THE CITY OF NORFOLK

OCTOBER 2024

ELECTRIC VEHICLE CHARGING PLAN
CITY OF NORFOLK

City of Norfolk
810 Union Street
Norfolk, VA 23510
www.norfolk.gov

Table of Contents

Glossary

AC	Alternating Current
ACCII	Advanced Clean Cars II. California zero emissions vehicle regulation, adopted in Virginia as Clean Cars Virginia in 2021.
AFC	Alternative Fuel Corridor as designated by the Federal Highway Administration
AFDC	United States Department of Energy Alternative Fuels Data Center
BEV	Battery Electric Vehicle. A vehicle powered exclusively by electricity, such as the Nissan LEAF.
BIL	Bipartisan Infrastructure Law
CCS	Combined Charging System. This is a direct current fast charging standard supported by Volkswagen, General Motors, BMW, Daimler, Ford, FCA, Tesla, and Hyundai.
CFI	Charging and Fueling Infrastructure Discretionary Grant Program
CHAdeMO	This is a direct current fast charging standard developed in Japan, originally supported by Nissan, Mitsubishi, and Fuji Heavy Industries (which manufactures Subaru vehicles). Toyota later supported the standard as well, and Tesla sells an adapter allowing its vehicles to use CHAdeMO chargers.
Charging Infrastructure	Above- and below-ground equipment and wiring that supports charging vehicles. In this document, charging infrastructure refers to both the charging station and to any utility or customer make-ready equipment needed for the station.
Charging Pedestal	A stand-alone piece of equipment capable of charging a vehicle. A charging pedestal is sometimes used interchangeably with the terms charger, machine, Electric Vehicle Supply Equipment (EVSE, defined below), or dispenser.
Charging Station	A set of one or more chargers at a single location operated by the same electric vehicle service provider.
Connector	The component of a charging station that connects with the vehicle and provides electricity. Connector is sometimes used interchangeably with the terms charge point, port or plug.
DAC	Disadvantaged Community
DC	Direct Current
DCFC	Direct Current Fast Charging equipment. DCFC chargers are sometimes called DC Level 3 (typically 208/480V AC three-phase input) and enable rapid charging of an electric vehicle.

DOE	United States Department of Energy
DOT	United States Department of Transportation
EJ	Environmental Justice
Electrification	The switching of processes typically powered by a fossil fuel source (gasoline, diesel, or any other derivative of oil) to electricity.
EPA	Environmental Protection Agency
EV	Electric Vehicle. A vehicle powered, at least in part, by electricity. Unless otherwise noted, the term EV in this report refers to all plug-in vehicles and includes BEVs and plug-in hybrid electric vehicles (PHEVs, defined below). The term EV is synonymous with plug-in electric vehicle (PEV, defined below).
EVI-Pro Lite	Analytical platform developed by the National Renewable Energy Laboratory used to estimate the number of chargers needed for a given electric vehicle population in jurisdictions across the country. Available at: https://afdc.energy.gov/evi-pro-lite.
EVSE	Electric Vehicle Supply Equipment. Includes devices that provide electric power to the vehicle and use that power to recharge the vehicle's batteries. EVSE systems include the electrical conductors, related equipment, software, and communications protocols that deliver energy efficiently and safely to the vehicle.
EVSP	Electric Vehicle Service Provider. An EVSP provides connectivity across a network of charging stations. Connecting to a central server, an EVSP manages the software, database, and communication interfaces that enable operation of the station.
FHWA	Federal Highway Administration
GHG	Greenhouse Gases. GHGs are gases that trap heat in the atmosphere, such as carbon dioxide, methane, and nitrous oxide.
ICEV	Internal Combustion Engine Vehicle. A vehicle that combusts fuel, such as gasoline or diesel, for power.
LDV	Light Duty Vehicle
IRA	Inflation Reduction Act
Level 1 Charging	AC Level 1 charging (often referred to simply as Level 1). Provides charging through a 120V AC port.
Level 2 Charging	AC Level 2 station. Offers charging through 208V (typical in commercial applications) to 240V (typical in residential applications) electrical service.
Level 3 Charging	Alternative term for DCFC charger.

LMI	Low- to-Moderate-Income
Make-ready	Work or costs associated with connecting a charging station to the electric grid.
MHDV	Medium- and Heavy-Duty Vehicles. Vehicles over 10,001 pounds, which includes walk-in delivery vans and transit buses.
MUD	Multi-unit Dwelling. Also called multi-family dwellings, these are apartments, condominiums, and group quarters. The other major housing category used in this report is single-family homes.
Micromobility	Small, manually or electrically powered vehicles used to travel short distances. Examples include bicycles, e-bicycles, scooters, e-scooters, one-wheels, and skateboards.
NHS	National Highway System
Opportunity Charging	Charging an electric vehicle when a good opportunity arises (e.g., for 30 minutes at the grocery store when purchasing food), rather at a dedicated time and place each day (e.g., at home at night).
PHEV	Plug-in Hybrid Electric Vehicle. A vehicle powered by electricity or an internal combustion engine.
Plug	The component of a station that connects with the vehicle and provides electricity. Plug is sometimes used interchangeably with the terms connector, charge point, or port. This document uses the term plug.
Port	The component of a station that connects with the vehicle and provides electricity. Port is sometimes used interchangeably with the terms connector or plug.
Public	Publicly accessible, i.e. public charging.
PUC	Public Utility Commission
ROW	Right-of-way
SCC	State Corporation Commission. Virginia regulatory agency whose authority encompasses utilities, insurance, state-chartered financial institutions, securities, retail franchising, and railroads.
Shared Mobility	The shared use of any form of transportation—bicycle, scooter, motorcycle, ICEV, or electric vehicle—in a way that reduces the need for personal ownership of these vehicles and devices.
ZEV	Zero Emission Vehicle

Executive Summary

The Norfolk Electric Vehicle Charging Plan (the "Plan") provides a framework and recommendations for how the City of Norfolk can prepare for the increased adoption of electric vehicles (EVs) and support its residents, businesses, and visitors who require access to EV charging. The content of this Plan is based on the latest literature, expert input, contributions from City staff, stakeholder and community engagement, and spatial analysis. The Plan provides forecasts of EV adoption and charging infrastructure needs, identifies priority locations for deployment of charging infrastructure, and identifies 26 strategy recommendations and actions the City can undertake, as described below.

The goals of this Plan include understanding current and future charging needs in Norfolk; identifying the role the City can play to help ensure accessible, reliable, and affordable EV charging; and adopting and implementing strategies to deploy charging infrastructure in a manner that increases local economic development and increases equity. This Plan was developed in alignment with the Norfolk Climate Action Plan (NCAP), plaNorfolk 2030, Vision 2100 and Green Infrastructure Plans, and the Norfolk Resilience Strategy in support of the City's commitment to equitably improve quality of life in all Norfolk neighborhoods, reduce the City's carbon emissions, and prepare Norfolk for the effects of climate change.

Motivation

EVs are changing how drivers in Norfolk travel. In 2023, over 1.2 million EVs were sold in the US, or 7.6% of all light duty vehicle sales, up from just 308,000 in 2020.[i] There are nearly 100,000 EVs on Virginia roads today,[ii] and by 2035 most new vehicle sales in the state will be zero-emissions.[iii] In Norfolk there are over 1,000 EVs registered to residents, and by 2030 this number is expected to grow to over 25,000. Thousands of EV charging ports will need to be installed in Norfolk in residences, at businesses, and on municipal properties to support this increase, which will have a significant impact on local transportation and energy systems and infrastructure.

As EVs deploy in greater numbers, the City sought to understand the local effects this emerging market may have to better prepare for this transition. Strategies that can assist Norfolk in meeting climate goals, capturing economic benefits, and creating a more equitable and accessible transportation system require proactive planning. This Plan identifies and promotes key actions that the City of Norfolk can take to guide EV deployment while meeting the needs of Norfolk's residents, businesses, and visitors both now and in the future.

How was this Plan Developed?

This Plan was developed by the Norfolk Environmental Sustainability Division in partnership with representatives across City departments and through extensive internal and external stakeholder engagement, desk research, and analysis. These activities informed the development of the Plan's recommendations and included conducting a contextual scan of existing Norfolk plans, spatial analysis of charging infrastructure, assessment of the municipal fleet, review of Norfolk's zoning, codes, and permitting policies, in addition to a comprehensive review of policies and funding opportunities at the federal, state, and local levels (Figure 1). A summary of the findings from the stakeholder engagement process is summarized below.

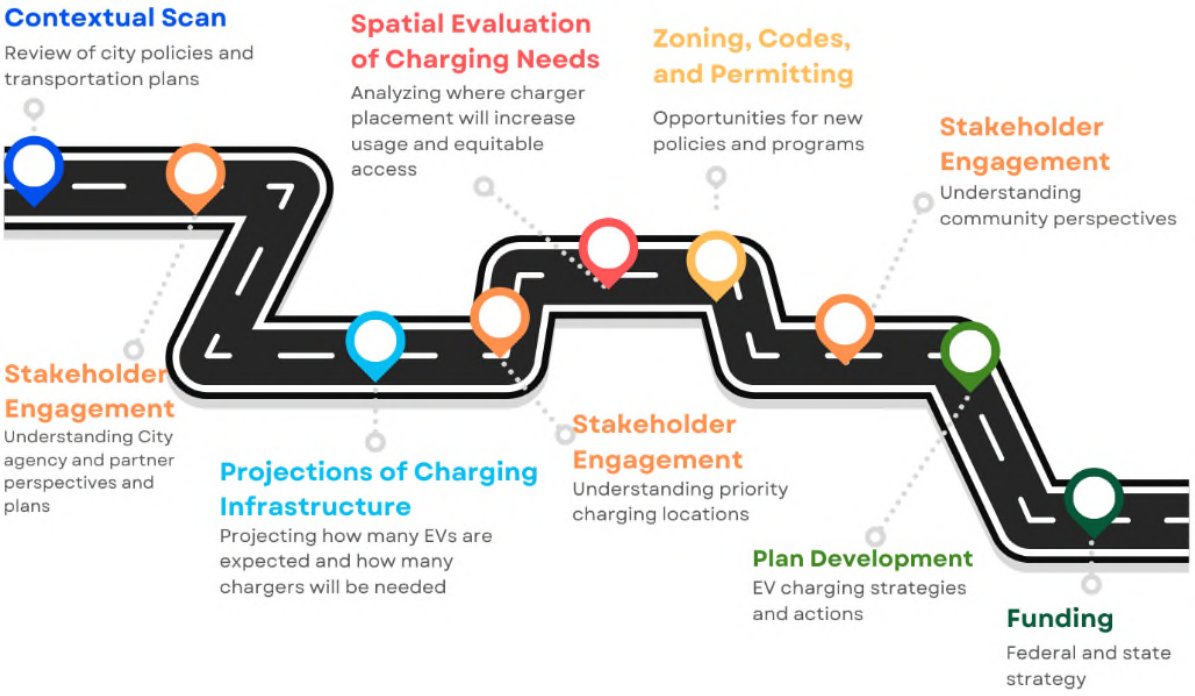


Figure 1. Norfolk EV Charging Plan development process

Stakeholder Engagement

To ensure the EV Charging Plan complements and addresses existing initiatives and community needs, Cadmus and the City of Norfolk conducted thorough stakeholder engagement activities that engaged interdisciplinary City agencies and community stakeholders throughout the plan's development. Activities included three City agency workgroup meetings and nearly 25 individual interviews with City offices and other key internal and external stakeholders. The intent of these activities was to ensure understanding of existing City initiatives and priorities, inform the development of the City's EV Charging Plan, ensure the Plan centers equity, and receive buy-in for EVs from stakeholders.

City of Norfolk Stakeholder Engagement Meetings

Throughout the development of this Plan, meetings with City staff were held to solicit input during major project milestones, including the project kickoff, following the completion of the contextual scan and priority block group analysis, and during development of recommendations. City staff received

educational information on EV charging infrastructure and an EV forecast for the City of Norfolk. In addition, staff had facilitated discussions about charging site priorities for both Level 2 and DCFC charging, which informed recommendations for charging locations and of the Plan. Following the development of recommendations, staff gathered to discuss capacity and training needs to support implementation of EV charging infrastructure rollout.

Individual Stakeholder Interviews

Cadmus conducted interviews with stakeholders in the City of Norfolk to ensure thorough understanding of existing City plans, priorities for EV charging infrastructure locations, potential geographic constraints, and strategies for ensuring equitable placement of charging infrastructure. Stakeholders included the City of Norfolk Departments of Transportation, Public Works, City Planning, General Services, Housing and Community Development, Neighborhood Services, Parks and Recreation; and Economic Development; Office of DEI, Office of Resilience, Parking Division; Fleet Management and other key stakeholders such as the Port of Virginia, Hampton Roads Transportation Planning Organization (HRTPO), Virginia Clean Cities, Old Dominion University, Norfolk State University, Tidewater Community College, Tidewater Tech, the Department of Defense, the Naval Facilities Engineering Systems Command (NAVFAC), and the Hampton Roads Workforce Council.

These interviews offered additional insight that complemented the findings from the contextual scan, desktop research, and spatial analysis to help inform the development of the Plan. Major themes heard from stakeholders through these interviews are summarized below.

The support for the City of Norfolk EV Charging Plan is sustained by ongoing projects to deploy charging infrastructure and opportunities to expand access. The City of Norfolk manages more than 20 parking facilities (i.e., garages, lots), including almost all downtown parking. Existing major development projects such as St. Paul's Transformation Project and the NEON District are already integrating EV charging infrastructure, including curbside installations, and there are opportunities for expansion. Adding EV chargers has the potential to strengthen commercial corridors and incentivize more people to come to these areas. There is interest in exploring the installation of charging stations through commercial corridor vision plans.

Access to EV charging infrastructure needs to be equitable and data-informed. In addition to prioritizing infrastructure development beyond the downtown area and in underserved communities, it is important that these communities are engaged to inform decision-making around the need and placement of chargers. EV chargers should be deployed in places where residents already live, work, and play, rather than just where space is available. Parking spaces allocated for EV charging should not be in the "best" parking spots, as this can unintentionally signal that those who can afford EVs are being prioritized.

Existing parking facilities should be leveraged to avoid adding paved spaces for new EV charging stations, but there are challenges. Municipal facilities in the City of Norfolk generally close at a certain time of the day (e.g., parks close at dusk), which would reduce the usability of chargers in these locations.

Workforce development opportunities should be sustainable. The City's workforce development priority is assisting people in earning livable wages. This requires that any workforce development program connects to jobs that are in high demand, pay well, require feasible training expectations, and align with the interests of job seekers. Specific opportunities and partnerships should be established to ensure that workforce training programs are driven by market demand.

In addition to the above stakeholder input, the City of Norfolk distributed a public survey to gain insight regarding community attitudes towards EVs, charging infrastructure, and to understand how the City might best participate in an evolving EV market. Detailed results of this survey can be found in the section *What is the Community's Perspective on EVs?* As the City continues its planning regarding EV charging infrastructure, it will engage more directly though community listening sessions, education and outreach programs, and potential workforce development programs to ensure City actions are based on the priorities and needs of local residents and businesses.

Primer on Electric Vehicles and Charging

What are Electric Vehicles?

EVs use electrical energy, stored in batteries inside the vehicle, for propulsion via an electric motor. There are two primary types of EV powertrains: battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). These two vehicle types are collectively referred to as EVs.

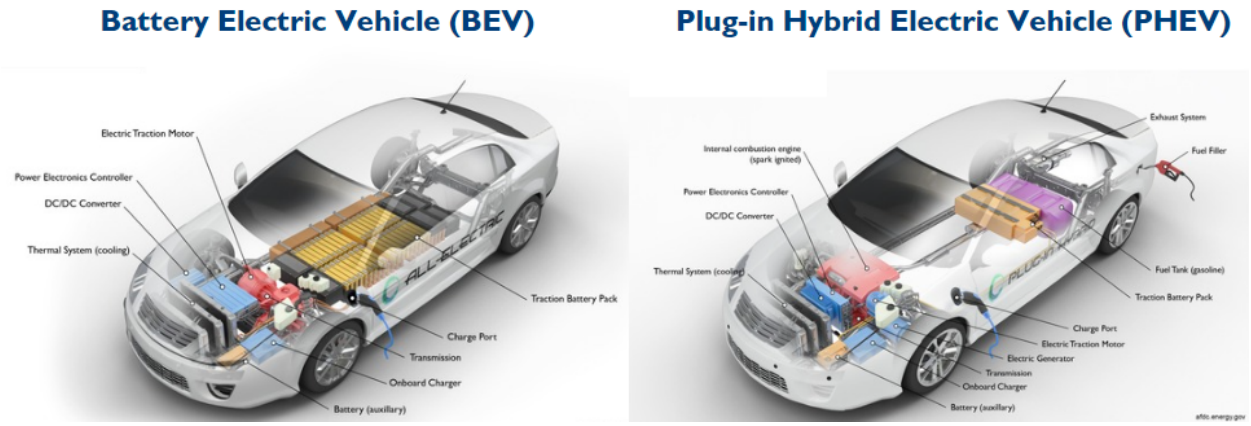


Figure 2. Overview of BEV and PHEV vehicle systems

Source: DOE AFDC

- **BEVs** are powered by an electric motor and use a battery that is recharged using an Electric Vehicle Supply Equipment (EVSE) port and electrical outlet or hardwired EVSE.[iv]
- **PHEVs** are powered by both an internal combustion engine (ICE) and an electric motor with a battery. Unlike conventional hybrids, PHEVs can recharge their batteries using an EVSE port.[v]

Today's PHEVs have an all-electric range of 20 miles to over 100 miles. There are currently 33 light-duty PHEV models available in the US. BEVs have a range of 80 miles to more than 500 miles, depending on the model. There are currently 40 BEV models available in the United States, and this number is expected to increase to over 100 by 2025.[vi]

The average price of a light-duty EV fell by 20% between 2022 and 2023, down to $53,000 compared with $48,000 for an ICE vehicle.

Between 2011 and 2023, sales of EVs rose from 0.2% to 8% of new light-duty vehicles in the US, and vehicle and battery manufacturers plan to invest $210 billion in the US by 2030. The average price of a light-duty EV fell by 20% between 2022 and 2023, down to $53,000 compared with $48,000 for an ICE vehicle,[vii] and average EV range has increased from 84 miles to 275 miles in the past decade.[viii]

What is Charging Infrastructure?

Charging infrastructure (Figure 3**)** refers to the structures and equipment necessary to support an EV, including all components to bring electricity from distribution power lines to the vehicle, which includes the connector, cable, pedestal, wiring, panels, and transformers. This includes **To-the-Meter (TTM)** infrastructure, which includes all components owned by the utility, and **Behind-the-Meter**

(BTM) infrastructure, which is typically owned and operated by either a site host, an Electric Vehicle Service Provider (EVSP), or, in some instances, a utility. **Electric Vehicle Supply Equipment (EVSE)** is the equipment that provides a connection between an EV and a power source to enable charging. EVSE is the hardware and enclosure to deliver power from the meter to the vehicle (like a gas pump for a vehicle with an ICE). In terms of costs, EVSE may only represent a small portion of the total costs for a charging infrastructure project.

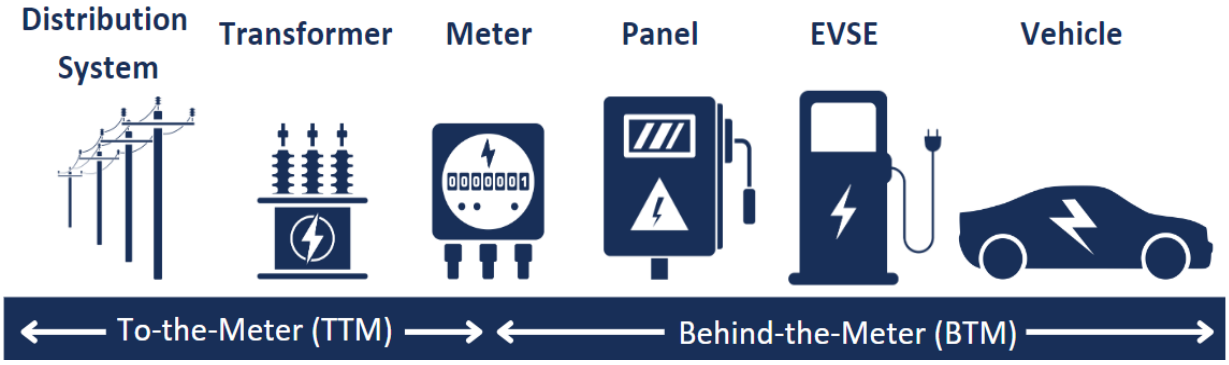


Figure 3. Components of EV charging infrastructure

Additional key charging infrastructure terminology includes:

- **Charging station (or station location):** A site with one or more EVSE ports at the same address. Charging stations can be found in parking garages, highway rest areas, parking lots, etc.
- **Charging pedestal (also called a charge point):** The unit that houses all equipment such as EVSE ports, user display screen, payment system, and electronic hardware. A pedestal with two EVSE ports can charge two vehicles at the same time.
- **EVSE port:** The unit that provides power to charge one vehicle at a time. The number of ports on a charging pedestal is equal to the number of vehicles that can concurrently charge at that pedestal. This piece of infrastructure is commonly referred to as a charger.
- **Connector:** The physical attachment at the end of the cable that links the EVSE to the vehicle. Multiple connectors and connector types (e.g., J1772, J3400/Telsa, CCS, CHAdeMO) can be available on a charging pedestal to serve different EV types.

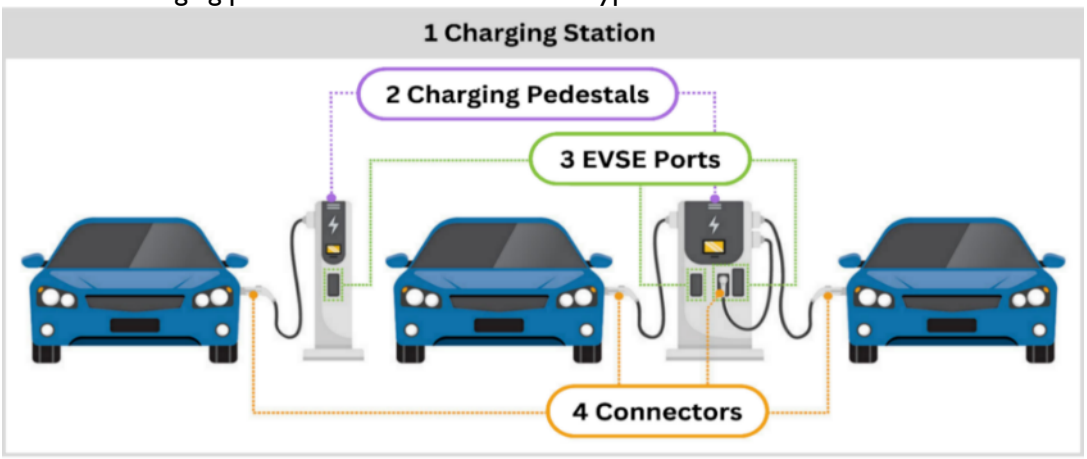


Figure 4. Primary components of an EV charging station

What are the Types and Uses of EVSE (EV Chargers)?

EVSE is classified by the rate at which it delivers power to recharge an EV battery. There are three primary categories of EVSE, as shown in Figure 5.

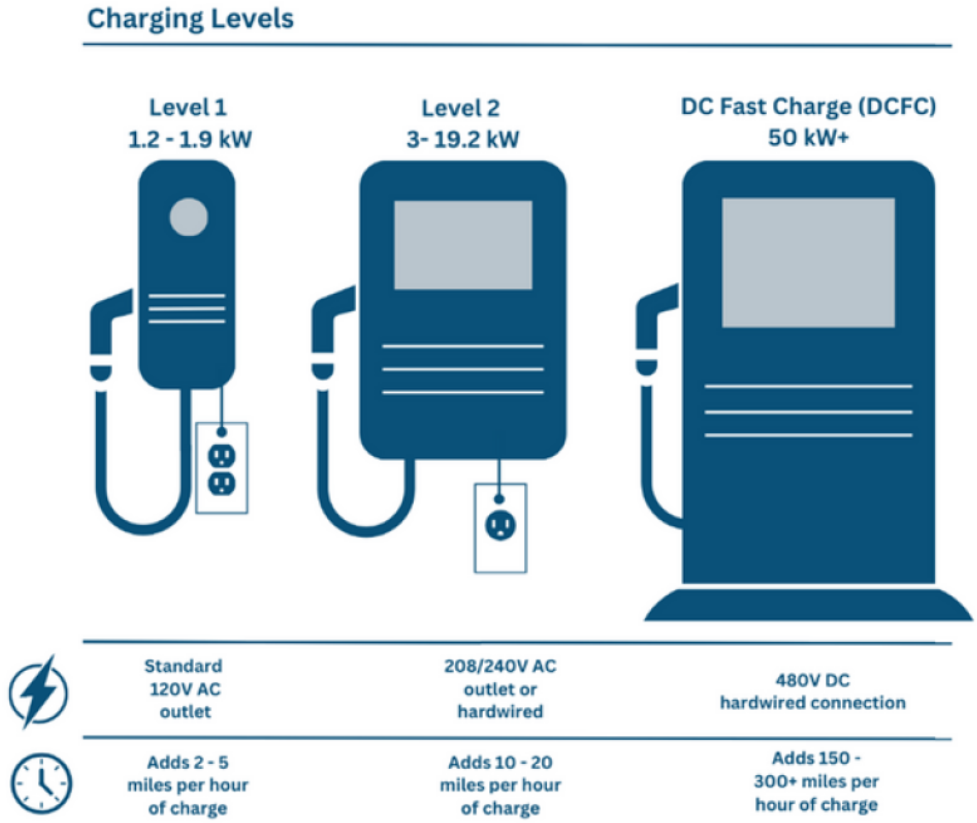


Figure 5. EVSE charging types and characteristics

Level 1 (L1) charging uses a standard 120V alternating current (AC) electrical outlet using an EV charging cord and is the slowest and lowest cost type of charging available. It will take a typical passenger EV a day or more to fully recharge a depleted battery. Because of its slow charging speed, the majority of L1 charging takes place in residential applications for overnight charging of vehicles that travel less than 40 miles per day.

Level 2 (L2) charging provides higher-rate AC charging than L1 charging through 240V (residential) or 208V (commercial) electrical service, such as is used for a clothes dryer. A L2 charger will take 8-10 hours to fully recharge a depleted passenger EV battery. Level 2 chargers are often installed for home charging and are the most common type for public charging locations, fleet vehicle charging or employee EV charging. L2 chargers are typically classified as networked or non-networked. Non-networked chargers are typically selected for private charging with no public access and without charging fees. Networked chargers are more common than non-networked chargers in shared-use locations and are typically operated by a third party. Networked stations often allow users to pay for charging sessions using a credit card, mobile device, key fob, or simply by plugging in.

Figure 6. Examples of L1 (left), L2 (center) and DCFC EVSE (right)

Direct Current Fast Charging (DCFC) (sometimes called Level 3) is the fastest and most expensive type of charging. DCFC EVSE convert grid supplied AC power to direct current (DC) power to directly charge a vehicle battery. DCFC chargers supply a minimum of 50 kW of rated power and are commonly classified as 50 kW, 150 kW, or 350 kW and can fully recharge an average-size passenger vehicle in 20 minutes to 60 minutes. DCFC chargers are typically installed at public charging stations that serve multiple vehicles daily and operate most similarly to a typical gas station fuel dispenser.

