Climate Resilient RVA

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RICHMOND, VA METROPOLITAN STATISTICAL AREA

CLIMATE PRIORITY ACTION PLAN

March 2024

Prepared for the U.S. EPA under the Climate Pollution Reduction Grants (CPRG) Program, Section 60114(a) of the Inflation Reduction Act

DISCLAIMER

This project has been funded wholly or in part by the United States Environmental Protection Agency (EPA) under assistance agreement 95317301 to the Richmond Regional Planning District Commission (PlanRVA). The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

PlanRVA, established in 1969 following adoption of the Regional Cooperation Act by the VA General Assembly, is the convener, planner, and shaper of Central Virginia's future. PlanRVA focuses on promoting regional cooperation and collaboration among localities and with the private sector and community organizations to address shared challenges through holistic solutions that sustain regional growth. PlanRVA manages regional programs and initiatives in partnership with affiliate organizations in the areas of community development, emergency management, the environment, and transportation.

This Priority Climate Action Plan (PCAP) for the Richmond, VA Metropolitan Statistical Area (MSA) was developed to meet the requirements of the Climate Pollution Reduction Grants program (authorized under section 60114(a) of the Inflation Reduction Act 60114), and it provides a set of priorities for the MSA that will enable governments and other stakeholder in the region to seek competitive implementation funding through the Climate Pollution Reduction Grants program, Inflation Reduction Act 60114(b).

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Acronyms

ACCII	Advanced Clean Cars II
AEO	Annual Energy Outlook (from EIA)
BAU	Business-as-usual
BEPS	Building Energy Performance Standards
BEV	Battery electric vehicle
CAP	Climate Action Plan
CBO	Community-based organization
CCA	Community Choice Aggregation
CCAP	Comprehensive Climate Action Plan
CEJST	Climate and Economic Justice Screening Tool
CPRG	Climate Pollution Reduction Grants
CVWMA	Central Virginia Waste Management Authority
DEQ	Virgina Department of Environmental Quality
DER	Distributed Energy Resources
EPA DEQ	Diesel Emissions Quantifier
ECH	Empty container handler
eGRID	Emissions and Generation Resource Integrated Database (EPA)
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
DOE	U.S. Department of Energy
EV	Electric vehicle
FCEV	Fuel cell electric vehicle
GHG	Greenhouse gas (emission)
HVAC	Heating, ventilation, and air conditioning
ICEV	Internal combustion engine vehicle
IRA	Inflation Reduction Act
LDV	Light-duty vehicle
LIDAC	Low-Income and Disadvantaged Community
LMOP	Landfill Methane Outreach Program (EPA)
MHDV	Medium and heavy-duty vehicle
MOVES	MOtor Vehicle Emission Simulator (EPA)
MPO	Municipal planning organization
MSA	Metropolitan Statistical Area
MSA	Metropolitan Statistical Area
MSW	Municipal solid waste
NIT	Norfolk International Terminal
NREL	National Renewable Energy Laboratory
PCAP	Priority Climate Action Plan
PDC	Planning district commission
PPA	Power purchase agreement
PPCY	Pinners Point Container Yard
RET	Retrofit
ROB	Replace on burnout
RRTPO	Richmond Regional Transportation Planning Organization
SIT	State Inventory Tool
VCEA	Virginia Clean Economy Act
VDOT	Virginia Department of Transportation
VIG	Virginia International Gateway
VMT	Vehicle miles traveled
VPA	Virgina Port Authority
WARM	Waste Reduction Model (EPA)

Introduction

PlanRVA developed this Priority Climate Action Plan (PCAP) to meet the requirements of the U.S. Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) program. The CPRG program provides funding to states, local governments, Tribes, and territories to develop and implement plans for reducing greenhouse gas (GHG) emissions and other harmful air pollution.

CPRG Program Overview

The Inflation Reduction Act (IRA), signed into law on August 16, 2022, directs federal funding to reduce carbon emissions, lower healthcare costs, fund the IRS, and improve taxpayer compliance. The IRA contains provisions that directly or indirectly address issues related to climate change, including reduction of greenhouse gas (GHG) emissions and promotion of adaptation and resilience to climate change impacts.[1]

The CPRG program, authorized under Section 60114 of the IRA, provides $5 billion in grants to states, local governments, Tribes, and territories to develop and implement plans for reducing GHG emissions and other harmful air pollution. The program consists of two phases: planning and implementation. The planning phase provided $250 million in noncompetitive planning grants for state and local agencies to develop climate action plans (CAPs) to identify emissions reduction measures. The implementation phase provides $4.6 billion for competitive implementation grants to eligible applicants to implement GHG reduction measures identified in a PCAP, which is the first deliverable of a CPRG planning grant.

PlanRVA coordinated with the State of Virginia and the Hampton Roads and Washington, D.C. MSAs in developing this PCAP.

Box 1. Definitions

Greenhouse Gas (GHG): the air pollutants carbon dioxide, hydrofluorocarbons, methane, nitrous oxide, perfluorocarbons, and sulfur hexafluoride.

GHG Reduction Measure: policies, programs, actions, or projects that reduce GHG emissions or enhance carbon removal.

Co-Benefits: positive effects beyond the stated goal of a GHG reduction measure (e.g., improved public health outcomes, economic benefits, and increased climate resilience).

Low-Income Disadvantaged Communities (LIDACs): communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. For the purposes of this report, LIDACs were identified using the Environmental Justice Screening and Mapping Tool and the Climate and Economic Justice Screening Tool. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. Per CPRG, Tribes are also considered LIDACs.

[1] CRS. "Inflation Reduction Act of 2022 (IRA): Provisions Related to Climate Change," October 3, 2022. https://crsreports.congress.gov/product/pdf/R/R47262

PCAP Overview and Scope

This PCAP covers the geographic area outlined in Figure 1. Richmond Metropolitan Statistical Area. The Metropolitan Statistical Area (MSA) is Census-defined and extends beyond PlanRVA's usual geography. The region also includes the following Tribes: Chickahominy, Chickahominy Eastern Division, Rappahannock, Pamunkey, and Upper Mattaponi. The state of Virginia has developed its own PCAP and PlanRVA is coordinating with state CPRG leads at the Virginia Department of Environmental Quality to align GHG reduction priorities.

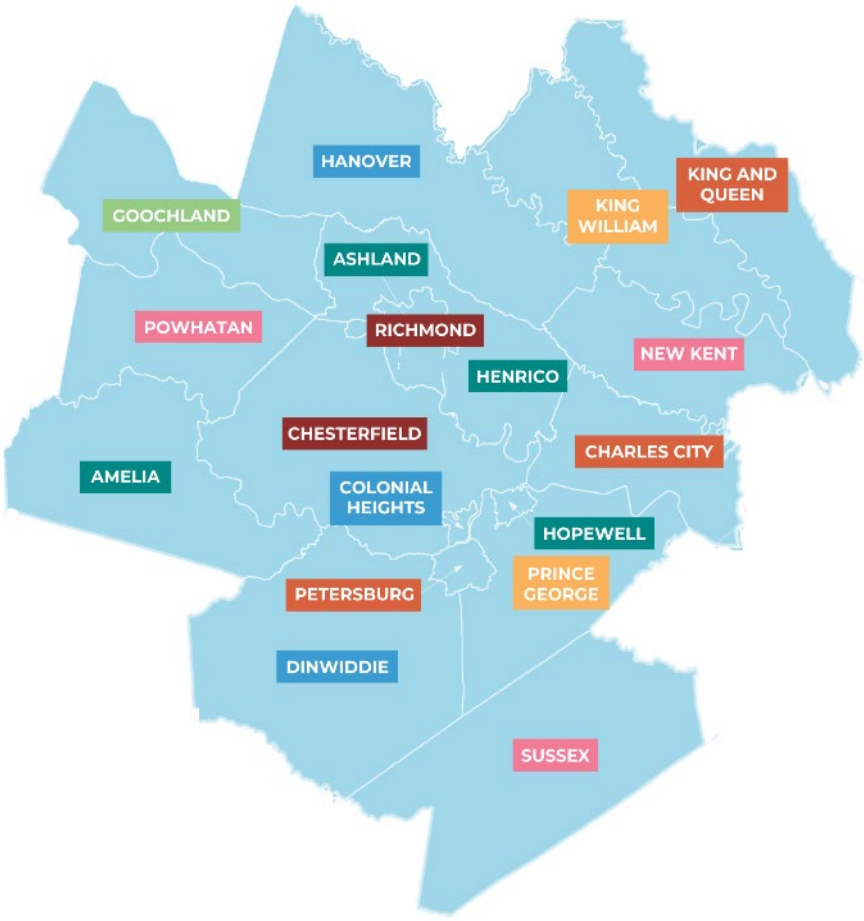


Figure 1. Richmond Metropolitan Statistical Area

This PCAP identifies high priority, ready-to-implement, GHG reduction measures that will provide significant GHG reductions and other benefits to the MSA and the communities within it. A measure being included within the MSA's PCAP is a pre-requisite for eligible agencies and organizations within it to compete for implementation grant funding in the second phase of the CPRG program. Accordingly, the measures identified in this PCAP are designed to be broad enough to encompass regional and local priorities for addressing climate pollution.

The PCAP serves as a starting point for a larger, more comprehensive climate planning effort to be conducted through 2024 and 2025 to develop the Comprehensive Climate Action Plan (CCAP).

PlanRVA has included within this PCAP the information outlined below in Table 1. In this table, the location of each piece or type of information required for the PCAP is also identified.

Table 1. Location of CPRG PCAP Requirements in this PCAP

PCAP Required Elements	PCAP Section
GHG Inventory	Simplified GHG Inventory and Appendix C. Richmond MSA GHG Inventory and BAU Projections
Quantified Priority GHG Reduction Measures	Priority Climate Action Plan Measures and Appendix D. Approaches for Quantifying GHG Reductions from PCAP Measures
Low-Income and Disadvantaged Community (LIDAC) Benefits Analysis	Richmond LIDAC Identification and Appendix B. Identification of LIDACs in Richmond MSA Climate Risks to Metropolitan Richmond's LIDACs PCAP Measure LIDAC Impacts Summary LIDAC Engagement
Benefits Analysis	Priority Climate Action Plan Measures
Review of Authority to Implement	Priority Climate Action Plan Measures
PCAP Encouraged/Not Required Elements	
GHG Emissions Projections	Appendix C
GHG Reduction Targets	Will be addressed in the CCAP
Intersection with Other Funding	Will be addressed in the CCAP
Workforce Planning Analysis	Will be addressed in the CCAP

Approach to PCAP Development: Stakeholder Engagement

During the PCAP development, PlanRVA conducted significant outreach and engagement with stakeholders and community representatives throughout the greater Richmond MSA with an emphasis on connecting with those communities most impacted by air pollution.

Specific outreach efforts included the creation of a digital public relations toolkit, email and personal outreach to an extensive list of local media (print, TV and radio, and digital), and individual outreach to more than 50 local and regional community organizations that regularly engage with local and regional communities.

Active engagement has included stakeholder phone calls and meetings; in-person "intercepts," focus groups, and conversations with residents; a detailed online survey targeting residents throughout the region; and coordination between PlanRVA and local and regional community leaders to ensure that both regional perspectives and local needs are reflected in the plan.

These activities are summarized in Table 2 below.

Table 2. Public Engagement and Outreach Summary

Date	Outreach Type	Stakeholders	Summary Activity	Summary Metrics
January 19, 2024	Outreach Email	Community and Nonprofit Organizations serving LIDACs	An initial email was sent to 55 organizations with an overview of the climate mitigation initiative and 5 specific ways to stay engaged or support the effort.	27 organizations responded with requests for more details.
January 31, 2024	Zoom Meeting	11 Community and Nonprofit Organizations	A one hour Zoom overview of the climate mitigation initiative and the five specific ways their organizations could stay engaged or support the process.	Participants expressed an interest in receiving updates going forward and in sharing the survey with their stakeholders and in the possibility of helping organize focus groups or engagement activities in the year ahead.
January 23 – February 7, 2024	Individual Meetings	9 Community and Nonprofit Organizations	Individual discussions about engagement possibilities, including focus groups and intercepts.	All organizations were interested in an active role going forward. One focus group and three intercept opportunities were initiated.
February 1 – 9, 2024	In-person intercepts	Residents of LIDACs in Richmond and Hopewell	In-person engagement of residents outside of three libraries, including a brief 5-question survey.	39 residents completed the survey.
January 19 – February 9, 2024	GHG Emissions Survey	MSA-wide communities	A survey was distributed in English and Spanish to engage the broader community, and to gather perspectives and insights on the ways in which airborne pollution is visibly impacting residents – and to gather their initial ideas on ways to mitigate pollution in their neighborhood.	More than 800 residents completed the survey, and more than 300 of them provided contact information to stay engaged in the process.
January 14 – onward	Website	MSA-wide communities	Main regional CPRG website that includes project updates, stakeholder news, and email contact. Website was also linked to the CPRG GHG Emissions Survey.	1,400 visits from users from January 14 to February 10.

Date	Outreach Type	Stakeholders	Summary Activity	Summary Metrics
December 15, February 2, and February 16, 2024	CPRG Steering Committee Meetings	MSA Localities	Locality representatives were presented with the project plan, methodology, preliminary data, public feedback results, and the draft PCAP report. Reduction measure and implementation grant ideas were solicited through active discussion.	Members provided input and feedback on the GHG reduction measures, stakeholder engagement, and the PCAP report.

Stakeholder Engagement

CPRG Steering Committee. PlanRVA formed a CPRG Steering Committee to advise on GHG emissions reduction priority projects, programs, and measures. Committee members include high-level staff from localities and from neighboring planning district commissions (PDCs) with localities included in the Richmond MSA. The priority projects provided by these groups informed the measures included in this PCAP. Steering Committee meetings were held from December 2023 through February 2024. Committee members reviewed PCAP and CCAP requirements, reviewed implementation grant evaluation criteria, held discussions on prioritizing projects, programs, and measures, and informed broader stakeholder engagement activities. The Committee will continue to meet to advise on the CPRG program through 2027, when the program concludes.

Industry, Government Partners, and Stakeholders. PlanRVA met with stakeholder groups not already represented by the Steering Committee including the Central Virginia Waste Management Authority (CVWMA), Greater Richmond Transit Company (GRTC), and EPA Region 3 Regional Tribal Operations Committee along with other tribal staff. We also met with other regional grantees to coordinate the state and MSA PCAPs, including VA Department of Environmental Quality, Metro Washington Council of Governments (MWCOG), and Hampton Roads PDC (HRPDC).

Community Engagement

Identification and Initial Outreach. In the development of the PCAP, the primary focus was two-fold: to engage the broader regional population (through media awareness and survey) and to connect with community organizations most engaged in the region's LIDACs to explore ways to collaborate going forward.

PlanRVA began by developing a list of the community-based organizations (CBOs) it knew served residents in the LIDACs most impacted by transportation- and waste-related air pollution. That initial list grew to 55 organizations, each of which was contacted by email with information about the CPRG and a request to collaborate going forward. In the end, 27 organizations responded with an interest in learning more about the CPRG and in further engagement. PlanRVA hosted a virtual meeting with 11 of the organizations and met individually with 9

organizations, providing an overview of the CPRG program and discussing opportunities for immediate support for the PCAP (e.g., sharing the community survey) as well as longer-term collaboration for engagement support during the CCAP process. Additional information on these meetings and organizations can be found in Appendix A.

Website. The Climate Resilient RVA (ClimateResilientRVA.org) website was designed to provide an initial starting point for all outreach and engagement efforts. It provides basic information about the CPRG program and development of the PCAP, including local media coverage of the initiative. The website has been a critical part of the outreach efforts, providing local media and community partners with a starting place to understand the key phases of the CPRG and PCAP. From January 14 to February 10, the website received more than 1,400 visits from users. The website directed visitors to the community survey (discussed below), included a Spanish-language page, and provided a general email contact.

GHG Emissions Community Survey. PlanRVA developed an online survey to quickly engage the broader community and generate initial perspectives on the community's experiences with air pollution from transportation and waste. Over three weeks in January and February of 2024, more than 800 residents responded, representing 17 of the 18 localities. More than a third of respondents indicated a desire to remain engaged going forward. The survey was available in both English and Spanish and was well-publicized across the region through outreach and engagement efforts. Over half of the survey respondents provided specific feedback in response to being asked for "one project idea" they would like to see completed in their community "to address pollution from transportation sources or waste." Individual responses were recorded and broad themes communicated to the Steering Committee. Desiring safer and more reliable public transportation options and addressing litter and plastic pollution were common threads in the open-ended question responses.

Shorter, in-person surveys were also conducted with 39 residents during intercepts outside of three local libraries serving LIDACs in the cities of Hopewell and Richmond.

Media Outreach. The success described above was made possible in part by a robust media strategy. For the PCAP, the media outreach focused on traditional media (print, television, and radio), an increasing regional portfolio of hyper-local Internet news sites, and social media platforms. Multiple local Internet news sites were also engaged to leverage their social media connections and daily e-news mailings to connect an increasingly diverse audience of people who care deeply about what is happening in their neighborhood. News outlets that covered the community engagement process included RIC Today, Good Morning RVA, Black Virginia News, RVA Hub, and the Commonwealth Times.

Social media/digital outreach: The team invested in social media advertising to promote the website and survey to people living within the Richmond MSA. The English-language ad set resulted in 451 link clinks and 35,000 post impressions. Another Spanish-language ad set included 205 link clicks and 25,000 post impressions. Local jurisdictions within the MSA also shared information about the survey on Facebook and Instagram channels, as well as in newsletters

LIDAC Engagement

A central component of the PCAP engagement strategy involved leveraging existing relationships, building new relationships, and creating meaningful space for the voices of residents and other stakeholders to be amplified and heard to help shape initiatives that can have a tangible impact on the community. PlanRVA conducted outreach across a range of stakeholders and communities, including with the five tribes in the MSA. PlanRVA looks forward to renewed and deeper engagement and partnership opportunities with Tribes during the CCAP process.

