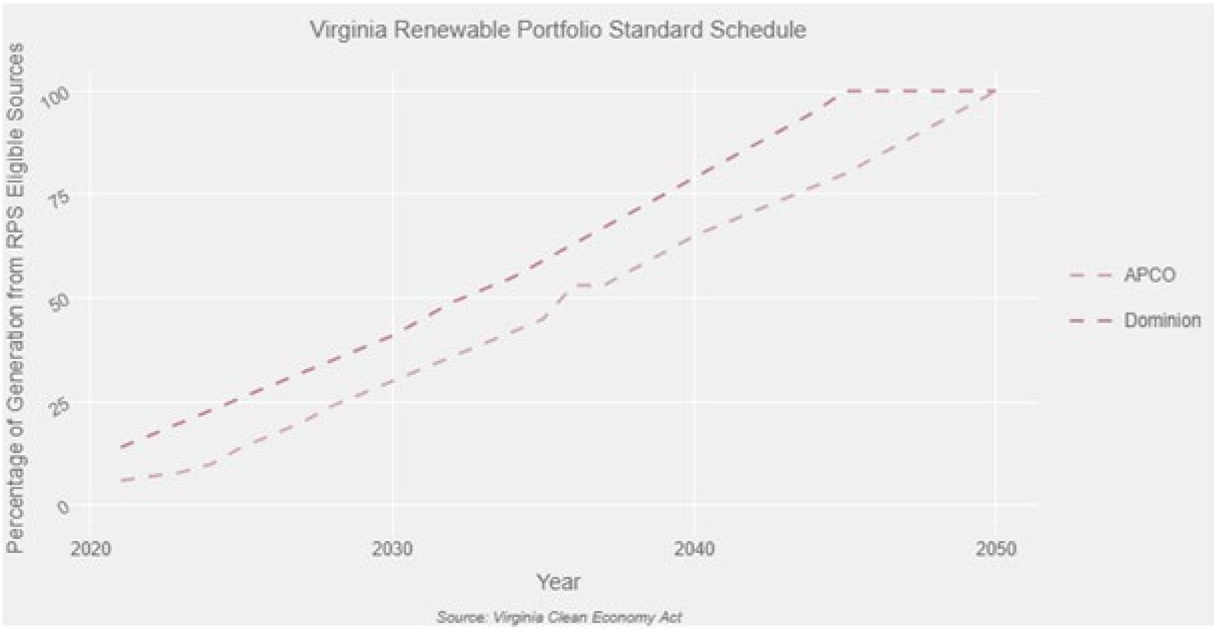

Figure 7 Virginia Renewable Portfolio Standard Schedule from the Virginia Clean Economy Act

Social Cost of Carbon

The social cost of carbon is a calculation that can help us further estimate the value of reducing petroleum use. The social cost of carbon is a dollar estimate of the economic damages resulting from each additional ton of greenhouse gas emissions released into the atmosphere. Assigning a dollar amount to the cost of climate change, allows policy makers and businesses alike understand and weigh how emissions-related policies and actions will impact the economy. In order to calculate cost or benefits of a policy or decision, we can multiply the expected increase or decrease of greenhouse gas emissions by the social cost of carbon ("Social Cost of Carbon Computing Platform").

In principle, the calculation includes the value of all climate change impacts on the United States of America for each ton of CO_2 produced. This includes the damage of increased natural disasters, changes in agricultural productivity, disruption of energy and supply chain services, resulting conflict, value of ecosystem services, and impacts on human health and many more. In whole, it represents "the societal value of reducing emissions of the gas in question by one metric ton" (Technical Support Document). The number was first calculated in 2009 after an interagency working group was established by an Executive Order (E.O.) 128661 in 2008 which ordered agencies consider the value of reducing greenhouse gas emissions in their policy and rulemaking processes. This working group was established to ensure the use of the best available science, and through the use of Integrates Assessment Models (IAMs) they created the first value to represent the social cost of carbon. Since first calculated in 2010, there has been a great expanse in the scientific knowledge of climate change and its societal implications. In 2017 Executive Order 13783 disbanded the working group and required agencies to use a separate calculation established by the Office of Management and Budget which shifted from a wholistic global calculation to a U.S. domestic only approach. In 2021, the interagency working group was reestablished under E.O. 13990 and the group has since released an interim social cost of carbon to be used until the full and official number is released in 2022 (“Technical Support Document”).