A summary of estimated cost of procurement and installation of EV charging infrastructure by type, as well as cost of electricity is shown in Table 1. Level 1 charging requires no new infrastructure, only a EV charging cable and a standard power outlet, and therefore is very inexpensive. Costs for L2 and DCFC charging can vary significantly depending on to EVSE types and procurement cost, as well as the level of infrastructure upgrades required, which can range to a simple 240V connection to upgrades to electrical panels, new transformers, trenching and laying of conduit and others. Residential L2 chargers will be at the low end of the cost range, while commercial L2 chargers will be in the mid to upper range of costs.

Table 1. Estimated Costs for EVSE Procurement and Installation

Charging Type	EVSE Cost	Design & Installation Cost
Level 1	< $150	--
Level 2	$500 - $2,500	$500 - $20,000
DCFC	$50,000 - $100,000	$50,000 - $100,000+

It is unlikely that drivers will charge an EV in the way that they fuel a typical vehicle. Rather than charging when a battery is fully depleted using DCFC charging, vehicles will likely be charged whenever there is convenient access to charging—similar to how someone may charge their phone. Figure 7 shows the EV "charging pyramid" which outlines that residential, the slowest and least expensive type, will be used the most often, while public DCFC charging will be used the least. Figure 7 shows the EV "charging pyramid" which shows that residential, the slowest and least expensive type, will be used the most often, while public DCFC charging will be used the least. EV owners will use a combination of charging types, though most charging will occur using L1, and increasingly L2 at home or at the workplace. Note

that not all charging use cases are represented in Figure 7 and not all charging will conform to this figure.

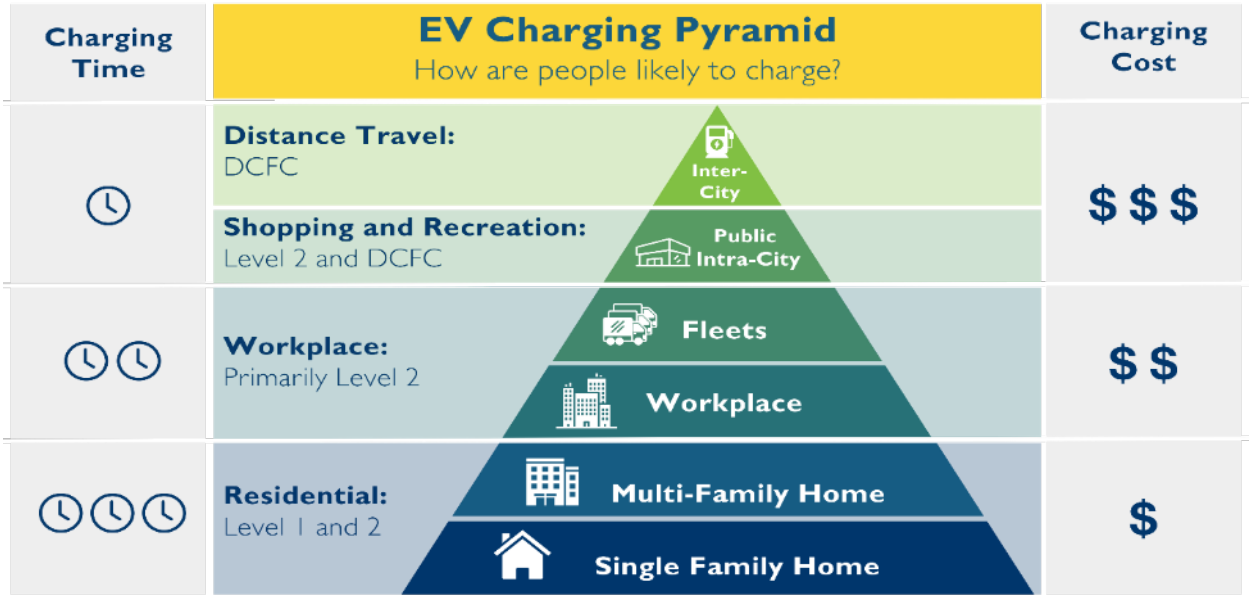


Figure 7. EV charging pyramid

EV charging is commonly grouped into two primary categories based upon the location and the charging behavior of the public that will be using the charging station:

- **Corridor Charging:** These sites are charging stations that are located along or near major roads and are focused on long-distance transportation. These sites are primarily DCFC charger installations, though they may contain a mix of Level 2 and DCFC chargers. Example site types are service stations, rest areas, and major retail sites near interstates.
- **Community Charging:** These sites are charging stations that are distributed in or around where people live, work, and shop. These sites are primarily Level 2 chargers, though in high traffic areas DCFC chargers may also be installed. Example site types include malls and shopping centers, parking facilities, hospitality sites, workplaces, community and recreation centers, government properties, multi-unit dwellings (MUDs), and transportation centers.

Figure 8 shows the distribution location types where L2 and DCFC chargers are commonly installed. As shown, locations such as restaurants, hotels (hospitality), and workplaces favor L2 chargers, while fueling stations and grocery stores are more likely to install DCFC chargers. Retail and parking garages tend to be a mix of both L2 and DCFC, depending on the population they are expected to serve. This is due to the expected dwell time of drivers – DCFC is suitable for drivers who are expected to be in a location for less than an hour, while Level 2 is more suitable for longer parking periods.

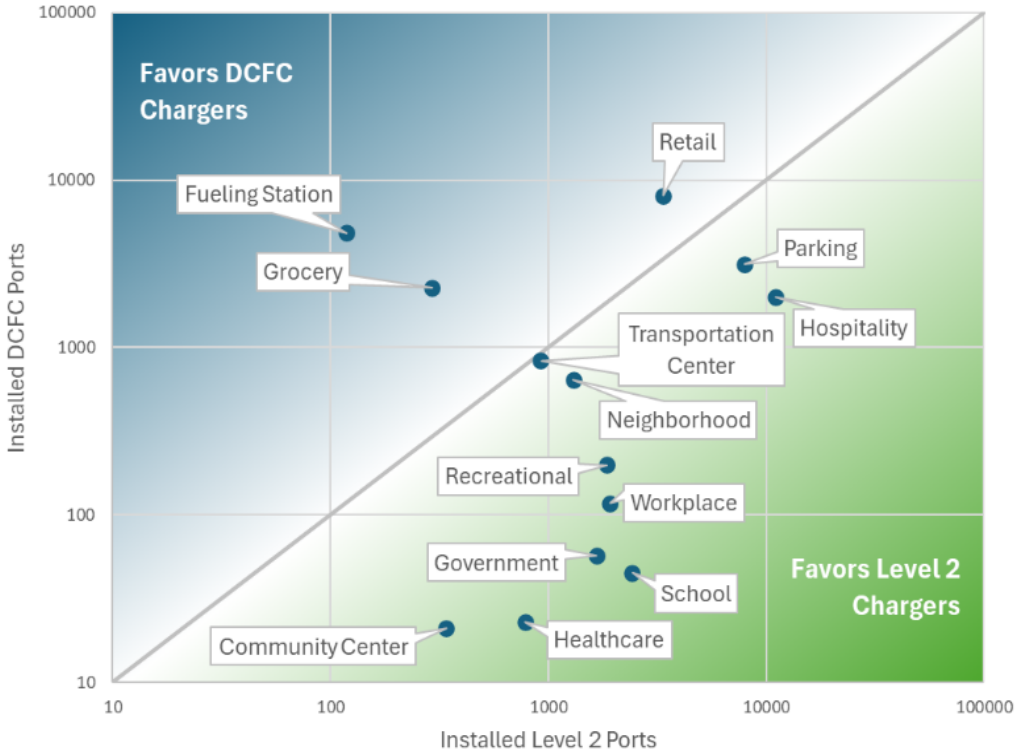


Figure 8. Distribution of EV charging ports by site type

What are the Types of Connectors for EV Charging?

EV charging connector types have evolved over the past decade, and there is currently no national standard for the connectors used for charging EVs. However, all EVs in the US can use the standard Society of Automotive Engineers (SAE) J1772 connector shown in Figure 9. This type of connector is used only for Level 1 and Level 2 charging with AC power and is the most common connector for most EV chargers today. Tesla vehicles require an adapter to use this kind of connector.

For DCFC charging, there are two primary charging port types. First is the Combined Charging System (CCS), which accounts for roughly one-third of DCFC EVSE ports in the U.S. The CCS connector uses the SAE J1772 connector and incorporates two high-speed DCFC pins. The majority of EVs (non-Tesla) have a connector that is compatible with this type of port. The second type is the J3400, or the Tesla connector, which is able to provide both L2 and DCFC charging. While the CCS connector was assumed to be the primary connector

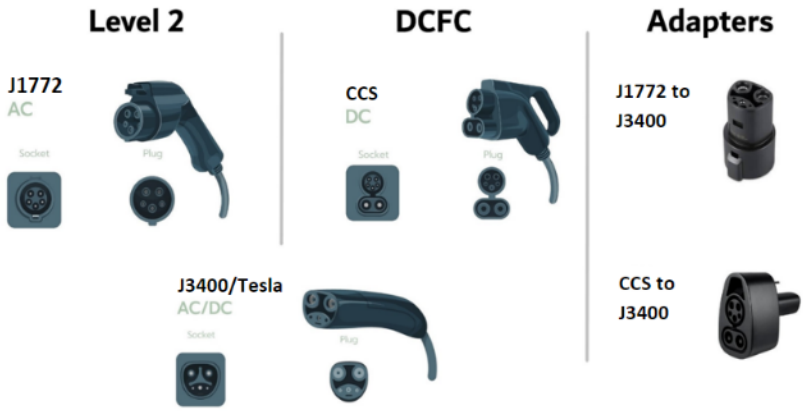


Figure 9. EVSE connector types

for DCFC charging in the future, the J3400 has emerged as the connector type that will be adopted in the U.S., with many auto manufacturers announcing that future models would be compatible with this type. Using adapters, many vehicles are able to use both charging port types today, and Tesla has recently begun to install CCS/J1772 ports.

Using adapters, many vehicles are able to charge with different charging port types.

Who Provides Public Electric Vehicle Charging Station Equipment?

There are numerous EVSE and Electric Vehicle Service Provider (EVSP) companies operating in the U.S. These companies will partner with site hosts to provide and install charging equipment, and will often provide a service network, as well as manage equipment operation and maintenance. Each company operates differently depending on the requirements of the specific site host, offering different services for installation and operation of EV chargers.

The most prevalent EVSP, ChargePoint, is primarily a technology provider who only supplies charging equipment to site hosts and provides subscription software services. Individual site hosts are responsible for installation and maintenance of the equipment and, as well as for setting fees for electricity usage. Other EVSPs, such as Electrify America and Blink, provide a turnkey solution to site hosts, managing the operation and maintenance of site infrastructure and setting retail electricity prices. Table 2 presents a summary of the largest EVSPs operating in the U.S.

Table 2. Largest EVSPs in the U.S.

EVSP Name	Level 2 Ports	DCFC Ports	Total Ports
ChargePoint	60,720	3,034	63,754
Tesla	13,308	26,229	39,537
Blink	17,714	438	18,152
Electrify America	219	4,267	4,486
EV Connect	3,148	1,227	4,375
EVGo	286	3,186	3,472
Volta	3,246	149	3,395
Shell Recharge	2,523	565	3,088
EV Gateway	2,506	264	2,770
AMPUP	2689	13	2702

Many EVSPs have proprietary charging networks, which means different payment mechanisms may or may not be available. Some EVSPs require specific apps or a membership to access their charging stations. However, there is a strong push at the federal level to increase interoperability of charging stations so all chargers and payment systems operate similarly and will be accessible to any driver.

What is the EV Vision for the City?

Expanding EV adoption and charging infrastructure are components of the City's overall commitment to being a great place to live, work, and play well into the future. The City desires to fully capture the benefits of EVs and leverage the positive change that electrification can bring while recognizing the limitations EVs present today. We envision the EV future of Norfolk to be one that expands transportation options, makes accessibility more affordable and equitable, reduces emissions, improves human health, and provides new economic opportunities for all residents in the community.

Combating Climate Change. As a coastal community, Norfolk is especially vulnerable to flooding, extreme heat, and severe weather, all of which are worsened by a warming climate. The transportation sector is the largest contributor of greenhouse gases (GHG) in the country, making up about 28% of total emissions. While EVs are just one step, electrification is a priority action for mitigating the impacts of climate change by improving energy efficiency and making a decarbonized transportation sector possible. As more renewable energy is deployed, the environmental benefit of EVs will also increase.

> As more renewable energy is deployed, the environmental benefit of EVs will increase.

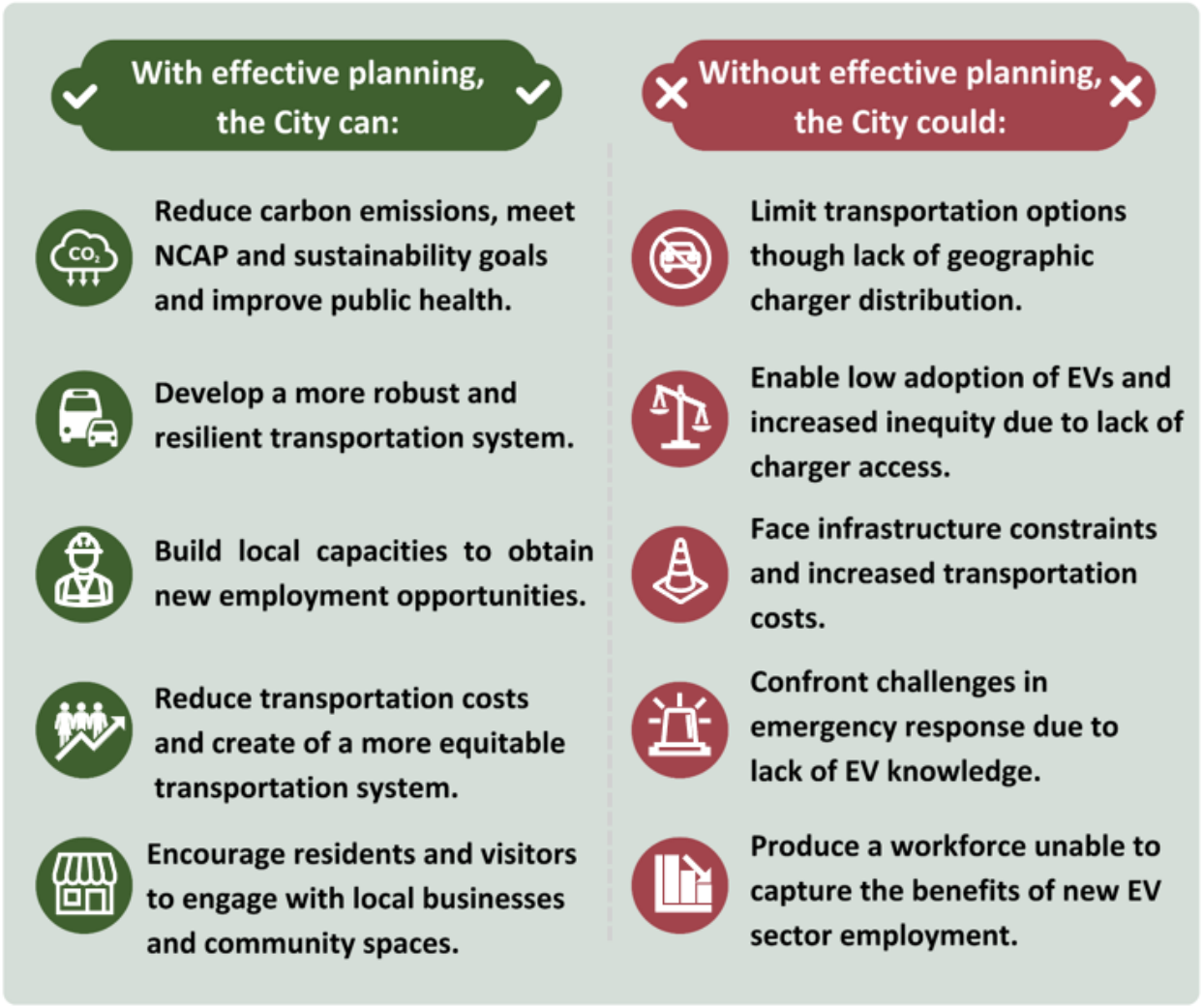
Healthy Neighborhoods. EVs produce no tailpipe emissions. The negative health effects posed by air pollutant emissions from fossil fuel vehicles, including carbon monoxide, nitrogen oxide, and particulate matter, present an even greater risk for communities in densely populated areas and close to major roadways. The switch to EVs means improved local air quality and contributes to healthy and safe neighborhoods.

Equitable Transition. Not everyone is currently positioned to benefit equally from EVs. Access to charging infrastructure has been limited and has often been deployed in an inequitable manner. The City is committed to expanding charging throughout Norfolk to ensure that all communities are able to access all transportation options and gain the economic and health benefits presented by EVs.

Economic Opportunity. As EVs are adopted in greater numbers, Norfolk will need to rapidly expand charging stations and electrical infrastructure. These new technologies will require ongoing operations and maintenance, which can be provided locally. The City is dedicated to capturing the potential economic benefits of this emerging sector and providing community members with the ability to develop new skills and access new opportunities for employment.

What are the Opportunities and Challenges?

EVs are rapidly transforming how transportation systems in Norfolk may operate in the future. Greater adoption of electric vehicles can result in reduced transportation costs and lower emissions, while improving public health, equity, and safety. Inclusive and thoughtful planning will ensure all Norfolk residents experience the benefits of EVs, infrastructure is resilient to a changing climate, and new job opportunities emerge locally.



By understanding both the benefits and risks associated with an electrified transportation sector, the City can work to equitably capture these benefits while mitigating potential risks. This new sector is evolving rapidly, but the City can progress in tandem to help capitalize on those opportunities, which will make Norfolk a more livable city for current and future residents.

What Role Can the City Play?

The adoption of EVs will be led by consumers and the private sector will be predominantly responsible for how charging infrastructure is deployed to serve drivers. The City's role is that of a facilitator, reducing barriers to adoption, enabling local development, identifying and working to fill gaps in charging station distribution to increase equity, and providing education and services to residents and businesses. The City's roles in facilitating the transition to EVs include:

What is the current and future state of EVs in Norfolk?

EV Adoption in Norfolk

As of December 2023, the City of Norfolk had a total of 899 registered EVs, including 599 BEVs and 300 PHEVs, with 878 of those registered since 2019 (Figure 11). Registrations of EVs in the City have grown significantly over the previous five years. Given the current growth rates, federal and state policies, policy and market trends, it is expected that by 2025 this number will grow to 4,000 EVs or more. Tesla currently accounts for a third of the registered EVs in the City (Figure 10). As more vehicles become

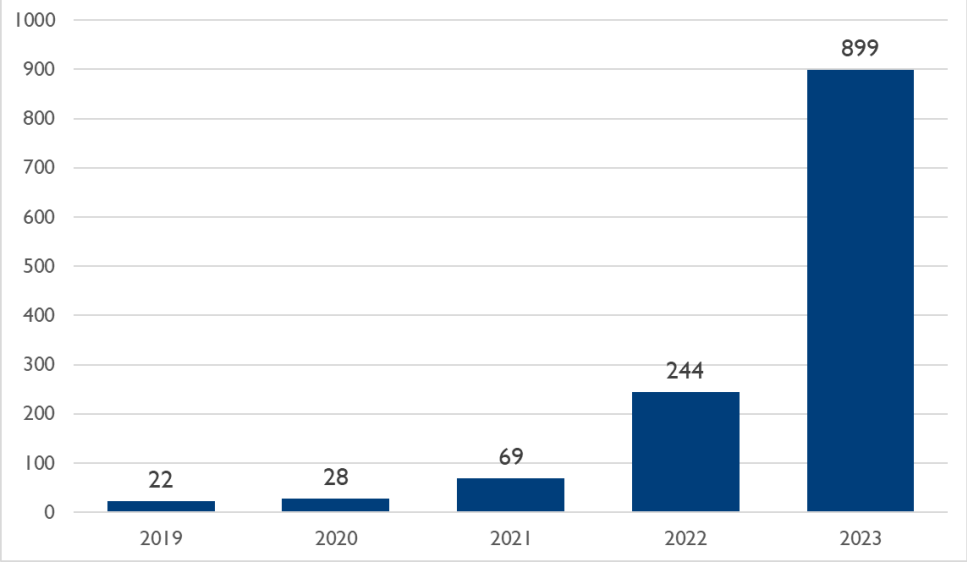


Figure 11. Cumulative EVs registrations in Norfolk by year, 2019-2023

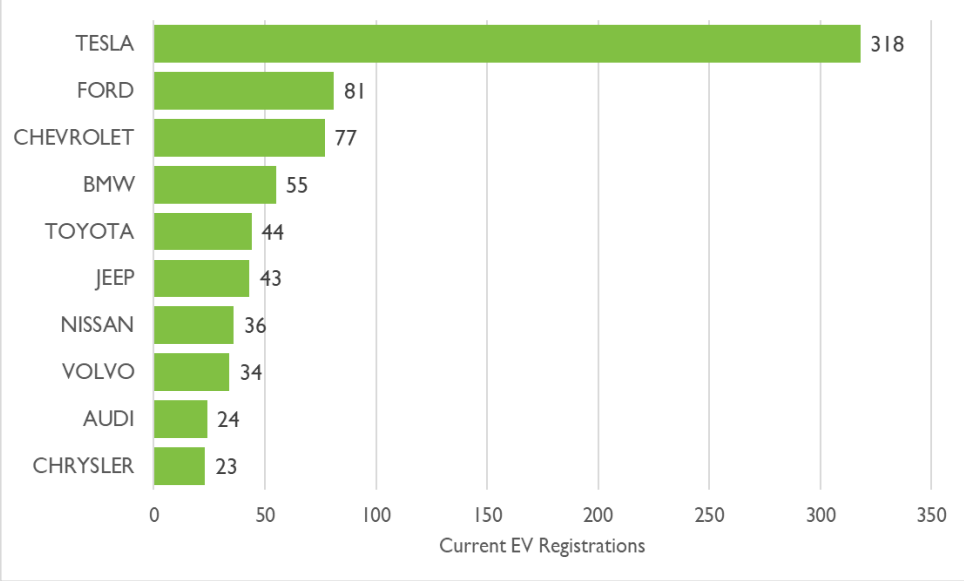


Figure 10. EV Registrations in Norfolk by make, 2023

Areas with higher rates of adoption to date may be an indicator of where adoption of EVs will be highest in the near term.

available in the coming years, however, this market share is expected to drop significantly. As of March 2024, 92 different EV models from 33 manufacturers were registered in Norfolk. Figure 12 displays the distribution by zip code of EVs currently registered in Norfolk. Darker coloration represents more total registrations on a per vehicle basis, while the data labels show the total number of EVs registered in that zip code as of December 31, 2023. As shown, adoption is higher within some specific zip codes, though distribution of vehicles on a per capita basis is similar across the City. Naval Station Norfolk and the Ghent area have a significant number of EV registrations. Areas with higher rates of adoption to date may be an indicator of where adoption of EVs will be highest in the near term. It is also important to note that while the Naval Station Norfolk has a high number of EV registrations, the true number is likely far higher than shown due to the number of military personnel who have registered their vehicles outside of Norfolk.

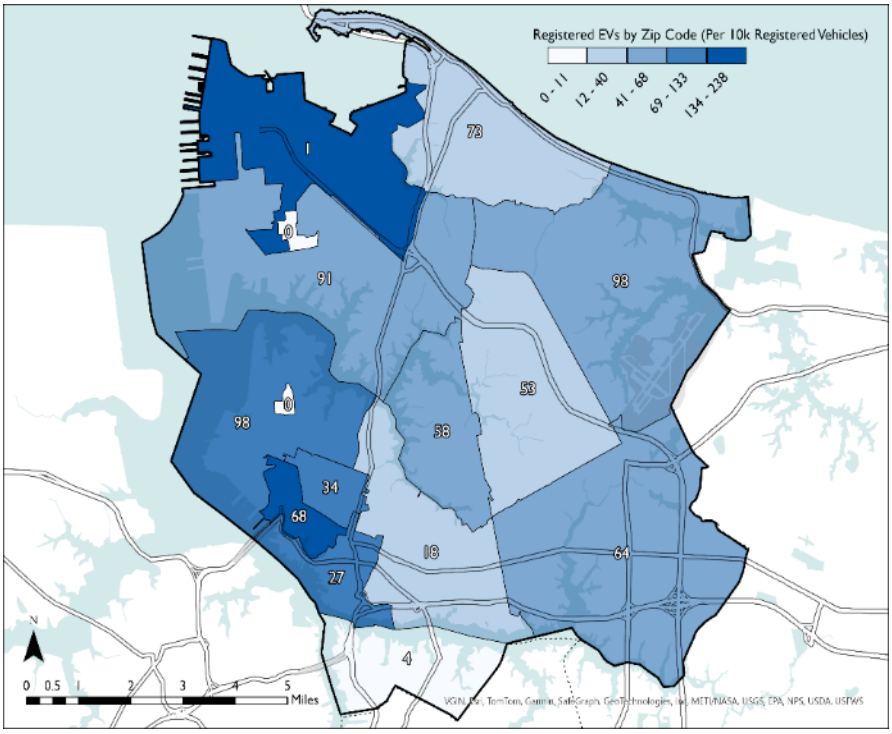


Figure 12. Total EV registrations and registrations per 10,000 vehicles

Greenhouse Gas Emissions from EVs

EVs serve as a critical solution towards decarbonization of the transportation sector, as illustrated in the Commonwealth's 2023 Carbon Reduction Strategy developed by the Virginia Department of Transportation.[ix] EVs reduce GHG emissions compared to internal combustion engine vehicles when charged using today's generation mix (Figure 13). For example, EVs charged in Dominion Energy Virginia's service territory have an equivalent GHG per mile of a gasoline car that obtains an 85 miles-per-gallon (mpg) fuel economy.[x]

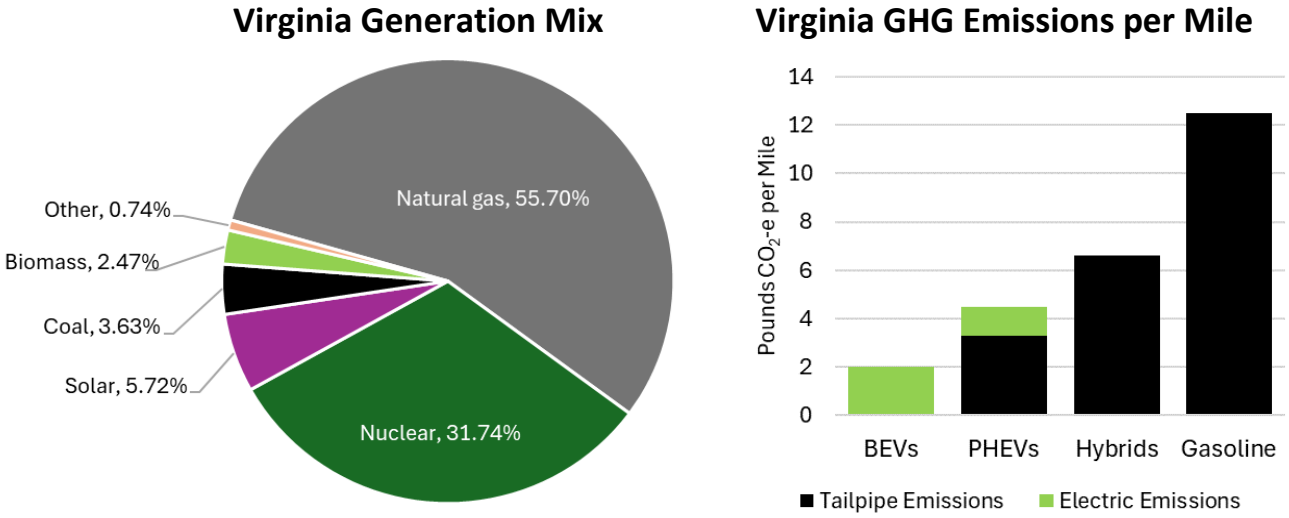


Figure 13. Virginia electricity generation (left) and emissions per mile of average sedan (right)

Manufacturing of an EV involves extraction and processing of raw materials, manufacturing of component parts, and the vehicle assembly processes. Most studies show that EV manufacturing is more GHG emissions-intensive than an ICE manufacturing, due primarily to battery manufacturing.[xi] However, studies also show that the lifecycle emissions of EVs—including vehicle manufacturing, operations, and end of life—are still substantially lower than ICE vehicles and will continue to decline as the electricity grid uses a lower fraction of fossil energy.[xii] For example, Dominion Energy, the majority electric utility in Virginia, maintains a goal of net zero emissions by 2050. As Dominion Energy and other utilities continue to shift their generation towards renewables in the coming years, the environmental benefits of EVs in comparison to ICE vehicles are expected to increase.