While many of the above discussed PCAP outreach and engagement activities did not specifically target LIDACs, emphasis was placed on reaching a diverse and varied audience (e.g., through multilingual documents). To engage with LIDACs more specifically during the limited timeframe, in-person outreach was conducted near libraries serving LIDACs to supplement the online community survey. The survey was available in Spanish as well as English, and 34% of respondents reported income below statewide median income levels. Looking forward to the CCAP process, PlanRVA is committed to increased engagement with residents most impacted by air pollution and climate change in ways that are transparent, equitable, and accessible.

Continued Engagement

During the PCAP development, PlanRVA strove for inclusivity and strengthening relationships with neighboring PDCs, localities, regional authorities, Tribes, and CBOs. As indicated above, PlanRVA will build on this work during CCAP development. A main focus going forward will be working with our local partners to create meaningful spaces for high school and college-aged community members, those who live and work in the LIDACs that are most impacted by air pollution and least able to respond to climate change impacts, and the CBOs most invested in supporting the most marginalized corners of the community. By bringing these voices to the center of the conversation about emissions, climate change, and community, residents will have an opportunity to shape the changes that will improve the quality of their communities. Surfacing their concerns in ways that help address historical and systemic environmental injustices—the result of historical *de jure* and *de facto* practices and policies—is essential for moving forward together.

PlanRVA also plans to leverage the website to create a vital resource for everyone in the Richmond region interested in tracking activities and data related to the CCAP and broader efforts in the region to tackle climate change. The website will be updated throughout the CCAP process in 2024 and 2025 to include GHG inventory data, project-specific information, opportunities for input and feedback, and other details on the planning and implementation of this work. PlanRVA also anticipates that the website will be increasingly leveraged to drive public engagement, grow awareness around other local efforts to reduce GHG emissions, and publicize engagement events and activities that will provide the public with specific ways to engage and shape the work locally and regionally, including additional surveys. PlanRVA expects to develop one or more community surveys to support the development of the CCAP and to increasingly engage residents in a dialogue about change in their neighborhoods and communities. Listening sessions, intercepts, and collaborations with neighborhood

organizations are tools PlanRVA will likely use during CCAP development. The response to the initial PCAP survey exceeded expectations and indicates that the broader community is eager to be engaged in a discussion about GHG emissions and climate change and to help shape regional efforts to improve their communities.

Approach to PCAP Development: Priority GHG Reduction Measures

PlanRVA used a multi-step process to develop priority GHG reductions measures identified in this PCAP, as outlined in Figure 3. Stakeholder engagement activities (discussed above and below) were done continuously throughout this process.

Figure 3. Approach to developing the Richmond MSA PCAP

1. PlanRVA used multiple mechanisms to collect ideas for GHG reduction priorities across the MSA. PlanRVA reviewed existing plans and climate actions and policies across the region, held a working session with Steering Committee members, distributed a community-wide survey, and conducted calls and listening sessions with stakeholders (see Appendix A for more information). PlanRVA also created a website with an option to provide comments.[2]
2. PlanRVA compiled information from existing plans and responses from the Steering Committee and other stakeholder conversations and filtered them for relevance for the CPRG program goals. PlanRVA then grouped similar ideas by relevant sector and theme (e.g., vehicle electrification or active transportation) to form broader GHG reduction measure categories that could be readily implemented.
3. The draft list of GHG reduction measures was shared with the Steering Committee and local governments for review. Specifically, PlanRVA asked for a review and feedback to identify any potential gaps reviewers saw in line with their priorities, especially related to CPRG implementation grants. Using this feedback, PlanRVA finalized the list of GHG reduction measures presented in this PCAP. PlanRVA also coordinated with other MSAs and the state to ensure alignment where needed for potential coalition implementation grant projects.
4. After developing a consolidated list of measures and sharing for review, PlanRVA worked internally with its contractors and with other local governments and stakeholders to develop the required information for each measure, such as quantified GHG reductions, authority to implement, LIDAC benefits analysis, and other information (e.g., available funding and key implementors). Additional information on quantification of GHG reductions may be found in Appendix D.

[2] http://www.ClimateResilientRVA.org

5. PlanRVA drafted the PCAP using information from the previous steps and shared a version with the CPRG Steering Committee for review and feedback, which was incorporated into the final PCAP report.

Richmond's Climate Context

Simplified GHG Inventory

Prior to this effort, the Richmond MSA did not have a GHG inventory representing all cities and counties, nor had most localities ever inventoried their own emissions. For the PCAP, a simplified GHG inventory was completed covering key sources of emissions for the Richmond MSA. The simplified inventory sectors represent all the priority GHG reduction measures.

Looking forward to the CCAP, PlanRVA will conduct comprehensive community-wide emissions inventories covering all sectors and pollutants, including industry, electricity generation and/or use, transportation (on- and off-road), commercial and residential buildings, agriculture, natural and working lands, and waste and materials management. Other GHGs (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) will also be included, along with a co-pollutant analysis (e.g., fine particulate matter, nitrogen oxides, sulfur dioxide, volatile organic compounds, air toxics, etc.).

The PCAP simplified inventory assesses the GHG emissions for 2019 from the buildings, on-road transportation, ports, and waste generation sectors. A simplified 2019 inventory was also compiled for GHG emissions from local government operations. In addition to the GHG inventories, business-as-usual (BAU) projections were drafted from 2019 through 2050. Appendix C discusses the methodology for both the development of the simplified 2019 GHG inventory and the BAU GHG projections for each sector out to 2050.

The inventory and projections were prepared using the following data and resources:

- EPA's Landfill Methane Outreach Program (LMOP) Landfill and Project Database
- EPA's Facility Level GHG Emissions Data
- US Census Bureau Population Data
- Virginia State Inventory Tool (SIT) GHG Inventory
- North Carolina SIT GHG Inventory
- Port of Virginia GHG Inventory
- Municipal building emissions and fuel usage data from Henrico County
- Municipal fuel usage data from Hanover County
- Municipal fuel usage data from Chesterfield County
- Municipal building and vehicle fleet emissions data from Richmond City

Buildings. The buildings sector consists of direct fuel use emissions and indirect electricity use emissions for residential, commercial, and industrial buildings.

On-Road Transportation. The transportation sector consists of on-road mobile source emissions and electricity consumption emissions.

Off-Road Transportation (Ports). This sector consists of emissions from ocean-going vessels, cargo, and other operations at the Richmond Marine Terminal.

Waste Generation. This sector covers landfill emissions data for all facilities within the Richmond MSA.

Municipal Operations. The Municipal Operations sector consists of direct fuel use and indirect electricity use emissions from municipal buildings (including schools) as well as emissions from municipal vehicle fleets.

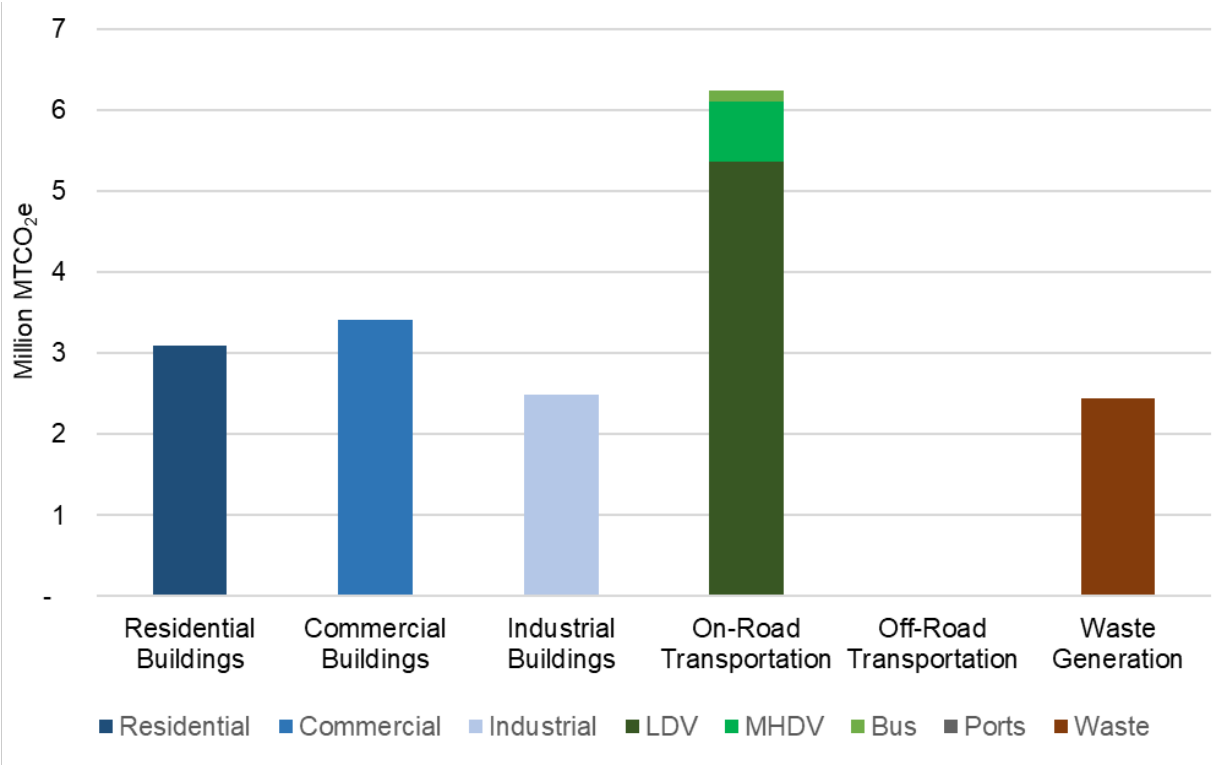
Table 3, Figure 4, and Figure 5 below show the results of the simplified GHG inventory for the Richmond MSA across the sectors assessed in metric tons of carbon dioxide equivalent ($MTCO_2e$). Building sector emissions data are broken down by direct emissions (on-site fuel use) and emissions from purchased electricity. On-Road Transportation sector emissions data are broken down by vehicle type. The waste generation sector reflects emissions from municipal solid waste that was landfilled in 2019. GHG emissions from municipal operations are a subset of the broader community-wide emissions in the building and on-road transportation sectors and reflect GHG emissions from government, public, and school buildings and vehicle fleets. Appendix C discusses the methodology for both the development of the simplified 2019 GHG inventory and the BAU GHG projections for each sector out to 2050.

Table 3. Simplified GHG Inventory Results from the Richmond MSA

TOTAL EMISSIONS BY SECTOR ($MTCO_2e$)	**2019**
Total Buildings	**8,990,990**
Residential - Direct	944,510
Commercial - Direct	923,379
Industrial - Direct	1,683,599
Residential - Electricity	2,146,725
Commercial - Electricity	2,483,230
Industrial - Electricity	809,547
Total Transportation	**6,234,586**
Light Duty Vehicles	5,355,146
Medium- and Heavy-Duty Vehicles	745,571
Buses	124,267
Motorcycles	9,108
Total Ports	**10,890**
Total Waste Generation	**2,440,482**
Landfill Emissions	2,440,482
Total Emissions	**17,676,948**

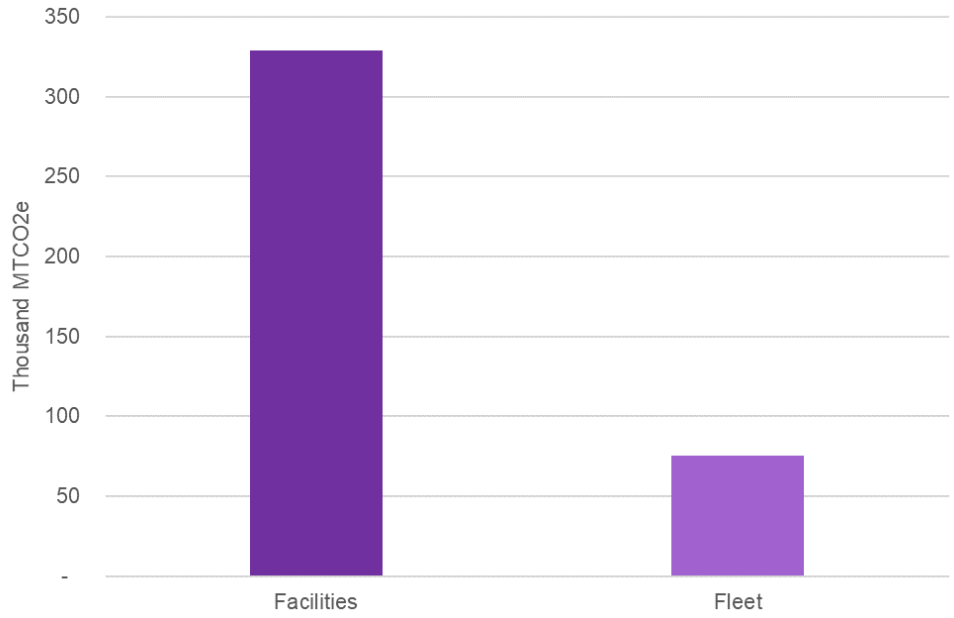
Total Municipal Operations	**404,432**
Municipal Facilities	329,110
Municipal Vehicle Fleet	75,322

Figure 4. Richmond MSA Simplified Community GHG Inventory Results by Sector, 2019



Note: Emissions from ports (off-road transportation) are too small to be seen in Figure 4.

Figure 5. Richmond MSA Simplified Municipal GHG Inventory Results by Sector, 2019



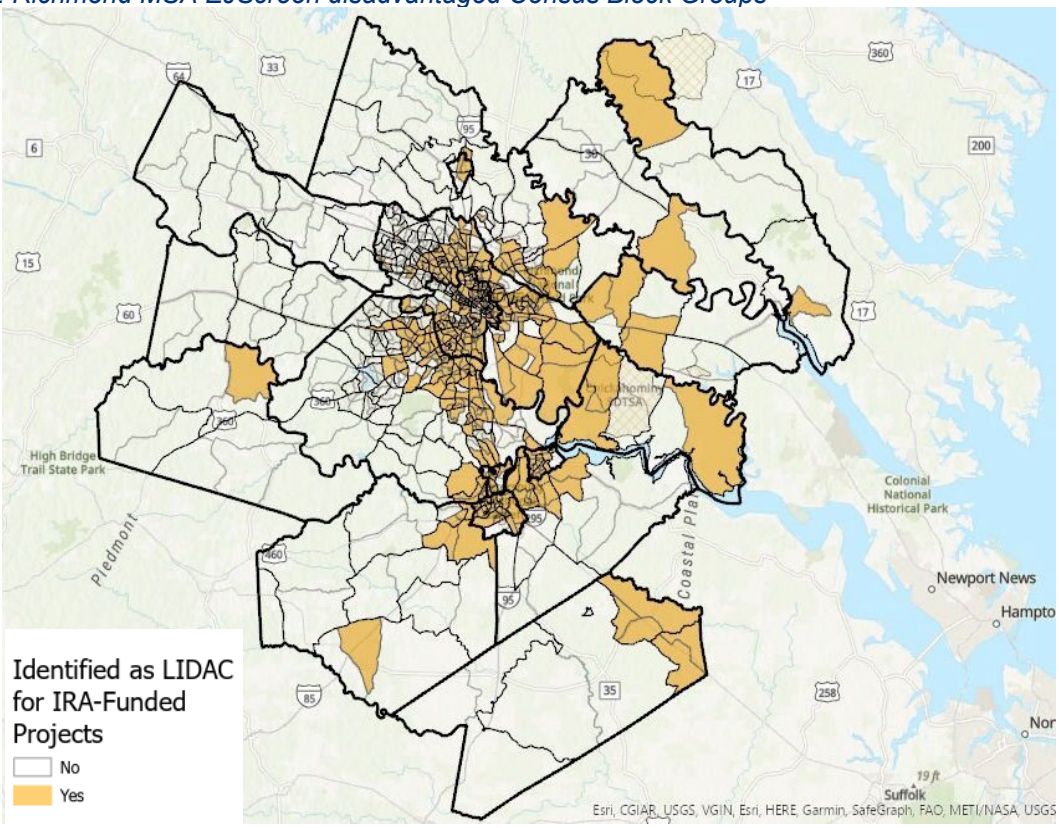
Richmond MSA LIDACs

A core component of the CPRG and much of the IRA is to provide benefits to LIDACs as these communities are particularly vulnerable to risks and impacts from climate change. Per CPRG requirements, this section identifies LIDACs in the state by Census Block ID using EJScreen (an EPA environmental justice screening tool), discusses the climate risks for LIDACs within the Richmond MSA, and presents how PlanRVA has meaningfully engaged with LIDACs in the development of this PCAP and how it will continue to engage these communities in the future.[3]

Richmond LIDAC Identification

PlanRVA utilized EJScreen to visualize and identify Census Block Groups that the EPA designates as disadvantaged in the state (see Figure 6). In Richmond, 52% of the population is located within a disadvantaged Census Block Group. Out of the 890 Census Block Groups, 500 are considered disadvantaged according to EJScreen (or 56%). A full listing of the Census Block IDs that are identified as LIDACs in Richmond is included in Appendix B.