In the high-end scenario, the interim report values the social cost of carbon at $152. Multiple calculations are made with differing discount rates. Discount rates are understood as time preferences and opportunities of cost and demonstrates the preference of present benefits (money today) over future benefits (money in the future). The social cost of carbon valued at $152 was calculated based on a discount rate of 3% for the 95th percentile. This scenario considers the harshest possible impacts of climate change (“Technical Support Document” 23). This calculation is the reasonable to consider for long term costal and agricultural Commonwealth planning as it considers the most economically damaging near and long-term effects of climate change.

All People and Equity

An important initiative for EV deployment is to ensure it is done equitably. In order assess how we can meet this goal we used a public government tool called the **Energy Zones Mapping Tool** produced by the Argonne National Laboratory. This tool allows the application of unique overlays to be placed over the United States for visual comprehension of data of certain geographical trends. There are multiple overlays available that we can use to assess where charging stations can be installed to best serve all people. These overlays include, Level 2 Charging Stations, DCFC Charging Stations, Low-Income Block Groups, Total Minority Block Groups, and Household Transportation Energy Burden (% of income). Blue hollow circles represent DC fast chargers and red hollow circles represent Level 2 chargers. Using this tool, you can see where current EVSE infrastructure efforts are, have been and should be.

Household Transportation Energy Burden and Charging

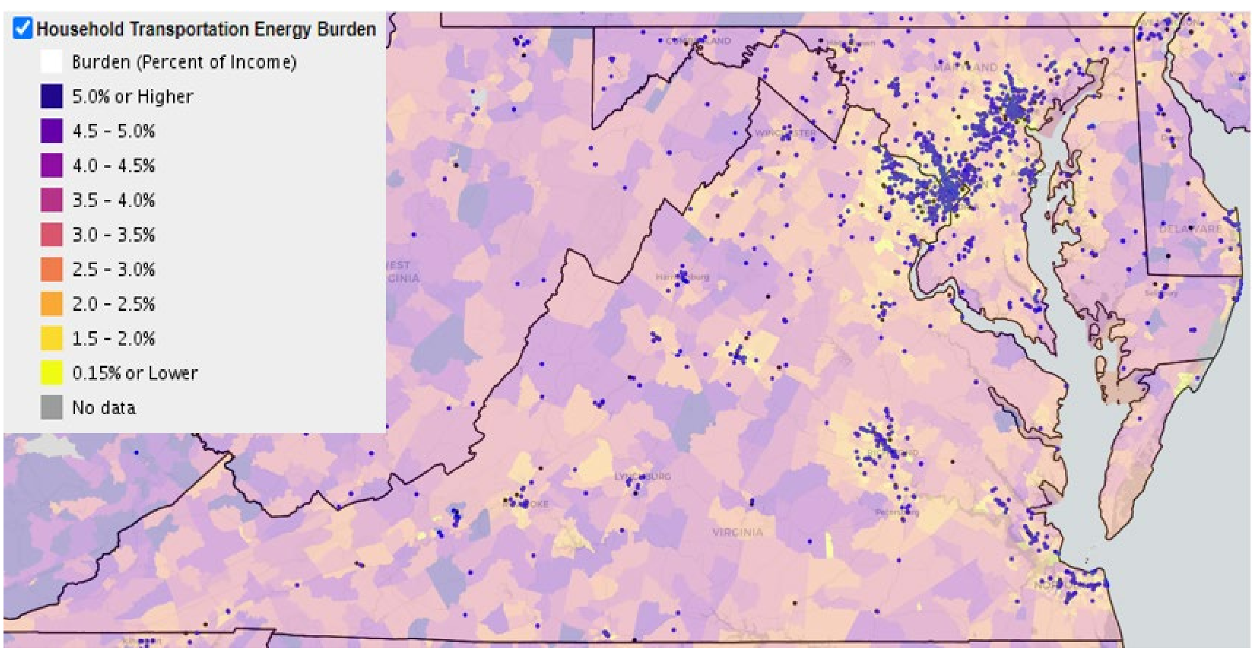

Figure 8 Household Transportation Energy Burden and EV Chargers generated using the Energy Zones Mapping Tool