Current EV Charging in Norfolk

As of 2024, there are a total of 118 plugs at 37 public charging stations in Norfolk. Eighty percent of public charging sites are open to anyone, with a majority located at parking garages, gas stations, and shopping centers. Level 2 chargers account for about 65% of the 118 plugs, while DCFC account for the other 35%. As shown in Figure 14, Norfolk has an estimated 76 Level 2 charging ports and 42 DCFC

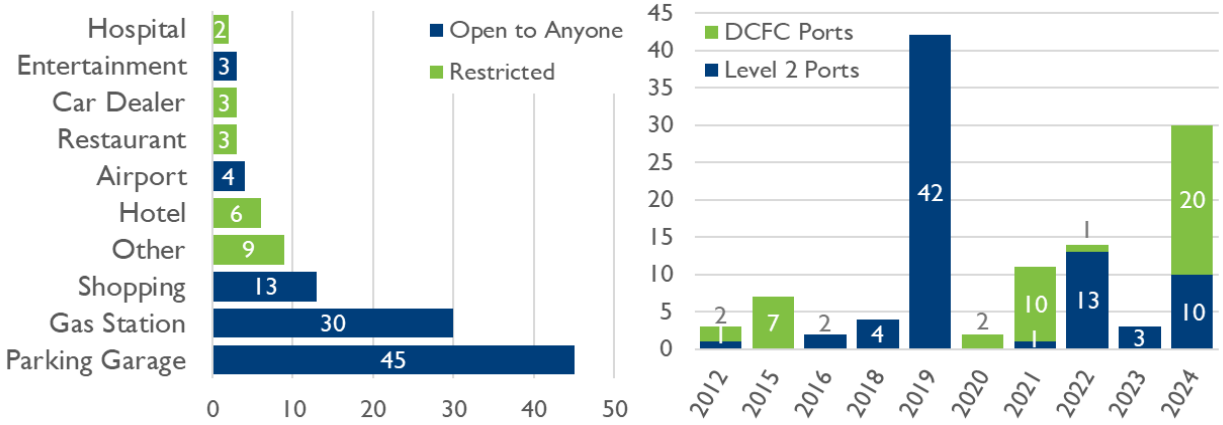


Figure 14. Location and installation year of public charging ports

charging ports.[xiii] The most common location for ports is at parking garages, followed by gas stations. The majority of charging ports installed in the City were constructed in 2019 and 2024 (Figure 14). The subsequent section contains a detailed assessment of future EV charging needs in Norfolk.

Figure 15 shows the locations of existing charging stations in the City, with blue dots representing Level 2 chargers and orange dots representing DCFC charging stations. The census tracts shaded in green are disadvantaged communities which have been identified as overburdened and underserved by the U.S. Department of Transportation (DOT) Climate and Economic Justice Screening Tool. As shown in Figure 15**.** the majority of charging infrastructure deployed in Norfolk to date has been outside these areas.

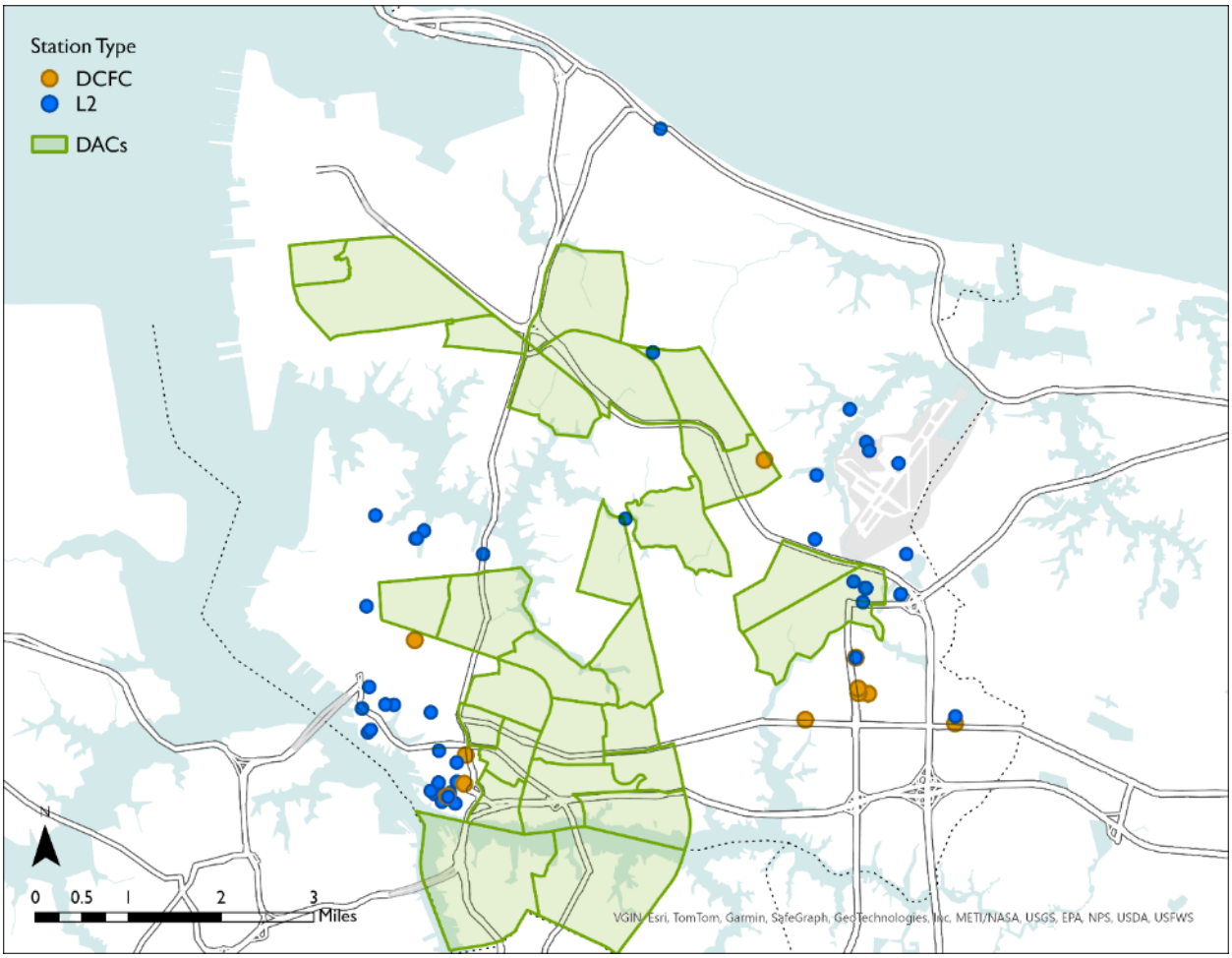


Figure 15. Level 2 (blue) and DCFC (orange) charging stations in Norfolk

Note: Includes publicly available and restricted-access plugs

Role of Charger Utilization

Table 3 shows utilization statistics for chargers, based on national averages from over 30,000 networked chargers tracked through the DOE EV Watts initiative.[1] This dataset is the largest publicly available dataset in the county on charger utilization. The table provides several insights relevant to Norfolk's charging deployment:

- **Session per Day:** Both Level 2 and DCFC chargers are used less than once per day, on average. Charging utilization directly corresponds to the financial viability of a charging station. As electric vehicle populations rise, charging utilization typically increases.
- **Energy use per Plug per Session:** Fleet chargers have the highest energy use per plug per session. These chargers include transit buses, which have mostly high-powered charging.
- **Charging Time:** The average charging time for vehicles ranges from 1.1 to 4.7 hours, with the longest charge time being at mobility hubs.
- **Plugged-In Time:** The hours a vehicle is connected to a charger is 2 to 5 times the charging time, suggesting vehicles are commonly plugged in but not charging.

Table 3. National statistics on charging station utilization

Charger Location	National Statistics					
	Sample Size (#Ports)	Sessions/ Port/Day	Energy (kWh)/ Ports / Session	Charging Time (Hr)/ Ports / Session	Plugged-In Time (Hr)/ Ports /Session	Charging Time / Plugged-In Time
Single Family Residential	9,052	0.25	12.6	2.4	11.7	21%
Business Office	5,780	0.21	15.7	2.1	4.3	50%
Multi-Unit Dwelling	5,143	0.19	19.0	3.7	9.8	37%
Shopping	2,966	0.28	15.3	1.1	2.0	55%
Hospital	1,999	0.28	12.4	2.5	4.7	53%
Parking Lot	1,783	0.27	15.5	2.5	8.1	31%
Fleet	1,522	0.23	40.1	2.9	15.2	19%
Leisure Destination	968	0.24	12.2	2.0	3.3	59%
Hotel	630	0.17	16.4	2.4	4.1	58%
L2 Port	29,246	0.22	13.2	2.7	9.1	30%
DCFC Port	3,269	0.34	25.9	0.9	1.7	56%

Influence of Housing Stock

The ability to charge a vehicle overnight at home increases convenience and lowers the cost of ownership for most EVs relative to gasoline vehicles. To charge at home, a driver needs access to an onsite garage, driveway, or on-street charger. A survey completed by the International Council on Clean Transportation (ICCT) found that the majority (about 85%) of early electric vehicle drivers live in detached single-family homes.[xiv] Additionally, about 80% of current electric vehicle drivers own their residence.[xv]

How Conducive is Norfolk's Housing Stock to Electric Vehicle Ownership?

Table 4 summarizes the fraction of residents by building type in Norfolk and the United States.[xvi] Residents of Norfolk are slightly more likely than the national average to live in MUDs and attached homes. Additionally, the prevalence of 1-unit, detached homes that are owner-occupied—i.e., the homes are most conducive to overnight charging— is only 38.9% Norfolk, compared to 48.4% nationally.

Table 4. Housing distribution nationally and in Norfolk

Type of Housing	U.S.	Norfolk
Total Housing Units	143,772,895	93,797
1-unit, detached (Owner-Occupied)	48.4%	38.9%
1-unit, detached (Renter-Occupied)	7.8%	10.9%
1-unit, attached	6.2%	7.9%
MUD, 2 units	3.3%	5.7%
MUD, 3 or 4 units	4.3%	7.7%
MUD, 5 to 9 units	4.5%	10.0%
MUD, 10 or more units	14.7%	18.2%
Mobile Home and Boat	5.7%	0.8%

As EVs become mainstream, greater fractions of EV owners will live in MUDs. This suggests a need to build out charging solutions tailored to this sizeable segment of the population. A variety of tools are now available to help renters, building managers, home-owner associations, and local government staff find the right solutions for MUD dwellers.[xvii]

Scenarios of Future Electric Vehicle Ownership

This report uses three scenarios, outlined in Table 5, to describe potential trajectories of future electric vehicle growth in Norfolk. The objective in developing these scenarios is to bound potential electric vehicle adoption within Norfolk to enable subsequent analysis and planning of charging infrastructure needs, costs, and deployment schedule.

Figure 16 shows the growth of electric light-duty vehicle adoption in Norfolk in the High Growth, Low Growth, and Baseline Scenarios. The figures use a stock turnover model to capture vehicle replacements and assume a 0.5% annual growth in total new vehicle sales. This figure follows the trajectories of recent projections for the Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan

Statistical Area created by the U.S. Department of Energy.[xviii] More assumptions are available in Appendix A. Vehicle and Charger Projections.

Even in the High Growth Scenario, in which 100% of new light-duty sales are electric by 2035, the stock of electric vehicles stays below 50% through 2040, since vehicle stock lags new vehicle sales. In the Low Growth Scenario, electric vehicle stock reaches 11% of the vehicle stock by 2035 and 20% by 2040.

Table 5. Description of electric vehicle trajectory scenarios

Scenario	Description	Why Scenario is Feasible
Baseline	Virginia EV adoption grows at a moderate level, slightly behind the pace prescribed in the Advanced Clean Cars II (ACC II) regulation.	ACC II is a strong regulatory driver of new EV sales, but its continuation under Clean Cars Virginia remains in question due to a ruling from the Virginia State Office of the Attorney General.[xix]
High Growth Scenario	Virginia continues to implement ACC II regulation, putting Norfolk on a path to no new internal combustion engine vehicle sales by 2035.	HB 1965 was signed into law March 2021, establishing Clean Cars Virginia. While the continuation of Clean Cars Virginia remains in question, the scenario follows the Department of Energy's High Growth trajectory for the Virginia Beach-Norfolk-Newport News, VA-NC Metropolitan Statistical Area (MSA).
Low Growth Scenario	Virginia repeals the ACC II regulation and EV adoption follows national forecasts, reaching 35% of new vehicle sales by 2035 and 46% by 2040.	Based on recent investments by the auto industry, even in the absence of ACC II, battery costs will continue to decline, while electric vehicle availability will increase. This scenario follows the Department of Energy's Low Growth trajectory for the Virginia Beach-Norfolk-Newport News, VA-NC MSA.

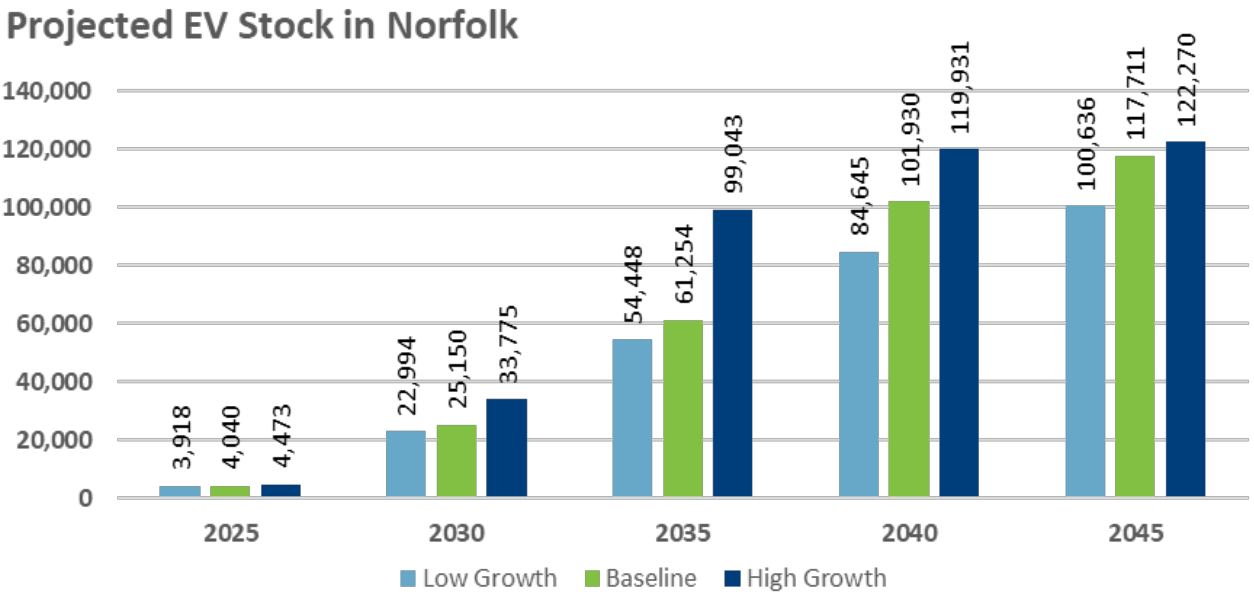


Figure 16. Projections for total EVs registered in Norfolk through 2045 in three scenarios

Future Charging Needs

This analysis estimates the number of public and workplace charging ports needed in Norfolk through 2045 to support the vehicle populations in the baseline scenario shown above. Inputs and assumptions in the EVI-Pro Lite tool are in Appendix A. Vehicle and Charger Projections. Figure 17 shows the estimated charging needs in Norfolk for the Baseline Growth Scenarios from today until 2045. As shown, approximately 1,300 EV charging ports will be needed in Norfolk by 2030, rising to 8,500 ports by 2045. Workplace Level 2 chargers account for over 50% of all public charging ports, followed by public Level 2, then DCFC.

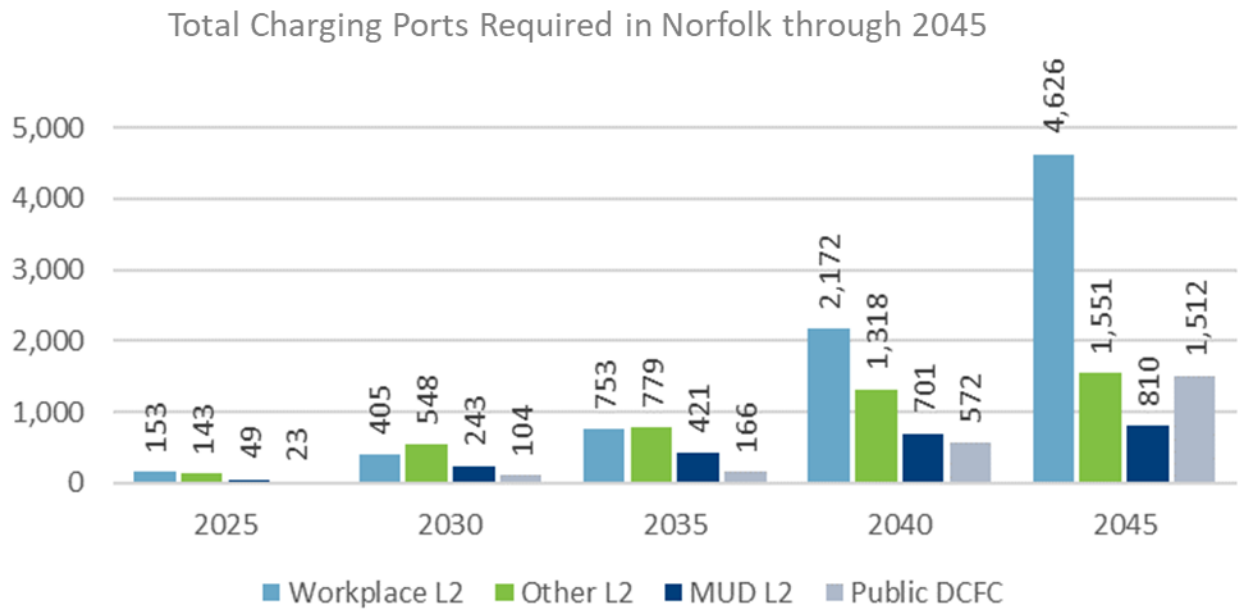


Figure 17. Total charging needs in Norfolk through 2045 (baseline scenario)

What is the Community's Perspective on EVs?

A public engagement survey was administered to community members in Norfolk between May 13 and July 1, 2024. The survey was developed to better understand Norfolk community members' and local businesses' knowledge and interest in EVs through a mix of multiple choice and open text questions.

The survey was distributed through multiple channels, including traditional media, social media, and online communications. Hard copies of the survey were also available at the City's public libraries as well as through electronic advertising in municipal buildings.[xx]

Summary of Survey Results

The survey results, which are summarized below, highlight a significant opportunity and need for EV charging infrastructure in the City of Norfolk. Survey responses included in this assessment did not include any personally identifiable information.

Feasibility of EV Charging at Home

City residents who own their residence, especially single-family homes with driveways or a garage, can most easily install a charger for their personal use. The majority of survey respondents (80%) characterized their residence as a single-family home, and 77% of respondents primarily park in a driveway or garage (as shown in Figure 18). Eighty-six percent reported owning their residence of any type.

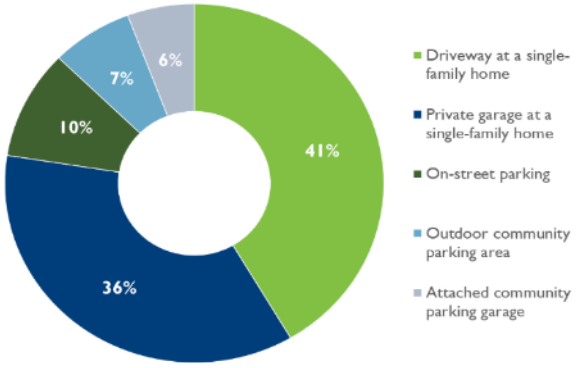


Figure 18. Which of the following describes the type of parking available at your residence?

Driving Habits

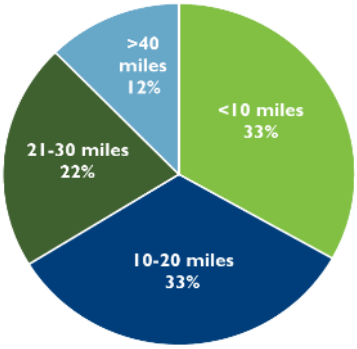


Figure 19. How many miles do you drive on a typical weekday?

Half of all respondents reported driving to work every day, and 71.1% reported that they drive to work at least a few times a month. Figure 19 illustrates the amount of driving (e.g., to work, running errands, school drop-offs, etc.) survey respondents do in a typical weekday. Two-thirds of respondents drive fewer than 20 miles daily during the week, and almost all drive fewer than 40 miles. The average range of available 2024 battery electric sedans and SUVS models is 280 miles.[xxi] Compared to reported normal driving habits, this suggests that many Norfolk residents would be able to transition to driving an EV with minimal changes to lifestyles and habits.

Interest in Owning an EV

Almost half of respondents said they either own an EV or would consider one within the next five years, as shown in Figure 20. However, Figure 20 suggests that vehicle range (380 responses), lack of access to charging stations (359 responses), and cost (335 responses) are obstacles to obtaining an EV. As this Plan is implemented across the City, there will be more equitable access to charging infrastructure. Increased access could help alleviate concerns about where residents can charge their car, especially if they are unable to install chargers at their residence.

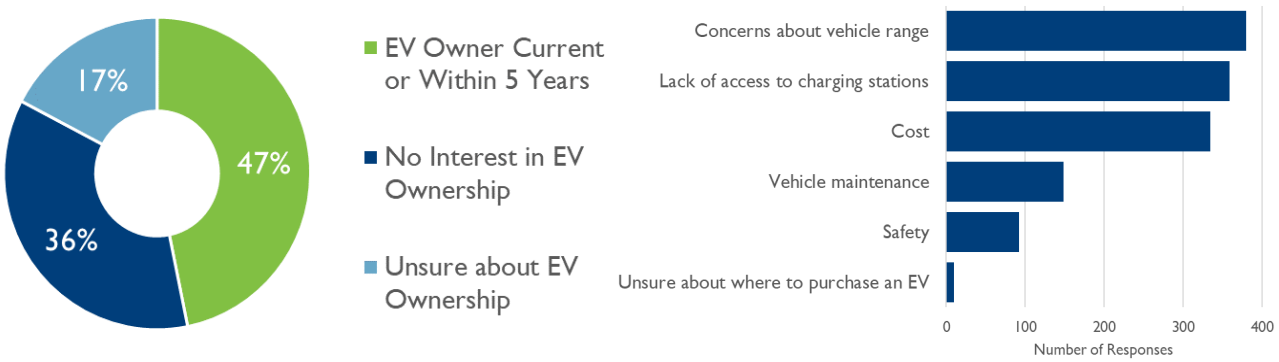


Figure 20. EV adoption attitudes of Norfolk (Left), Primary obstacles preventing adoption (Right)

Preferred Charging Locations

As EV adoption increases, many residents will be able to use private chargers, but a significant portion of Norfolk residents will rely on public and community charging sites. As the survey responses suggest, the top places residents would like to have access to chargers are grocery stores, box stores, and on-street parking spots. These locations offer reliable charging options for those who do not have a charger at home and can help decrease range anxiety.

Where Could EV Charging be Deployed in Norfolk?

To better understand areas of Norfolk with the highest need for publicly accessible chargers, this section uses a spatial analysis, which combines several factors into two single, weighted scores. When paired with the public engagement results expressed in earlier sections, this analysis can help identify priority charging locations.

Methodology

This study identified the need for two single, weighted scores to determine the need for public electric vehicle charging: a score to locate optimal placement of Level 2 chargers and a score to locate optimal placement of DCFC chargers. These scores identify census block groups in Norfolk of high priority for charging infrastructure and can be aligned with other criteria, such as economic development regions, to select block groups for early installation of electric vehicle charging stations. As indicated in the call-out box to the right, similar methodologies were used to prioritize location of electric vehicle charging infrastructure in other jurisdictions.

CITIES THAT USED A SIMILAR EV SCORING PROCESS

- Virginia Beach, VA
- Alexandria, VA
- Contra Costa County, CA
- Somerville, MA
- Berkeley, CA

In addition to the Level 2 and DCFC block group scoring, this study identified municipal properties located within priority block groups. These sites are presented subsequent to the Level 2 and DCFC Index scoring sections below and identify sites that may be prioritized for construction of public Level 2 charging infrastructure. The sites are shown by location type.

Level 2 Charging Index

This index identifies census block groups in Norfolk where charging infrastructure placement can aid individuals who need to park their cars for longer periods of time. The index is comprised of: (1) number of MUDs, (2) number of renters, (3) length of commutes made by cars, (4) population with income under $75,000, (5) existing Level 2 EV charger access, (6) number of long dwell time locations, and (7) employment density. Several of the factors integrated into this assessment correlate with criteria which prioritize low- to moderate-income (LMI) populations, including number of MUDs, number of renters, and household income.

As annotated in Table 6, block group-level data on each factor were collected from U.S. Census data, data provided by Norfolk, vehicle registrations[1] provided by the Virginia Department of Motor Vehicles, and the U.S. Department of Energy's (DOE) Alternative Fuel Data Center.

[1] No personal information was obtained from the Department of Motor Vehicles.

Table 6. Weights and rationales to develop four Level 2 composite score maps

Indicator	Rationale for Factor	Factor Weighting
Multi-Unit Dwellings per 1,000 Residents [a]	Residents of multi-unit dwellings (MUD) have less access to at-home charging. These "garage orphans" are a relatively large segment of potential electric vehicle adopters who are locked out of the market.	14.3%
Percentage of Households that are Renters [a]	As with residents of MUDs, renters are less likely to have access to at-home charging than owners.	14.3%
Total Commuter Travel Time (Minutes) [a]	Areas with longer commute times have a higher need for charging than areas with a lower density of car commuters.	14.3%
Percent of Households with Income below 75k[a]	Lower-income residents will have lower access to at-home charging and should be prioritized for infrastructure deployment to ensure equal access.	14.3%
Existing EV Charger Access [b] **(Level 2)**	Areas with low publicly accessible charging access should be higher scoring than areas with high charging access.	14.3%
Density of Long-Dwell Time Locations [c]	Areas where residents are likely to park their cars for more than two hours should be prioritized for Level 2 charging access.	14.3%
Employment Density [d]	Employment density is an indicator of where workplace charging should be prioritized for Level 2 charging.	14.3%

[a] U.S. Census Bureau 2024
[b] U.S. DOE Station Locator and Plugshare.com
[c] Data provided by
[d] U.S. EPA Smart Location Database

Next, these data were weighted using a weighted mean methodology and compiled into scoring maps. The composite scoring system results in a unique score for each block group that represents the charging need, as shown in the score map in Figure 21.