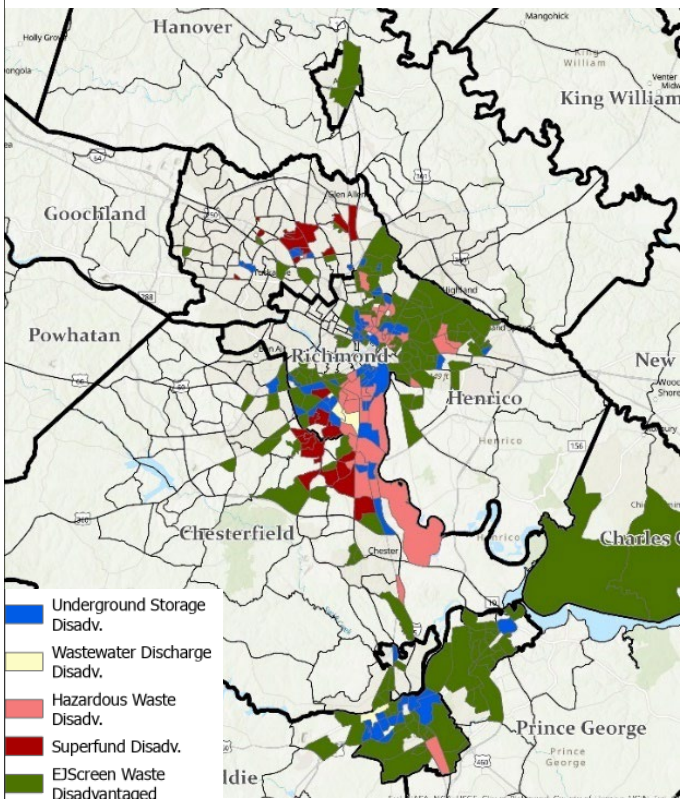
Figure 6. Richmond MSA EJScreen disadvantaged Census Block Groups



[3] The EPA defines a disadvantaged community in the following manner: 1) if it is disadvantaged according to the Climate and Economic Justice Screening Tool (CEJST); 2) if the census block is at or above the 90th percentile for any of EJScreen's Supplemental Indexes compared to the nation or state; 3) any geographic area within Tribal lands and indigenous areas as included in EJScreen.
U.S. EPA Office of Air and Radiation. "Climate Pollution Reduction Grants Program: Technical Reference Document for States, Municipalities and Air Pollution Control Agencies. Benefits Analyses: Low-Income and Disadvantaged Communities," April 27, 2023. https://www.epa.gov/system/files/documents/2023-05/LIDAC%20Technical%20Guidance%20-%20Final_2.pdf.

Because the PCAP focuses on the waste and transportation sectors, per feedback from the Steering Committee and other stakeholders (see Appendix A), Plan RVA also analyzed specific EJScreen indicators related to these sectors.

Figure 7. EJScreen Waste Disadvantaged Census Blocks in Richmond MSA, overlayed with Waste-Related Disadvantaged designations from CEJST



Using EJScreen, PlanRVA identified Census Block Groups that were specifically disadvantaged for waste-related reasons (symbolized green in Figure 7). In addition, PlanRVA overlayed waste-disadvantaged data from the Climate and Economic Justice Screening Tool (CEJST), providing a broader look at certain types of potential waste concerns, including communities with superfund or hazardous waste sites.[4] This information will help direct CCAP engagement and overall implementation efforts related to waste programs, as not all communities disadvantaged for waste-related reasons are designated as LIDACs, but they do face unique issues with potential air and water quality concerns.

As can be seen in Figure 8 below, a bivariate analysis of particulate matter 2.5µm (PM2.5) exposure and the demographic index shows that the urban center and surrounding areas of Richmond stand out as areas of concern. Particulate matter pollution comes primarily from burning gasoline and diesel in internal combustion engine vehicles. The combination of high PM2.5 exposure and the concentration of disadvantaged communities highlights an environmental justice challenge in Richmond MSA. The adverse health effects associated with prolonged exposure to PM2.5, such as respiratory issues and cardiovascular diseases, are exacerbated in these communities, where access to healthcare and resources may already be limited.

[4] EJScreen considers communities identified as disadvantaged in CEJST as one of its criteria. If a community is labeled as disadvantaged in CEJST, it is also recognized as disadvantaged in EJScreen.

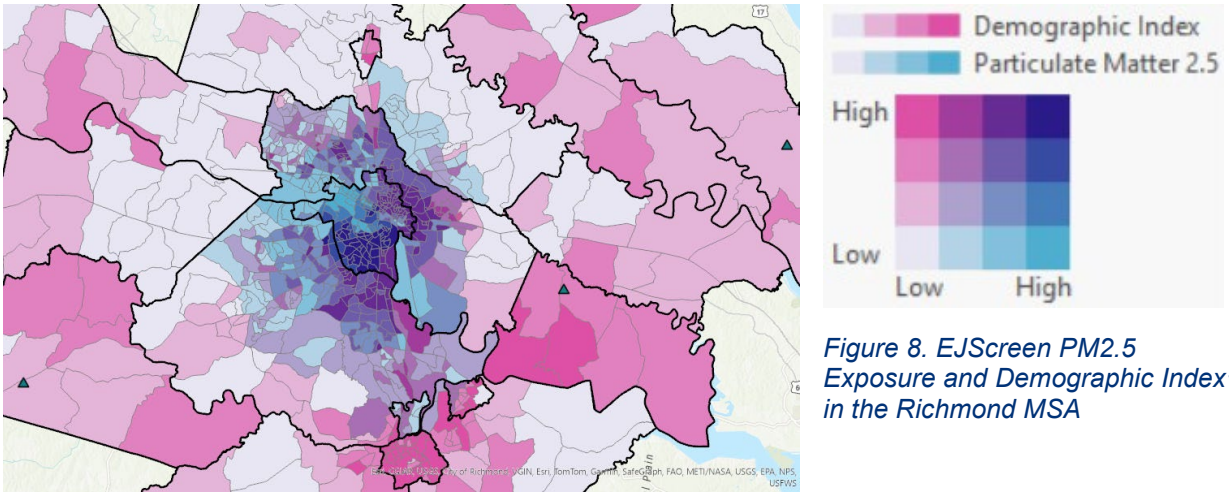


Figure 8. EJScreen PM2.5 Exposure and Demographic Index[5] in the Richmond MSA

Climate Risks to Metropolitan Richmond's LIDACs

Social systems inequitably distribute negative impacts from climate risks on Black, Indigenous, and People of Color (BIPOC) individuals and communities, low-income households, unhoused individuals, rural communities, and agricultural workers. Not only do these communities experience the most severe impacts of climate change, but they are also the least able to prepare for and respond to these impacts due to a lack of resources and socio-political power. According to a 2021 EPA analysis, racial and ethnic minorities are particularly vulnerable to climate change impacts, especially Black and African American individuals.

Due to limited access to resources, such as adequate infrastructure and insurance, minority and low-income communities are more likely to suffer the consequences of climate change with heightened exposure to climate risks. Many factors contribute to this inequality, including historical discriminatory practices in housing, education, and employment. Pre-existing health status and living

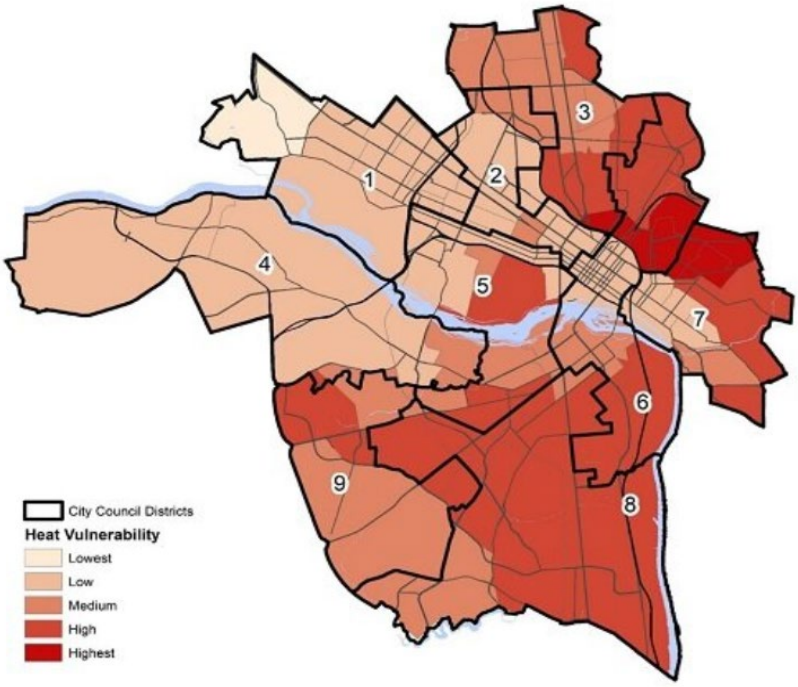
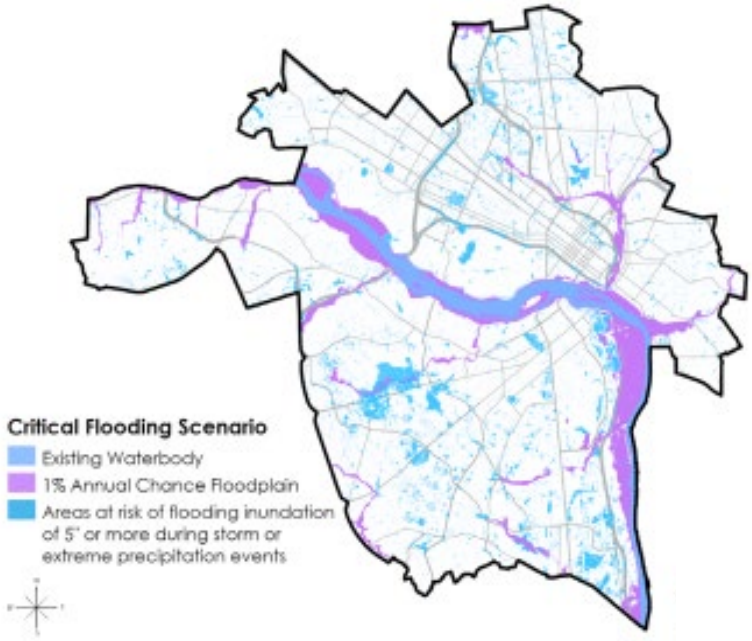


Figure 9. Heat vulnerability by census tract (RVAgreen 2050 Climate Equity Index, 2019)

[5] The Demographic Index in EJScreen is a combination of percent low-income and percent minority.

conditions are two key components of climate vulnerability that are often determined by economic power, social policies, political influence, and structural racism.

Figure 10. Map of Flood Risk by Census Tract (RVAgreen 2050



The Richmond MSA, like many parts of the United States, may face challenges of extreme weather events, extreme heat, flooding, sea level rise, drought, and wildfires due to climate change. However, because of the socio-economic landscape and local factors of the MSA, a closer examination is needed to identify which of these risks pose the most imminent and severe threats to disadvantaged communities. A majority of the LIDACs in the Richmond MSA are located within the City of Richmond, so it is necessary to take a close look at the city's climate risks and how they interact with disadvantaged communities. In 2022, the City of Richmond created RVAgreen 2050: an equity-centered climate action and resilience planning initiative led by the Office of Sustainability. To understand the specific risks facing Richmond, a Climate Vulnerability and Risk Assessment was conducted.

Richmond is seeing continued increases in annual average daily maximum temperatures. By 2070, annual average daily maximum temperatures may increase to as much as 77˚F under a high emissions scenario (as compared to the baseline of 68.5˚F for the 1961–1990 period).[6] There have been more and more days reaching 95˚F or higher as well. Historically, Richmond has seen 9 days per year over 95˚F. By 2100 (under a high emissions scenario), this could rise to 74 days. Future heat waves will be more intense as well.[7]

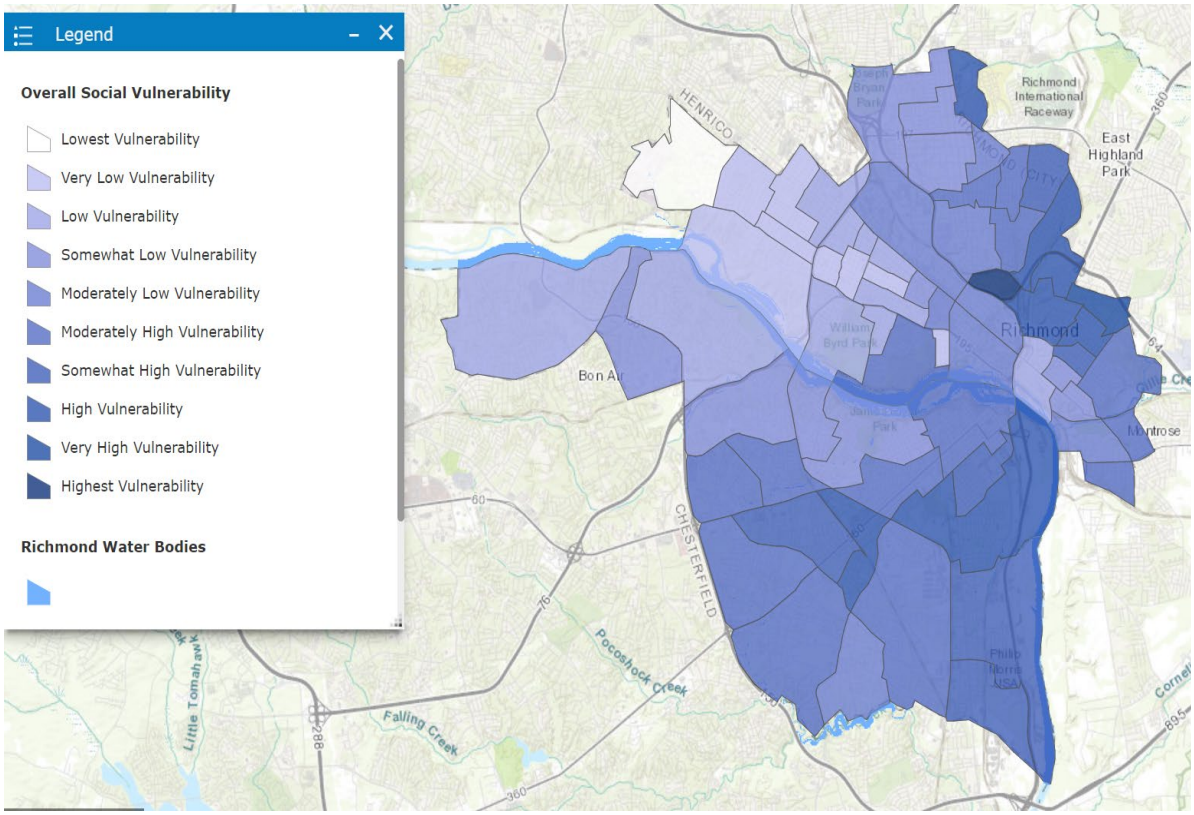
Average annual precipitation is projected to increase in the winter and spring, with winter precipitation levels increasing by 15% under a blender scenario by the 2080s. [8] The annual number of extreme precipitation events is projected to increase as well.[9] Virginia is facing sea level rise at a greater-than-average rate than the rest of the world due to post-glacial rebound, a process where melting ice sheets cause once-covered land to lift up, and land around the

[6] A high emissions scenario refers to a Shared Socio-economic Pathway (SSP) that represents the upper boundary of radiative forcing (for example, SSP5-8.5 represents a pathway with an additional radiative forcing of 8.5 W/m2 by 2100). Under a high emissions scenario, there is intensified exploitation of fossil fuel resources and a more energy-intensive global lifestyle (Böttinger, M. and Kasang, D. The SSP Scenarios. Deutsches Klimarechenzentrum.)
[7] City of Richmond. RVA Green 2050. 2022. https://www.rvagreen2050.com/virtual-resilience-hub
[8] A blended scenario refers to a scenario which uses a combination of moderate and high global emissions scenarios.
[9] Extreme precipitation events are defined as events with more than 2 inches of precipitation in 24 hours

periphery (like Virginia) to sink.[10] Since 1880, global sea levels have risen 7–8 inches, while sea levels along the Virginia coast have risen 17 inches between 1930 and 2020. By 2100, global sea level is projected to rise another 1–4 feet. Although Richmond is more inland and will thus be less impacted by sea level rise, some communities along the James River may be affected. Beyond the city, farmland and riverside properties in Prince George, Charles City, New Kent, King William, and King and Queen counties are vulnerable to sea level rise.

The city created the Climate Equity Index to understand how social and demographic factors are tied to the climate vulnerabilities described above.[11] Figure 11 shows the Index's social vulnerability map, which visualizes relative climate vulnerability (due to a combination of climate impacts, demographics, built assets, and natural resources) across Richmond's census tracts. The neighborhoods most adversely impacted by climate change risks, such as extreme heat and flooding, are the East End, Southside, and Northside. These neighborhoods are also most impacted by wealth inequity, underlying health conditions, and lack of transportation access.

Figure 11. Richmond MSA social vulnerability map by census tract from the RVAgreen Climate Equity Index



[10] Woods Hole Oceanographic Institution. 2018. Why is Sea Level Rising Faster in Some Places Along the U.S. East Coast Than Others? https://www.whoi.edu/press-room/news-release/why-is-sea-level-rising-higher-in-some-places-along-u-s-east-coast-than-others/

[11] The Index uses a list of 15 demographic variables from the CDC Social Vulnerability Index as well as an additional 24 geographic factors based on research for a total of 39 factors. These 39 factors impact an individual's or community's vulnerability to climate change – particularly heat, severe storms, and flooding.

Priority Climate Action Plan Measures

The Richmond MSA has identified seven priority, implementation-ready measures that will reduce GHG emissions in the short- and long-term. The measures were developed through the process outlined in the Approach to PCAP Development: Priority GHG Reduction Measures section. A list of CPRG project and program ideas submitted to PlanRVA is included in Appendix A, though this list is not comprehensive of all potential projects and programs that may be pursued under a measure.

The PCAP measures and the potential cumulative GHG emissions reductions for each are identified in Table 4 below, followed by an overview of implementation milestones (see Appendix D for details on the GHG reduction quantification methodology). The following sections provide an overview of potential benefits and a summary of potential impacts to LIDACs. Each priority measure is then described in detail, including the measure description, geographic coverage, key implementing agency(ies), implementation actions, authority to implement, and potential impacts to LIDACs.