This energy burden overlay of the Commonwealth shows the "census-tract-level estimates of household transportation energy affordability in terms of the transportation energy burden, defined as the percentage of annual household income spent on the household vehicle fuel costs" (Energy Zones Mapping Tool). In this map of the Commonwealth, we can see that many places with chargers align with areas that have overall lower household vehicle fuels costs. Lower household transportation energy burden can come from a number of factors such as access to good and affordable public transportation, vehicle miles traveled, access to fuel-efficient vehicle technologies and fuel type and cost. These burdens are often particularly high in low-income and rural communities. The extension of fuel-efficient vehicles would greatly decrease household transportation energy burden (Zhou, Yan, et al. 49). This is especially true of electric vehicles as electric fuel costs frequently equate to around $1 per gallon gas equivalent in the Commonwealth.

Block Groups: Low-Income and Charging

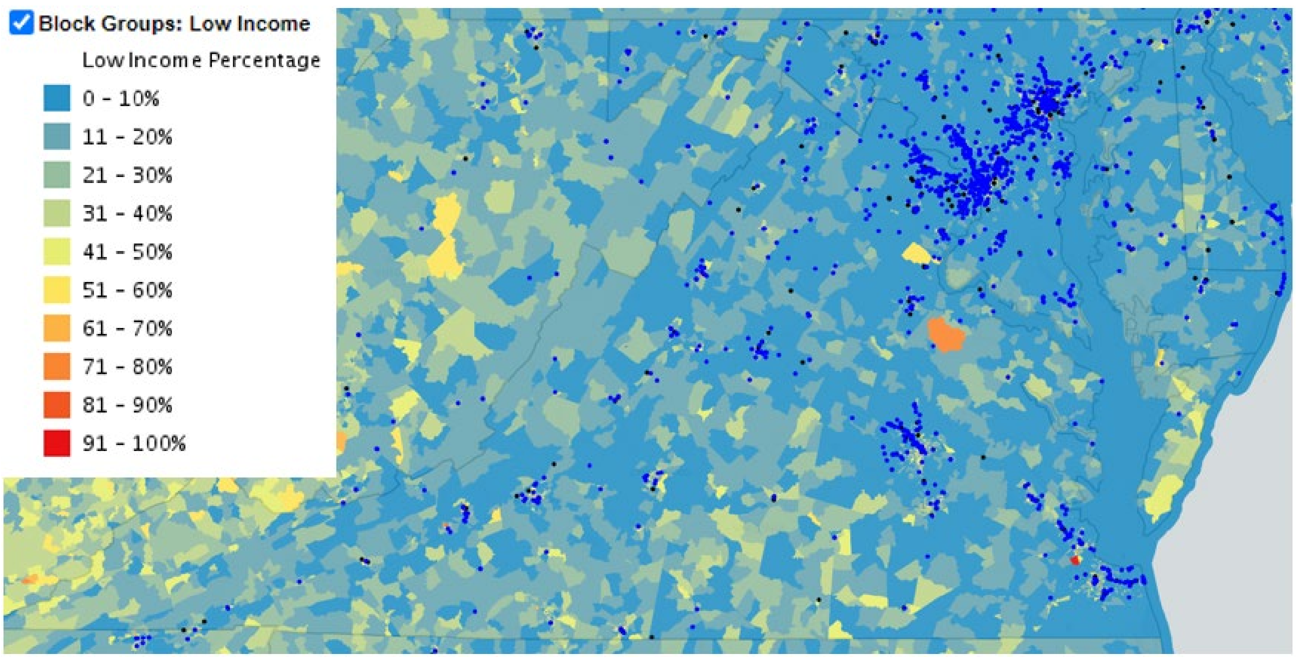

Figure 9 Low-Income Block Groups and EV Chargers generated using the Energy Zones Mapping Tool