Index Calculation: To calculate the two indices, L2 and DCFC, for each block group, the mean of the normalized indicators is calculated. Normalization is applied to each indicator to convert the value to a scale of 0 – 10, so that each indicator can be equally weighted, otherwise an indicator like Total Commuter time, with a value of 114,285 minutes, could disproportionately influence the index score for a block group when compared to 30% of households that are renters. Let X_{ij} represent the *i*-th indicator in the *j*-th block group, X_{imin} *the minimum value for the* i-th indicator, X_{imax} represent the maximum value for the i-th indicator, and N_{ij} is the normalized value for the *i*-th indicator in the *j*-th block group:

$$N_{ij} = \frac{X_{ij} - X_{imin}}{X_{imax} - X_{imin}} \cdot 10$$

In the above example, for the hypothetical block group 114,285 minutes might be converted to a normalized value of 6.2, while the indicator value 30% of households that are renters might have the value 8.4.

Next the index is calculated by block group, taking the mean of each normalized block group, where *k* is the total numbers of indicators, each composite index is calculated.

$$Index_j = \frac{1}{k}\sum_{i=1}^{k} N_{ij}$$

The resulting index value for each block group shows the combined influence of the indicators at a consistent scale.

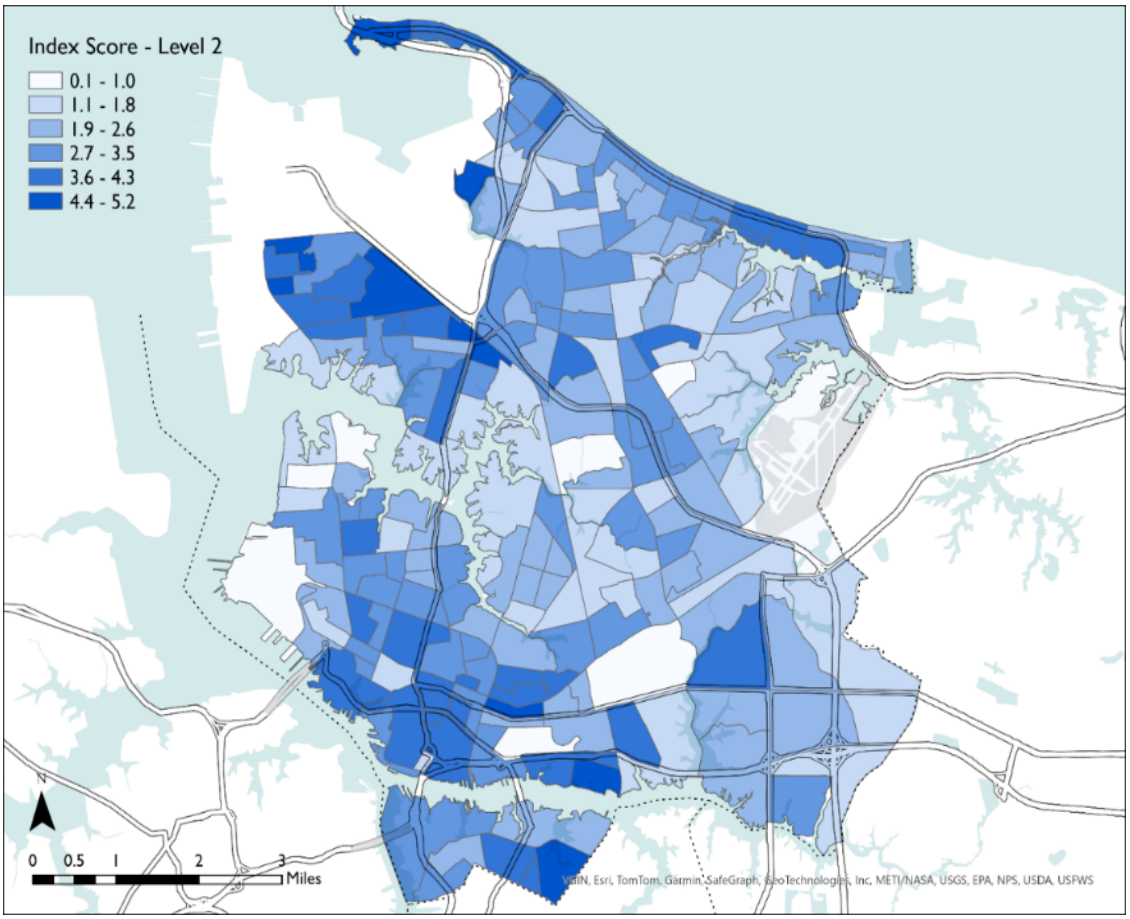


Figure 21. Composite Level 2 charging prioritization for Norfolk

Notes: This map depicts seven composite scores. All factors were normalized to 0 and 1 and multiplied by the weights in Table 15.

Level 2 Results

Figure 21 shows the composite score Level 2 charging map, developed for each block group after summing the seven factors. Those block groups that are darker blue in color scored more highly and are good candidates for identifying Norfolk's greatest Level 2 EV charging infrastructure needs.

Highest Scoring Block Groups: Level 2

Figure 22 shows the 20% of block groups that ranked most highly in this analysis. These block groups may be prioritized for Level 2 charging infrastructure on municipal properties in Norfolk. Note that while these block groups scored the most highly in this study, this does not preclude additional block groups from being assessed for deployment of charging infrastructure. Selection of specific locations should be based on public engagement to determine charging needs and understand community priorities. In addition, each site must undergo a detailed engineering assessment to understand any required electrical infrastructure upgrades, determine accessibility, and identify existing or planned transportation infrastructure in proximity to the site.

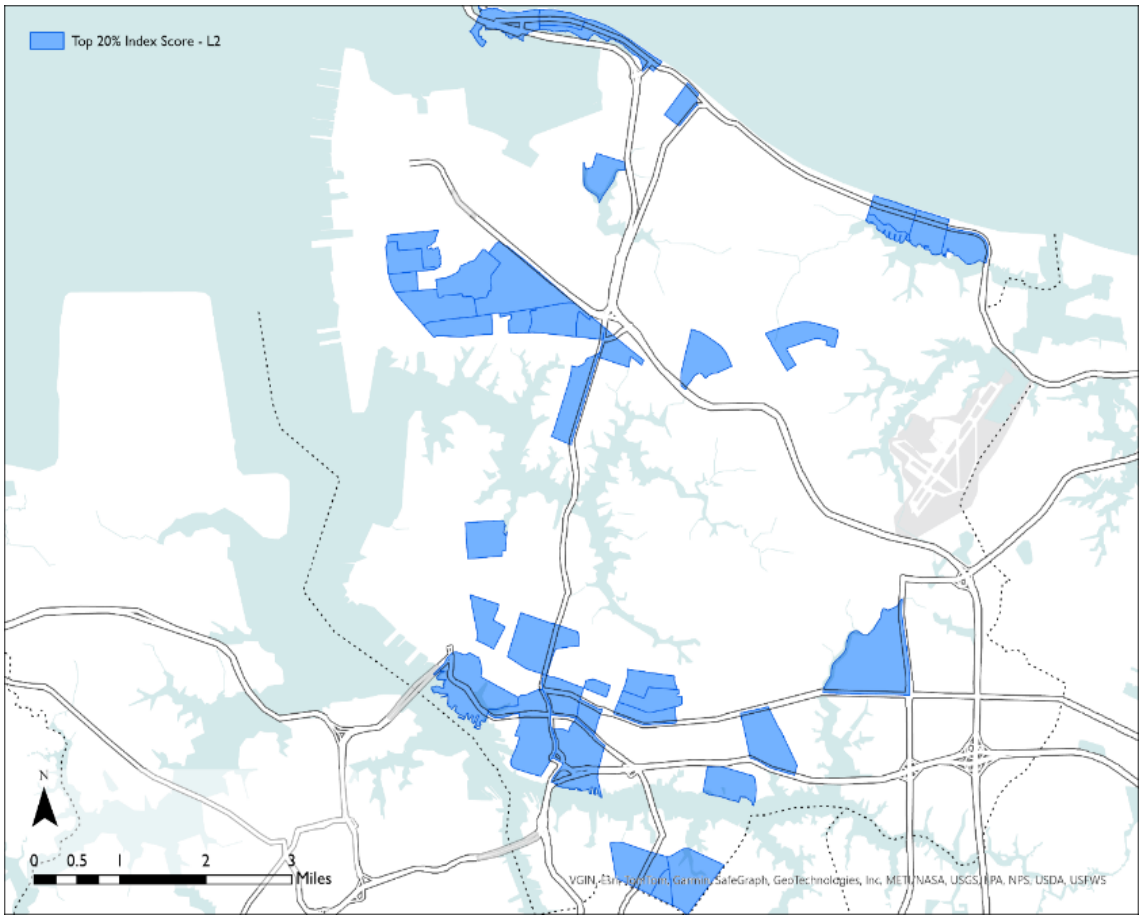


Figure 22. Highest scoring 20% of block groups in Norfolk for Level 2 charging

DCFC Charging Index

This index identifies census block groups in Norfolk where charging infrastructure placement can aid individuals who need to park their cars for shorter periods of time (e.g., to refuel along a commute, or long-distance drivers on a road trip). The index is comprised of: (1) number of multi-unit dwellings, (2) numbers of renters, (3) average daily traffic, (4) density of existing electric vehicle DCFC chargers, (5) density of short dwell time locations, and (6) population density.

As annotated in Table 7, block group-level data on each factor was collected from U.S. Census data and land use data provided by Norfolk staff.

Table 7. Weights and rationales to develop four DCFC composite score maps

Indicator	Rationale for Factor	Factor Weighting
Multi-Unit Dwellings per 1,000 Residents [a]	Residents of multifamily dwellings have less access to at-home charging. These "garage orphans" are a relatively large segment of potential electric vehicle adopters who are locked out of the market.	16.7%
Percentage of Households that are Renters [a]	As with garage orphans, renters are less likely to have access to at-home charging than owners.	16.7%
Average Daily Traffic [c]	DCFC stations should be deployed where traffic flows are highest to increase utilization rates.	16.7%
Existing DCFC Charger Access [b]	Areas with low publicly accessible charging access should be higher scoring than areas with high charging access.	16.7%
Density of Short-Dwell Time Locations	Areas where residents are likely to park their cars for short periods should be prioritized for DCFC charging access.	16.7%
Population Density [a]	Areas with dense populations will require higher access to DCFC charging due to lower access to residential charging and higher utilization of public charging.	16.7%

[a] U.S. Census Bureau 2022
[b] U.S. DOE Station Locator and Plugshare.com
[c] Virginia Department of Transportation

Next, this data was weighted using a weighted mean methodology and compiled into scoring maps. The composite scoring system results in a unique score for each block group that represents the charging need. It should be noted that it is not expected that any public DCFC stations will be operated by the City in the near term.

DCFC Results

Figure 23 shows the composite score DCFC charging map, developed for each block group after summing the six factors. Those block groups that are darker blue in color scored more highly and are good candidates for identifying Norfolk's greatest DCFC charging infrastructure needs.

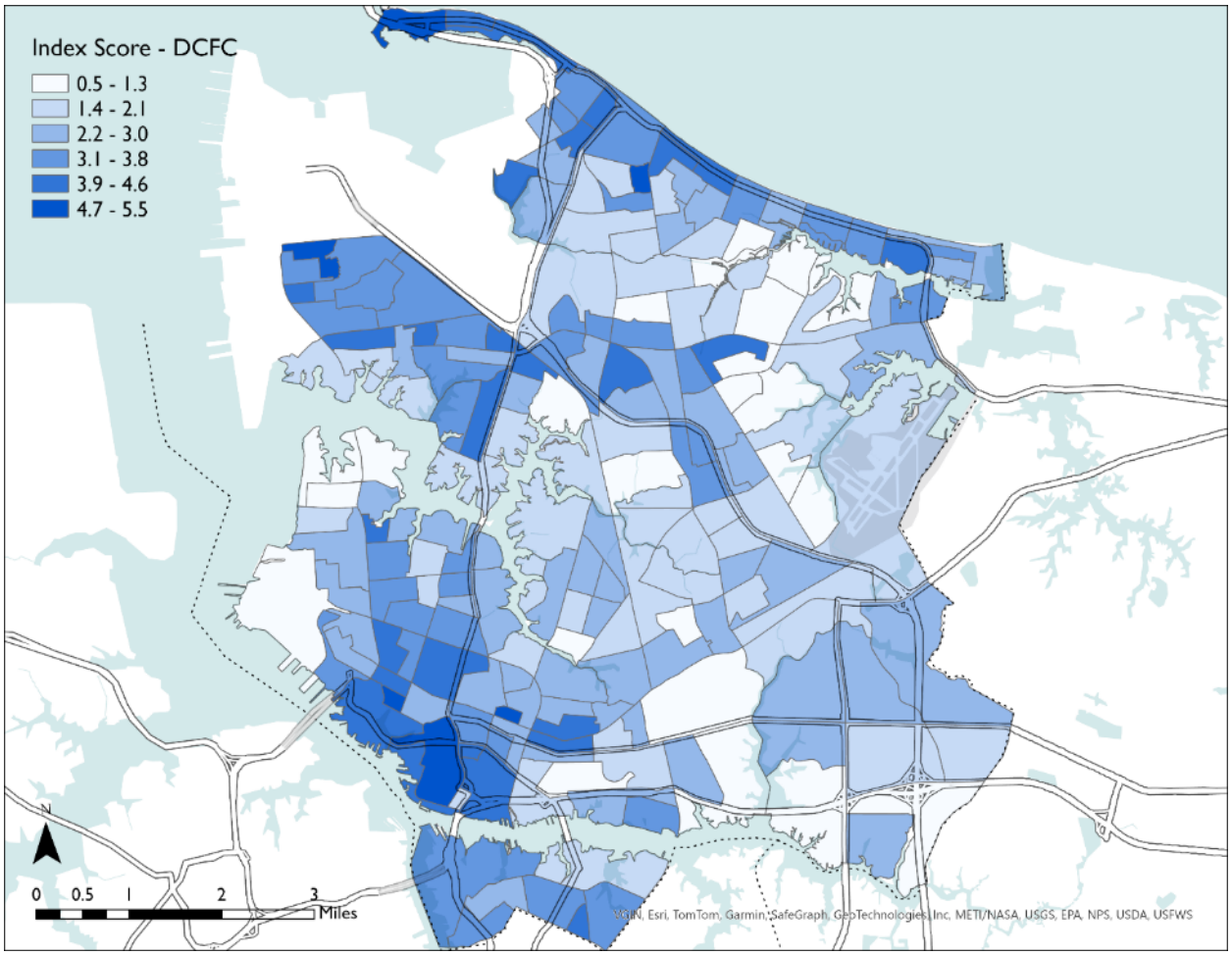


Figure 23. Composite Level 2 charging prioritization for Norfolk

Notes: This map depicts six composite scores. All factors were normalized to 0 and 1 and multiplied by the weights in Table 6.

Highest Scoring Block Groups: DCFC

Figure 24 shows the 20% of block groups that ranked most highly using an equal weighting analysis. These block groups may be prioritized for DCFC charging infrastructure in Norfolk. Note that while these block groups scored the most highly in this study, this does not preclude additional block groups from being assessed for deployment of charging infrastructure. Selection of specific locations for DCFC charging should be based on public engagement to determine charging needs and understand community priorities. In addition, each site must undergo a detailed engineering assessment to understand any required electrical infrastructure upgrades, assess existing capacity constraints, determine accessibility and identify existing or planned transportation infrastructure in proximity to the site.

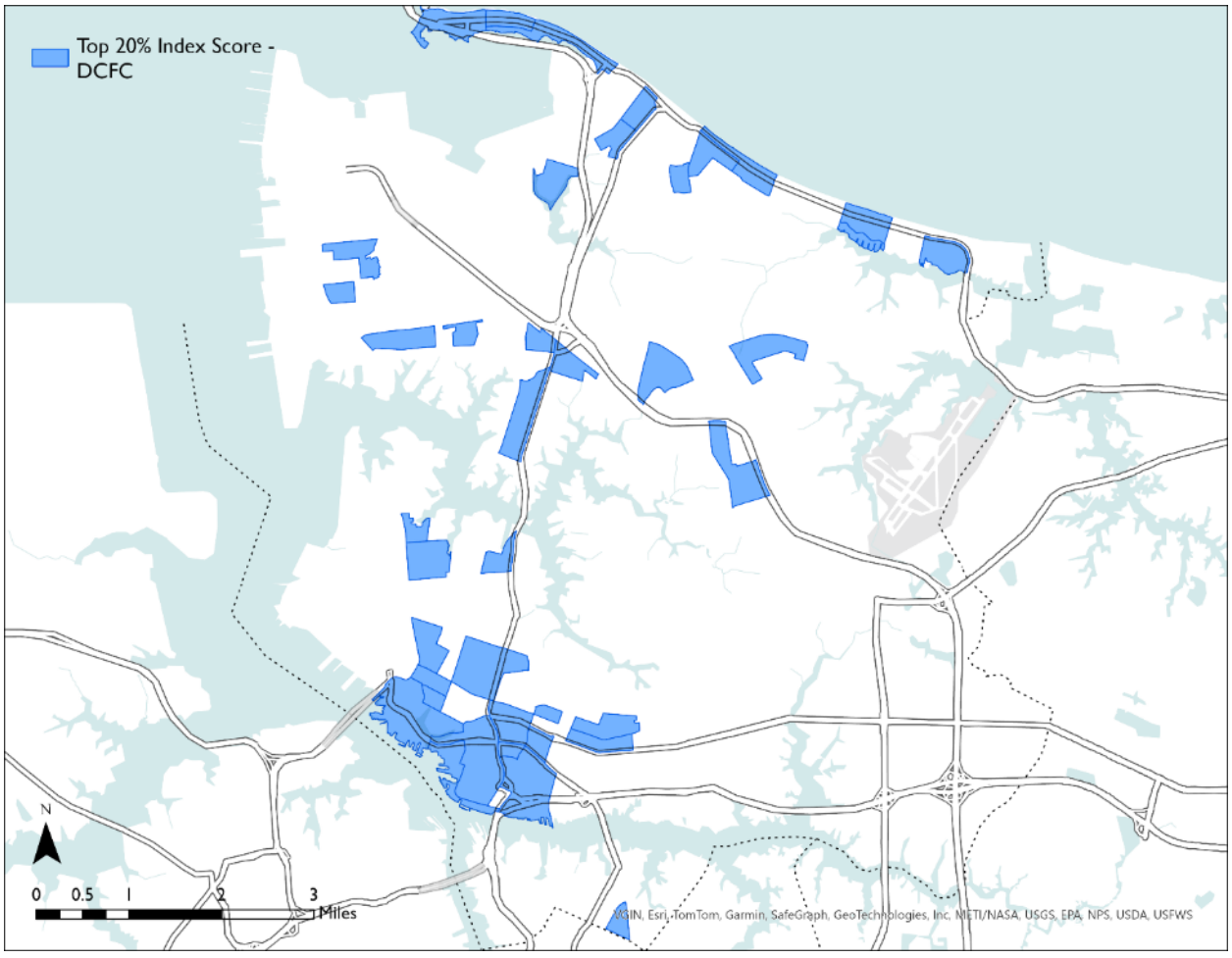


Figure 24. Highest scoring 20% of block groups in Norfolk for DCFC charging

Priority Municipal Properties for Level 2 Charging

This study identified over 300 specific locations (with addresses) in Norfolk that could potentially be considered for Level 2 public EV charging infrastructure at municipal sites. From this list, a subset of priority locations for potential siting of Level 2 charging infrastructure was developed, presented in Figure 25 below. This refined list can be found in Appendix D. Priority Site Inventories. These locations are prioritized based upon the spatial analysis conducted above, in addition to identification of high-visibility locations, sites with significant known utilization by the public, equity and environmental justice considerations, stakeholder input, survey results, and other criteria. The list includes community centers, municipal buildings, tourist attractions, landmarks, libraries, and parking garages. An aggregate map of the locations is shown in Figure 25 below.

Orange points indicate municipal sites of interest in Norfolk for Level 2 EV charging infrastructure. This does not imply that one area of the City will receive closer consideration for electric vehicle infrastructure than any other. Norfolk should work to ensure the distribution of electric vehicle charging infrastructure is as equitable as possible throughout the City, including prioritizing charging sites to expand access in disadvantaged communities and underserved residents. These maps can be updated using indices that further prioritize equity considerations, such as the Climate Vulnerability Index or Social Vulnerability Index. See Appendix D. Priority Site Inventories for the full list of sites of interest in Norfolk. Note that each row of the table in Appendix D represents one site and multiple sites may be in a block group.

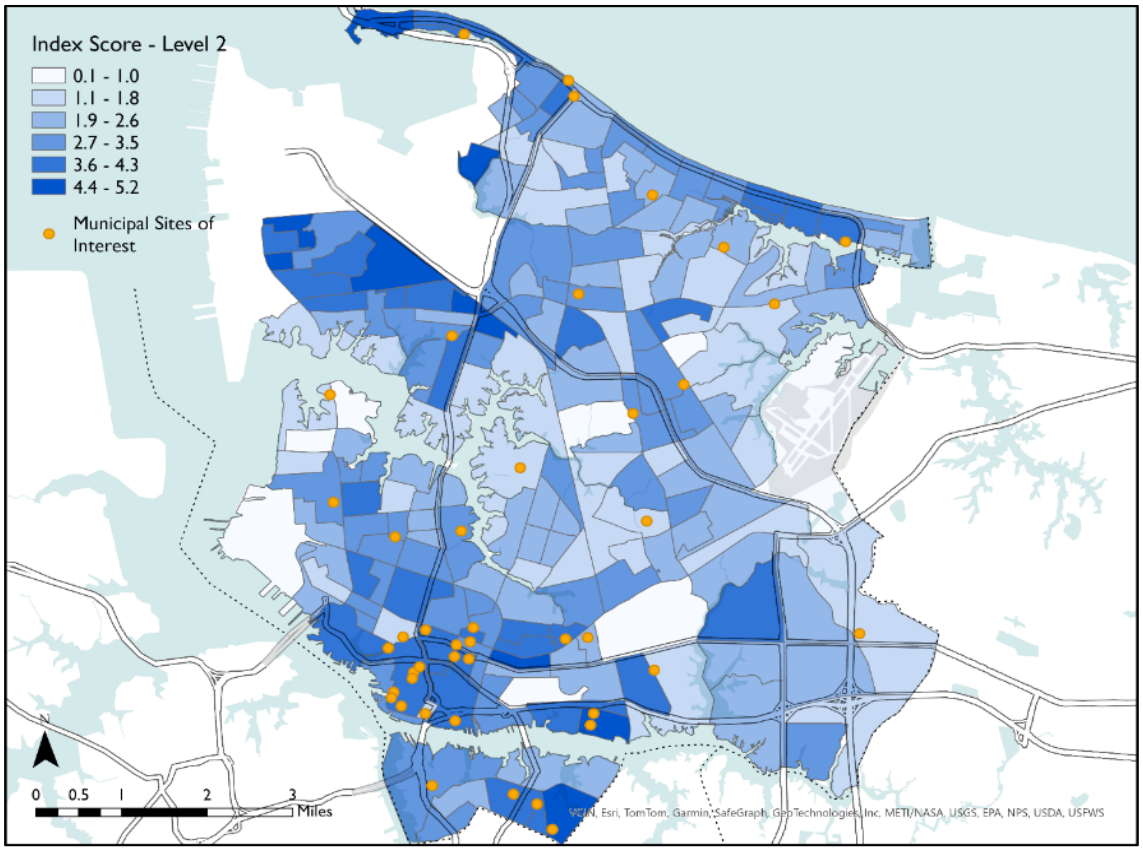


Figure 25. Level 2 charging sites of interest on Municipal properties

Into Action

Steps the City can take to facilitate the deployment of EV charging.

This section provides six key focus areas and outlines specific recommendations the City can implement to facilitate EV adoption and encourage EV charger deployment. Doing so will help achieve an EV future that expands transportation options, makes transportation more affordable and equitable, reduces emissions, improves human health, and provides new economic opportunities for all residents and businesses in Norfolk. The City can remove barriers, engage with stakeholders, identify and pursue funding opportunities, establish programs that improve equitable access, and ensure the economic development associated with this new sector is available to all.

Implementing the strategies in this section requires not only City leadership but also participation from a diverse set of stakeholders, including residents, community groups, small businesses, homeowner associations, utilities, educational institutions, EVSPs, ridesharing firms, and others. As it implements recommended strategies, the City should track its progress toward achieving these goals and update the Plan as more EVs are adopted and more EV chargers are deployed to align with a rapidly changing transportation sector.

Summary of Focus Area and Strategies

Focus Area: Access

Strategy 1.1: Fill Charging Gaps and Provide Charging in Neighborhoods

Strategy 1.2: Promote EV Charging at Workplaces and Multi-Family Homes

Strategy 1.3: Establish Guidance for ROW Charging

Strategy 1.4: Promote Curbside Charging Programs

Focus Area: Leadership

Strategy 2.1: Establish Partnerships for EV Charging at Municipal Sites

Strategy 2.2: Electrify the City Fleet

Strategy 2.3: Future-proof Charging Sites

Strategy 2.4: Set Targets for Public EV Charging and Benchmark Locally

Strategy 2.5: Develop Training Programs for Emergency Responders and Other City Staff

Strategy 2.6: Appoint an EV Navigator

Focus Area: Equity

Strategy 3.1: Cultivate Partnerships with Community-Based Organizations

Strategy 3.2: Establish an EV Equity Working Group

Strategy 3.3: Provide Charging in Underserved Communities

Strategy 3.4: Establish EV Charging Goals in Disadvantaged Communities and Track Deployment

Strategy 3.5: Ensure that EV Charging is Accessible to Different Types of Users

Strategy 3.6: Prioritize Shared Mobility Hubs and Multi-Modal Charging

Focus Area: Opportunity

Strategy 4.1: Develop EV and EVSE Workforce Development Programs Through Partnerships with Local Educational Institutions

Strategy 4.2: Maximize Use of Federal and State Incentive and Financing Programs

Strategy 4.3: Streamline Permitting and Track Permit Applications to Encourage Local Investment

Focus Area: Resilience

Strategy 5.1: Assess EV Charging in High-Risk Flood Areas for Reliability and Redundancy

Strategy 5.2: Integrate EV Charging with Renewable Energy and Energy Storage

Strategy 5.3: Deploy Mobile Charging Solutions

Strategy 5.4: Install EV Chargers on Evacuation Routes and Integrate EV Charging into City Emergency Communications Protocols

Focus Area: Engagement

Strategy 6.1: Work Directly with Communities to Identify Needs through Listening Sessions and Surveys and Continuously Integrate Community Feedback

Strategy 6.2: Provide Publicly Accessible Educational Resources and Promote EV Adoption through the City's Website

Strategy 6.3: Hold Education and Outreach Events to Provide Resources to Businesses

Focus On: Access

Make EV charging available and affordable for everyone who needs to charge.

Strategy 1.1: Fill Charging Gaps and Provide Charging in Neighborhoods

Demand for public charging infrastructure will increase as EVs are adopted in Norfolk. The majority of charging infrastructure will be deployed by the private sector to provide charging where residents and visitors travel, particularly in areas with higher rates of EV adoption. However, this can lead to disparities in charging access in certain locations, which can impact the ability of residents to adopt EVs in the future – particularly residents in low-income communities. By supporting EV projects that bring charging infrastructure to neighborhoods with less access, residents may be more motivated to adopt EVs. Projects may also facilitate the ease of EV integration into residents' lifestyles.