Table 4. Summary of PCAP Measures and Related GHG Inventory Sector(s)

PCAP Measure	Sector(s)	Cumulative GHG Reductions ($MMTCO_2e$)
1. Support, incentivize, and provide assistance for the rapid adoption, equitable installation, and use of Zero-Emission Vehicles	On-Road Transportation	2025–2030: 1.08 2025–2050: 45.02
2. Expand equitable transit access.	On-Road Transportation	2025–2030: 0.02 2025–2050: 0.67
3. Provide and promote new and expanded opportunities to reduce vehicle miles traveled through micromobility options and connected multimodal infrastructure.	On-Road Transportation	2025–2030: 0.14 2025–2050: 1.47
4. Reduce GHG emissions from solid waste.	Solid Waste	2025–2030: 2.29 2025–2050: 24.64
5. Implement decarbonization strategies for municipal operations.	Local Government Operations	2025–2030: 0.42 2025–2050: 7.29
6. Accelerate and support the deployment of energy efficiency solutions and incentivize the transition to clean energy of residential and commercial buildings	Buildings	2025-2030: 0.77 2025-2050: 6.31
7. Reduce emissions from port operations through the adoption of low-carbon fuels, electric equipment, and operational changes.	Off-Road Transportation	2025–2030: 0.010 2025–2050: 0.031

The majority of the potential GHG reductions will occur in the long run, particularly for the waste diversion and ZEV adoption measures. However, the implementation of actions and projects across all PCAP measures will begin in the near term (i.e., pre-2030), albeit subject to available staffing, funding, and other resources. Depending on the funding available, it may take more time to ramp up actions and secure additional funding and resources for implementation. Successful implementation of the measures will require significant coordination and partnerships across all key implementing agencies/actors, and PlanRVA intends to further develop those relationship and partnerships throughout the CCAP and implementation phases

of the CPRG program. Table 5 below summarizes the general timeline for implementing the CPRG program and PCAP measures in the near-term.

Table 5. CPRG Implementation Milestone Summary

Milestone	Timeframe
2024	
Deliver PCAP to EPA, which includes stakeholder input on measures.	March 1, 2024
Submit CPRG Implementation Grant applications.	April 1, 2024
CCAP development, which will include identifying additional measures, broad engagement activities, and quantifying emission, cost, benefit, workforce, and LIDAC impacts.	Mid–Late 2024
2025	
Coordinate resources across jurisdictions and take initial actions across the PCAP measures where feasible.	2025
Finalize CCAP, which will include identifying additional measures, broad engagement activities, and quantifying emissions, cost, benefit, workforce, and LIDAC impacts, and deliver to EPA.	Summer 2025
2026	
Continue implementing CPRG measure actions where feasible.	2026+
Secure local government approval and budget for ongoing GHG reductions, in addition to seeking additional outside funding opportunities.	2026+
Track progress toward GHG reduction targets and other milestones, and collect data as needed to prepare the Status Report.	2026+
2027	
Deliver Status Report to EPA.	Mid-2027
Continue to implement measures and reduce GHGs at the county level and for municipal operations. Track progress across the Richmond MSA.	2027+
2030	
Complete initial stage of implementing PCAP actions; actual timing and specific projects implemented will depend on available staffing, funding, and other resources.	2030+

PCAP Measure Co-Benefits

The measures outlined in the PCAP will not only reduce GHG emissions but will also reduce co-pollutants and provide several co-benefits across the Richmond MSA region. Potential benefits include reduced noise and air pollution, physical and mental health improvements, economic development and job creation, and community capacity building.

The reduction of GHG emissions and other co-pollutants through decreased fossil fuel (e.g., coal, natural gas, and petroleum) use in vehicles and electric power generation, combined with increased waste diversion and improved landfill management practices will have near- and long-term public health and socioeconomic co-benefits for the region. In the near term, benefits include improving indoor and outdoor air quality and reducing hazardous air pollutants, toxins, and other pollutants. Reducing these types of pollutants can immediately benefit the physical and economic wellbeing of communities. In the long term, reducing GHGs will mitigate the

effects of climate change and further bolster regional public health and socioeconomic wellbeing.

The pollutants impacted by the PCAP measures include those listed in Table 6 below.

Table 6. PCAP Measures and Related Pollutant Types

Pollutant	Air Pollutant Type	Categories of Related Measures
Carbon Dioxide (CO2)	GHG	All
Hydrofluorocarbons (HFCs)	GHG	Buildings, Transportation
Methane (CH4)	GHG	All
Nitrous Oxide (N2O)	GHG	Buildings, Transportation
Carbon Monoxide (CO)	Co-pollutant: Criteria Air Pollutant	Buildings, Transportation
Lead	Co-pollutant: Criteria Air Pollutant	Buildings, Transportation
Nitrogen Oxides (NOx)	Co-pollutant: Criteria Air Pollutant	Buildings, Transportation
Particulate Matter (e.g., PM2.5)	Co-pollutant: Criteria Air Pollutant	Buildings, Transportation
Sulfur dioxide (SO2)	Co-pollutant: Criteria Air Pollutant	Buildings, Transportation
Ozone	Co-pollutant: Criteria Air Pollutant	Buildings, Transportation
Volatile Organic Compounds (VOCs)	Co-pollutant: VOCs	Buildings, Transportation
Other hazardous air pollutants (HAPs)	Co-pollutant: Air Toxics	Buildings, Transportation

Public Health Co-Benefits. Improved public health is a significant and direct co-benefit of reducing GHG and co-pollutant emissions in the region. Health risks arise from both outdoor and indoor air pollution caused by the combustion of fossil fuels, like coal, natural gas, and petroleum, and consequent release of GHGs, hazardous air pollutants (HAPs), toxins, and other pollutants. In the United States roughly 87 percent of people's lives are spent indoors, so indoor exposure to combustion pollutants, such as natural gas for cooktops or heating, has the potential for substantial health effects.[12] Exposure to co-pollutants from the combustion of coal, natural gas, and petroleum are linked to a litany of physical health concerns, including illness and premature mortality. A large body of research on the detrimental health effects of exposure to air pollution provides strong evidence that long-term exposure to ambient particulate matter (i.e., PM2.5), ambient ozone, and household air pollution contributes to premature mortality and increased risk of illness. Evidence is also growing on the association between long-term exposure to air pollution and adverse birth outcomes, cognitive declines, and gastrointestinal inflammatory diseases. Short-term exposure to high levels of air pollution can also exacerbate asthma and cardiopulmonary symptoms.[13]

[12] U.S. EPA. 1989. Report to Congress on indoor air quality: Volume 2. EPA/400/1-89/001C. Washington, DC.
[13] Health Effects Institute. 2020. *Health Effects Institute Annual Report 2020: Valuing Science Informing Decisions.* https://www.healtheffects.org/system/files/hei-annual-report-2020.pdf

This PCAP includes measures that will directly reduce GHG and co-pollutant emissions from the combustion of fossil fuels by promoting energy efficiency, electrification, and adoption of clean energy in municipal buildings; promoting the use of zero-emission vehicles and actions to reduce vehicle miles traveled; and by promoting actions to reduce landfill emissions in the waste sector. These public health co-benefits particularly support LIDACs, which have been shown to face the highest risk of air pollution and poor transportation resources.[14] Measures in this PCAP will also improve public health by making bicycle and pedestrian transportation safer.

Economic and Workforce Co-Benefits. Implementing these PCAP measures and actions will also have several social and economic, or socioeconomic, benefits for the MSA population, particularly for LIDACs. A key co-benefit of efforts to reduce GHGs is the expansion of the clean energy workforce. The growth of clean energy technologies, such as solar installations and EV charging infrastructure, requires trained individuals who understand how to install and maintain this hardware. Clean energy jobs training, especially for individuals in LIDACs, supports the supply chain of climate infrastructure and technology while also generating jobs and economic opportunities for communities. Installation of clean energy technologies, including distributed resources (e.g., rooftop solar PV installations and battery storage), creates more redundancy in the grid and lessens the likelihood of blackouts.[15] Therefore, these investments and clean energy workforce trainings enhance climate resilience and curb the economic impact of extreme weather events.

Many of the PCAP measures address energy use in buildings and in the transportation sector. Electrifying these fossil fuel-driven sectors and enhancing efficiencies reduces the percentage of budget or income that goes toward energy costs. Electric vehicles have lower maintenance and fuel costs than internal combustion engine vehicles.[16] Efficiencies and electrification of municipal buildings and fleets reduces the amount of public funds that must be used for energy costs alone. Reducing the energy cost burden, particularly for LIDAC residents, reduces financial stress for households and businesses, and allows funds to be used elsewhere to stimulate the economy.[17]

Community Co-Benefits. In addition to creating jobs and lowering financial stress, these measures also benefit society and the economy by promoting public education and fostering a sense of community. All the measures described in this PCAP were developed through stakeholder engagement and will be built upon during the CCAP to provide public education and outreach to ensure community members can access climate resources. This promotes social inclusion and buy-in from community members and CBOs. Additionally, the measures include actions to expand public transit, better manage waste, and improve pedestrian and bicycle routes. These factors, as well as reduced air pollution and a healthier environment, are key to promoting social inclusion and community gathering, such as opportunities to use green spaces

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[14] Ebi, K. L., and Hess, J. J. (2020). Health Risks Due to Climate Change: Inequity In Causes And Consequences. *Health Affairs. 39*(12). https://doi.org/10.1377/hlthaff.2020.01125
[15] Stout, S., Hotchkiss, E., Lee, N., Holm, A., & Day, M. (2018). *Distributed Energy Planning for Climate Resilience.* NREL. https://www.nrel.gov/docs/fy18osti/71310.pdf
[16] U.S. DOE. 2022. Saving Money with Electric Vehicles. https://www.energy.gov/energysaver/articles/saving-money-electric-vehicles
[17] U.S. DOE. 2019. *Low-Income Household Energy Burden Varies Among States — Efficiency Can Help In All of Them*. Energy.gov. https://www.energy.gov/sites/prod/files/2019/01/f58/WIP-Energy-Burden_final.pdf

and gather communally outside. Therefore, these measures may improve social capital, encourage community members to engage with their community and local economy, and benefit the overall socioeconomic well-being of the Richmond MSA.

PCAP Measure LIDAC Impacts Summary

For the PCAP, PlanRVA qualitatively assessed the potential impacts on LIDACs. Table 7 below summarizes the LIDAC benefits achieved by implementing the PCAP measures. For each measure, it is critical that careful consideration be given to potential LIDAC impacts as programs or actions are designed to minimize any potential negative impacts and maximize the potential benefits to these communities.

Table 7. Summary of Potential LIDAC Benefits from PCAP Measures

LIDAC Benefits from GHG Emissions Reductions	Achieved via this PCAP Measure
Enhanced public health outcomes stemming from reductions in co-pollutants (e.g., GHGs, particulate matter, hazardous air pollutants), leading to declines in illnesses and premature mortality associated with air pollution.	✓ All Measures
Strengthened resilience to climate change events from measures that reduce GHGs and offer climate adaptation co-benefits. GHG emissions drive climate change, so reducing emissions lowers the likelihood of climate events (e.g., extreme heat) and associated risks (e.g., heat-related illness).	✓ All Measures
Greater social capital that arises when communities can enjoy public spaces safely (i.e., without air pollution), have greater access to public resources (e.g., transportation), and overall live healthier lives with improved socioeconomic well-being.	✓ All Measures
More purposeful community engagement and enhanced public awareness of climate-related projects and their outcomes.	✓ All Measures
Less noise pollution (e.g., from vehicle traffic).	✓ Measure 1 ✓ Measure 2 ✓ Measure 3 ✓ Measure 5 ✓ Measure 7
Expanded access to alternative transportation.	✓ Measure 2 ✓ Measure 3
Cost savings associated with the transition from ICE vehicles to EVs due to lower vehicle fuel and maintenance cost.	✓ Measure 1
Increased comfort and quality of space, such as a safer, healthier workplace due to reduced indoor air pollution.	✓ Measure 5 ✓ Measure 6
Establishment of high-quality employment opportunities and workforce development initiatives in LIDAC communities, prioritizing access to the clean workforce and economy for LIDAC workers and small businesses.	✓ Measure 1 ✓ Measure 5 ✓ Measure 6
Bolstered energy security through enhancements in energy efficiency and the adoption of more resilient energy generation technologies.	✓ Measure 5 ✓ Measure 6 ✓ Measure 7

PCAP Measure 1. Support, incentivize, and provide assistance for the rapid adoption, equitable installation and use of Zero-Emission Vehicles.

GHG Reduction Measure Description

Measure 1 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **1.08 MMTCO$_2$e**

Cumulative GHG Reductions from 2025–2050*: **45.02 MMTCO$_2$e**

** See Appendix D for a summary of methods, data, and assumptions.*

To reduce emissions from the transportation sector, this measure focuses on accelerating the transition to electric vehicles (EVs) and developing a regional, equitable charging network. Supplemented by existing federal incentives, this measure will be supported through the creation and expansion of a robust charging network, development of incentive programs, workforce development, and other activities to encourage widespread adoption of EVs. Localities may also electrify their municipal fleets and equipment, such as school buses, public works trucks, refuse trucks, and department vehicles (see also Measure 5). Indirect co-benefits of this project, including improved public health and the creation of clean energy jobs, will spread throughout communities, with a particular emphasis on benefits to historically underserved LIDACs.

Key Implementing Agency(ies)

- **Regional Transportation Planning Organizations (TPOs).** Richmond Regional Transportation Organization (RRTPO) and Tri-Cities TPO can coordinate with PlanRVA to share best practices, align transportation goals and funding, and coordinate with other neighboring transportation networks to identify opportunities for collaboration.
- **Virginia State Government Agencies.** State government agencies such as the Virginia Department of Transportation (VDOT) and the Virginia Department of Motor Vehicles (DMV) will help coordinate the implementation of policies and programs and may be able to provide funding for infrastructure development. The Virginia DMV established the 2022 Electric Vehicle Rebate Program, which offers rebates of $2,500 for people who purchase EVs from participating dealers; this program is not currently funded.[18]
- **Utilities.** Local utilities need to be involved to ensure the electricity grid can support electrification of transportation. They can also provide incentives or assistance for charging installation and may provide specific rate incentives for EV charging. Dominion Energy has piloted similar programs in the past.
- **Local Government organizations.** Local governments can transition fleets to EVs supported by the adoption of green fleet policies and plans. They can devise and adopt incentives to support EV adoption, such as EV-ready building codes, and build out publicly available charging infrastructure. Local governments can also implement community-wide buying co-ops for EVs for public and private fleets as well as personal vehicles.
- **Private sector actors**. Companies can take advantage of incentives and buy/use EV and alternative fuel vehicles and build out the charging infrastructure. For example,

[18] Code of Virginia. 2021. Article 8. Electric Vehicle Rebate Program. § 45.2-1726. https://law.lis.virginia.gov/vacodefull/title45.2/chapter17/article8/

ridesharing companies can procure and offer EVs and provide EV charging infrastructure. In addition, local businesses can coordinate with local governments to bring publicly accessible charging stations to the region.

Authority to Implement

The actions taken under this measure would be predominantly voluntary incentives. Local jurisdictions have the authority to purchase vehicles for their fleets; such purchases have already been started across the MSA. In some instances, purchasing or procurement policies may need to be adjusted to prioritize low- and zero-emissions vehicles (ZEVs). Private and personal purchasing of low emission vehicles and ZEVs does not have any statutory limitations. Local zoning, code or other policy changes may need to be made for charging infrastructure.

Implementation Activities and Milestones

Actions to implement this measure could include, but are not limited to the following:

- Update the 2013 Regional EV Infrastructure Plan (REVI).
- Create incentives and programs for EV and low-emissions vehicles. Incentives can include direct financial incentives or exemptions to certain restrictions (such as high occupancy vehicle (HOV) lane exemptions in Virginia or emissions testing exemption in Virginia).
- Develop and support regional EV and ZEV fueling infrastructure:
    - Conduct regional charging/siting analysis with contractor support and community engagement.
    - Develop incentive programs for EV chargers in multifamily, public, commercial, and rental properties, including affordable housing developments.
    - Create and implement model ordinances that mandate or incentivize clean fuel infrastructure into development and/or provide model zoning code or other policy updates. This may leverage updated requirements in Virginia's High-Performance Buildings Act (HB2001), which includes building performance standard requirements for new public buildings related to EV charging infrastructure.
    - Conduct workforce assessment to understand gaps in the labor market needed to support widespread ZEV and EV adoption. Provide training (e.g., through the Electric Vehicle Infrastructure Training Program) for installation and maintenance of EV charging and fueling infrastructure. Some of these opportunities should be focused in LIDACs to bring benefits to these communities.
    - Conduct regular analysis of the state of clean fuel infrastructure to address any gaps in charging/refueling needs that may hamper the rate of transition. Virginia is investing in statewide EV infrastructure, a key factor in widespread EV adoption, with significant funding through the National Electric Vehicle Infrastructure (NEVI) Program, including along alternative fuel corridors within the MSA.[19]
    - Leverage statewide resources such as Drive Electric Virginia, an initiative to advance EV adoption. Led by Virginia Clean Cities and partnering organizations,

[19] https://www.fhwa.dot.gov/environment/nevi/ev_deployment_plans/va_nevi_plan.pdf

the program engages stakeholders to address EV adoption barriers and accelerating plug-in EV use throughout the state.[20]

- Public education and engagement for all actions included above: Education, marketing and outreach (to develop plans and implement incentives and programs), and real-time data will help accelerate the deployment of ZEVs. Targeting education and engagement efforts on LIDACs through partnering with community leaders and CBOs will help bring additional co-benefits to these populations (e.g., air pollution and health benefits, social capital, etc.).