This map, featuring charger sites in blue and black dots and low-income overlays demonstrates that across the Commonwealth, underserved areas often have limited access to chargers within their block groups. This also aligns with the household transportation energy burden analysis, as many of the block groups with high transportation energy burden overlap with this low-income overlay. In this analysis, it is important to note that the tight definition of low-income is restrictive and thus there are low-income populations in the Commonwealth that are not well represented as they do not exceed the thresholds defined in the EZMT tool. Here, block groups that are identified as low-income in this analysis are those with individuals in households living below the federal definition of poverty, that exceed 50% of the total block group population, and/or where the low-income percentage is at least 20 percentage points higher than the average for all block groups the state in which they are located.

Block Groups: Total Minority and Charging

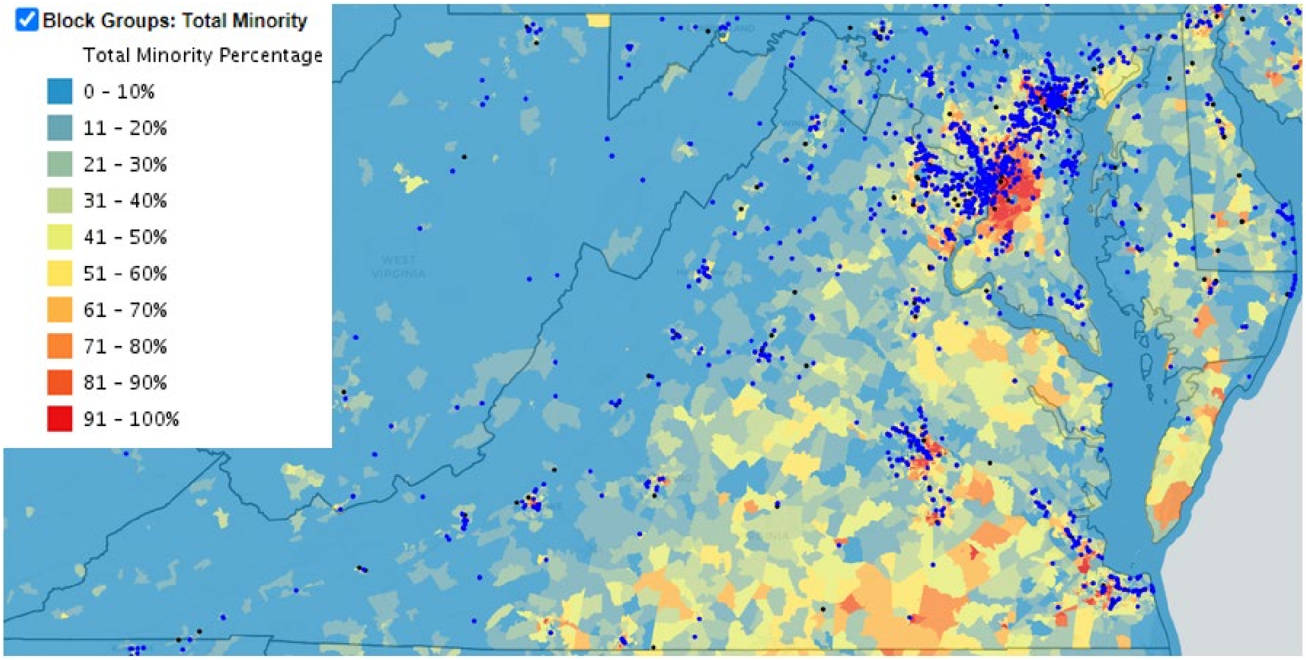

Figure 10 Total Minority Block Groups and EV Chargers generated using the Energy Zones Mapping Tool

This map demonstrates where chargers are sited in relation to communities of color. As can be seen, there are clusters of chargers in multiple major urban areas such as D.C., Richmond, and the Tidewater region that include high minority percentages. However, a closer look at these regions would reveal that many chargers lie outside of these block groups. This map also shows that there are a number of rural areas, specifically in the lower half of the Commonwealth that have high minority population and little or no access to EV charging infrastructure. This demonstrates the opportunity for a more equitable distribution of chargers and the importance of rural sites and inclusion in this process.