Figure 26. Example of MUD EV charging
Source: ChargePoint

Using the charging needs assessment provided in *Where Could EV Charging be Deployed in Norfolk?* and the U.S. DOE Alternative Fueling Station locator, the City can regularly assess how public EV charging is being deployed and identify gaps in infrastructure beyond what is

presented in the section *Where Could EV Charging be Deployed in Norfolk?* of this Plan. In addition, the City can track permit applications (*Strategy 4.3*) to understand where private EV charging is being deployed in MUDs, workplaces, and other locations.

For example, areas with high concentrations of MUDs may have less opportunity to install private home chargers, so EV adopters in these areas would benefit more from accessible charging (Figure 27). The City should regularly review these areas to ensure that public EV charging is being deployed to meet residents' needs. Additional factors Norfolk should consider include disadvantaged communities, LMI neighborhoods, and areas with significant air pollution (NAAQS nonattainment areas), which may have lower rates of EV adoption and lower public charging EV infrastructure available. Addressing these needs decreases the barrier to entry for Norfolk residents who want to purchase an EV but are concerned about charger access.

The City can take advantage of federal funding opportunities (see Appendix C. Funding Programs) to fill gaps in access to charging by deploying EV charging on municipal properties or establishing grant programs for local businesses and building owners to deploy charging. Applying for support for EV projects helps build momentum to make EV charging more prevalent and increases driver confidence that they will be able to charge. Norfolk should review and apply for these opportunities with the potential projects they identified in their own analysis of gaps in neighborhoods.

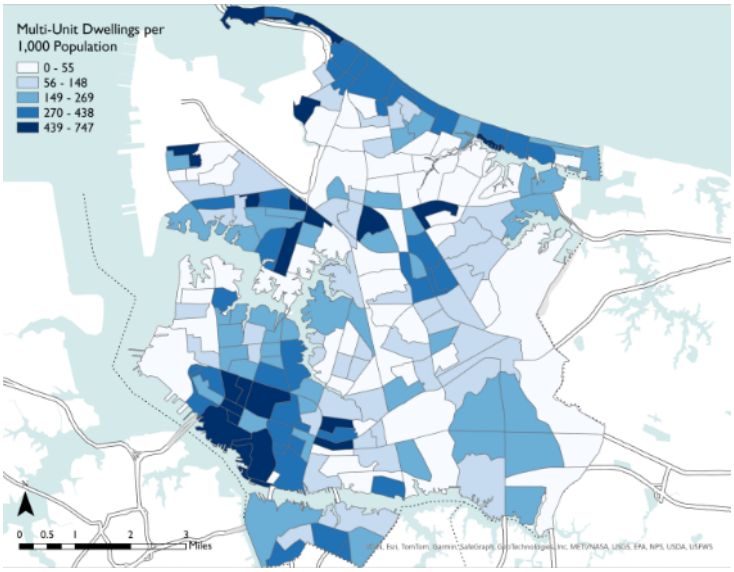


Figure 27. Concentration of MUDs per 1,000 people in Norfolk

Actions already taken by the City, including plans to deploy curbside and surface parking EV chargers in the NEON District Streetscape and St. Paul's District transformation projects, are examples of how the City can support its residents and support EV adoption. EV charging at these sites can be expanded and additional EV chargers deployed as new development projects take place in Norfolk in the coming decade.

Strategy 1.2: Promote EV Charging at Workplaces and Multi-Family Homes

Renters and residents that live in apartments or other MUDs are far less likely to have access to home charging. Installing charging in parking garages can also be more difficult and costly than in other applications, presenting a barrier for building owners who want to provide charging for these residents. The City can expect these residents to be heavily reliant on public charging infrastructure in the future, increasing the need for charging in proximity to where they live and work.

Norfolk has a far higher percentage of the population that are renters than the national average.[xxii] A greater number of both private and public EV chargers will be needed to serve these populations, especially in majority renting neighborhoods highlighted in Figure 29. To help bridge this gap, workplace charging will be extremely important. By 2030 over 50% of all non-residential charging ports in the U.S. are predicted to be workplace chargers, with some 20-30% of EV owners using workplace charging.[xxiii]

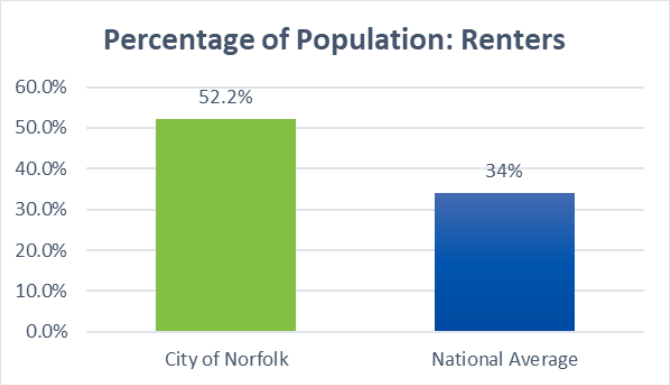


Figure 28. Percentage of population that are renters, Norfolk vs. U.S.

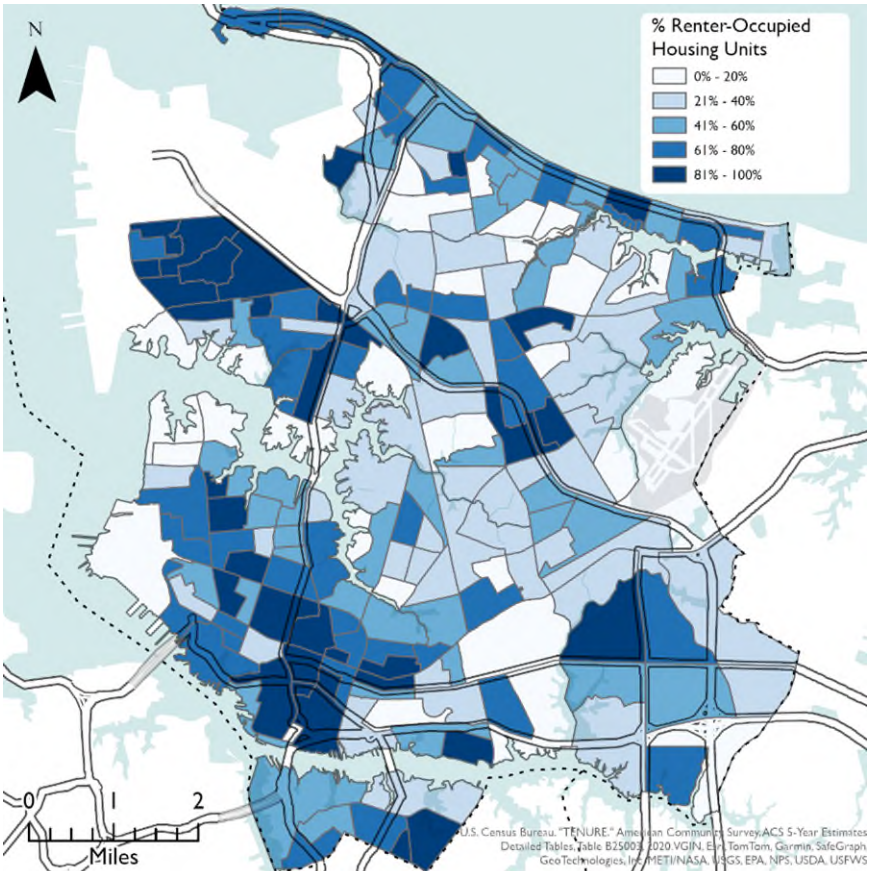


Figure 29. Percentage of Housing Units Occupied by Renters by Census Block

To support deployment in workplaces and MUDs, the City can provide resources and programs to engage residents, business owners, housing developers, and HOAs about the benefits of installing charging infrastructure, including tenant and worker attraction and retention. Norfolk can also inform business owners about the federal, state, and utility incentives available for workplace charging (see Appendix C. Funding Programs). Finally, Norfolk can directly incentivize MUD owners to install chargers for residents in shared parking areas using federal and state grants and assistance programs and provide technical assistance for HOAs and MUD managers pursuing EV charging projects.

The City can directly support this strategy by installing EV charging for government employee use and on municipal properties that are in walking distance of multifamily housing areas, such as parking garages,

libraries, and community centers, as well as curbside charging in the right-of-way (ROW). Appendix D. Priority Site Inventories of this report provides a detailed list of municipal properties that may be suitable for installation of public charging infrastructure both now and in the future.

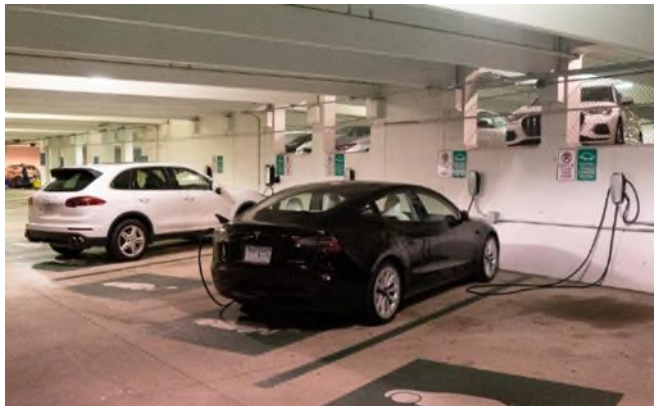


Figure 30. EVSE at Town Point Garage, Norfolk

Strategy 1.3: Establish Guidance for ROW Charging

Many residents of Norfolk primarily utilize street parking. State-wide, just 40% of Virginians have access to electricity within 20 feet of their home parking location. While many EV users in this group may choose to charge at work or rely on other public charging, this is typically more expensive than residential charging due to the cost premium associated with retail electricity sales and network fees. To achieve a more equitable charging system in Norfolk, the City can proactively address charging may for residents without access to a driveway or garage wish to charge their vehicle curbside. In other jurisdictions, incidents of "improvised charging" have occurred, particularly in urban settings.

In these circumstances, residents have run charging cords from resident buildings across the right of way and plugged into the car. This creates safety risks for pedestrians and fire hazards for homes and communities. As EVs are deployed in greater numbers, the likelihood of these situations increases, as does the likelihood of incidents.

Figure 31. Example of improper ROW charging

Source: The U.S. Sun

To enable residents to safely charge curbside in residential applications, the City should develop guidance for what methods are permitted. In other jurisdictions, such as Cambridge, MA and Washington, DC, residents are permitted to use temporary cable protectors (Figure 32). Norfolk has previously approved limited permits for ROW charging with charging infrastructure installed in the ground through the right of way and power supplied directly curbside. The City could choose specific design(s) that are permitted, which will expedite the permitting process and reduce the administrative burden.

Figure 32. EV cable protector

Source: Boston Globe

Strategy 1.4: Promote Curbside Charging Programs

Curbside charging in public parking areas is beginning to gain widespread adoption in the U.S., including at several sites in Norfolk. For example, projects are in development which include curbside charging spaces in the St. Paul's Transformation project and the NEON District Redevelopment, and there is an existing curbside charger in operation at the Elizabeth River Project on Colley Avenue. Curbside charging provides drivers with an option in areas that are densely populated but may not have public parking readily available. In some cases, electrical infrastructure may be more easily accessible in the ROW.

Figure 33. Elizabeth River Project curbside charger

Norfolk should consider expanding the development of curbside charging, which provides accessible charging available to any driver. An emerging application of curbside charging is deploying chargers on light poles, which are often far less expensive to install, as electricity is already available at the site. The City has already explored establishing a pilot program with Dominion Energy, which may include installing light pole chargers in areas of Norfolk with limited off-street parking, with the potential to expand to other areas upon successful implementation.

Focus On: Leadership

Integrate EVs into the City fleet and strengthen municipal governance of EVs.

Strategy 2.1: Establish Partnerships for EV Charging at Municipal Sites

Although the majority of charging will likely take place at home and the workplace, the City can play a pivotal role in helping to deploy charging at municipally owned sites using federal and state funding programs and through partnerships with EVSPs who may install and operate chargers without significant cost to the City. Norfolk can leverage its parking facilities, community and recreation centers, and other sites near where people live and work, but where public charging is not expected to be deployed. These properties can meet a critical charging need and act to complement, rather than compete with, public charging made available by local businesses.

In development of this Plan, the City of Norfolk conducted an analysis to determine what municipal sites are most suitable for deploying charging infrastructure in the near term. Through several rounds of review and input across City departments and offices (see section: *Stakeholder Engagement*), this list was refined to include municipal sites, including parking municipal parking garages, that could be prioritized. These sites are shown in Figure 34, with additional site details provided in Appendix D. Priority Site

Inventories. Those communities shaded in green are those that have been designated as an environmental justice community by the U.S. DOT and should be prioritized for the development of any new project.

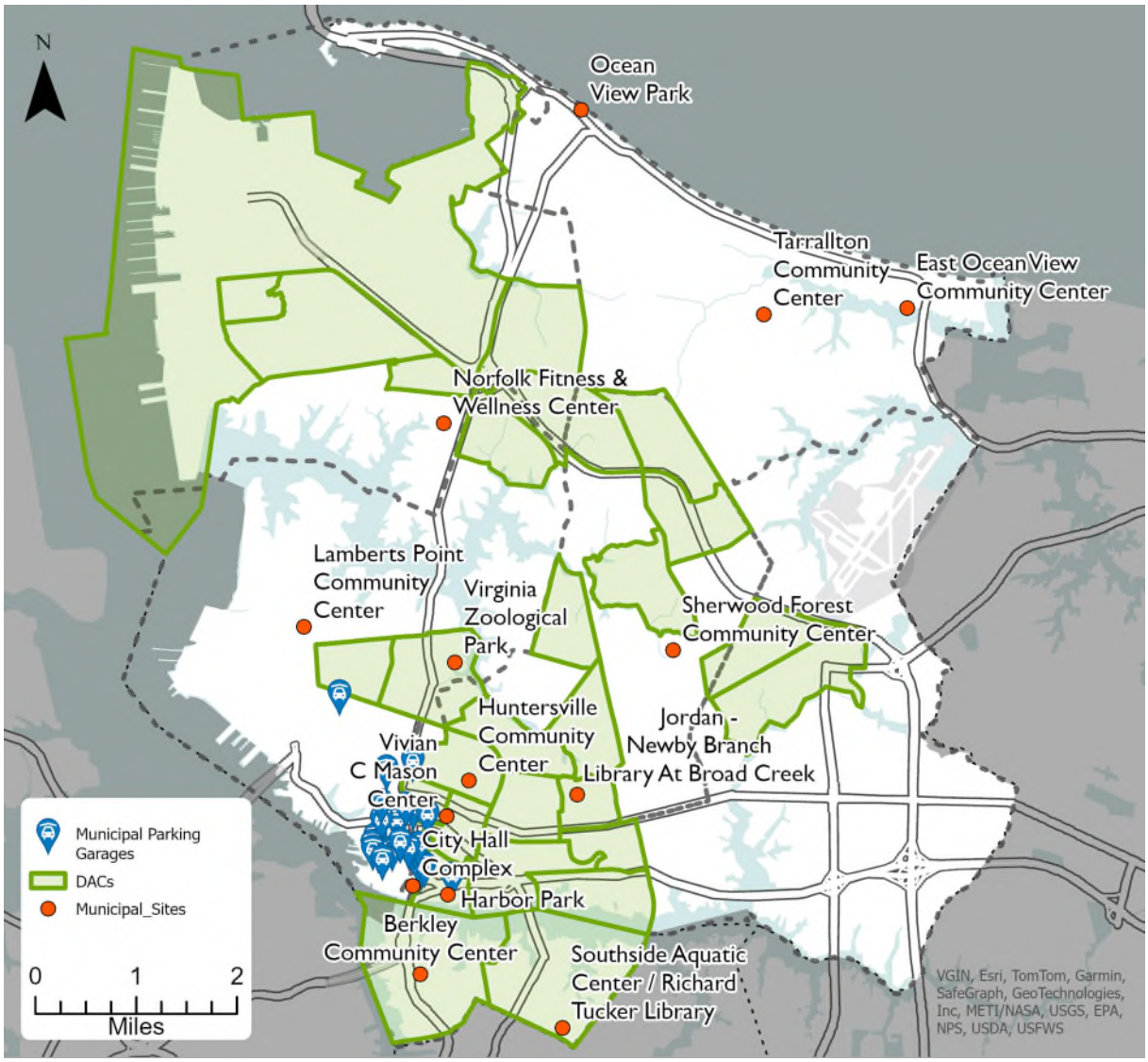


Figure 35. Potential sites for EV charging on municipal properties

As the City moves forward in electrification planning, these or additional sites can help guide where charging might be deployed. Site selection will require significant public engagement to understand how local community members view the possibility of new EV projects being built in their neighborhoods, provide feedback on these or additional sites that may be better suited to meet community needs, and enable community members to ask questions about the impact that EVs and EV charging may have locally. A more thorough description of stakeholder engagement strategies can be found in Strategy 6.1.

Most cities do not own and operate public charging stations, instead opting for grants, incentives, and partnerships with utilities and EVSPs to install, operate, and maintain EVSE on municipal properties. While site hosts in the private sector, such as retail locations, may wish to own and operate EV charging

to generate revenue though electricity sales, this also increases the up-front investment necessary for EVSE procurement.

Instead, most cities partner with a third-party EVSP to install, operate, and maintain charging equipment on municipal properties as a turnkey service provider at little to no cost to the city. Alternatively, the cities may choose to partner with the local electric utility, such as Dominion Energy, to provide services whereby the utility provides electricity, make-ready efforts, and electrical infrastructure, along with EVSE equipment to streamline the installation process. While third-party owner-operator models offer low revenue potential for the City, they also drastically reduce investment and operational costs (Table 8). It is recommended that the selected partnership arrangement minimize any costs incurred to the City for installation of infrastructure and ensure EV charger maintenance services are supplied by the EVSP, rather than being overseen by City staff.

Table 8. Public EV charging ownership models

Ownership Model	Costs to City	Revenue Potential
Third-party owned and operated	Low; program management	Low
City-owned, third-party operated	Medium; hardware and management costs	Medium
City-owned and operated	High; hardware, operation, and management costs	High (but may generate losses)
Charging as a Service (CaaS)	Medium; subscription fee	Medium, potential shared revenue

Strategy 2.2 Electrify the City Fleet

The City of Norfolk maintains a fleet of over 2,000 vehicles, including over 1,000 light duty vehicles (LDV) including sedans, trucks, minivans, and vans. However, to date the City has only procured three electric vehicles. To emphasize its commitment to reducing carbon emissions and to reduce operational costs, the City can identify high-priority vehicles that may be suitable for electrification. In conjunction with the development of this Plan, the City has also undertaken a fleet electrification assessment, which identified approximately 100 LDVs that would offer a cost savings if they were converted from internal combustion engine (ICE) vehicles to electric. While cost effective vehicle offerings are limited for some vehicle types, particularly emergency response and pick-up trucks, the number of models that will be available for procurement will increase significantly in the next few years—and EVs are expected to reach cost parity with ICE vehicles by 2027.[xxiv]

The City should consider enacting a plan for the phased roll-out of EVs to replace ICE vehicles in certain applications. In a survey that was distributed in May 2024 to all City departments and offices which operate fleet vehicles, numerous respondents were open to integrating EVs into their fleet. The fleet electrification assessment also identified priority locations for the installation of charging infrastructure to serve the City fleet, including motor pool and fleet maintenance. Deploying EVs at these locations would offer the opportunity for City fleet operators to familiarize themselves with EV technologies and

understand how operations may be impacted by EV use. Gaining familiarity with EVs in the short term is critical to enabling the pragmatic rollout of EVs across the City fleet in the coming years.

Using the list of prioritized vehicles provided in the fleet assessment, fleet electrification can be further ranked at those sites which (a) have high concentrations of vehicles co-located for overnight charging, (b) facilities that have planned construction or renovations, which can provide significant cost savings for deployment (c) those sites which will enable greatest employee access to utilize EVs (such as motor pool), and (d) those sites which may be co-located with public charging, including charging for City employee, to provide synergy with transformer upgrades, installation of conduit, and other construction activities that will need to be undertaken.

Figure 36. Nissan Leaf EV at City of Norfolk motor pool

Source: Virginia Clean Cities

Due to the variability in EV costs, vehicle makes and models, and fuel prices, the City will need to conduct additional fleet assessments in the future to determine the cost effectiveness of electrification. It is recommended that the City use the Virgina Department of General Services Fleet Total Cost of Ownership Calculator to assess individual vehicles as more vehicles are electrified.

In addition, the City should also seek out opportunities to utilize tax credits to electrify its municipal fleet and help fund charger installation, such as using the "elective pay" (or "direct pay") option for the section 30D and 45W federal tax incentives. Elective pay allows applicable entities, including tax-exempt and governmental entities that would otherwise be unable to claim certain credits because they do not owe federal income tax, to benefit from some clean energy tax credits. By choosing this election, the amount of the credit is treated as a payment of tax and any overpayment will result in a refund. More details can be found in Appendix B. Virginia State Electric Vehicle Laws and Policies.

Strategy 2.3. Future-Proof Charging Sites

As new chargers are installed in Norfolk on municipal properties for public charging and to serve the municipal fleet, the City should work to ensure that sites are designed and constructed to accommodate charger expansion, or higher power charging, in the coming years. Referred to as "future proofing," this can include installing larger substations and transformers, laying higher capacity conduit, installing additional electrical circuits, or designing the project site to enable future on-site energy storage and/or distributed generation. Critically, it will be important to communicate with Dominion Energy regarding the expected future load at the project site to assist in grid planning and necessary upgrades to the distribution system.

Futureproofing infrastructure will be most important at locations with large concentrations of municipal fleet vehicles and public parking. Some municipal sites may host fleets of 100 or more EVs in the coming decade. Figure 37 provides an example of a fleet site which installed infrastructure to be able to add future chargers as more vehicles are electrified, referred to as "stub outs." Designing to accommodate rapid expansion of charging infrastructure will greatly reduce future construction costs.

Figure 37. Example of stub-outs installed to add EV chargers in the future

Strategy 2.4: Set Targets for Public EV Charging and Benchmark Locally

Setting targets for EV and EV charger adoption communicates the City's commitment to both internal and external stakeholders and helps planning efforts across City departments to track progress over time. Ultimately, targets show a leadership position and indicate to residents and businesses that the City places a priority on sustainable transportation.

The City can establish short- and medium-term targets for the number of public EV charging ports in Norfolk. The charging needs assessment presented in the section *What is the current and future state of EVs in Norfolk?* can be used to develop these targets, as shown in Table 9 below.

Table 9. Potential EV charging deployment targets

Scenario	Year	Total Publicly Accessible Level 2 Ports Needed[b]	Total Publicly Accessible DCFC Ports Needed[b]
Current	2024	76	42
Future	2030	1,196	104
	2035	1,953	166

Due to the rapidly evolving EV charging technology sector, the City should reassess charging deployment targets based on how the local EV market has developed. The City should also consider benchmarking itself with cities in Virginia, such as Newport News or Richmond, or nationally, such as Buffalo, NY or Winston-Salem, NC. When applicable, the City should publicize leadership in charging infrastructure deployment, fleet conversion statistics, and emissions impacts and integrate these achievements into public-facing documents.

Strategy 2.5. Develop Training Programs for Emergency Responders and Other City Staff

Even at low levels of EV adoption, it is critical that emergency responders and City staff learn how to operate, maintain, and handle EVs in emergency situations. Norfolk should continue to prepare its emergency responders to be able to manage risks and potential emergencies specific to EVs, in particular EV battery fires, which require different protocols than ICE vehicle fires and can be very time- and resource-intensive for responders. There are also additional safety risks for responders related to the emission of toxic and flammable gases from damaged batteries and the unpredictability of thermal runaway and re-ignition. While ICE vehicle fires are 11x more common that EV fires,[xxv] EV fires can be longer and more severe.

Flooding, particularly from saltwater, presents specific challenges. Residual salt within the battery or battery components can form conductive "bridges" that can lead to short circuit and self-heating of the battery, resulting in fires. The time frame in which a damaged battery can ignite has been observed to vary widely, from days to weeks. This will require proactive communication with EV owners to ensure that vehicles are moved away from coastal flood zones during severe weather events, utilizing municipal parking garages to store their vehicles if necessary.

On March 10, 2023, Virginia passed HB 2451, which requires all firefighters, including volunteers, to enroll in a training program on the risks of fires in electric vehicles and how to safely and effectively manage such fires. The program will be administered by the Virginia Department of Fire Programs, and all Norfolk firefighters will be required to complete the program by December 1, 2025.

Figure 38. EV Training for first responders
Source: Carroll EMC

For other staff, the City should consider offering training to increase understanding of EV charging infrastructure technology and safe installation and operation. These trainings can be held as a series of workshops, either in person or online, on a wide variety of topics, including EV operations and maintenance, EVSE installation, and best practices for permitting processes. Priority audiences for training should include the City's planning and zoning staff, code administrators, right-of-way staff, and fleet operators. However, these trainings should also be open to all City staff that are interested in expanding their understanding of EV technology. Primer materials and videos provided by DOE, the National League of State Legislators, the Electrification Coalition, and others can also be made available to introduce staff to EVs and charging technology at no cost.

Strategy 2.6. Appoint an EV Navigator

The City should consider hiring an EV Navigator, who will be a centralized point for contact and outreach coordinator to engage with the Norfolk community on electric vehicles and oversee EV charging infrastructure matters for the City. The EV Navigator could perform the following roles:

- Assist with development of educational materials to promote electric vehicle infrastructure for diverse audiences (drivers, dealerships, local governments, etc.).
- Educate community members on technical requirements, incentives, best practices, and benefits of electric vehicle charging infrastructure, including promoting consumer-facing smart phone and website applications and tools to help community members locate available charging infrastructure or promote charging-infrastructure sharing.
- Coordinate a community EV advocates program similar to the City of Cincinnati to help the City educate and demonstrate the benefits of electric vehicles and provide information on electric vehicle charging infrastructure. Educate electric vehicle owners who have installed charging infrastructure at their residence on how to take advantage of Dominion Energy EV programs and federal and state tax incentives.
- Use existing open-source alternative fuel vehicle and infrastructure models and tools to assist with planning charging stations.
- Assist with developing and maintaining EV stakeholder lists and organizing meetings community meetings.
- Serve as a central contact or ombudsman, working with the residents and key decision-makers in multifamily buildings (such as the building's management or condominium board) to answer questions and support efforts to install charging infrastructure on behalf of tenants. This may include promoting Virginia's right-to-charge law or programs where condo or homeowner associations may otherwise limit or restrict tenants from reasonable access to charging within the building of residency or dwelling location.
- Perform outreach at workplaces and tourism sites to determine interest in, and capability to, host charging stations for their respective needs.
- Develop ongoing promotion and guidance materials for City departments engaged in promoting and supporting EV charging infrastructure, including guidance materials for the Division of Permitting and Zoning (*Strategy 4.3*).

Focus On: Equity

Ensure that all voices are heard, and that charging is accessible, reliable and affordable for all residents.

Strategy 3.1: Cultivate Partnerships with Community-Based Organizations

The City of Norfolk acknowledges the disparities, advantages, and disadvantages that exist among residents, communities, and businesses, and will focus on institutional strategies and external programming and services that promote opportunity and access for all. Meaningful community outreach and engagement are key to informing equitable access to EV charging infrastructure. This first requires identifying and mapping local stakeholders, such as neighborhood and civic associations, school boards, local housing organizations, advocacy organizations, and business associations to target for outreach and partnerships. Identified stakeholders should be representative of diverse groups and points of view and include disadvantaged communities, communities of color, LMI communities, individuals with disabilities, and environmental justice communities that have historically lacked representation in transportation planning activities and have been marginalized by transportation infrastructure development.