Geographic Coverage

The initiatives outlined in this measure target the entire MSA region.

LIDAC Benefits

Air pollution from burning fossil fuels has historically been concentrated in LIDACs where community members also have reduced access to medical care and other resources due to poverty, disenfranchisement, lack of transportation, etc.[21] This is particularly true for LIDACs that are highway adjacent. Benefits for LIDACs may include improved air quality and health benefits resulting from reductions in tailpipe emissions from internal combustion engine vehicles (ICEVs), including potential reductions in new asthma cases, hospital admissions, and emergency department visits, reduced noise pollution, and reduced cost for vehicle ownership, especially as the second-hand market for EVs grows.[22] Cost barriers to EV ownership will still exist for LIDACs, so programs and incentives may be expanded or designed to help overcome these barriers.

Community members of LIDACs who are currently employed in auto industry related jobs, such as maintenance, repair, and resale, may see opportunities decline as the market transitions to primarily electric vehicles. Job training programs may be targeted at LIDACs to retain those employees in the field and prevent blue-collar LIDAC workers from being left out of the EV transition. Similarly, job training and apprenticeship programs can be targeted to support the deployment of new charging infrastructure, which requires skilled tradesfolk from many disciplines.

Additionally, with the Virginia Clean Economy Act's target for net zero emissions from the electric power sector, electric vehicles are likely to be charged with cleaner sources of electricity generation over time (e.g., solar and offshore wind). These will replace fossil fuel-fired coal and natural gas plants in the region, which contribute to poor air quality and health issues, particularly for adjacent communities.

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[20] Drive Electric Virginia. About. Virginia Clean Cities. https://driveelectricva.org/about/
[21] American Lung Association. 2023. Driving to Clean Air: Health Benefits of Zero-Emission Cars and Electricity. https://www.lung.org/getmedia/9e9947ea-d4a6-476c-9c78-cccf7d49ffe2/ala-driving-to-clean-air-report.pdf
[22] Department of Energy. 2022. Saving Money with Electric Vehicles. https://www.energy.gov/energysaver/articles/saving-money-electric-vehicles

PCAP Measure 2. Expand equitable transit access.

GHG Reduction Measure Description

To address emissions from the transportation sector, this measure aims to expand equitable access to public transit options. Improving public transit is an effective method to reduce emissions by reducing the vehicle miles traveled (VMT) from largely single-occupancy vehicles. Improving access to and the design of transit services can reduce VMT by increasing accessibility to local and regional destinations, such as housing, jobs, and goods/services.

Measure 2 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **0.02 $MMTCO_2e$**

Cumulative GHG Reductions from 2025–2050*: **0.67 $MMTCO_2e$**

** See Appendix D for a summary of methods, data, and assumptions.*

Key Implementing Agency(ies)

- **Local governments and municipalities**. Local governments are responsible for land-use planning and comprehensive planning, transportation planning and transportation-related policies, and local policies and programs that may incentivize or unintentionally disincentivize public transit use and equitable access. Funding for public transit also comes in part from local governments.
- **VDOT and Virgina Department of Rail and Public Transport (VDRPT).** These state agencies will be key partners in transportation infrastructure planning, development, and operations, such as changes to roads to prioritize bus transportation along state routes. Certain road planning decisions could also induce demand for car travel, which could weaken GHG reduction progress.
- **Metropolitan Planning Organizations (MPOs)**. RRTPO and Tri-Cities MPO coordinate transportation planning for most of the Richmond MSA localities. As of January 2024, new federal rules require MPOs to set emissions reduction targets and to publish regular accounting of transportation emissions. RRTPO and Tri-Cities MPO will coordinate with PlanRVA to set a shared target that aligns with the CPRG. MPOs also prioritize transportation initiatives, craft policies for financial programming, and coordinate planning with VDOT and VDRPT, the Central Virginia Transportation Authority, and other partners.
- **Public Transportation Operators.** The GRTC Transit System provides public transit services to Richmond and parts of Chesterfield and Henrico. This includes fixed routes, rapid transit routes, and paratransit services. It also operates RideFinders, which is a regional nonprofit agency that works to reduce the number of single-occupancy vehicle trips. Petersburg Area Transit operates public transit and paratransit services in the Tri-Cities area. Other smaller operators, such as Bay Transit, provide service in the more rural portions of the region.
- **Private sector partners.** Landowners and developers may play a role in development decisions that shape the viability of transit options. Private rail companies (e.g., Amtrak) are also essential players in connecting the MSA to the broader state and region.

Authority to Implement

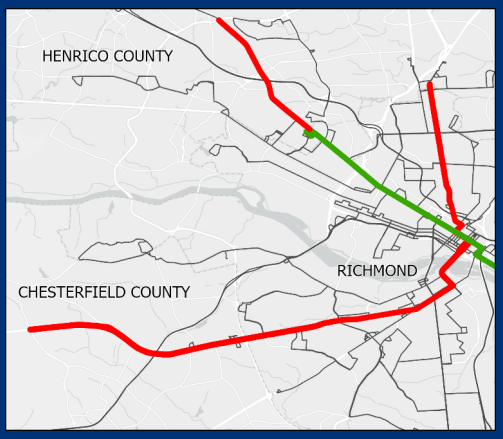
Actions related to public transportation may need approvals from regional or state transportation agencies to be implemented and will need higher levels of authority depending on the scope and scale of changes to public infrastructure. Employers also play a key role in providing company polices to allow for teleworking or incentives for transit ridership. Actions and policies that impact land use can be administered by local jurisdictions though zoning codes and potential changes, and developers can act on where to build based on these policies.

Implementation Activities and Milestones

Actions to implement this measure could include, but are not limited to the following:

- Provide improvements and enhancements in public transit service, including:
  - Expanded bus service/bus rapid transit (BRT)
  - Operational and service enhancements (such as increased route frequency and live bus tracking)
  - Bus stop improvements (such as benches and bus shelters)
  - Transit station improvements (such as mobility hubs that bring together transit, maintenance, and investments to improve reliability and quality of service)
- Assess Park-and-Ride lot locations, and place Park-and-Rides in strategic locations to provide drive-to access for the higher-speed transit services throughout the region.
  - The Virginia Department of Rail and Public Transit has conducted multiple studies and plans on transit modernization, connectedness, road needs, rural micro-transit, rail connectivity, transit equity, and more that could be leveraged to support assessments in the MSA.[23]
- Support land use policies that encourage development near high-capacity transit stations and within activity centers, including design that supports multimodal transit.
- Implement incentives that encourage use of sustainable modes, such as incentives for using transit/reduced or fare-free transit.
- Public education and engagement for all actions included above: Education, marketing and outreach (when developing project plans and implementing incentives), and real-

Box 2. Bus Rapid Transit (BRT) Project Highlight



Partners in the Richmond Region, including GRTC, the City of Richmond, Chesterfield County, Henrico County, and the RRTPO are moving forward with an expansion of the current Pulse BRT that includes a 4-mile extension of the existing Pulse route and an entirely new 16-mile North–South BRT route. The existing Pulse line is green and both BRT expansion projects are shown in red.

(Visit https://arcg.is/W0GLC0 and https://arcg.is/0vLaSW for more)

[23] Virginia DRPT. "All DRPT Studies & Reports – DRPT." Virginia Department of Rail and Public Transportation, 2024. https://drpt.virginia.gov/studies-and-reports/.

time data will help increase use of public transit options. Targeting education and engagement efforts on LIDACs through partnering with community leaders and CBOs will help bring additional co-benefits to these populations (e.g., air pollution and health benefits, social capital, etc.).

Geographic Coverage

The initiatives outlined in this measure target the entire MSA region.

LIDAC Benefits

Air pollution from the burning of fossil fuels has historically been concentrated in LIDACs where community members also have reduced access to medical care and health resources due to poverty, lack of transportation, etc.[24] This is particularly true for LIDACs that are highway adjacent. Benefits for LIDACs from reduced VMT across the region may include improved air quality and health benefits resulting from reductions in tailpipe emissions from ICEVs, including potential reductions in new asthma cases, hospital admissions, emergency department visits, and reduced noise pollution. Members of LIDACs also disproportionately rely on public transportation to reach work, school, medical facilities, and other necessary destinations. Expansion and enhancements of the public transit options may help alleviate certain barriers to educational and job opportunities.

This measure also includes transit-oriented development considerations for land use policies. Transit-oriented development historically leads to gentrification when supportive policies are not implemented to protect underserved homeowners and renters. This measure will require partnership among municipalities, transit agencies, and the development community to truly benefit LIDACs.

[24] American Lung Association. 2023. Driving to Clean Air: Health Benefits of Zero-Emission Cars and Electricity. https://www.lung.org/getmedia/9e9947ea-d4a6-476c-9c78-cccf7d49ffe2/ala-driving-to-clean-air-report.pdf

PCAP Measure 3. Provide and promote new and expanded opportunities to reduce vehicle miles traveled through micromobility options and connected multimodal infrastructure.

GHG Reduction Measure Description

This GHG reduction measure will implement projects and policies to reduce emissions in the transportation sector across the MSA by making changes to expand micromobility options (e.g., bike sharing) and active transportation infrastructure (e.g., sidewalks and bike lanes) to reduce single-occupancy vehicle travel in the region. Telework options may also be incentivized to reduce VMT and provide more flexibility.

Measure 3 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **0.14 MMTCO$_2$e**

Cumulative GHG Reductions from 2025–2050*: **1.47 MMTCO$_2$e**

** See Appendix D for a summary of methods, data, and assumptions.*

Key Implementing Agency(ies)

- **Local governments and municipalities.** Localities are responsible for land-use planning and comprehensive planning, transportation planning, development and operations of transportation programs and policies. They are responsible for the design, construction, and maintenance of bike/ped infrastructure. Public Works departments are typically responsible for maintenance of bike/ped infrastructure.
- **Regional planning organizations**. PDCs and MPOs coordinate bike/ped and other micromodal transportation across jurisdictions. They also help bring nonprofit and private stakeholders into the process. Regional planning organizations evaluate and, in some cases, fund active transportation projects.
- **Virginia State Agencies.** VDOT and other state agencies will be key partners in transportation infrastructure planning, development, and operations, especially for projects that span multiple jurisdictions.
- **Private sector partners.** Private sector partners, such as land-use owners, developers, and businesses play a key role in development decisions and design that affect the viability of using alternatives to driving. Business can also implement telecommuting policies, active transportation incentives, and other policies that help manage travel demand. Building developers can incorporate amenities such as bike storage that support micromobility options. Private companies also provide micromobility options on a rental basis, either through contracts with localities or in the free market.

Authority to Implement

The actions associated with making changes to increase pedestrian and bicycle infrastructure can be administered by local jurisdictions. Policies that impact land use can similarly be administered by local jurisdictions though zoning codes and potential changes, and developers can act on where to build based on these policies. Employers also play a key role in providing company policies to allow for teleworking.

Implementation Activities and Milestones

Actions to implement this measure could include, but are not limited to the following:

- Implement infrastructure improvements to support non-motorized travel, such as roadway design that makes walking and biking safer, adding protected bicycle and pedestrian pathways like the Fall Line trail[25] (see Box 3), and adding/repairing sidewalks, and improving crosswalks.
    - On the state level, the Virginia Department of Transportation has developed a Bicycle Policy Plan in 2011 and Pedestrian Policy Plan in 2014 to advance these elements from the 2004 policy.[26,27] These are supported by implementation guidance for design and construction of active infrastructure, as well as annual reports that track improvements in bicycle and pedestrian accommodations.[28] These resources could be leveraged to support strategic improvements in the MSA region.
- Implement incentives that encourage use of sustainable modes, such as rebates for purchasing e-bikes and for employers to adopt telework and alternative transportation options (including ridesharing, public transit, biking, and walking).
- Expand/require the use of transportation planning tools (e.g., ECO-Logical) to measure the impact of projects on surrounding ecosystems and minimize environmental impacts and project costs.[29]
- Implement or expand policies that promote car/ride sharing and reducing vehicle travel, such as through reduced or eliminated parking minimums, parking pricing, and congestion pricing, as well as HOV-3 free and other policies to encourage ride sharing.
- Public education and engagement for all actions included above: Education, marketing and outreach (when developing project plans and implementing incentives), and real-time data will help increase use of public transit options. Targeting education and engagement efforts on LIDACs through partnering with community leaders and CBOs will help bring additional co-benefits to these populations (e.g., air pollution and health benefits, social capital, etc.).

Geographic Coverage

The initiatives outlined in this measure target the entire MSA region.

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[25] Read more about the Fall Line project at falllineva.org.
[26] VDOT. 2011. State Bicycle Policy Plan. https://www.vdot.virginia.gov/media/vdotvirginiagov/about/programs/biking-and-pedestrian/bike_ped_policy.pdf
[27] VDOT. 2014. State Pedestrian Policy Plan. https://www.vdot.virginia.gov/media/vdotvirginiagov/about/programs/biking-and-pedestrian/SPPP_FINAL_OnLine_LowRes.pdf
[28] VDOT. 2024. Bicycle and Pedestrian Accommodations. https://www.vdot.virginia.gov/doing-business/technical-guidance-and-support/transportation-and-mobility-planning/bicycle-and-pedestrian-accommodations/
[29] ECO-Logical is an ecosystem approach to developing infrastructure projects created by the U.S. DOT Federal Highway Administration. It provides a transportation planning framework that leverages stakeholder engagement and agency collaboration to help integrate natural resource and ecological considerations into infrastructure planning, design, review and constructure. PlanRVA is already using the ECO-Logical process for project planning.

LIDAC Benefits

Air pollution from the burning of fossil fuels has historically been concentrated in LIDACs where community members also have reduced access to medical care and health resources due to poverty, lack of transportation, etc.[30] This is particularly true for LIDACs that are highway adjacent. Benefits for LIDACs from reduced VMT across the region may include improved air quality and health benefits, resulting from reductions in tailpipe emissions from internal combustion engine vehicles (ICEVs), including potential reductions in new asthma cases, hospital admissions, emergency department visits, and reduced noise pollution. An improved active transportation system also supports more physical activity. As LIDACs have higher rates of physical inactivity due to social and structural barriers, and related chronic conditions, increased physical activity supports healthier lifestyles, improving physical and mental health outcomes and reducing medical costs.

Benefits from this measure may also include social and physical health, such as greater social inclusion, including in sharing, local, and circular economies and increased access to social and cultural activities, and promotion of exercise when engaging in active transportation. LIDACs also disproportionately suffer from lack of access to reliable transportation and have lower car ownership rates. At the same time, these communities are also less likely to have safe biking and walking routes to school or work and may have less access to micromobility options such as bikeshares. Increasing and improving micromobility opportunities may improve LIDAC

Box 3. Fall Line Project Highlight

Fall Line is a proposed 43-mile trail connecting seven localities between Ashland and Petersburg[1]. Fall Line evolved from the developing network of active transportation routes in the greater Richmond region. Several sections of the planned trail corridor have already been implemented as bike lanes, park trails, or existed in localities' comprehensive and special area plans. A natural corridor for a long-distance trail began to emerge from cooperation among the seven localities connected along the corridor that could provide opportunities for active transportation, recreation, and economic development. The localities include the Town of Ashland, Hanover and Henrico Counties, City of Richmond, Chesterfield County, City of Colonial Heights, and City of Petersburg.

Figure 12 Fall Line project route

[30] American Lung Association. 2023. Driving to Clean Air: Health Benefits of Zero-Emission Cars and Electricity. https://www.lung.org/getmedia/9e9947ea-d4a6-476c-9c78-cccf7d49ffe2/ala-driving-to-clean-air-report.pdf

access to employment and activity centers and reduce the transportation cost burden to LIDAC households.

PCAP Measure 4. Reduce GHG emissions from solid waste.

GHG Reduction Measure Description

This measure is focused on reducing emissions from the disposal of municipal solid waste in landfills by diverting waste (including organic and recyclable materials) from landfills and implementing programs to reduce the unnecessary consumption of single-use plastics.

Measure 4 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **2.29 MMTCO$_2$e**

Cumulative GHG Reductions from 2025–2050*: **24.64 MMTCO$_2$e**

** See Appendix D for a summary of methods, data, and assumptions.*

Key Implementing Agency(ies)

- **Local government departments of public works and/or water**. Municipal agencies oversee landfills, solid waste management and recycling contracts, wastewater treatment operations and facilities, and other waste related programs. They are empowered by the Virginia State Code to pass recycling and waste ordinances. Local governments will also provide policy implementation.
- **Regional Waste Authorities.** Central Virginia Waste Management Authority (CVWMA) will be a key implementer of alternatives to landfilling MSW and will provide policy implementation. CVWMA does not serve all localities in the MSA.
- **Private sector partners.** All landfills in the region are owned by private companies. Regional waste authorities contract with private companies to collect and transport municipal waste. Commercial composting and waste-to-energy facilities may also be operated by private companies and could be key partners. Owners or operators of solid waste disposal facilities, with some exceptions, shall implement a gas management plan in accordance with the gas control requirements to protect the landfill cap and prevent the migration of landfill gas into structures or beyond the facility boundary.
- **Virginia Department of Environmental Quality**. DEQ reviews and issues permits for the construction, operation, or modification of a solid waste management facility.

Authority to Implement

The implementing authorities for this measure are county government agencies (e.g., Public Works) in partnership, where applicable, with regional waste authorities, private utilities, landfills, and composting facilities, among others. Public waste management, demonstration projects, waste-related policies, and public education campaigns can all be carried out under the existing powers of local governments. Partnerships with the private sector will be required for projects that relate to solid waste management facilities.