Jobs

As with any major technology shift, jobs are a frequently cited area of concern for electric vehicles. However, the transition to EVs should have a positive impact on the U.S. Job Market. A recent report from the Goldman School of Public Policy at the University of California Berkeley suggests that the switch to EVs will bring millions of jobs with it. In their 2035 Transportation report, the authors outline and compare two scenarios. The first scenario, referred to as the DRIVE Clean Scenario, they outline a future in which EVs comprise 100% of new U.S. light-, medium-, and heavy-duty vehicle sales by 2035. The second is a No New Policy scenario which predicts EVs will constitute 45% of light-duty, 38% of medium-duty, and 12% of heavy-duty new vehicles sales in 2035 if we continue at our current pace. They predict that if the U.S. follows the DRIVE Clean Scenario there will be consistent job gains over the 15-year period between 2020 and 2035. These gains are expected to peak at just over 2 million jobs and will begin with ramped up growth as gird capacity and infrastructure is needed to support EV adoption (*The 2035 Report 2.0- Transportation*).

The reduction of maintenance is frequently cited as one of the benefits of EVs, but it has also conjured some discussion of reduction of jobs related to EVs and transportation infrastructure. However, while electric vehicles do require less maintenance than a traditional ICE vehicle, the creation of these 2 million jobs will provide a number of direct, indirect, and induced job opportunities in the power sector and across the broader economy. The direct and indirect jobs will be created through many of the similarities that EV and ICE (internal combustion engines) share including the need for road infrastructure and fueling infrastructure and parts manufacturing. In addition, many induced jobs will also be created and help stimulate the economy beyond the transportation sector. Since EVs have lower fueling costs and lower costs of maintenance, EV drivers will be able to spend the money they would have used refueling and maintaining their ICE engines on other commodities, thus helping to expand other economic sectors (*The 2035 Report 2.0- Transportation*).

Opportunities, Limitations, and Barriers

In 2021, we still have limited EVSE charging infrastructure due to funding restrictions, reliance on free chargers and educational barriers.

Funding for EVSE is becoming more common, but it is still insufficient to keep up with charging demand and often comes with tight deadlines and restricting requirements. While there have been multiple grant opportunities over the years, limited application windows can make it impossible for municipalities or other groups that rely on yearly budgeting processes to apply or be rewarded funding. The rebate structure of many funding opportunities can also be limit who can utilize funds. Access is limited when an organization, company, or locality with limited funding cannot afford to put forward the entire cost of a technology or infrastructure up front and then wait to be reimbursed. This could put entities with greater access to resources in advantage over already disadvantaged communities. Cost-share requirements in funding opportunities can also limit eligibility. Cost-share requirements at 30% or above can be unattainable for community foundations and smaller organization. Furthermore, cost-share requirements in federal and state funding can make federal and state fleets ineligible as cost-share must come from non-federal or non-state sources.

As we move forward as a Commonwealth, must also recognize opportunities to expand equitably from free charger programs such as the Tesla charging program previously utilized to deploy chargers with tourism sites. While we still advocate for these programs, they cannot be the only way we install infrastructure if we want to support EVs and expand the market. Additional community-based charging at low cost and at a range of geographies including rural, and diverse incomes is needed.

Education and visibility also play a large role in electric vehicle and EVSE adoption. Manufactures are beginning to shift their lines to be EV inclusive and EV visibility is on the rise, but many individuals have yet to experience an EV. A key part of EV charging education that needs to be shared is how standardized and simple it is. The process can be demystified for all those involved, for localities and business charging infrastructure can be likened to installing a parking meter, lamp, or even just a pedestal with a standard GIF outlet. For users charging electric vehicle charging can be as simple as charging a cellphone.