The City should leverage its internal capacities to meaningfully engage with community members through the Department of Neighborhood Services and the Office of Diversity, Equity and Inclusion. The City maintains a comprehensive list of local civic and business associations who can provide a platform to gather a diversity of opinions and ideas about how EV charging infrastructure may be deployed. The City can leverage resources such as the Joint office of Energy and Transportation (JOET) Public Electric Vehicle Charging Infrastructure Playbook and Community Engagement Tips for EV Infrastructure Deployment **(**Figure 39**),** and the Electric vehicle program designs and strategies to enhance equitable deployment to help guide the development of an engagement strategy.

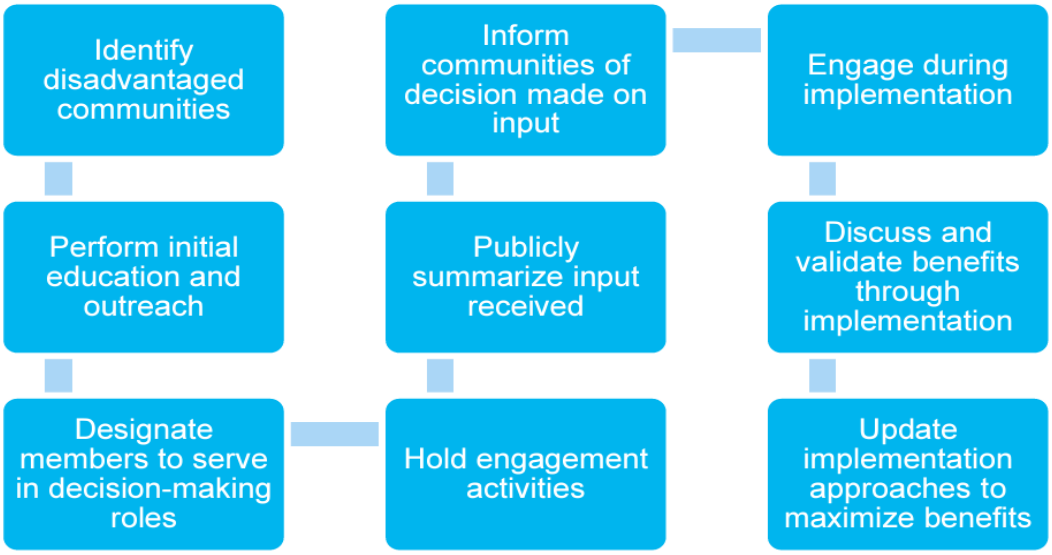


Figure 39. Example process for designing, implementing, and tracking community engagement

This strategy can be implemented through the EV Equity Working Group (Strategy 3.2). The City should consider the development of the Community Advisory Board to formalize partnerships with community-based organizations. This Board can help conduct outreach and engagement with underserved communities and provide feedback and accountability to the Working Group.

Strategy 3.2. Establish an EV Equity Working Group

The development of this Plan required partnership across City departments and with numerous stakeholders, both internal and external. Building on the momentum of these relationships, the City should formalize its leadership role by establishing an EV Equity Working Group that will assist in implementing the strategies outlined in this Plan. This working group can serve as a mechanism to bring together diverse stakeholders into the decision-making process and can collectively prioritize strategy execution, monitor progress, and update the Plan as the transportation electrification market evolves.

This Working Group can prioritize actions that ensure equitable access to charging infrastructure and economic development opportunities and provide a platform for members of the community to be meaningfully involved in EV development in Norfolk. This group also can work to ensure that the City's

actions on EVs and charging infrastructure are supported by a diversity of thought and can guide how the Cite progresses in achieving its climate action goals.

Strategy 3.3: Provide Charging in Underserved Communities

While EV adoption has increased dramatically in recent years, it has not been equal among all communities. EV sales are disproportionately greater in high-income regions and upper-income households, and EVs are often marketed as luxury goods. Because EV adoption is higher in these areas, they are more likely to be selected for the deployment of charging infrastructure. This can lead to a cycle in which lower-income communities are prevented from purchasing an EV due to the lack of charging available where they live. Today many EVs are less expensive to own and operate than comparable ICE vehicles when accounting for fuel costs, maintenance, registration, and insurance,[xxvi] and as the price of EVs continues to drop in the future (Figure 40), potential savings will grow.

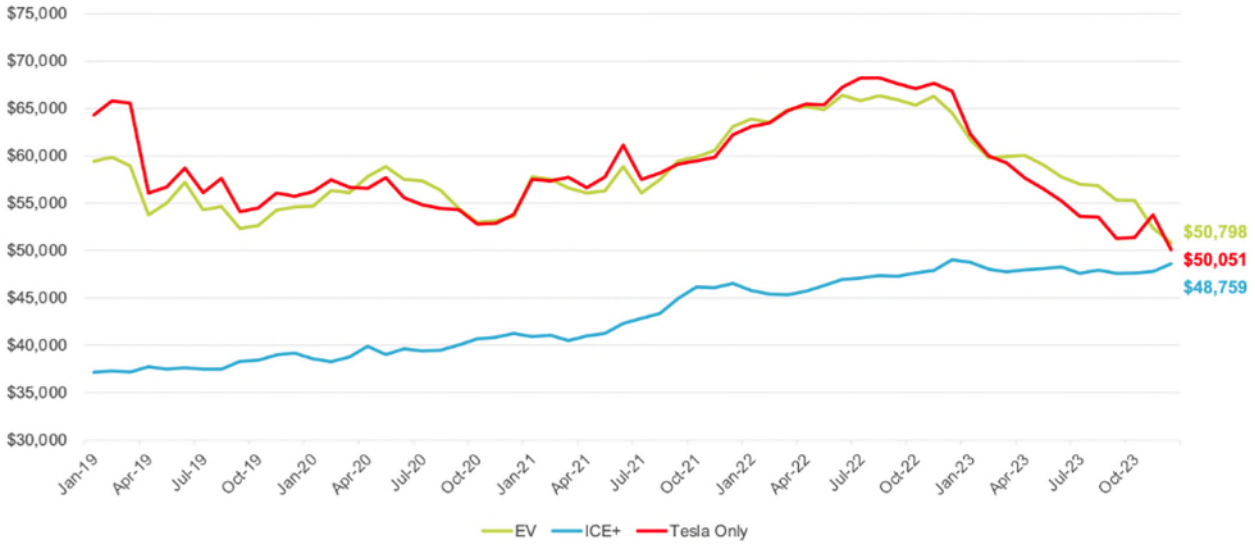


Figure 40. Comparison of historic vehicle transaction price, ICE, EV, and Tesla

Source: Cox Automotive and Kelley Blue Book

To ensure that all communities have equal access to EV charging, the City can focus on deploying EV charging in areas with limited charging today. This may include installation of EV charging on municipal properties in these areas, expansion of EV charging near affordable multifamily housing, or the development of grant and incentive programs using federal and state funding to encourage building owners or local businesses to install EV charging in these communities. Multifamily housing in particular faces high barriers to EV charger installation, with indoor parking or larger installations having higher costs. Charger installation may trigger expensive electrical infrastructure or distribution upgrades.

The City has already begun establishing charging programs in underserved communities, including both surface lot and curbside charging as part of the St. Paul's Transformation Project (Figure 41). As the City continues its progression in this and other development projects, EV chargers should be incorporated into all planning, and considerations for expansion of current installation plans and future-proofing sites for additional chargers in the future should be prioritized.

Figure 41. Rendering of St. Paul's Transformation Project

Strategy 3.4: Establish EV Charging Goals in Disadvantaged Communities and Track Deployment

In conjunction with tracking EV charging across Norfolk (Strategy 2.4), the City should set specific goals and criteria for prioritizing charging infrastructure in disadvantaged communities. There are multiple resources the City can use to identify these communities, including the Energy Justice Mapping Tool, the Climate and Economic Justice Screening Tool, and VA EJScreen+. The federal Justice40 Initiative is a requirement that at least 40 percent of the overall benefits from certain federal investments go to disadvantaged communities.[xxvii] The City can use this as a benchmark for how it provides assistance locally for distribution of funds, or for where EV charging is deployed on municipal property. To support this strategy, the City can look to other jurisdictions that have developed programs to expand charger access for residents without access to home charging or residents of multi-family dwellings, including:

- The City of Denver partnered with a nonprofit car-sharing organization and the local housing authority to bring electric carshare vehicles to low- and medium-income multifamily public housing properties.
- The Los Angeles Bureau of Street Lighting transitioned its streetlights to more efficient light bulbs, freeing up excess power for lamppost-based EV charging stations at approximately 600 locations.
- The City of New York launched a curbside charging pilot program with 100 charging ports at 35 locations, collectively providing nearly 50,000 charging session by the end of 2022.
- The City of Seattle developed a Multifamily Electric Vehicle (EV) Charging Program which provides free site assessments and EV charger rebates.

Strategy 3.5. Ensure EV Charging Accessibility to Different Types of Users

The City should ensure that EV charging site design is compliant with the Americans with Disabilities Act (ADA) by considering accessibility, ease of use, and safety for disabled drivers and vehicle occupants, including those using wheelchairs or other assistive equipment. This includes adequate space for exiting and entering the vehicle, unobstructed charger access, free movement around the charger and connection point on the vehicle, and clear paths and proximity to building entrances.

There are currently no established federal ADA standards with specific application to EV charging installations. However, the U.S. Access Board has developed design recommendations. Even in the absence of specific provisions, many of the existing ADA accessibility standards are applicable to EV charging stations. In addition to mobility requirements, EV charging spaces have accessible communication requirements for charger operation, as well as requirements for connector and receptacle height. As the City seeks partners for the installation of public charging infrastructure on municipal properties, projects should be required to meet all existing federal accessibility standards and integrate designs using U.S. Access Board Criteria.

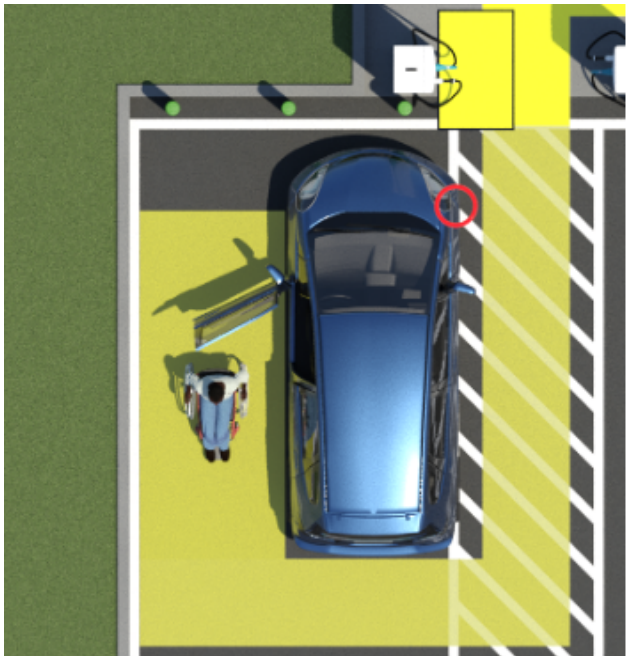


Figure 42. Example of ADA compliant EV charging station design from U.S. Access Board

Strategy 3.6: Prioritize Shared Mobility Hubs and Multi-Modal Charging

A Shared Mobility Hub is an emerging concept in transportation land-use planning where transportation connections and community amenities are brought together to serve community needs holistically. Shared Mobility Hubs are typically located with major transit facilities and in places where frequent services intersect to allow easy transfers between mobility services. In addition to transit, Shared Mobility Hubs may include connections to car share, transportation network companies (TNCs), taxis, bike share, bike parking, pick-up and drop-off, kiss-and-ride, freight delivery, as well as connections to local bike and pedestrian routes. Hub projects can vary in size and scope, ranging from regional to neighborhood applications providing a variety of different transportation services.

The City should coordinate with transportation stakeholders such as HRTPO and Hampton Roads Transit to identify opportunities for the design of shared mobility hubs. Multi-modal shared mobility hubs can provide charging for passenger vehicles in conjunction with buses, rail and mobility devices such as e-bikes and scooters. A shared mobility hub could include different types of EV charging, including Level 2, DCFC, overhead charging for buses, and charging docks for electric micro- mobility bike and scooter services. When deployed in disadvantaged communities, a shared mobility hub can

provide residents with access to numerous sustainable transportation options that they might otherwise be unable to access. Working directly with local communities, the City should develop a vision for how this innovative concept might be deployed to both meet transportation and community development needs. These strategies could be integrated into current public transit development plans, such as construction of the new HRT Evelyn T Butts Transfer Center.

Figure 43.Example design of a mobility hub
Source: Metropolitan Transportation Commission

Focus On: Opportunity

Establish programs and policies that enable benefits to be captured locally by all members of the community.

Strategy 4.1: Develop EV and EVSE Workforce Development Programs through Partnerships with Local Educational Institutions

In the development of this Plan, the City engaged with numerous local educational institutions, including Norfolk State University, Old Dominion University, Tidewater Community College, and Tidewater Tech, as well as with workforce development facilitators including Norfolk Economic Development and the Hampton Roads Workforce Council. These meetings showed that there are existing programs for skills training in EV operations and maintenance and EV charging infrastructure installation, operation, and maintenance, in addition to more broadly applicable training programs for electricians that are relevant to the emerging transportation electrification sector.

The City should utilize these significant local educational resources to establish a workforce training program that will enable residents to gain relevant skills and access new opportunities for employment. The City can leverage existing model training programs and work with educational faculty, industry

experts, and EV companies to develop comprehensive curricula that cover the latest technologies and practices in the EV and EVSE fields. Established workforce development programs would ideally incorporate practical, hands-on training, including on-the-job opportunities as well as access to national certifications that provide recognized credentials for participants.

The City should collaborate with workforce development partners to pursue grant applications for federal and state funding to help with program development, scholarships, and research initiatives. Through partnerships with local educational institutions and with trade unions, such as the International Brotherhood of Electrical Workers (IBEW), grant funding can also provide assistance for job placement support to assist graduates in finding employment following their training.

Strategy 4.2: Maximize Use of Federal and State Incentive and Financing Programs

The City should monitor and track funding opportunities for EVs and EV charging infrastructure at the state and federal levels. This includes financing strategies, grants, incentives (rebates and tax credits), and vouchers which are used to reduce or eliminate EVSE procurement and installation costs. A list of federal and state funding programs, as well as utility incentives, can be found in Appendix C.

A primary source of federal funding for EV charging infrastructure projects at the municipal level is the Charing and Fueling Infrastructure (CFI) Community Grant program, which will provide $1.25 billion in funding for communities to install electric vehicle charging and alternative fuel in locations on public roads, schools, parks, and in publicly accessible parking facilities.[xxviii] Using the results of the spatial analysis in this Plan and through stakeholder engagement and feedback, a potential list of sites and priority regions was developed that could be used to inform the development of an application to this program. This application could be structured to use funding to deploy charging infrastructure and develop a workforce development program, such as shown in Figure 44, and a map showing the potential priority sites and areas in which local applicants could apply to install charging is provided in Figure 45.

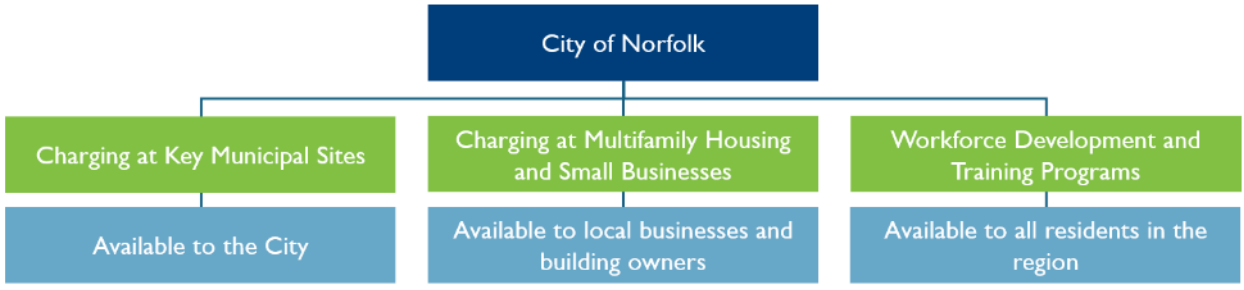


Figure 44. Potential structure of CFI grant application

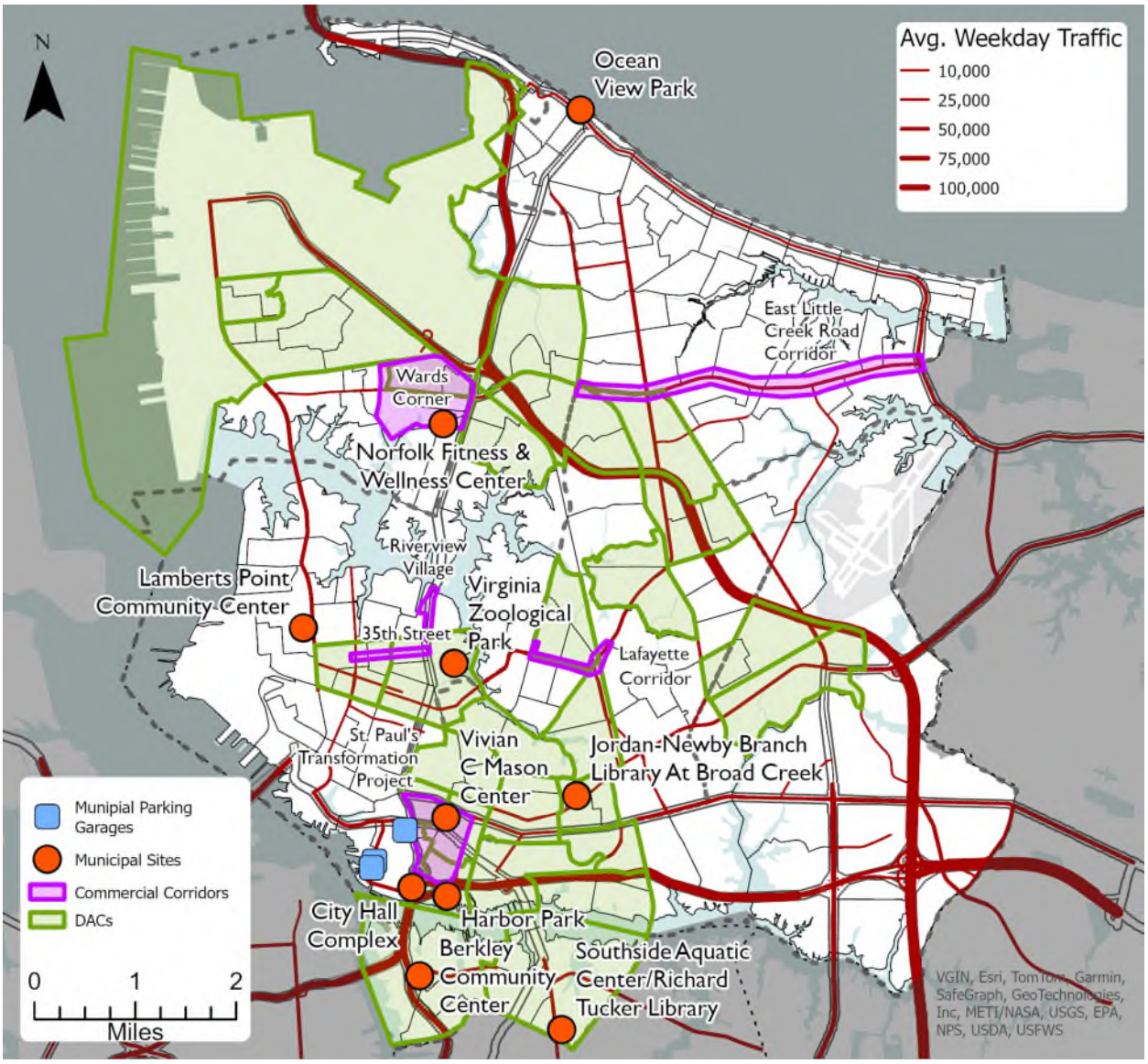


Figure 45. Potential municipal sites and in commercial corridors in Norfolk for CFI application

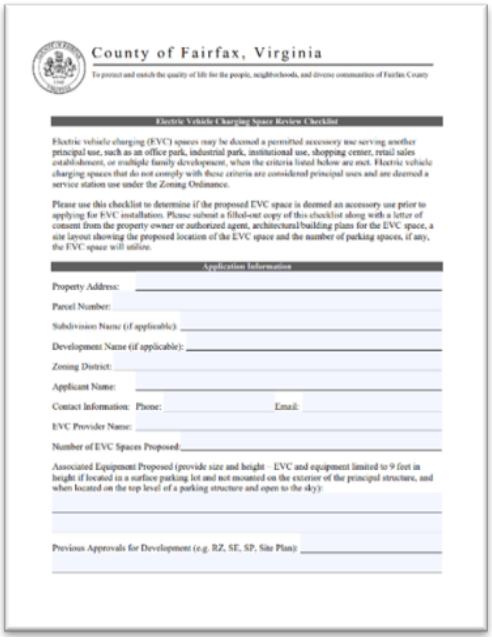
DACs are shown in green, commercial corridors shaded in purple; roads in red are displayed based on average daily traffic, with thicker red lines denoting higher numbers of daily vehicles.

Strategy 4.3: Streamline Permitting and Track Permit Applications to Encourage Local Investment

As EV adoption grows, the number of residents and businesses requiring electrical permits to install EV charging equipment will rapidly increase. While residents and contractors may be familiar with typical electric permit applications, it may be challenging both for the applicant to provide all necessary project details and for the City to review large and complex projects, leading to delays in getting new projects

developed. "Soft costs" such as permitting can account for a significant portion of EV charging projects costs developed by the private sector, and an expedited and clear permitting process can encourage more investment in both residential and public EV charging installations.

The City should first conduct a mapping exercise and develop a permitting checklist. This step-by-step mapping will result in a decision tree that demonstrates how each different type of chargers is permitted (e.g., by charger location, zoning district, EVSE type and quantity, site and architectural plans, proof of property ownership, license exemptions, or other information). This information can be translated into an EV charger permit checklist (Figure 46) and application posted to the City's website.



County of Fairfax, Virginia

To protect and enrich the quality of life for the people, neighborhoods, and diverse communities of Fairfax County

Electric Vehicle Charging Space Review Checklist

Electric vehicle charging (EVC) spaces may be deemed a permitted accessory use serving another principal use, such as an office park, industrial park, institutional use, shopping center, retail sales establishment, or multiple family development, when the criteria listed below are met. Electric vehicle charging spaces that do not comply with these criteria are considered principal uses and are deemed a service station use under the Zoning Ordinance.

Please use this checklist to determine if the proposed EVC space is deemed an accessory use prior to applying for EVC installation. Please submit a filled-out copy of this checklist along with a letter of consent from the property owner or authorized agent, architectural/building plans for the EVC space, a site layout showing the proposed location of the EVC space and the number of parking spaces, if any, the EVC space will utilize.

Application Information

Property Address: _____

Parcel Number: _____

Subdivision Name (if applicable): _____

Development Name (if applicable): _____

Zoning District: _____

Applicant Name: _____

Contact Information: Phone: _____ Email: _____

EVC Provider Name: _____

Number of EVC Spaces Proposed: _____

Associated Equipment Proposed (provide size and height – EVC and equipment limited to 9 feet in height if located in a surface parking lot and not mounted on the exterior of the principal structure, and when located on the top level of a parking structure and open to the sky):

_____

Previous Approvals for Development (e.g. RZ, SE, SP, Site Plan): _____

Figure 46. Example EV permitting checklist for Fairfax County, VA

The City Office of Permits and Inspections already provides guidance on the types of information needed for numerous types of projects, which can be expanded to provide explicit instructions on EV charging projects. The City also can consider several changes to the current zoning and permitting process to streamline the EV charger permitting process, including:

- Permitting chargers as an accessory use to parking lots in all zoning districts for both private and public charging. Codify in the zoning ordinance that EV charging stations are allowed by right in parking lots as an accessory use across residential, commercial, industrial, and other major zoning categories.
- Providing direct guidance on the City permitting website with details regarding the types of permits (electrical, building) required for residential and commercial L2 and DCFC projects.
- Developing a permitting checklist for applicants to ensure that all required information is available and submitted accurately to support expedited review of applications.
- Amending the existing electrical permit application to include information specific to an EV charging project in the form of a check box or a field for completion with details regarding the type and characteristics of the EVSE being installed. This will allow the City to track the deployment of EV chargers locally over time.
- Developing criteria for EV chargers that are to be installed in historic districts and make this available on the City website.

Tracking applications for permits will help the City better comprehend the quantity, location, and type of chargers being deployed, as well as information on denied applications. Tracking data should include, at minimum, locational information and denied applications (with rationale). This information can help the City better identify where EVs are being deployed in greater numbers and identify locations where infrastructure gaps exist (including the number of chargers being deployed in MUDs and DAC communities).

Focus On: Resilience

Adopt processes and technologies that address vulnerabilities and enable adaption to a changing environment.

Strategy 5.1: Assess EV Charging in High-Risk Flood Areas for Reliability and Redundancy

Norfolk's elevation and proximity to natural waterways make it susceptible to precipitation flooding, especially during periods of heavy rain, hurricanes, or nor'easters. During these events, properties throughout the City are threatened and those near natural waterways have increased risk due to tidal inundation and wind-driven flooding. As EV charging infrastructure is deployed locally, it is important that the City understand where EV charging is located to assess the ability for residents to access charging during flooding and extreme weather events.

It is best practice to avoid installation of an EV charging station in a 100-year floodplain due to safety and accessibility considerations.[xxix] However, due to the flooding characteristics of Norfolk, avoidance of these areas entirely is infeasible. Therefore, it is important for the City to consider the location and design criteria for EV chargers located in these areas to ensure that travelers are able to access EV charging during a flooding event.

EVs and EV chargers are designed to be operated safely in any weather condition, and EV chargers can be designed to be resistant to flooding without damage to electrical components. EV charging

infrastructure will be subject to the same zoning ordinance as other electrical systems installed in the City, which requires that all systems are installed at three feet above Base Flood Elevation (BFE) in the floodplain, coastal floodplain, and coastal high hazard districts.[xxx] Elevation of electrical systems can add costs to EV infrastructure projects,[xxxi] but this is a critical consideration for Norfolk.

EV chargers located in floodplains have been installed throughout the City and will continue to be in the future. However, as the City considers additional installation of charging infrastructure, it should give particular attention to sites located outside the floodplain. In addition, the City must consider the accessibility of stations during any flooding event, including "sunny day" flooding. If chargers are likely to be rendered inaccessible during a flooding event, there need to be redundancies in the charging system so there are alternative locations nearby. The City should regularly assess the distribution of EV chargers in Norfolk to ensure that charging is being built outside of high-risk flood areas to enable charging during emergency events. A map showing flood hazard areas and the distribution of existing EV charging stations and municipal sites of interest are shown in Figure 47.