Implementation Activities and Milestones

Actions to implement this measure could include, but are not limited to the following:

- Increase solid waste diversion rate to at least 80% while exploring and implementing alternative options to landfilling MSW.
    - Expand existing programs or establish new ones to enable using organic waste for compost, including yard trimmings and food waste, and create/increase curbside pickup of organic waste. Provide technical assistance to regional waste authorities and local governments to determine the best programmatic option for each community, whether it be drop-off sites or curbside pickup, with a particular focus on expanded access to community members in LIDACs.
    - Invest in organics and food composting operations at existing and new solid waste facilities, including composting, mulching, and landfill facilities.
    - Enhance pre- and post-consumer organic waste programs. For example, reduce food waste by redirecting edible food to vulnerable communities.
    - Encourage and increase solid waste diversion from businesses/institutions by scaling pilot projects (see Box 4) and providing incentives.
- Conduct waste education and public service campaigns around options for waste diversion. Targeting education and engagement efforts on LIDAC through partnering with community leaders and CBOs that represent LIDACs will help bring additional benefits to these populations.
- Engage with the business community and other stakeholders to develop and enact policies to reduce the use of single-use packaging (e.g., plastic bags, plastic straws, polystyrene).
- Explore options to incentivize the expansion of landfill gas capture systems as applicable and increased monitoring of off gas from landfills. Additionally, consider options for expanded beneficial use of captured gas from landfills and anaerobic digesters.

Box 4. Hospital Recycling Pilot Program Highlight

Henrico Doctors' Hospital pilot recycling program, which was launched in 2018 and paired with an environmental education program for hospital staff, helped the hospital win the 2023 Virginia Governor's Environmental Excellence Gold Medal Award in Sustainability. With full staff participation, Henrico recycles more than 12,500 pounds of waste each month, about 6% of the hospital's total waste generated. The program has since expanded to two ambulatory surgery centers, leading to 200,000 pounds of recycled waste per year.

Geographic Coverage

The initiatives outlined in this measure target the entire MSA region.

LIDAC Benefits

Benefits for any LIDAC within the MSA located near a landfill or affiliated operations may include improved air quality and therefore health benefits, resulting from potential reductions in

landfill emissions. This can also lead to lower overall healthcare costs, fewer impacted days of work, and other economic benefits.

PCAP Measure 5. Implement decarbonization strategies for municipal operations.

GHG Reduction Measure Description

This GHG reduction measure focuses on deploying renewable and low-carbon energy resources, energy efficiency measures, and low-carbon solutions for municipal and school buildings, operations, and fleets. This measure will support existing and new clean energy, efficiency, and decarbonization efforts that demonstrate leadership by example, while also providing an additional co-benefit where these facilities serve as community and public resource centers.

Measure 5 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **0.42 MMTCO$_2$e**

Cumulative GHG Reductions from 2025–2050*: **7.29 MMTCO$_2$e**

** See Appendix D for a summary of methods, data, and assumptions.*

Key Implementing Agency(ies)

- **Local Government organizations**. All local government entities, such as counties, cities, boroughs, townships, and other forms of local government, as well as their respective school districts and public agencies, can set decarbonization goals, develop plans and policies, and update procurement policies and guidance.
- **Regional Planning Organizations (RPOs).** In collaboration with state and local governments, PlanRVA, Crater PDC, and others can provide support and best practices to enable electricity efficiency and decarbonization of buildings and fleets. They may also develop and provide model ordinances and comprehensive plan language and provide technical assistance.
- **Utilities.** Local utilities need to be involved to ensure the electricity grid can support electrification of government operations and the expansion of renewable energy. Utilities may also provide incentives for energy saving practices and energy efficiency upgrades.

Authority to Implement

Local and regional authorities that own and operate specific facilities and fleets have the authority to undertake the actions in this measure and to apply for other funding or internally raise funds to support the project costs. To enact specific decarbonization projects, policies, and/or pilot programs, local governments may need to gain approval from a legislative body or other administrative authority that oversees budgets and/or regulations.

Implementation Activities and Milestones

Many local governments in the region are already taking action to increase the efficiency of public and school buildings and electricity their fleets. Actions to implement this measure will build upon these existing efforts and may include the following:

- Expand and/or create new programs and incentives for retrofits and upgrades to municipal and government buildings, including public schools, government buildings, and operations (e.g., building efficiency and electrification retrofits and street lighting retrofits).
    - Conduct building energy audits and develop facility-specific decarbonization plans. Integrate projects into Capital Improvement Plans (CIPs) for each locality.
    - Provide clean energy feasibility assessments at key facilities (e.g., geothermal heat pumps).
    - Leverage updated requirements in Virginia's High-Performance Buildings Act (HB2001) to create a regionwide example of a green buildings policy for localities to adopt and implement. As part of the policy, consider enacting stricter building energy efficiency goals, such as achieving certain LEED certification levels, for new municipal construction or major retrofits.The policy may also include standards for the addition of enabling infrastructure, such as new electrical systems, solar-ready roofs, or other items to support building electrification, transportation electrification, or new on-site renewable energy and battery storage systems.
    - Leverage state program resources. Virginia has supported energy efficiency efforts at state agencies and other public facilities through Virginia Energy's Energy Savings Performance Contracting Program, which allows state agencies and local government entities to enter contracts with energy service companies to reduce energy costs through efficiency measures.[31]
- Create and implement clean vehicle procurement policies.
    - Conduct fleet assessments and develop ZEV procurement plans with supporting clean fueling infrastructure siting assessments.
    - Install EV chargers and other supporting infrastructure for alternative fuel vehicles at public buildings.
    - Reduce government employee VMT.
- Utilize local renewable energy sources to meet electricity needs.
    - Install renewable energy systems and energy storage (rooftop systems or on publicly owned land).
    - Establish power purchase agreements to provide clean electricity to local government facilities, potentially aggregating demand with other local jurisdictions or large local businesses to reduce cost.
- Workforce development for all actions above: develop new programs or expanding existing ones to provide training, paid internships, and job opportunities for a clean energy workforce. Some of these opportunities should be focused in LIDACs to bring benefits to these communities.

Geographic Coverage

This measure will cover local governments and schools across the entire Richmond MSA.

[31] Virginia Energy. Energy Savings Performance Contract. Virginia DOE. https://www.energy.virginia.gov/energy-efficiency/PerformanceContracting.shtml

LIDAC Benefits

As this measure will be carried out by cities and counties across the MSA, all LIDACs within the MSA and in neighboring regions will benefit from steps to decarbonize local government operations and reduce GHG emissions across the MSA. Reducing air pollution by decarbonizing local government operations has the co-benefit of improving the public health of individuals in LIDACs and the overall community. The reduction of indoor air pollution in public schools serving LIDAC communities particularly benefits children in LIDACs. Therefore, this measure will also lead to economic co-benefits for LIDACs as improved public health results. Furthermore, local government adoption of energy efficiency and clean energy technologies (heat pumps, ZEVs, etc.) will facilitate the expansion of the clean energy workforce. Additionally, increasing local renewable energy sources will help displace fossil fuel-fired coal and natural gas plants in the region, which contribute to poor air quality and health issues, particularly for adjacent communities. Economic savings resulting from this measure also reduce the amount of public funds that must be spent on energy costs alone.

PCAP Measure 6. Accelerate and support the deployment of energy efficient and low-carbon solutions and incentivize the transition to clean energy for residential and commercial buildings.

GHG Reduction Measure Description

This measure focuses on increasing opportunities for owners and users of all building types to access and install technologies to decrease overall energy consumption, increase energy efficiency, shift to renewable energy and energy storage systems, and reduce GHG emissions from the built environment. It covers both market rate and low/moderate income customers and private and public buildings.

Measure 6 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **0.77 MMTCO$_2$e**

Cumulative GHG Reductions from 2025–2050*: **6.31 MMTCO$_2$e**

** See Appendix D for a summary of methods, data, and assumptions.*

Key Implementing Agency(ies)

- **State and Local governments.** The Virginia Department of Housing and Community Development (VDHCD), Virginia Department of Environmental Quality (VDEQ), Virginia State Corporation Commission (VSCC), and other state agencies can support implementation. Relevant local government organizations can provide support and share best practices when implementing this measure.
- **Dominion Energy.** As the main utility provider for the MSA, Dominion Energy provides existing energy efficiency programs for ratepayers that can be expanded. In addition, Dominion Energy will be key for ensuring that the electrical grid infrastructure is able to support the electrification of processes and an increased supply of renewable energy. Per the Virginia Clean Economy Act (VCEA), Dominion Energy is required to produce 100% renewable energy by 2045.

- **Businesses, hospitals, private schools, universities, water utilities, airports, places of worship.** These entities may implement building improvements and design/build decarbonized buildings.
- **Property owners, developers, renters.** As end users, homeowners, property owners, developers, and renters can make behavior changes and decisions that affect building efficiency. While property owners and developers generally have more control over changes to and within buildings, especially at the time of new construction or major renovations, renters can also make behavior and other changes that will result in GHG reductions.
- **Non-profit organizations.** Nonprofits can conduct community engagement, education and outreach, capacity building, research on environmental and social impacts of clean energy projects, and/or developing and installing community renewable energy projects. Project:HOMES provides assistance to low-income homeowners for efficiency upgrades and weatherization, as well as directly addressing the production of affordable housing. Other nonprofits, like Viridiant, also provide energy efficiency upgrade services to low-income households.
- **Contractors and equipment/energy service providers.** These partners provide the services and equipment to decarbonize buildings, and may include architects, engineers, energy auditors, consultants, and more. Workforce development organizations also play a key role in building the pipeline of skilled workers to serve the building sector's decarbonization needs.

Authority to Implement

Virginia law does not currently allow local governments to establish building energy performance standards (BEPS) or related policies such as energy benchmarking. Energy code implementation across the region is governed by state law, which with some variations limits local governments' ability to implement codes different from that adopted at the state level. Notwithstanding the lack of home rule in Virginia to adopt local building codes, cities and counties in the Commonwealth of Virginia have—for as long as 22 years—fashioned and implemented green building incentive programs based on tiers of BEPs and performance certifications. City and county governments within the MSA can implement clean energy projects in their own operations within their respective jurisdictions. Thus, activities within this measure can be implemented or are being implemented through existing voluntary or regulatory programs.

Implementation Activities and Milestones

Actions to implement this measure could include, but are not limited to the following:

- Create voluntary benchmarking and labeling programs for buildings.
- Conduct energy audits and site assessments. By conducting these assessments, implementers can collect information on which areas of the building inventory, if any, need additional support in achieving improved energy efficiency and decarbonization, and have the highest potential to result in energy savings.

- Incentivize net zero building development. Prioritizing low-emissions practices across the lifecycle (in construction, maintenance, and end of life) of new buildings and retrofits to existing buildings can yield more integrated emissions savings.
- Expand or create new programs and incentives for retrofits and upgrades to residential, multifamily, and commercial properties (e.g., building efficiency retrofits including window replacements, insulation, more efficient and/or electric appliances, hybrid or all-electric heat pumps or more efficient gas heat pumps).
- Plan for and address electric panel and electrical transformer upgrades in residential and commercial properties to support electrification and the addition of residential solar.
- To increase local solar adoption:
    - Map solar opportunities across the MSA to determine potential priorities and investments.
    - Incorporate community energy infrastructure needs, goals, and strategies in master plans, comprehensive plans, and small area plans.
    - Provide or promote incentives to encourage installation of solar and battery storage in the community and for battery storage, especially in new buildings.
    - Provide technical assistance and support for negotiating and navigating power purchase agreements and community solar, and examine the possibility of regional demand aggregation.

Geographic Coverage

This measure will reduce GHG emissions across the entire MSA.

LIDAC Benefits

These actions could contribute to reducing energy expenses for private and public entities. Indirect benefits include green energy jobs and training for auditors, construction workers, contractors, and other building trades such as HVAC suppliers and carpenters. Additionally, these measures may encourage infill development, preserve and improve homes and buildings in LIDACs, and improve the resilience of the energy grid.

These measures may result in direct benefits including reduced energy costs from the implementation of energy efficiency measures and educational programs that influence user behavior and result in lower utility bills. The incorporation of microgrids may benefit LIDACs by providing alternative network sources for energy during high demand and increases reliability. This measure will also improve local air quality, leading to a reduction in related health impacts such as asthma.

Potential impacts or dis-benefits for business and residential lease holders include construction noise, fugitive dust, utility interruptions, and in some cases early lease termination to complete construction activities. Following construction, increased rents may be a concern. “Revitalization” projects in LIDACs have often – intentionally or unintentionally – resulted in gentrification and historic and minority populations being priced out of their neighborhoods. Countereffforts should be taken to ensure benefits primarily flow to the original community occupants, although lack of authority, as discussed above, may hamstring such efforts.

PCAP Measure 7. Reduce emissions from port operations through the adoption of low-carbon fuels, electric equipment, and operational changes.

GHG Reduction Measure Description

This measure focuses on reducing off-road transportation GHG emissions through actions to decarbonize operations and electrify ports. Measure could involve deploying shore power (electric power supplied to docked ships to reduce idling), installing renewable energy, or switching to electric forklifts and other cargo handling equipment, among other activities.

Measure 7 Quantified GHG Reductions

Cumulative GHG Reductions from 2025–2030*: **0.01 $MTCO_2e$**

Cumulative GHG Reductions from 2025–2050*: **0.03 $MTCO_2e$**

** See Appendix D for a summary of methods, data, and assumptions.*

Key Implementing Agency(ies)

As a state entity, the Virgina Port Authority (VPA) will be implementing this measure for its facilities across the state, in alignment with the Hampton Roads and Virgina State PCAP, in addition to its Marine Terminal facility and operations within the boundary of the Richmond MSA.

- **Virginia Port Authority:** VPA owns and /or operates (through its private operating subsidiary, Virginia International Terminals, LLC) four five general cargo facilities in Hampton Roads MSA (Norfolk International Terminals, Virginia International Gateway, Portsmouth Marine Terminal, Newport News Marine Terminal, and the Pinners Point Container Yard),and the Virginia Inland Port in Front Royal), in the Hampton Roads MSA and the Richmond Marine Terminal in the Richmond MSA.
- **Utilities:** Utilities connect and manage load and renewable energy opportunities for port operations.
- **Trade groups.** Trade groups will implement the infrastructure updates specified in this measure.
- **Private sector partners.** Private companies and landowners with property near port infrastructure may need to be engaged to coordinate land-use planning.
- **Community colleges.** The Port of Virginia works with Tidewater Community College to provide necessary training for technical operators and maintenance technicians.

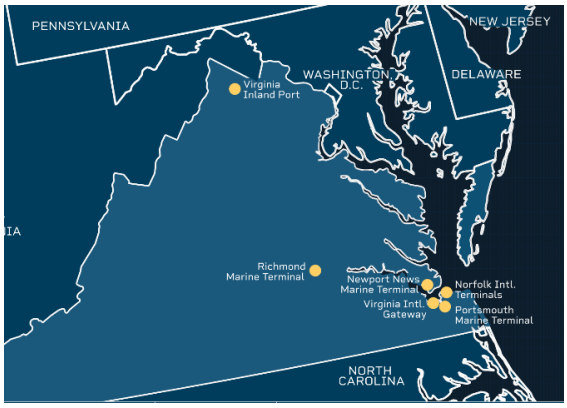

Figure 13. Port of Virginia Locations

Figure 14. Richmond Marine Terminal

Authority to Implement

VPA has the authority to modify its infrastructure and acquire low-emission equipment and systems used within their facilities as described under this measure.

Implementation Activities and Milestones

VPA has committed to become net zero by 2040, and in 2022, they released a sustainability report detailing their progress and future decarbonization targets.[32] This includes a goal to source all their energy from renewable sources by 2024. VPA plans to continue replacing diesel carrier shuttles with hybrid shuttles, electrifying yard tractors, developing an offshore wind energy hub, and implementing a living shoreline project.

In addition to continuing the activities described above, additional example actions for Measure 7 implementation are listed below. These actions are illustrative and not intended to be exhaustive of all actions that could be used to implement this measure.

- Source clean energy for port operations. As discussed above, VPA is on track to meet their 2024 goal of utilizing 100% renewable energy sources.
- Continue to fund the port's green operator dray truck replacement program.
- Provide programs and incentives to decarbonize ports/port electrification.
- Explore expanding barge operations to reduce VMT of port-supporting vehicles.
- Evaluate potential for the provision of shore power or alternative fuels to reduce emissions from oceangoing vessels.
- Continue replacing diesel straddle carriers with hybrid shuttle carriers.

Geographic Coverage

The areas near and around ports (the Richmond Marine Terminal) will be most impacted.

LIDAC Benefits

Within Virginia, as with many parts of the country, there is overlap between locations of ports and the location of LIDACs. LIDACs directly around the Richmond Marine Terminal will primarily be affected, in addition to those in neighboring regions that will benefit from steps to reduce emissions from port operations across the MSA, notably trucking. Through implementing this measure, benefits for LIDACs may include improved air quality and health benefits resulting from potential reductions in off-road emissions, as well as potential reductions in new asthma cases, hospital admissions, and emergency department visits and reduced light and noise pollution.[33]

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[32] The Port of Virginia. 2022. Sustainability Report: Net-Zero by 2040. https://www.portofvirginia.com/wp-content/uploads/2023/09/Port-of-VA-Sustainability-Report_2023_12pgs.pdf

[33] US EPA. “Environmental Justice Primer for Ports: Impacts of Port Operations and Goods Movement.” Overviews and Factsheets, July 31, 2019. https://www.epa.gov/community-port-collaboration/environmental-justice-primer-ports-impacts-port-operations-and-goods.

Moving Forward

CPRG Implementation Grants

Immediately following the finalization of this PCAP, state, regional, municipal, and tribal agencies and consortia are eligible to apply for CPRG competitive funding to implement the targeted measures presented within this plan. The September 20, 2023, CPRG Implementation Notice of Funding Opportunity (NOFO) sets the stage for $4.3 billion of funds that are available through a general competition, potentially resulting in individual grants ranging from $2 million to $500 million each. An additional $300 million will be available to Tribes and territories for implementation. Implementation funding applications are due April 1 and May 1, 2024, with anticipated awards of funding later in 2024.