Conclusion

The time has come for the Commonwealth and its localities to being the process of creating an EV infrastructure network that supports all people. A projected total of 155,622 workplace and public chargers to be installed to support a 10% EV ownership scenario can seem daunting, but it is important to be aware of scale. Through the creation of ordinances localities can help reduce their burdens by creating opportunities for more EV owners to safely charge at home. By supporting EV infrastructure, Virginia will lessen its reliance on outside oil, stimulate local economies, improve its air quality, and reduce transportation financial burdens on underserved communities. Electric vehicles coming at scale will serve the Commonwealth, with air quality, economic opportunity and quality of life benefits and together we can build out the infrastructure step by step.

Individual Major Urban Area Electrification Reports

During this activity, individual reports for major urban areas in the Commonwealth and Washington D.C. were created. These reports can be found on vacleancities.org under formal reports.

How to use the tools

Alternative Fueling Station Locator

1. Go to https://afdc.energy.gov/stations/#/find/nearest
2. From the "Alt Fuels" drop down menu select "Electric".
3. Select any charger or connector types you are interested in.
4. Enter a location. This can be broad like a state, or narrow like a zip code.
5. From here you can:
    a. Click on charger icons to learn more about the stations and their locations
    b. Map a travel route
    c. Apply more advanced filters using the "Advanced Filters" tab such as:
        i. Public or Private stations;
        ii. Available, Planned, or Temporarily Unavailable stations;
        iii. Station Owners; or
        iv. Payment accepted
6. You can also download your results or embed them
    a. To download, navigate to the "Advanced Filters" tab and in the lower right-hand corner click "Download Results". This will download an excel spreadsheet with the station information.
    b. To embed you map on another webpage, navigate to the bottom of the tool click "Embed Tool". This will give you HTML code to copy and paste into your website.

EVI-Pro Tool Lite

1. Go to https://afdc.energy.gov/evi-pro-lite
2. Select either State or City/Urban Area estimate
3. You will be prompted with the amount of Plug-in electric vehicles you would like to support. Note that the maximum is 10% of the 2016 total vehicle population listed.
4. Once you input your amount click calculate. You will be presented with the EVI-Projections.
5. To receive EVI-Projections with different assumptions look to the right side of the output screen. Here you can change the number of vehicles under calculation, the electric vehicle mix, the amount of support given, and the percentage of access to home charging.
6. To obtain similar numbers as presented in the statewide report or your individual locality's report, change "partial support" to "full support" and change access to home charging to 50%. Read Projections tab for philosophy of these changes.
7. You can read about the EVI-Pro Assumptions Methodology by selecting "See all assumptions" below the calculate button.

   *When changing regions always click "Start Over" and not your web browsers back button. If not, data will be mixed together and incorrect.

Energy Zone Mapping Tool

1. Go to https://ezmt.anl.gov/ and register for an account. It's free! You will receive confirmation and be cleared to use the tool usually in 24 hours.
2. Once you have been verified you can login to the tool.
3. Opening the tool will take you to a map of the United States with a left-hand side bar. Click Library.
4. This will open up all overlays currently available in the EZMT tool. Read through and decide which overlay you'd like, then click the small left-most box to "add this layer to the map"
5. It will immediately be added to your map! Right click the overlay to access its properties such as to increase transparency.

MJ-Bradley Tool

1. Go to https://www.mjbradley.com/content/electric-vehicle-infrastructure-planning-tools-1
2. You will be immediately introduced to the tool. Warning the tool loads very slowly.
3. Use the Exit Filters and Inputs side bar to narrow your region/search.
4. Once you have a narrowed region or specific corridor, zoom in and click on a circle. This will open a small ranking summary of what the tool is measuring. For more information on the rankings select "User guide" directly above the tool and go to section 2.1.5

5. The Exit scores will be from 1-100, 1 being the most suitable for DCFC charging stations, and 100 being the least suitable. The lower the score (closer to 1) the greener the circle will be. The higher the score (closer to 100) the more purple the circle will be.

Tools Referenced

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EVI-Pro Tool Lite: https://afdc.energy.gov/evi-pro-lite

PlugShare: https://www.plugshare.com/

EZMT Energy Zone Mapping Tool: https://ezmt.anl.gov/

MJ-Bradley Tool: https://www.mjbradley.com/content/electric-vehicle-infrastructure-tools

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