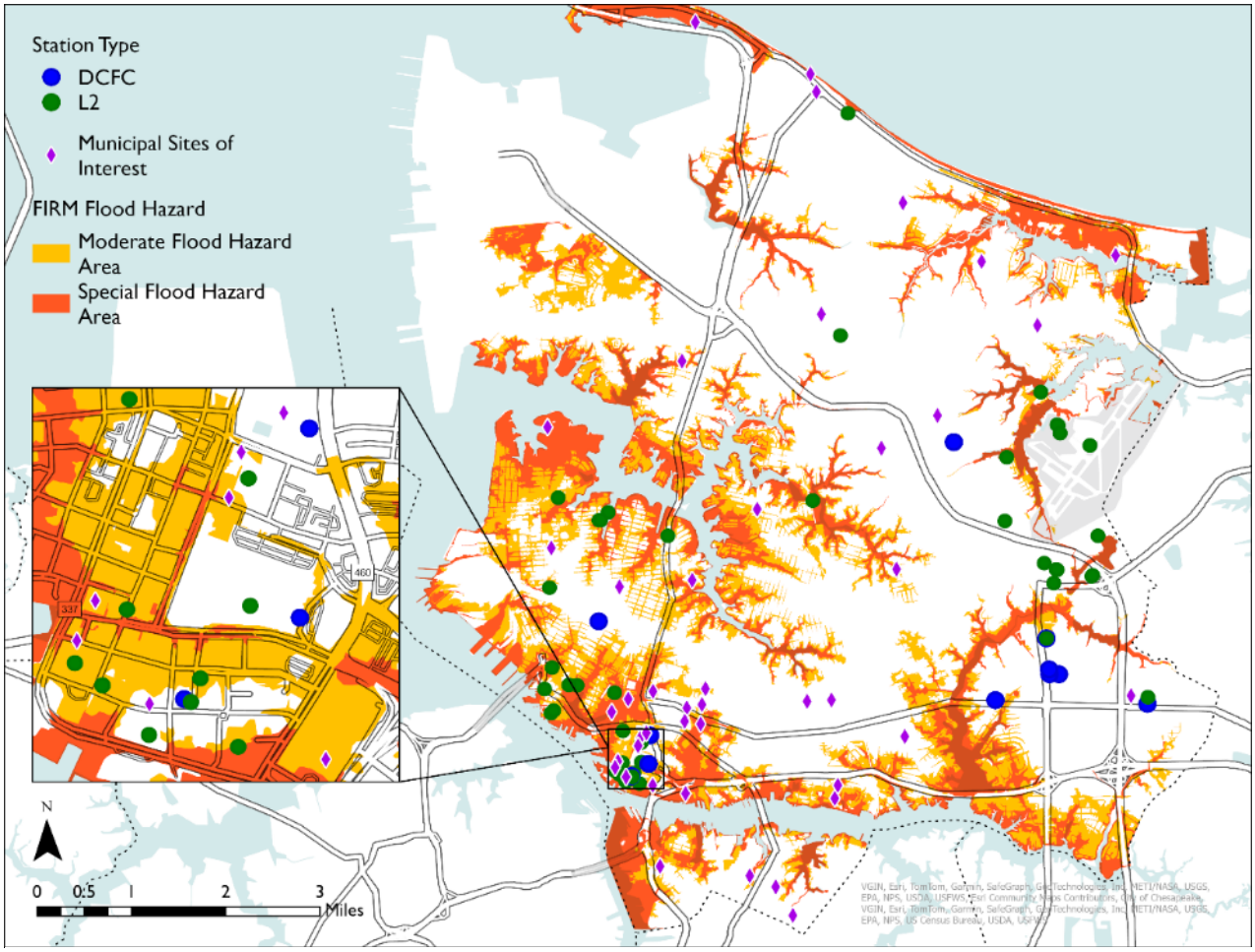


Figure 47. Norfolk floodplains and existing and potential EV charging infrastructure

Strategy 5.2: Integrate EV Charging with Renewable Energy and Energy Storage

A common question about EV charging is "what happens when there is a power outage?" EVs do pose a significant challenge in terms of access to charging when power isn't available, but there are technologies and preparedness strategies that can help overcome some of these obstacles. However, fueling stations in the U.S. are also not able to operate during a power outage situation—so emergency preparedness planning should ensure both ICE vehicles and EVs are adequately fueled prior to an expected extreme weather event.

Integration of renewable energy, such as solar photovoltaics (PV), and energy storage, such as battery systems, is a common practice to improve the resilience of EV charging infrastructure. These technologies offer multiple benefits; they can provide access to power during grid-failure events, they can make EV charging cleaner, and they can reduce cost and reduce peak demand for DCFC charging stations. Solar plus storage systems are flexible enough to be deployed in both residential and commercial settings and sized according to need, offering zero emission vehicle charging.

Deployment of EV charging with battery storage is far more common than integration with renewables. For example, Electrify America has installed over 150 battery storage systems in the U.S.[xxxii] This offers the ability to not only provide EV charging from energy stored in batteries on site when the grid is down, but can also enable the batteries to be charged at night when energy demand is low, then dispatched during peak periods. Battery storage also offers the benefit of reducing peak demand charges by limiting how much electricity is pulled from the grid, which reduces operational costs for the stations.

Figure 48.Example of solar plus energy storage EV charging installation

Source: Beam Global

The City of Norfolk adopted a new zoning ordinance in 2018, Building a Better Norfolk, to promote flood risk reduction, stormwater management, and energy resilience. This includes a resilience quotient system, which offers points for adopting more resilient measures to promote flood risk reduction, including EV charging. In addition to encouraging EV charging infrastructure and renewable energy individually through its resilience quotient standards, Norfolk could further reward EV chargers that are integrated with renewable energy generation or energy storage systems its resilience quotient standards to encourage adoption of these technologies.

Strategy 5.3 Deploy Mobile Charging Solutions

Mobile charging is a relatively new technology. It has the ability to serve many of the same functions as a traditional charging station with several additional capabilities. These charging solutions do not require a permanent grid connection and can be dispatched to operate where they are needed using battery systems. Large mobile chargers can service entire vehicle fleets with reduced fixed infrastructure, while smaller chargers can provide critical range for stranded EVs. Mobile chargers have the added benefit of acting as stored energy sources, offering similar grid-resilience benefits as traditional storage systems. Both Level 2 and DCFC mobile stations are currently available.

Mobile chargers can range significantly in size, but all are designed to be deployed to sites where charging is needed on demand. For example, the Tesla Megapack Mobile Supercharger is a 3.9 MWh battery approximately the size of a shipping container that can provide DCFC charging, and numerous vendors offer mobile L2 charging solutions, which is shown in Figure 49. AAA also now provides EV charging in multiple cities.[xxxiii]

Figure 49. Mobile Charging Solutions

Source: Tesla (left), Lightning eMotors (right)

There are also mobile charging technologies designed to be deployed in extreme weather environments, which can support emergency response and disaster recovery. For example, the Dannar Mobile Power Station can be configured as a 500 kWh mobile charger, which can operate in up to four feet of water and be controlled remotely for extreme environments. As the City applies for federal funding for both EV charging and deployment of resilience infrastructure, it should consider procuring mobile charging technologies, which can aid in both emergency planning and disaster recovery.

Strategy 5.4. Install EV Chargers on Evacuation Routes and Integrate EV Charging into City Emergency Communications Protocols

EV owners in Norfolk may face challenges during emergency events due to lack of access to public charging stations and the longer period of time it takes to charge an EV compared to refueling a gasoline vehicle. This can result in long lines at public EV charging stations, which can create greater risk during evacuations or extreme weather events. Deploying EV chargers along evacuation routes and proactive communication with community members can help mitigate this risk.

Installing more electric charging stations in known evacuation regions and along evacuation routes could allow more evacuees to charge at one time without overloading the charging network. The primary evacuation routes in Norfolk are I-264 and I-64, which currently have limited EV charging infrastructure installed (Figure 50). During evacuations, charging networks are often most stressed at geographies just outside of flooded areas. Strategically installing additional chargers further outside of flood-prone areas may support improved evacuation response. This may also require coordination with other municipalities in the region to ensure charger distribution.

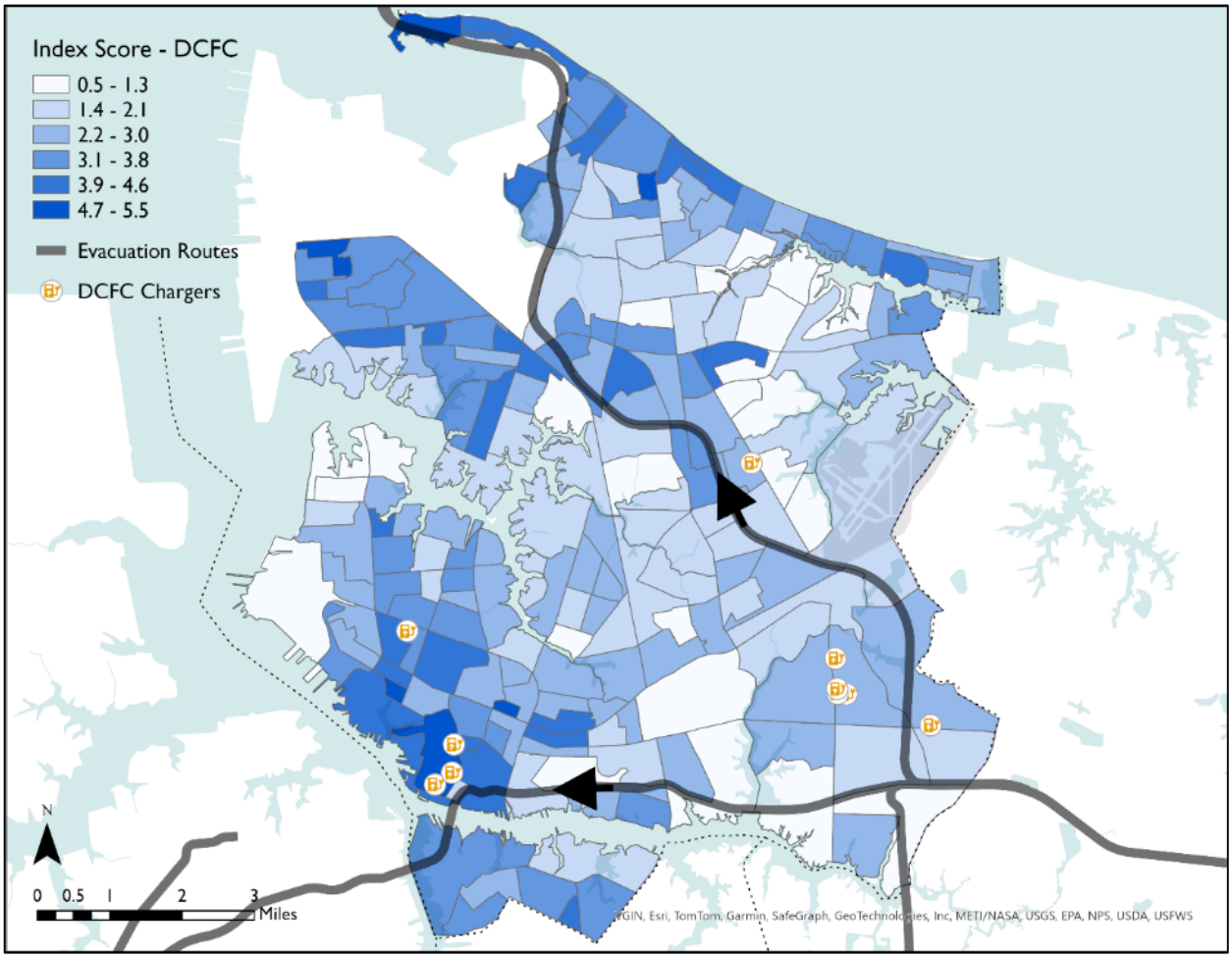


Figure 50. Norfolk evacuation routes, evacuation zones, and existing EV charging sites

Norfolk Alert is an emergency notification system that provides real-time updates on emergencies, weather events, and other critical situations affecting the area. This optional service is provided by the Department of Emergency Management in partnership with local public safety agencies[xxxiv] and distributes information to community members by phone, text, or email. Public messaging, such as recommending residents recharge their vehicle before a storm, can help reduce grid strain. Early and consistent communication with energy utilities could help better prepare the City in case of power shortages or outages.[xxxv] The City should consider amending its emergency response plan to include communicating the following to residents:

- Charging an EV prior to an emergency event can avoid the need to charge during the event.
- Locations of alternative fuel stations, including public DCFC charging stations.
- Emphasize the need to move EVs from flood prone areas to higher elevations, such as municipal parking garages (strategy 5.1).

Focus On: Engagement

Provide residents with information to make informed decisions and be meaningfully involved in transportation planning.

Strategy 6.1: Work Directly with Communities to Identify Needs through Listening Sessions and Surveys and Continuously Integrate Community Feedback

Ensuring equitable access to EV charging infrastructure requires collaboration and an engagement approach that aims to understand communities' needs; specifically, engaging with the disadvantaged communities who have historically lacked quality access to transportation systems. The City should consider working closely with these communities, leveraging the Working Group described in strategy 3.2, to identify priority sites as well as the barriers to and their concerns about EV implementation.

Norfolk should utilize existing relationships built by the City's Neighborhood Engagement team to host listening sessions with each neighborhood. Listening sessions provide an opportunity for residents to share their input and discuss their needs with the project team. To foster trust and openness, it is critical that these sessions be developed and run by those who have strong relationships with

community members. It is also important that the project team is transparent and sets clear expectations about the types of feedback they are seeking from community members based on what they are able to influence. Topics of focus for these sessions could include understanding location convenience, displacement concerns, safety, and employment and economic opportunities and needs for the surrounding community.

As EV charging infrastructure is deployed, the City should continually engage with community members through a bi-annual survey to understand their evolving needs, prioritize additional sites, and assess the overall functionality of charging infrastructure, as well as barriers to EV adoption and charger utilization. The City could leverage existing communication listservs and the relationships built in neighborhoods to reach a broad audience. In addition, the City should ensure that the surveys are accessible (i.e., translated into applicable languages; available online and in-print) and results, as well as a path forward, are made publicly available.

Hosting listening sessions and utilizing surveys can help ensure the deployment of EV charging infrastructure is equitable, affordable, accessible, and reliable to all. In turn, access to transportation and workforce development and job opportunities may increase while reducing exposures to transportation emissions for these communities.

Strategy 6.2: Provide Publicly Accessible Educational Resources and Promote EV Adoption through the City's Website.

Residents who are interested in EVs should have access to information needed to purchase, operate, and maintain an EV, as well as access to vehicle charging as easily as possible. They should also be informed about the environmental benefits of EV ownership.

The City maintains a dedicated EV resource page (Figure 51), which can be expanded to integrate additional resources, tools, and other educational materials that build off of available federal, state, and partner resources. Using a user-friendly interface, the hub should list local EV dealers and charger installation professionals; link to City codes and permitting processes; detail federal and state incentives; overview federal, state, and local grant programs; provide information about workforce development opportunities; and link to relevant outreach events and materials, including surveys and results.

The City has recently added a map that shows all publicly accessible chargers in Norfolk. In the future, this resource could be developed to be mobile friendly and be integrated with public data aggregators such as plugshare.com, which enables drivers to see charger availability in real time. The City should publicize the link to the interactive maps in various marketing and educational resources to promote its use.

Other core elements the information hub could include are:

- Roadmaps, strategy documents, and plans related to EVs and charging in the City.
- EV guidance documents, information about vehicle models, costs, and charging technologies.
- Resources connecting local service providers, such as certified electricians and EVSPs.

- Links to City ordinance, codes, and online permitting processes related to EVs and charging infrastructure.
- Decision-making tools, vehicle comparison charts, and EV checklists.
- Fact sheets describing past or current pilot programs.
- Installation guides for installing home, work, and/or publicly accessible charging stations.
- Maps showing existing or planned EV charging stations.
- Information on workforce training and economic development opportunities.
- Links to federal, state, local, and utility incentives and grant programs.
- Links to presentations, workshops, webinars, and training materials.
- A frequently asked question sheet.

This information hub would help increase the adoption of EVs by disseminating educational information and promoting EVs as more accessible, which can help establish the City as a leader in EV adoption. The hub can also direct residents to community outreach events that may be held that integrate EV education, such as EV Ride and Drive events or e-mobility programs.

Figure 51. Norfolk EV homepage

Strategy 6.3: Hold Education and Outreach Events to Provide Resources to Businesses

Deployment of public charging infrastructure is not limited to large businesses such as grocery stores or big box retail stores. Small businesses will be a critical component of a robust charging network in Norfolk, and commercial corridors offer significant opportunities for EV charging infrastructure

implementation. To continue to encourage the adoption of EVs, the City should host education and outreach events aimed at sharing resources with Norfolk's business community.

Through the Office of Diversity, Equity and Inclusion and Department of Economic Development, the City should leverage existing events and outreach methods to provide information and resources to businesses about EVs. In addition, Norfolk's Commercial Corridor Program, aimed at revitalizing urban commercial corridors and uplifting surrounding communities, presents a unique opportunity to implement EV charging infrastructure. These corridors are located in areas not only with a high density of employment, but also in disadvantaged communities, providing an opportunity to both spur economic development and improve equity in Norfolk (Figure 52).

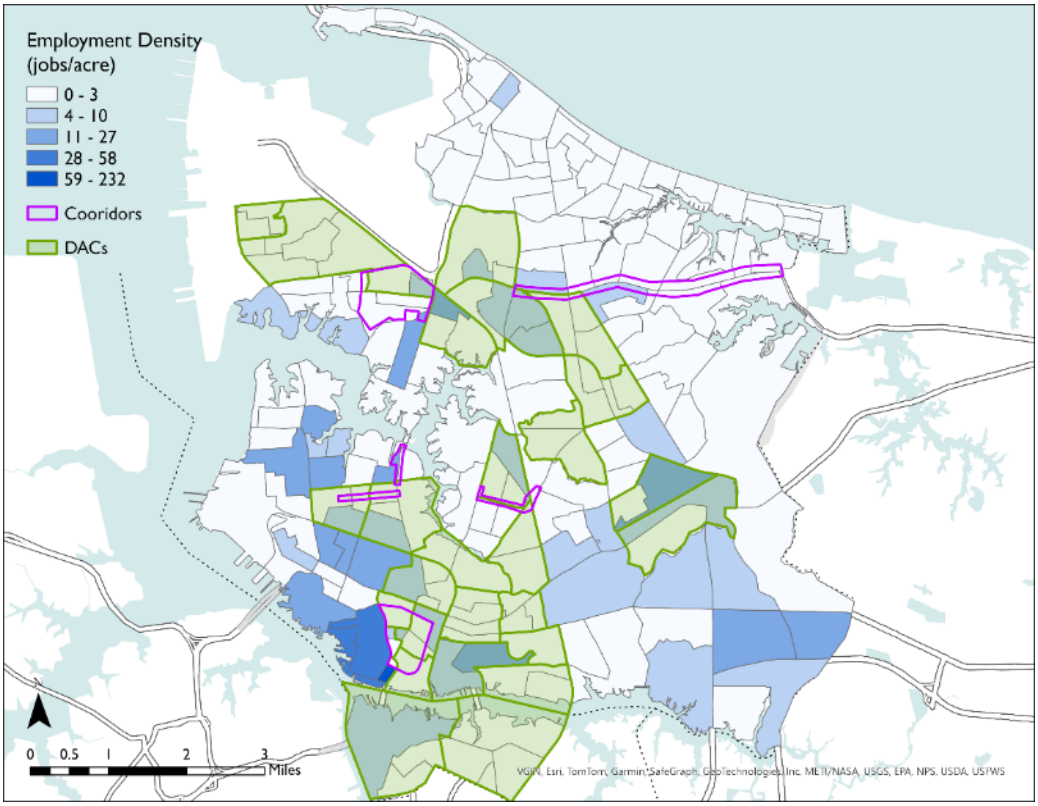


Figure 52. Norfolk commercial corridors, employment density and DACs

Outreach to businesses in Norfolk, particularly small businesses, could help strengthen the area's commercial corridors and incentivize more people to come to these areas The program's outreach materials should include information about EV charging infrastructure, and funding programs could be expanded from façade improvement grants to also include EV charging. Information could include guidance for installation and operation of charging stations, estimated costs and benefits of EV charging, local vendors, federal, state, and utility incentive programs and information on other benefits of EV charging (i.e., attracting patrons).

What are the Next Steps?

EV adoption and charger deployment in Norfolk are in the early stages. This Plan was developed in order to help set a foundation for how the City can prepare for and facilitate the transition to EVs and support its residents, businesses, and visitors who require access to EV charging. The strategies outlined in this Plan are just the first phase of the planning process, and many of these strategies will require ongoing planning, management, and revision over the next decade. However, there are first steps that can be undertaken in the near term that can help the City to achieve its electrification goals.

Focus Area	Strategies
Access	*Strategy 1.1*: Identify Charging Infrastructure Gaps and Identify Priority Site
	Strategy 1.4: Work with Dominion Energy to Further Explore Curbside Charging Applications
Leadership	*Strategy 2.2*: Enact Electrification Strategy for City Fleet
	Strategy 2.4: Create EV Equity Working Group and Set Deployment Targets
Equity	*Strategy 3.1*: Create Stakeholder Engagement Plan and Outreach to Communities
	Strategy 3.3: Establish Equitable Charging Goals
Opportunity	*Strategy 4.1*: Explore Development of Workforce Development Programs
	Strategy 4.2: Develop Application for Federal Funding through the CFI Grant Program
	Strategy 4.3: Provide Permitting Guidance
Resilience	*Strategy 5.2*: Identify Potential Sites for Renewable Energy and Battery Storage
	Strategy 5.4: Integrate EV Charging into Emergency Communications Protocols
Engagement	*Strategy 6.2:* Provide Additional EV Guidance on City Website
	Strategy 6.3: Outreach to Businesses, Including those Located in Commercial Corridors

Appendices

A. Vehicle and Charger Projections
B. Virginia Electric Vehicle Laws and Policies
C. Federal, State, and Utility Funding and Incentive Programs
D. Priority Site List

Appendix A. Vehicle and Charger Projections

The consultant team created projections of BEVs and PHEVs in Norfolk between 2025 and 2045 in Low, Baseline, and High scenarios. The EV population in 2022 was 822 EVs in the City of Norfolk—30% of which were PHEVs and 70% of which were BEVs. To obtain this estimate, the consultant team decoded vehicle identification numbers (VINs) of registration data from the Department of Motor Vehicles (DMV). Additionally, the consultant team assumed that one percent of the 57,000 military members stations at Naval Station Norfolk drove EVs which were not registered within Virginia—or 570 vehicles. Members of the military often bring cars from out of state and are not required to register them with the DMV.

To estimate future EV adoption, the consultant team used projections from the National Renewable Energy Laboratory (NREL) for the Metropolitan Statistical Area (MSA) of Virginia Beach-Norfolk-Newport News.2 Norfolk-specific projections were scaled to the MSA-level projections using the ratio of today's EV population—17.3% of the MSA's EVs are in Norfolk.

The consultant team used a similar methodology to quantify charging needs within Norfolk, using the same NREL dataset. As with the EV population, NREL provides charging needs for the MSA level, not for the City of Norfolk. Thus, the consultant team scaled NREL's charging projections for the MSA by 17.3%, corresponding to the relative fraction of EVs in Norfolk compared to the MSA.

Table 10 provides a breakdown of the number of ports in the City of Norfolk needs to support the EV populations for each scenario in the year 2030.

Table 10. Ports need by 2030 in Norfolk, Virginia

	Baseline	High Growth	Low Growth
Single Family L2 Ports	15,202	19,881	13,907
Single Family L1 Ports	5,736	7,479	5,249
Multi-unit Dwelling L2	243	327	224
Workplace L2	285	426	264
Neighborhood L2	243	319	221
Retail L2	95	136	88
Recreational L2	43	55	38
Public Office L2	120	179	111
Health Care L2	57	82	52
Schools L2	40	57	37
Community Center L2	34	49	33
Transport Hub L2	35	53	33
Retail DCFC-150	31	36	31
Recreational DCFC-150	11	12	11
Retail DCFC-250	25	29	24
Recreational DCFC-250	8	11	8
Retail DCFC-350+	19	29	17
Recreational DCFC-350+	10	13	8

[2] Wood, Eric, and Brennan Borlaug. 2023. "Data Files for "The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure"." NREL Data Catalog. Golden, CO: National Renewable Energy Laboratory. Last updated: December 12, 2023. DOI: 10.7799/1969130.