Other CPRG Planning Grant Deliverables

Recipients of a PCAP planning grant must submit a CCAP two years after the date of the PCAP award (August 9, 2025). PlanRVA will develop a CCAP that builds off the PCAP by providing an expanded GHG analysis covering all significant sources and sinks, creating both short-term and long-term GHG emissions reduction targets and articulating a comprehensive set of measures to achieve the targets. A significant stakeholder and public engagement process will support the development of the CCAP.

Per the CPRG guidance, the CCAP will include the following:

- An updated GHG inventory for the MSA.
- BAU GHG emissions projections and an economy-wide GHG emissions reduction scenario.
- GHG reduction targets for the MSA (short and long term).
- A comprehensive list of GHG reduction measures that address economy-wide emissions. Building on the PCAP, this will include the following for each measure:
    - Quantified estimates of GHG reduction and costs,
    - Key implementing agency or agencies,
    - Implementation schedule and milestones,
    - Expected geographic location if applicable,
    - Quantified estimates of co-pollutant reductions,
    - Quantified analysis of benefits for LIDACs,
    - A review of the statutory or regulatory authority to implement the measure,
    - Identification of funding sources that have been secured for implementation,
    - Metrics for tracking progress, and
    - A workforce planning analysis.

In 2027, PlanRVA will develop and share a CPRG Status Report that will include the following:

- The implementation status of the quantified GHG reduction measures from the CCAP.
- Relevant updated analyses or projections supporting CCAP implementation.
- Next steps and future budget or staffing needs to continue CCAP implementation.

Appendix A. Stakeholder Engagement

Local Document Review of GHG Reduction Measure Input

PlanRVA conducted a review of multiple regional and local documents and pulled out 179 actions related to GHG reduction measures related to transportation, buildings, industrial, waste, agriculture and land use, local government operations, clean energy, and equity. The documents reviewed are listed below. The compiled actions were used in combination with other stakeholder feedback to develop the initial priority GHG reduction measures.

Key documents reviewed:

- Connect RVA 2045
- Connect RVA 2045 StoryMap
- Greater RVA Transit Vision Plan
- Richmond Regional Bicycle & Pedestrian Plan
- Charles City County Comprehensive Land Use Plan
- Powhatan County 2021 Comprehensive Plan
- City of Petersburg Comprehensive Plan
- Chesterfield County Comprehensive Plan
- Central Virginia Waste Management Authority Strategic Plan
- Henrico County Environmental Policy Statement
- City of Richmond Climate Equity Action Plan 2030
- Petersburg Area Transit Strategic Plan
- Richmond Master Plan 2020
- Greater RVA Transit Vision Plan: Near-Term Strategic Technical Analysis
- City of Hopewell Comprehensive Plan
- Henrico County Vision 2026

Steering Committee PCAP GHG Reduction Measure Input

During the kickoff meeting with the Steering Committee, PlanRVA held a brainstorming session to generate potential projects, programs, and actions that are priorities or areas of interest for committee members. This list informed the creation of the priority GHG reduction measures.

Project Description
E-bike incentive program
Fall Line Trail
N/S BRT expansion
Expand EV charging infrastructure
Make public transit free for all riders, permanently
Convert 10% of vehicle trips to bike/ped by 2030; 40% by 2050
Expand and Fund RVA bikeshare to the region
Bike/Ped infrastructure improvements
Invest in Public Transit
Decrease total VMT

Implement VEPGS Renewable Energy Cohort by installing solar farms
Install equipment to 3 major private industries (e.g., air scrubbers)
Relocate and modernize asphalt plant
Finalize industrial sites with utility infrastructure
Reduce or eliminate small gas-powered lawn equipment
Increase and protect urban agricultural space; develop agricultural community land trusts
Provide subsidies or rebates for agrivoltaic installations or PV installs on farm buildings
Increase agriculture soil conservation practices
Install solar shelters over shared bike path
Install solar pavers that can be trail surface
Update codes to promote solar
Convert all streetlights to LED
Install small-scale wind turbines along interstates
Plant X number of trees annually
Develop a Green Infrastructure Plan
Low-income weatherization (continue DHCD program funded by RGGI)/Retrofit homes in LIDACs
Fund roof replacements to solar-ready state
Promote solar installations through PPA model
Improve energy efficiency of and install solar on municipal buildings, school, public facilities
Eliminate SF zoning
Eliminate parking minimums
Require new homes to be EV compatible
Reduce energy burden in LIDAC
Incentivize solar installations on new buildings
Improvements to existing wastewater plants and regional connectivity
Promote circular economy (e.g., Tool libraries)
Increase recycling in health care industry
Capture methane from landfills
Reduce construction and demolition waste
Reduce food waste by redirecting edible food to vulnerable communities
Increase municipal composting
Establish zero-waste business tax credit

Community Engagement Meeting Summary

- PlanRVA hosted a Zoom call with 11 organizations (Diversity Richmond, ART180, Blue Sky Fund, Colonial Heights Food Pantry, Health Brigade, Central Virginia Waste Management Authority, Storefront for Community Design, Dominion Innovation Center, Science Museum of Virginia, The James House, Virginia LISC) to provide an overview of the CPRG and key next steps. Each of these organizations expressed an interest in staying engaged going forward and committed to sharing the GHG Emissions Survey with their stakeholders. Seven of the organizations were interested in helping to convene

focus groups or other engagement activities for their community stakeholders later in the process.

- PlanRVA met individually with nine organizations for one-on-one discussions to provide an overview of the CPRG and key next steps. These organizations—project:HOMES, Latinos in Virginia Empowerment Center, the Community Foundation for a greater Richmond, Greater Richmond Fit4Kids, The James House, Oakwood Arts, Richmond Public Library, Appomattox Regional Library, Neighborhood Resource Center of Fulton—committed to staying engaged and sharing the GHG Emissions Survey with their community stakeholders.
- Of these organizations, three immediately invited PlanRVA to engage their communities at a grassroots level. In-person intercepts were conducted outside of two Richmond Public Library branches (North Avenue and East End) and outside of the Appomattox Regional Library in Hopewell. PlanRVA engaged with 39 residents, each of whom completed a brief survey and received VISA or Amazon gift cards for their investment of time and perspective. In addition, Oakwood Arts (in Richmond's East End) scheduled an in-person focus group with their staff and student interns.
- Thirteen organizations asked to work with PlanRVA later in the spring to organize focus groups or another engagement opportunity for their staff and/or community stakeholders. These included Diversity Richmond, ART180, Colonial Heights Food Pantry, Health Brigade, Storefront for Community Design, Dominion Innovation Center, Science Museum of Virginia, The James House, project:HOMES, Latinos in Virginia Empowerment Center, the Community Foundation for a greater Richmond, Greater Richmond Fit4Kidsand the Neighborhood Resource Center of Fulton.

Community Survey Details

A detailed survey was created in both English and Spanish and well-publicized across the region through our outreach and engagement efforts. The survey was open to the public for three weeks, and 820 individuals representing 17 of the 19 localities in the Richmond MSA (including tribal residents) completed the survey. Of those, 358 respondents indicated an interest in staying engaged (providing their email and/or physical mailing address).

- 89% of survey respondents live in the region's largest localities (Richmond, Henrico, and Chesterfield).
- Just over 9% were under the age of 29. About 64% were aged 30–64, and about 28% were 65 or older.
- 85% of respondents were White or Caucasian.
- 34% of respondents reported income below median income levels.

Key themes from a series of open-ended questions in the survey included the following (*italics are direct quotes from a survey respondent)*:

The impact of transportation issues:

- Safety Concerns: *Most streets in Richmond are not safe for bike travel. Access to public transit is limited due to infrequent bus routes and bus stops without seating or shelter.*

- Lack of Public Transit and Infrastructure: *Would use public transit if it was more convenient and safer (better lighting, benches for waiting, trash/recycling receptacles).*
- Noise and Air Pollution: *The noise is disrupting my sleep at night. Several times a week between 11pm and 4am, very loud ICE vehicles wake me up as they drive by my home.*

The impact of pollution from waste:

- Air Quality and Health Concerns from Landfills: *When I first moved to Petersburg 7 years ago I woke up choking due to the landfill gases; I could not breathe. This caused me to reach out to the city, but they did not report anything to the Virginia Department of Environmental Quality.*
- Physical Hazards and Environmental Blight from Waste: *Road hazards from tire retreads on the interstate. Ninety-five is always littered with tire waste, year-round.*
- Water Pollution and Community Cleanliness: *Litter litter everywhere! I spend a lot of my time walking around picking up trash... Never is there a day where I don't find something on a walk.*

Project ideas to reduce pollution:

- **Enhanced Public Transportation Options**: A desire for more public transportation options, including increased bus routes, better bus services, and initiatives to encourage the use of mass transit to reduce individual car usage.
- **Infrastructure for Pedestrians and Cyclists**: A need for better infrastructure to support walking and biking, such as more sidewalks, bike lanes, and pedestrian-friendly development, to reduce reliance on vehicles.
- **Waste Management Improvements**: Better recycling programs, municipal composting, and education on waste reduction. A need for more frequent trash pickups and proper disposal methods for large items.
- **Greener Energy and Vehicle Options**: A shift toward EVs, including public buses, and support for alternative energy sources. This includes the installation of EV charging stations and incentives for electric car ownership.
- **Reduction of Single-Use Plastics**: A reduction or elimination of single-use plastics, suggesting bans on plastic bags and encouraging the use of recyclable or compostable materials.

Appendix B. Identification of LIDACs in Richmond MSA

County	Census Block ID
Charles City County	510366001001
Charles City County	510366001002
Chesterfield County	510366003002
Chesterfield County	510411001071
Chesterfield County	510411001072
Chesterfield County	510411002091
Chesterfield County	510411002101
Chesterfield County	510411003001
Chesterfield County	510411004033
Chesterfield County	510411004041
Chesterfield County	510411004042
Chesterfield County	510411004051
Chesterfield County	510411004052
Chesterfield County	510411004061
Chesterfield County	510411004071
Chesterfield County	510411004072
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Chesterfield County	510411004095
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Chesterfield County	510411005055
Chesterfield County	510411005062
Chesterfield County	510411005063
Chesterfield County	510411005071
Chesterfield County	510411005081
Dinwiddie County	510411005082
Hanover County	510411005101
Hanover County	510411005102
Hanover County	510411006001
Hanover County	510411006002
Hanover County	510411006003
Hanover County	510411007011
Hanover County	510411007012
Hanover County	510411009071
Hanover County	510411009072
Henrico County	510411009152
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Henrico County	510538405001
Henrico County	510853208041
Henrico County	510853209021
Henrico County	510853210011
Henrico County	510853210013
Henrico County	510853211001
Henrico County	510853211002
Henrico County	510853211003
Henrico County	510853212011
Henrico County	510853212012
Henrico County	510853212013
Henrico County	510853212022
Henrico County	510853212023
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Henrico County	510872001253
Henrico County	510872001254
Henrico County	510872001262
Henrico County	510872001332
Henrico County	510872001343
Henrico County	510872001443
Henrico County	510872001531
Henrico County	510872001532
Henrico County	510872003011
Henrico County	510872003012
Henrico County	510872003023
Henrico County	510872003031
Henrico County	510872003052
Henrico County	510872003053
Henrico County	510872004041
Henrico County	510872004042
Henrico County	510872004043
Henrico County	510872004073
Henrico County	510872004091
King and Queen County	510872004112
King William County	510872004113
New Kent County	510872004121
New Kent County	510872004122
Prince George County	510872004171
Sussex County	510872004172
Sussex County	510872004173
Sussex County	510872004174
Sussex County	510872004181
Sussex County	510872004182
Colonial Heights City	510872004183
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Colonial Heights City	510872005022
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Hopewell City	510872006002
Hopewell City	510872006003
Hopewell City	510872007001
Hopewell City	510872007002
Hopewell City	510872007003
Hopewell City	510872007004
Hopewell City	510872008011
Hopewell City	510872008012

County	Census Block ID
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Hopewell City	510872008022
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Hopewell City	510872008054
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Petersburg City	510872008071
Petersburg City	510872008072
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Petersburg City	510872008074
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Richmond City	510872014064

County	Census Block ID
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Richmond City	510872015033
Richmond City	510872015042
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Richmond City	516708205002
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Hanover County	517600411001
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County	Census Block ID
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Sussex County	510411008142
Colonial Heights City	510411008152
Colonial Heights City	510411008161
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Petersburg City	510411008163
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Richmond City	510411008181
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County	Census Block ID
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Richmond City	510411009221
Amelia County	510411009222
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Chesterfield County	510411009343
Chesterfield County	510538401022
Chesterfield County	510538403002
Chesterfield County	510538403003
Chesterfield County	510538404001
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Goochland County	510853206012
Goochland County	510853206013
Goochland County	510853206022
Hanover County	510872001233
Hanover County	510872001243
Hanover County	510872001311
Hanover County	510872001312
Hanover County	510872001321
Hanover County	510872001322
Henrico County	510872001361
Henrico County	510872003022
Henrico County	510872003032
Henrico County	510872003051
Powhatan County	517600708021
Powhatan County	517600708022
Powhatan County	517600708032
Sussex County	517600708041
Richmond City	517600708042
Richmond City	517600708043
Richmond City	517600709011
Richmond City	517600709012

Appendix C. Richmond MSA GHG Inventory and BAU Projections

For the PCAP, PlanRVA compiled a simplified GHG inventory and associated business-as-usual (BAU) projections. The simplified GHG inventory was only compiled for sectors related to a PCAP measure. A comprehensive GHG inventory will be complete for the CCAP.

The methodology for each is summarized below, with Figure 15, Figure 16, and Figure 17 depicting the GHG inventory and BAU projections for the community and municipal operations. (*Note: Off-Road Transportation emissions are too small to be seen in Figure 15*)

Figure 15. Richmond MSA Community GHG Inventory in 2019

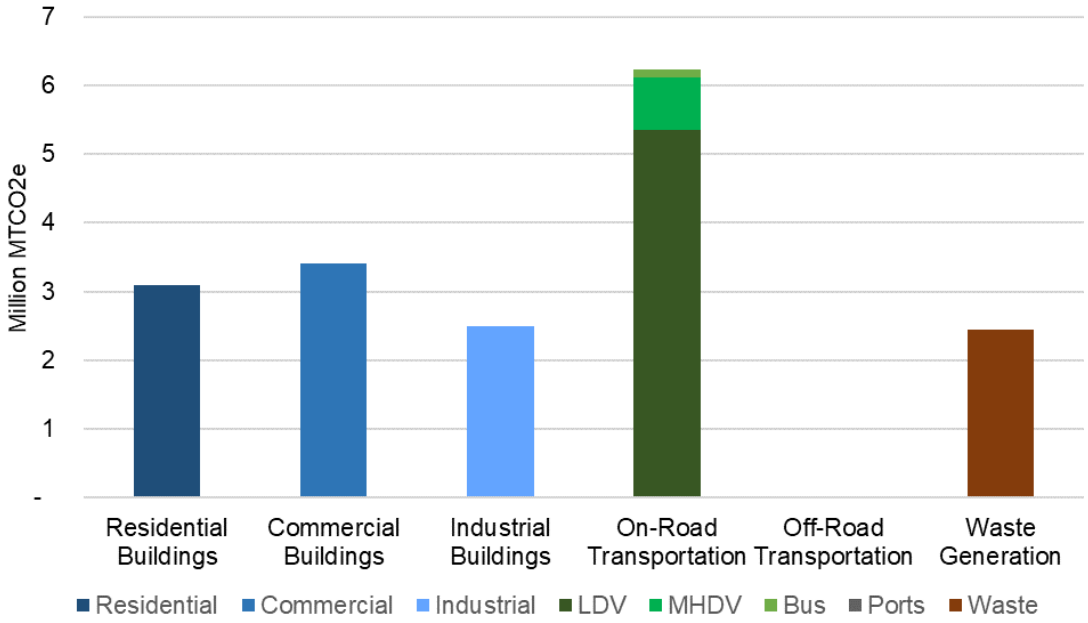
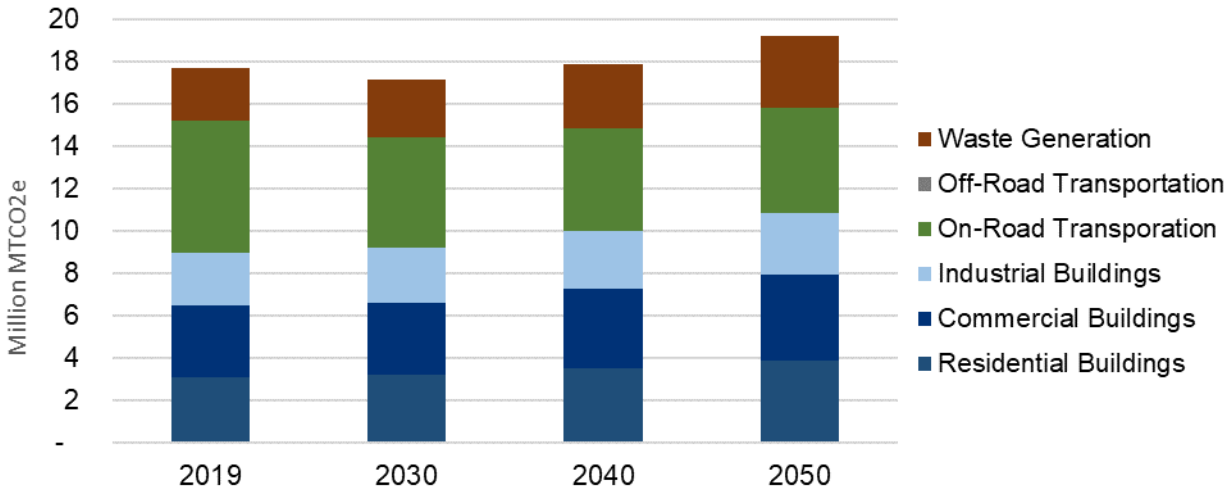


Figure 16. Richmond MSA Community GHG Inventory and BAU Projections



Buildings. PlanRVA acquired state-level building sector emissions data from energy use from EPA's SIT for residential, commercial, and industrial buildings. These state-level data were then scaled to the counties within the MSA based on a population scaling factor using the following equation:

$$County\ building\ data_{2019} = \frac{County\ population_{2019}}{Virgina\ population_{2019}} \times Virginia\ building\ data_{2019}$$

The BAU projections were compiled by growing the MSA-level building data by a rate of growth calculated from the U.S. Energy Information Administration's (EIA) Short-Term Energy Outlook. EIA's Short-Term Energy Outlook provides energy consumption by sector and source from 2019 to 2050. A yearly growth rate was applied to the 2019 inventory data to project building sector emissions from energy use through 2050.