Appendix B. Virginia State Electric Vehicle Laws and Policies

Table 11. Virginia State Electric Vehicle Laws and Regulations

Name	Summary	Legislation
Aftermarket Electric Vehicle (EV) Conversion Regulations	Any motor vehicle, other than a motorcycle, that has been modified to replace the internal combustion engine with an electric propulsion system must be titled by and registered with the Virginia Department of Motor Vehicles (DMV) as a converted EV. The vehicle must pass inspection and be equipped with the appropriate systems. There is a $15 fee, in addition to any fee imposed for Virginia safety inspection. Converted EVs must be equipped with special equipment, including high voltage cables, a temperature monitoring system for traction batteries other than lead acid batteries, and labeling on three sides of the vehicle identifying it as "Converted Electric."	Virginia Code 46.2-602.3, 46.2-625, and 46.2-1001.1
Alternative Fuel Provider License	Alternative fuel providers, bulk users, and retailers, or any person who fuels an alternative fuel vehicle from a private source that does not pay the alternative fuels tax must obtain an alternative fuel license from the Virginia Department of Motor Vehicles (DMV).	Virginia Code 58.1-2244
Alternative Fuel Tax	Alternative fuels used to operate on-road vehicles are taxed at a rate of $0.262 per gasoline gallon equivalent (GGE). Alternative fuels are taxed at the same rate as gasoline and gasohol (5.1% of the statewide average wholesale price of a gallon of self-serve unleaded regular gasoline).	Virginia Code 58.1-2217 and 58.1-2249
Alternative Fuel Tax Exemption	Alternative fuel is exempt from taxes if it is sold to a government entity for its exclusive use, a non-profit charitable organization for the purpose of providing charitable services for low-income medical patients, or produced by an agricultural operation and used exclusively for farm use or vehicles of that producer.	Virginia Code 58.1-2250
Alternative Fuel Vehicle (AFV) Grant Authorization	Local governments are authorized to establish a green bank to promote investment in clean energy technologies, including AFVs and related infrastructure.	Virginia Code 15.2-958.3:1
Alternative Fuel Vehicle (AFV) Tax Reduction Authorization	Local governments may reduce personal property taxes paid on AFVs and low-speed vehicles. AFVs include vehicles that operate using natural gas, liquefied petroleum gas or propane, hydrogen, or electricity.	Virginia Code 58.1-3506
Electric Vehicle (EV) Charging Station New Construction and Building Renovation Requirement	Any executive branch agency or institution designing new building construction of more than 5,000 square feet, or a renovation that costs more than 50% of the value of the building, must include EV charging infrastructure. EV charging infrastructure must be sufficient to support charging for every centralized fleet vehicle based at that building.	Virginia Code 2.2-1182 and 2.2-1183
Zero Emission Vehicle (ZEV) Infrastructure New Building Requirement for Localities	Any locality designing new building construction of more than 5,000 square feet, or a renovation that costs more than 50% of the value of the building, must include sufficient ZEV charging and fueling infrastructure. The building must be capable of supporting projected ZEV charging and fueling demand over the first 10 years following building occupancy. Alternatively, the building must earn an EV or electric vehicle charging credit from the Virginia Energy	15.2-1804.1

	Conservation and Environmental Standards (VEES), the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) green building rating standard, or the Green Building Initiative's Green Globes building standard.	
Utility Company Electric Vehicle (EV) Charging Station Requirement	Utilities must establish electric distribution grid transformation projects that facilitate the integration of electrical facilities and infrastructure necessary to support EV charging stations. Utilities will petition the State Corporation Commission for program approval and will receive a final order within six months of the petition filing.	Virginia Code 56-576 and 56-585.1
Electric Vehicle (EV) Charging Station Policies for Associations	Homeowners Associations (HOAs) or condominium associations may not prohibit the installation of an EV charging station for personal use within the EV charging station owner's designated parking space. HOAs may establish restrictions on the number, size, placement, manner of installation, and insurance requirements for the EV charging station if it is installed on the exterior of the property or in a common area. HOAs are not liable for the EV charging station. A condominium association may prohibit the installation of an EV charging station if it is not technically feasible or practical due to safety risks, structural issues, or engineering conditions. Condominiums may establish requirements on the manner of installation, architectural design, insurance requirements, and community-related expenses for the EV charging station.	Virginia Code 55.1-1823.1, 55.1-1962.1, and 55.1-2139.1
Electric Vehicle (EV) Parking Space Regulation	Any vehicle that is not actively charging may not park in a designated EV-charging parking space. The penalty for violation is $25. Local governments may issue an additional penalty of up to $25.	House Bill 450, 2022
Electric Vehicle (EV) Rebate Authorization	The Virginia Department of Mines, Minerals, and Energy is authorized to administer a rebate program for the purchase of a new or used EV. Rebates may not exceed $2,500. An additional rebate of $2,000 must be available for residents whose annual household income does not exceed 300% of current poverty guidelines. Eligible used vehicles may not have a purchase price of more than $25,000.	Virginia Code 45.2-1725 and 67-1900 through 67-1907
Public Entity Retail Electric Vehicle (EV) Infrastructure Authorization	Any state government entity, as well as any locality, park authority, public institution of higher education, or school boards, may operate retail fee-based EV charging infrastructure on its property. A locality may restrict use to employees of the locality and authorized visitors and may install signage that details these restrictions. Retail fee-based EV charging provided by state agencies must be offered at rates similar to those in competitive areas. EV charging infrastructure access must be restricted to employees, students, and authorized visitors only during school hours, and must be accompanied by appropriate signage.	Virginia Code 22.1-131, 56-1.2, 56-1.2:1, 56-232.2:1, and 2.2-614.5 and House Bill 443, 2022
Vehicle Acquisition Total Cost of Ownership (TCO) Assessment Requirement	By October 1, 2022, the Virginia Department of General Services (DGS) must identify a publicly available TCO calculator to assess and compare the total lifetime cost of purchasing, owning or leasing, and operating light-duty internal combustion engine (ICE) vehicles and EVs. The calculator must consider vehicle make, model, age, annual mileage, lifespan, depreciation, and capital, maintenance, repair, and infrastructure costs. The TCO calculator must be updated on an annual basis to reflect current prices and vehicle models. Beginning January 1, 2023, DGS and all other state	Senate Bill 575, 2022

	agencies must purchase or lease EVs instead of ICE vehicles if the calculator indicates EVs have a lower TCO. Beginning January 1, 2026, and triennially thereafter, DGS must report estimated cost savings and emissions reductions as a result of purchasing EVs instead of ICE vehicles. Emergency and law-enforcement vehicles are exempt from this requirement.	
Zero Emission Vehicle (ZEV) Infrastructure New Building Requirement for Localities	Any locality designing new building construction of more than 5,000 square feet, or a renovation that costs more than 50% of the value of the building, must include sufficient ZEV charging and fueling infrastructure. The building must be capable of supporting projected ZEV charging and fueling demand over the first 10 years following building occupancy. Alternatively, the building must earn a ZEV or electric vehicle charging credit from the Virginia Energy Conservation and Environmental Standards (VEES), the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) green building rating standard, or the Green Building Initiative's Green Globes building standard.	Virginia Code 15.2-1804.1
Mid-Atlantic Region Electric Vehicle (EV) Support	Virginia joined Maryland, West Virginia, and the District of Columbia (Participating States) in creating the Mid-Atlantic Electrification Partnership (MAEP) to support the deployment of EVs and EV charging stations throughout the region. Participating States commit to creating a regional network of EV charging stations that will make it possible to seamlessly operate light-, medium-, and heavy-duty EVs across transportation corridors and in low-income communities.	MAEP Website
Fuel-Efficient Driving Training	Commonwealth-approved driver education programs must include fuel-efficient driving practices as a curriculum component.	Virginia Code 22.1-205
Alternative Fuel School Bus Regulations	The Virginia Board of Education may not unreasonably limit the authority of any local school division to purchase and use school buses powered by or converted to compressed natural gas or other alternative fuels. The Virginia Board of Education may provide for the display of signs or other markings on school buses using alternative fuels to identify the vehicle as an alternative fuel vehicle and indicate the type of alternative fuel used.	Virginia Code 22.1-177 and 46.2-1089.1
State Energy Plan	Virginia Energy is responsible for creating the Virginia Energy Plan (Plan) to assess the commonwealth's primary energy sources and recommends actions to meet state energy goals. The Plan must include policies to promote alternative fuel use, transportation electrification, efficient driving techniques, and reducing vehicle miles traveled. The Plan must assess statewide electric vehicle (EV) charging infrastructure and consider the impact of statewide policies, EV market projections, and statewide EV registration data to support the state's 2045 net-zero carbon target in the transportation sector. Virginia Energy must submit the Plan to the governor, the State Corporation Commission, and the General Assembly by October 1 of each year following the election of a new governor.	Virginia Code 67-203
Medium- and Heavy-Duty (MHD) Zero Emission Vehicle (ZEV)	California, Colorado, Connecticut, District of Columbia, Hawaii, Maine, Maryland, Massachusetts, Nevada, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, and Washington (signatory states) signed a memorandum of understanding (MOU) to support the deployment of medium-	Action Plan Development Website

Deployment Support	and heavy-duty (MHD) ZEVs through involvement in a Multi-State ZEV Task Force (Task Force). In July 2022, the Task Force published a multi-state action plan to support electrification of MHD vehicles. The action plan includes strategies and recommendations to accomplish the goals of the MOU, including limiting all new MHD vehicle sales in the signatory states to ZEVs by 2050, accelerating the deployment of MHD ZEVs, and ensuring MHD ZEV deployment also benefits disadvantaged communities.	
Zero Emission Vehicle (ZEV) Sales Requirement and Low-Emission Vehicle (LEV) Standards	In January 2024, Virginia adopted the California vehicle emission standards and compliance requirements set forth in the California Air Resources Board Advanced Clean Cars II regulation. These new emissions standards and requirements will begin with model year 2027 and require that 100% of new passenger vehicles sold in Virginia must be ZEVs by 2035.	Virginia Code 10.1-1307.04
Alternative Fuel and Hybrid Electric Vehicle (HEV) Emissions Testing Exemption	Vehicles powered exclusively by natural gas, propane, hydrogen, a combination of compressed natural gas and hydrogen, or electricity are exempt from the Virginia emissions inspection program. Qualified HEVs with U.S. Environmental Protection Agency fuel economy ratings of at least 50 miles per gallon (city) are also exempt from the emissions inspection program unless remote sensing devices indicate the HEV may not meet current emissions standards.	Virginia Code 46.2-1177 through 46.2-1178 and 46.2-749.3

Appendix C. Funding Programs

Table 12. Federal Funding and Incentive Programs

Program	Purpose	Max Award
30C: Alternative Fuel Vehicle Refueling Property Credit	To provide a tax credit for installing qualified vehicle refueling and recharging property in your home or business, including tax exempt entities.	Up to $100,000 or 6% of project costs
45W: Credit for Qualified Commercial Clean Vehicles	To provide a tax credit for businesses and tax-exempt organizations that buy a qualified commercial clean vehicle, including tax exempt entities.	Credit is the lesser value of 30% of the vehicles cost up to $7,500 or $40,000 depending on vehicle weight
Building Resilient Infrastructure and Communities (BRIC)	To invest in and undertake hazard mitigation projects, reducing the risks communities face from disasters and natural hazards.	$50,000,000
Bus and Bus Facilities - Section 3017 (Competitive)	To make federal resources available to states and direct recipients to replace, rehabilitate and purchase buses and related equipment and to construct bus-related facilities including technological changes or innovations to modify low or no emission vehicles or facilities. The competitive Bus and Bus Facilities program includes the Low or No Emission Vehicle Program.	$39,000,000
Bus and Bus Facilities - Section 5339 (Formula)	To make federal resources available to states and direct recipients to replace, rehabilitate and purchase buses and related equipment and to construct bus-related facilities including technological changes or innovations to modify low or no emission vehicles or facilities.	N/A
Capital Investment Grants Program (CIG) - Core Capacity Improvement Program	To invest in substantial corridor improvements in areas that are at or over capacity (or will be within 10 years). This is a robust project development process not geared at maintaining a state of good repair, rather the focus is on increasing corridor capacity by 10% or more.	N/A
Capital Investment Grants Program (CIG) - New Starts	To fund major investments in new or extended fixed guideway public transit systems, including light rail, heavy rail, commuter rail, streetcar, and bus rapid transit (BRT) projects.	N/A
Capital Investment Grants Program (CIG) - Small Starts	To fund major investments in new or extended fixed guideway public transit systems, including light rail, heavy rail, commuter rail, streetcar, and bus rapid transit (BRT) projects. This may include corridor-based BRT systems.	150,000,000

Catalyst Program	To fund economic development and infrastructure projects throughout designated counties in its 4-state service area of Maine, New Hampshire, New York, and Vermont. Revolving loan funds may be used to fund workforce development and job training.	$3,000,000 (infrastructure projects); $500,000 (all other projects)
Charging and Fueling Program Discretionary Grants - Community Program	As part of the Electric Vehicle Charging and Refueling Infrastructure Program at least 50% of this funding must be used for a community grant program "Community Charging" where priority is given to projects that expand access to EV charging and alternative fueling infrastructure within rural areas, low- and moderate-income neighborhoods, and communities with a low ratio of private parking spaces.	$15,000,000
Charging and Fueling Program Discretionary Grants - Corridor Program	To strategically deploy publicly accessible electric vehicle charging infrastructure and other alternative fueling infrastructure along designated alternative fuel corridors.	N/A
Clean Bus Planning Awards	To provide school and transit bus fleets with free technical assistance to develop comprehensive and customized fleet electrification transition plans.	N/A
Clean Energy to Communities Program (C2C)	To connect local governments, tribes, electric utilities, and community-based organizations with national laboratory experts and customized, cutting-edge analysis to achieve clean energy systems that are reflective of local and regional priorities. Programs include In-Depth Partnerships, Peer-Learning Cohorts, and Expert Match.	N/A
Clean Heavy-Duty Vehicles	To support the adoption and deployment of zero-emission Class 6 or Class 7 heavy-duty vehicles.	$60,000,000
Clean School Bus Grant Program	To decarbonize school bus fleets by replacing existing school buses with zero-emission buses and alternative fuel-based buses.	$9,375,000
Clean School Bus Rebate Program	To replace existing school buses with clean, zero-emission models. Rebate applications can request funds for replacing up to 25 buses.	$345,000
Climate Pollution Reduction Grants (CPRG) - Implementation	To implement GHG reduction programs, policies, projects, and measures identified in a Priority Climate Action Plan (PCAP) developed under a CPRG planning grant.	$500,000,000 for general competition; $25,000,000 for Tribes and territories
Community Change Grants Program	To support partnerships of community-based organizations (CBOs) to implement pollution reduction, workforce development, and community engagement projects.	$20,000,000 (track 1); $3,000,000 (track 2)

Diesel Emissions Reduction Act (DERA) National Grants	To achieve significant reductions in diesel emissions and exposure, particularly from fleets operating in areas designated by the Administrator as poor air quality areas.	$4,000,000
Electric or Low-Emitting Ferry Pilot Program	To purchase electric or low-emitting ferries and the electrification of or other reduction of emissions from existing ferries.	N/A
Electric Vehicle Charger Reliability and Accessibility Accelerator	To repair or replace existing, publicly accessible chargers that are listed as "temporarily unavailable" because they are broken or non-operational.	N/A
Low or No Emissions Vehicle Program (Low-No)	To support the purchase or lease of zero-emission and low-emission transit buses, including acquisition, construction, and leasing of required supporting facilities such as recharging, refueling, and maintenance facilities.	N/A
Planning and Local Technical Assistance Program (LTA)	To support economic development, foster job creation, and attract private investment in economically distressed areas by creating and implementing regional economic development plans to build capacity and guide prosperity and resilience.	$300,000
Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Discretionary Program	To improve the resiliency of transportation infrastructure, including community resilience and evacuation route grants, and at-risk coastal infrastructure grants.	N/A
RAISE Discretionary Grants Program	To support investments in surface transportation projects that promote safety, accessibility, mobility, and economic redevelopment.	$25,000,000
RAISE Discretionary Grants Program - Planning	To support planning, preparation, or design— for example environmental analysis, feasibility studies, and other preconstruction activities—of eligible surface transportation capital projects. This can also support the development of master plans, comprehensive plans, corridor plans, and/or risk assessments.	$25,000,000
Surface Transportation Block Grant Program (STBGP)	To provide flexible funding that can preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.	Varies by state

Table 13. Virginia State Funding Programs

Program Name	Description
Virginia Energy	
Electric Vehicle Charging Assistance Program	• Grants are open to EV charging vendors or for collaborations between governments and technology providers. Projects include the installation of EV chargers. • Priority given to brownfields. Focuses on disadvantaged and rural communities as defined by Justice 40. • Up to $1,000,000 in funding available • First round of proposals already closed
Virginia Department of Transportation	
Electric Vehicle Charging Assistance Program	• Under the NEVI Formula Funding Program, VDOT is seeking partnerships with entities interested in establishing, operating, and maintaining EV charging stations along Virginia's Alternative Fuel Corridors (AFCs). • The program offers awards that cover up to 80% of the total project costs, with a maximum award capped at $1,000,000 per NEVI-compliant charging station. This includes both the installation and the operational aspects of the charging station for a minimum of five years from the station's initial operation.
CMAQ Fuel Conversion Incentive Program	• State agencies and local governments in current or former specific air quality non-attainment, ozone attainment and/or maintenance areas may be reimbursed for incremental costs to transition to alternative fuels such as electric, natural gas or propane Autogas. Agencies are encouraged to apply. • Reimbursements are up to an average of $10,000 for the incremental cost of new vehicles or reasonable aftermarket conversions.
Electric Vehicle Charging Station Deployment Grants	• The Virginia Department of Energy offers grants of up to $400,000 to private businesses and public-private partnerships for the installation of EV charging stations in rural or underserved communities. For more information, including additional requirements, see the Virginia Department of Energy EV Charging Assistance Program website.

Table 14. Utility EV Programs – Dominion Energy

Program Name	Description
Residential EV Charger Rewards Program	• Enrollment in EV charger rewards allows Dominion Energy Virginia (DEV) to make remote adjustments to charger's energy use during periods of high demand for electricity. Residents can earn $40 each year for participation. Residents may also qualify for an enrollment bonus of $125 after purchasing charging equipment.
Residential Charger Program	• Enables Dominion Energy Virginia to install EV Charging Stations for up to 1,000 customers • For 100 eligible low-income customers, no costs. • For all other customers, $40.27 per month for 60 months or $1,835.96 upfront
Level 2 Charging Program	• Enables DEV to install, own and maintain make-ready and level 2 charging stations for up to 110 customers • For 10 eligible customers located in low-income community or community of color, no costs. • For all other customers, 50% upfront incentive on EVSE make-ready; customers pay monthly charge for remaining balance for 10 years.
EV Charger Rewards	• The EV charger rewards program incentivizes residential customers for allowing us to leverage their Level 2 EV smart chargers to make adjustments to their charging behavior during periods of high electric demand. • In return, you will receive $40 after you have participated in the program for one year (after your anniversary date).
Dominion EV Savings Calculator	• A tool where potential buyer can evaluate potential cost comparisons and savings between ICE and EVs.
Electric Vehicle Hosting Capacity GIS Map	• Shows EV charging capacity of different locations and facilities on a GIS map.
Dominion EV Charger Finder	• Map locating EV charging infrastructure.
Dominion Electric Vehicle Explorer	• Compares features including price and driving range of various EVs on the market.
Off Peak Plan	• Customers can save money by shifting their energy usage to more affordable off-peak hours. • Could encourage EV owners to charge EVs at off-peak times.
Multifamily EV Charging Guide	• Provides information about installing charging stations in apartments or condominiums. Dominion Level 2 Charging Program also provides a turnkey solution for EV charging at multi-family locations.

Electric School Bus Program	• Provides fast charging solutions to schools who receive electric school bus funding from Federal and state grants.
Fleet Charging Program	• Customers can receive and 50% upfront incentive on EV charging construction and installation. • Customers pay the remaining balance on their monthly bill over 10 years.
EV Capacity Map Tool	• This tool provides information about which parts of the electric grid system may be more suitable for EV fast Charing installations.

Appendix D. Priority Site Inventories

Table 15. All Priority Municipal Sites Across Block Groups

Property Name	In DAC	Property Type	Block Group ID	Level 2 Rank	DCFC Rank
Ocean View Park	No	Park	517100003001	119	48
Southside Aquatic Center/Richard Tucker Library	Yes	Rec/Community Center	517100051004	9	52
Park Place Multipurpose Center	Yes	Rec/Community Center	517100027001	51	142
Bayview Recreation Center	No	Rec/Community Center	517100002021	102	114
Berkley Community Center	Yes	Rec/Community Center	517100050001	95	65
Campostella Center	Yes	Rec/Community Center	517100051002	37	60
Crossroads Recreation Center	No	Rec/Community Center	517100056022	86	41
East Ocean View Community Center	No	Rec/Community Center	517100065024	18	28
Fairlawn Recreation Center	No	Rec/Community Center	517100068001	170	101
Grandy Village Recreation Center	Yes	Rec/Community Center	517100046002	4	49
Ingleside Recreation Center	No	Rec/Community Center	517100064001	179	183
Sherwood Forest Community Center	No	Rec/Community Center	517100061002	172	161
Tarrallton Community Center	No	Rec/Community Center	517100066021	147	178
Captains Quarters	No	Rec/Community Center	517100004001	39	10
Huntersville Community Center	Yes	Rec/Community Center	517100035012	77	119

Virginia Zoological Park	Yes	Zoo	517100029001	73	91
Harrison Opera House	No	Venue	517100040011	177	126
Chrysler Museum of Art	No	Museum	517100040023	17	7
City Hall Complex	No	Office	517100049002	175	143
Harbor Park	Yes	Venue	517100048001	28	20
Barron F Black Branch Library	Yes	Library	517100058002	84	77
Blyden Branch Library	Yes	Library	517100042001	61	74
Jordan-Newby Branch Library At Broad Creek	Yes	Library	517100044003	42	84
Lafayette Branch Library	No	Library	517100021001	158	137
Little Creek Branch Library	No	Library	517100066051	178	155
Mary D Pretlow Branch Library	No	Library	517100003001	119	48
Attucks Theatre	Yes	Venue	517100042001	61	74
Calvert Square Community Center	Yes	Rec/Community Center	517100042002	26	37
Norfolk Fitness & Wellness Center	No	Fitness/Health/Gym	517100015002	72	59
Vivian C Mason Center	Yes	Rec/Community Center	517100042002	26	37
Norview Community Center	Yes	Rec/Community Center	517100059012	54	39
Lamberts Point Community Center	No	Rec/Community Center	517100025001	88	106
Diggs Town Recreation Center	Yes	Rec/Community Center	517100051002	37	60
Chesterfield Pool	Yes	Pool	517100046002	4	49
Bowling Green Park Community Center	Yes	Rec/Community Center	517100044001	97	131
Larchmont Branch Library	No	Library	517100024001	186	185
Bank Street Garage	No	Parking Garage	517100049003	11	1

Boush Street Garage	No	Parking Garage	517100049003	11	1
Cedar Grove Lot	Yes	Parking Garage	517100041001	36	38
Charlotte Street Garage	No	Parking Garage	517100049003	11	1
Main Street Garage	No	Parking Garage	517100049003	11	1
Scope Garage	No	Parking Garage	517100049003	11	1
West Plume Street Garage	No	Parking Garage	517100049003	11	1

Table 16. Potential Sites for CFI Grant Application

Property Name	In DAC	Property Type	Block Group ID	Level 2 Rank	DCFC Rank
Ocean View Park	No	Restrooms	517100003001	119	48
Southside Aquatic Center/Richard Tucker Library	Yes	Pool	517100051004	9	52
Berkley Community Center	Yes	Rec/Community Center	517100050001	95	65
East Ocean View Community Center	No	Rec/Community Center	517100065024	18	28
Sherwood Forest Community Center	No	Rec/Community Center	517100061002	172	161
Tarrallton Community Center	No	Rec/Community Center	517100066021	147	178
Huntersville Community Center	Yes	Rec/Community Center	517100035012	77	119
Virginia Zoological Park	Yes	Zoo	517100029001	73	91
City Hall Complex	No	Office	517100049002	175	143
Harbor Park	Yes	Venue	517100048001	28	20

Jordan-Newby Branch Library At Broad Creek	Yes	Library	517100044003	42	84
Norfolk Fitness & Wellness Center	No	Fitness/Health/Gym	517100015002	72	59
Vivian C Mason Center	Yes	Rec/Community Center	517100042002	26	37
Lamberts Point Community Center	No	Rec/Community Center	517100025001	88	106
Bank Street Garage	No	Parking Garage	517100049003	11	1
Boush Street Garage	No	Parking Garage	517100049003	11	1
Cedar Grove Lot	Yes	Parking Garage	517100041001	36	38
Charlotte Street Garage	No	Parking Garage	517100049003	11	1
Main Street Garage	No	Parking Garage	517100049003	11	1
Scope Garage	No	Parking Garage	517100049003	11	1
West Plume Street Garage	No	Parking Garage	517100049003	11	1

Table 16. Potential Areas for CFI Grant Application

Name	Type	In DAC (%)	Block Group ID(s)	Average L2 Rank	Average DCFC Rank
35th Street	Commercial Corridor	100	517100029001, 517100027003, 517100029004, 517100027001	84	89.5
East Little Creek Road Corridor	Commercial Corridor	11	517100058001, 517100066022, 517100066061, 517100066051, 517100056021, 517100066042, 517100066052, 517100057014, 517100066011, 517100058003, 517100066032,	115.8571	110.5

			517100066041, 517100066063, 517100056022		
Lafayette Corridor	Commercial Corridor	53	517100061002, 517100031001, 517100031003, 517100032001, 517100032003, 517100033002, 517100031002, 517100061001	134.5	132.625
Riverview Village	Commercial Corridor	8	517100029001, 517100028001, 517100028004, 517100029004, 517100028002	120.6	87
St. Paul's Transformation Project	Commercial Corridor	85	517100049003, 517100048002, 517100042002, 517100049002, 517100041001, 517100042001, 517100048001	54	48.57143
Wards Corner	Commercial Corridor	44	517100013002, 517100017001, 517100015002, 517100015001, 517100013001, 517100016001	44.66667	46

[i] Light Duty Electric Drive Vehicles Monthly Sales Updates | Argonne National Laboratory (anl.gov)

[ii] https://www.atlasevhub.com/materials/state-ev-registration-data/#data

[iii] include battery electric vehicles, plug-in hybrid electric vehicles, and fuel cell electric vehicles

[iv] Alternative Fuels Data Center. n.d. "How Do All-Electric Cars Work?"

[v] Alternative Fuels Data Center. n.d. "How Do Plug-In Hybrid Electric Cars Work?"

[vi] Environmental Defense Fund, April 2023. *Electric Vehicle Market Update.*

[vii] Alvey, Rebekah, E&E News. October 18, 2023. "EV prices drop as inventory soars, batteries improve." https://subscriber.politicopro.com/article/eenews/2023/10/18/ev-prices-drop-as-inventory-soars-batteries-improve-00120723

[viii] Department of Energy. n.d. *All-Electric Vehicles.* *https://www.fueleconomy.gov/feg/evtech.shtml#:~:text=EVs%20have%20a%20shorter%20driving,take%203%20to%2012%20hours*.

[ix] VDOT (2023) Carbon Reduction Strategy https://www.transportation.gov/sites/dot.gov/files/2024-04/Virginia%20CRS%20%282%29.pdf

[x] Union of Concerned Scientists. 2023. *How clean is your electric vehicle?* https://evtool.ucsusa.org/

[xi] Union of Concerned Scientists. 2021. *EV Battery Recycling*.https://www.ucsusa.org/resources/ev-batteryrecycling

[xii] Hill et al. Ricardo Energy & Environment. 2020. *Determining the environmental impacts of conventional and alternatively fueled vehicles through LCA*.https://ricardo.com/news-and-media/news-and-press/ricardo-delivers-major-europeanreport-on-the-lifecycle-impacts-of-road-vehicles

[xiii] Plugshare. 2023. https://www.plugshare.com/

[xiv] Nicholas et al. (2019) Quantifying The Electric Vehicle Charging Infrastructure Gap Across U.S. Markets, January 2019. ICCT report https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf

[xv] CSE (2020) https://cleanvehiclerebate.org/

[xvi] 2017-2021 American Community Survey. US Census. https://www.census.gov/programs-surveys/acs

[xvii] For example, see https://vci-mud.org/

[xviii] Wood, E., B. Borlaug, M. Moniot, D.-Y. Lee, Y. Ge, F. Yang, and Z. Liu. 2023. The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5400-85654.

[xix] https://www.oag.state.va.us/media-center/news-releases/2743-june-5-2024-virginia-will-exit-california-electric-vehicle-mandate-at-end-of-year

[xx] In total, 706 individuals responded to the survey, and 659 of those respondents live or work in Norfolk. The survey reached individuals representing every Norfolk zip code and ward.

[xxi] Department of Energy. N.d. *Alternative Fuels Data Center.* *https://afdc.energy.gov/vehicles/search/results?view_mode=list&search_field=vehicle&search_dir=desc&per_page=8&current=true&display_length=25&model_year=2024&fuel_id=41,-1&category_id=27,-1&manufacturer_id=365,490,377,355,211,231,215,223,225,409,379,367,219,478,213,209,351,385,275,361,387,243,227,482,469,479,229,389,239,425,263,217,462,391,349,470,491,383,237,221,483,347,395,493,67,205,117,394,495,415,201,113,5,408,481,9,13,11,458,81,435,474,57,416,141,197,417,121,475,53,397,418,85,414,17,21,143,403,476,492,23,484,398,27,477,399,31,396,489,107,465,487,193,460,35,459,115,37,147,480,199,-1*

[xxii] ACS 2020 5-year estimates, National Housing Preservation Database, 2022

[xxiii] https://about.bnef.com/electric-vehicle-outlook/

[xxiv] https://www.gartner.com/en/newsroom/press-releases/2024-03-07-gartner-outlines-a-new-phase-for-electric-vehicles

[xxv] https://insideevs.com/news/584722/tesla-car-fires-statistic-2021/

[xxvi] https://www.cleanegroup.org/wp-content/uploads/EVs-and-Equity.pdf

[xxvii] https://www.whitehouse.gov/environmentaljustice/justice40/

[xxviii] https://www.transportation.gov/rural/grant-toolkit/charging-and-fueling-infrastructure-grant-program

[xxix] https://www.transportation.gov/bipartisan-infrastructure-law/regulations/2023-03500

[xxx] https://www.norfolkva.gov/norfolkzoningordinance/#Norfolk-ZO/3_9_Overlay_Districts_and_Designations.htm?Highlight=flood

[xxxi] https://www.utilitydive.com/news/urban-flooding-presents-challenges-for-electric-vehicle-charging-stations/626575/

[xxxii] https://www.electrifyamerica.com/renewable-energy/

[xxxiii] https://newsroom.aaa.com/2023/07/update-electrifying-aaa-member-benefits/

[xxxiv] https://www.norfolk.gov/5590/Norfolk-Alert

[xxxv]