On-Road Transportation. PlanRVA used EPA's emissions modeling system, MOtor Vehicle Emission Simulator (MOVES), to calculate the emissions from the on-road transportation sector. MOVES has on-road vehicle projection data for vehicle population, VMT, energy consumption, and tailpipe GHG emissions by vehicle type and fuel type for ICEVs. It accounts for projected fuel efficiency improvements for ICEVs as a result of existing policies. PlanRVA ran MOVES with default settings to create the 2019 inventory and BAU projections for population, VMT, energy consumption, and emissions from on-road vehicles for each locality in the MSA. This was then scaled to 2019 VDOT data for the region to better reflect observed VMT in the MSA.

Off-Road Transportation. PlanRVA developed emissions estimates for ports only for the PCAP. Ports emissions estimates were calculated in alignment with the methodology used in the statewide PCAP for Virginia that was prepared by DEQ. The 2021, U.S. Army Corps of Engineers Entrances and Clearances data was used to develop the number of ship calls in conjunction with Lloyd's Register of Ships produced by IHS Global Limited. For loads and hoteling times, the 2021 Port of Los Angeles was used. Port of Los Angeles is the like port both in ship calls and cargo movements. The 2011 Port of Virginia inventory was used to derive the in bay, RSZ and maneuver times and speeds. For ocean going vessels, the Port of Virginia ratio of calls for the various terminals was used to divide the Port of Virginia calls (and associated emissions) among the appropriate terminals. For all other sectors, the Port of Los Angeles emissions data was used and ratioed using cargo data from the U.S. Army Corps of Engineers Waterborne Cargo data for the various Virgina ports and for the Port of Los Angeles. For harbor craft, only tug movements were used. The 2021 data is used as a proxy for 2019 emissions. For the BAU, ports emissions were held constant over time.

Waste Generation. Based on data from EPA Greenhouse Gas Reduction Program Facility Level Information on Greenhouse gases Tool (FLIGHT), the Richmond MSA does not have any waste combustion facilities within its boundaries. Therefore, no emissions associated with the incineration of MSW were included in this simplified inventory. PlanRVA calculated landfill emissions for 2019 using data from EPA's LMOP. LMOP data presents annual and cumulative MSW tonnage, the total capacity of the landfill, and whether the landfill has a gas capture system. The 2019 LMOP data did not include a value for annual tons of MSW, and therefore 2021 data were used as a proxy for 2019 data. The following equation was used to calculate the emissions from each landfill, based on the EPA Waste Reduction Model (WARM) tool:

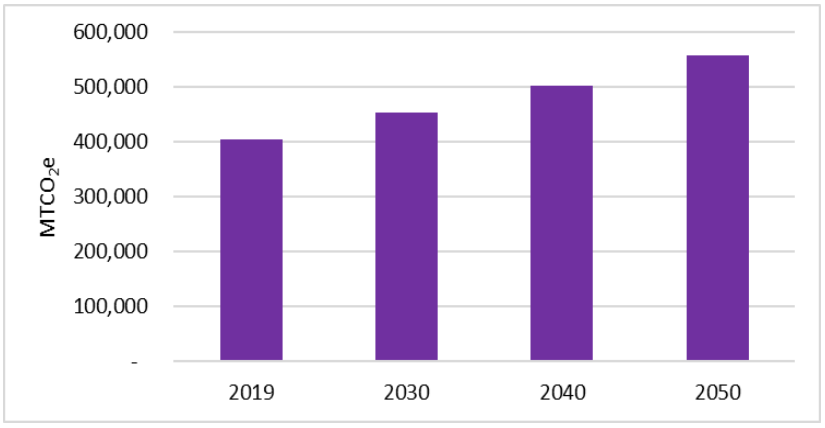
$$Emissions = MSW_{annual} \times (Methane_{EF} \times Methane_{GWP}) \times (1 - O_{rate}) \times (1 - G_{capture})$$

Variable	Value	Description
Emissions	Calculated	Annual emissions for the landfill in $MTCO_2e$.
MSW_{annual}	Retrieved from LMOP data	Annual tons of MSW buried.
$Methane_{EF}$	0.0648	Methane emission factor based on EPA WARM assumptions.
$Methane_{GWP}$	28	The AR5 global warming potential of CH_4.
O_{rate}	0.1 for landfills without gas capture; 0.2 for landfills with gas capture	Oxidation rate based on EPA WARM assumptions.
$G_{capture}$	0 for landfills without gas capture systems; 0.6 for landfills with gas capture systems	Gas capture rate based on EPA WARM assumptions.

The sum of emissions from all landfills within the Richmond MSA in 2019 was used to represent the total emissions from solid waste for 2019 for the MSA. The BAU projections were calculated using an average annual population growth rate using U.S. Census 2020 population data and 2050 population projection data from PlanRVA. The average annual growth rate through 2050 for the MSA is 1.04%.

Municipal Operations. To calculate the municipal inventory for the Richmond MSA, PlanRVA estimated the GHG emissions from municipal buildings (including schools) and from municipal vehicle fleets for the year 2019.

Figure 17. Richmond MSA Municipal Operations GHG Inventory and BAU Projections



Buildings. To estimate municipal building GHG emissions, PlanRVA used data from Henrico County.[34] The county was able to readily provide annual building electricity and fuel emissions data for all public buildings and schools. PlanRVA then extrapolated this data to the rest of the localities in the MSA using a population scaling factor. PlanRVA used the Henrico buildings emissions data as the base for the scaled approach because it was the most comprehensive municipal data inventory readily available. For Richmond City, buildings emissions data available directly from the city for 2018 were used instead of scaling the 2019 Henrico County data.

[34] Henrico Environmental Action Resource Team. "Energy Dashboard - Henrico County, Virginia." Henrico County Virginia. 2024. https://henrico.us/heart/dashboard/.

Vehicle Fleet. Similarly, to estimate municipal vehicle fleet emissions, PlanRVA used municipal vehicle fleet fuel usage information for Henrico County and then extrapolated to the rest of the MSA using a population scaling factor. Henrico County provided data for the number of diesel and gasoline gallons used for their municipal fleet for fiscal year 2023, which was used as a proxy for 2019. PlanRVA then used emissions factors from the EPA MOVES model for diesel and gasoline to estimate the GHG emissions for the municipal fleet. These data were extrapolated to the rest of the localities in the MSA using a population scaling factor. Although the Henrico fuel usage data were not available for the inventory year (2019), PlanRVA used the Henrico fuel usage data as the base for the scaled approach because it was the most comprehensive municipal inventory available throughout the localities in the Richmond MSA. For Hanover County, Chesterfield County, and Richmond City, direct fuel usage data from each municipality were used instead of scaling the Henrico County data.

BAU Projections. The BAU projections were calculated using an average annual population growth rate for each county in the Richmond MSA using U.S. Census 2020 population data and 2050 population projection data from PlanRVA.

Appendix D. Approaches for Quantifying GHG Reductions from PCAP Measures

The following is a summary of methods used for calculating emissions reductions in the Richmond MSA PCAP. In developing these values, modeling assumptions were made to determine reasonable GHG emissions reductions from the deployment of specific measures. In some cases, there may be areas of overlap for emissions reduction values between measures. For example, local government operations are a subset of the total community, and reductions for their fleets (Measure 5) are also modeled in the community-wide ZEV modeling under Measure 1. Similarly, port vehicle electrification (Measure 7) will have some overlap with broader community-wide ZEV modeling under Measure 1. The estimates provided in this PCAP reflect the implementation of each measure with all the identified actions included, to the extent data were available to support the analysis for this PCAP. Since a number of these measures cover the same activity sector, their impacts are not additive as they sometimes overlap with each other. Modeling for these measures is anticipated to be revised as part of the CCAP process.

Measure 1. Incentivize and promote the rapid adoption of electric vehicles through partnerships, technical assistance, financial incentives, and other mechanisms, and support the siting, procurement, installation, and use of charging infrastructure.

This measure models the resulting GHG emissions reduced if the Richmond MSA meets the ZEV sales targets outlined by California's Advanced Clean Cars II (ACCII) rule for light-duty vehicles (LDVs) and the Multi-State Zero Emission Medium- and Heavy-Duty Vehicle (MHDV) Memorandum of Understanding (MOU). Virginia is one of 14 states (including Washington, D.C.) that has adopted California's ACCII rule and is one of 18 states (including Washington, D.C.) that has signed the MOU. Figure 18 below shows the sales targets assumed for LDVs and MHDVs. The model uses outputs from the EPA MOtor Vehicle Emissions Simulator (MOVES4) to project baseline VMT, vehicle population, energy consumption, and Scope 1 emissions for on-road transportation in the MSA by fuel type (gasoline, diesel, ethanol (E-85), compressed natural gas, and electricity), vehicle source type, and model year.[35] Default input values were used.

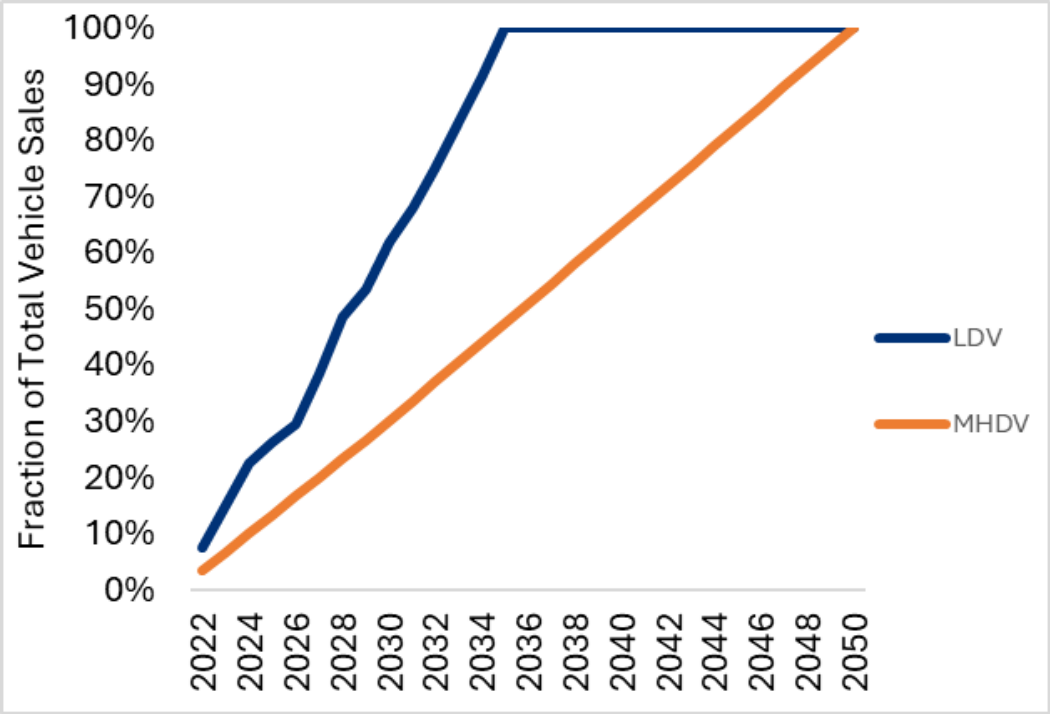
Scope 2 emissions from electricity consumption by EVs were found using the following equation:

$$Scope\ 2\ Emissions = Electricity\ Consumption \times Electricity\ Emission\ Factor \quad (1)$$

[35] U.S. Environmental Protection Agency. 2024. Motor Vehicle Emission Simulator: MOVES4 (Version 4.0.1) [Computer software]. https://www.epa.gov/moves.

The electricity emissions factor was held at 2020 EPA's Emissions and Generation Resource Integrated Database (eGRID) reported levels for the Virgina region (SRVC) through 2050 for the baseline.[36]

Figure 18. Percent sales of vehicles that are zero-emission vehicles



To model GHG emissions reductions in the policy scenario, for each model year, a fraction of VMT was designated as fuel type "electricity" or "hydrogen" based on the ZEV sales curve. The resulting energy consumption was found using the following equation:

$$Energy\ Consumption = VMT\ \times Energy\ Efficiency, \quad (2)$$

where energy efficiency was in units of kJ/mi for battery EVs (BEVs) and fuel cell EVs (FCEVs). Implied BEV energy efficiencies from the MOVES4 baseline results were used. FCEV energy efficiencies were sourced from the California Advanced Clean Fleets (ACF) rule making.[37] Scope 1 emissions were found by reducing baseline ICEV emissions by the ZEV sales fraction. Scope 2 emissions were found using Equation (1). The grid emissions factor used for the ZEV measure reflects a cleaner grid overtime in line with state policy. The grid emissions factor projection is sourced from EIA's Annual Energy Outlook (AEO) 2023 Reference Case, which

[36] U.S. Environmental Protection Agency. 2022. Emissions & Generation Resource Integrated Database (eGRID), 2020. Washington DC: Office of Atmospheric Protection, Clean Air Markets Division. https://www.epa.gov/system/files/documents/2022-01/egrid2020_summary_tables.pdf.

[37] California Air Resources Board. 2022. Appendix G: Total Cost of Ownership Discussion Document. Advanced Clean Fleets Regulation. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/appg.pdf.

includes the impact of state policy and federal tax credits for clean energy.[38] The emissions factor for the PJMD region was used for the CO_2 emission factor projection. The CO_2 emissions factor was combined with the CH_4 and N_2O EPA eGRID emission factor data for the SRVC region to estimate a CO_2e emissions factor representing the MSA.

The following additional key assumptions were made throughout the analysis:

- ZEVs exist in the vehicle fleet for the same length of time as ICEVs.
- ZEV activity/use is identical to an ICEV.
- The annual ZEV sales fraction applies to every fuel type.
  Long-haul medium and heavy-duty vehicles (MHDVs) ZEVs are modeled as FCEV and all other MHDVs ZEVs are modeled as BEV. The hydrogen supply is assumed to be 50% green hydrogen and 50% blue hydrogen.
- All LDVs ZEVs are modeled as BEVs.
- All BEV populations 2021 and earlier are EPA MOVES4 default.
- 2022 LDV ZEV share was sourced from the Alliance for Automotive Innovation.[39]
  The methodology in some cases required re-allocating MOVES4 baseline projected electric vehicle back to ICEVs. Where this was necessary, LDVs were designated as gasoline, and MHDVs were designated as diesel.

Measure 2. Expand equitable transit access.

This measure models resulting VMT and GHG emissions reduced if the Richmond MSA enhances its public transit system by increasing transit service frequency, extending transit network coverage or hours, and implementing transit-supportive roadway treatments throughout the MSA. The measure assumes these strategies only result in light-duty passenger vehicle VMT reduction. The potential VMT reduction due to each of these actions was calculated based on the methodology outlined in the *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity,* a document compiled for the California Air Pollution Control Officers Association to provide methods for estimating GHG reductions resulting from various measures.[40]

Passenger vehicle VMT reduction due to transit enhancements was only modeled in counties with existing bus systems for this measure. The resulting passenger VMT reduction in each applicable county is shown in the following table. Larger reductions are possible when this measure is paired with other items such as improved transit-oriented development, congestion and/or VMT pricing, encouragement of teleworking, and other disincentives for driving, which

[38] United States Energy and Information Administration. 2023. Annual Energy Outlook 2023 Table 54. Electric Power Projections by Electricity Market Module Region: Reference Case | PJM/Dominion. https://www.eia.gov/outlooks/aeo/tables_ref.php.
[39] Alliance for Automotive Innovation. 2024. Economic Insights. https://www.autosinnovate.org/resources/insights/va.
[40] California Air Pollution Control Officers Association. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. https://www.airquality.org/ClimateChange/Documents/Handbook%20Public%20Draft_2021-Aug.pdf

are not quantified as part of this PCAP measure and will be further reviewed as part of the CCAP process.

Strategy Name	2030 VMT Reduction	2050 VMT Reduction	Applicable Counties
Increase Transit Service Frequency	-0.016%	-0.031%	City of Richmond, Henrico, Petersburg city, Colonial Heights, Hopewell city
	-0.0078%	-0.016%	Chesterfield, Goochland, Hanover
Extend Transit Network Coverage or Hours	-0.042%	-0.084%	City of Richmond, Henrico
Implement Transit-Supportive Roadway Treatments	0.0025%	-0.0050%	City of Richmond, Henrico, Petersburg city, Colonial Heights, Hopewell city
	-0.0012%	-0.0025%	Chesterfield, Goochland, Hanover

Where calculation input data from specific plans were not available, conservative estimates were made for each transit strategy based on the maximum input value listed in the *Handbook.*

The following additional key assumptions were made throughout the analysis:

- VMT reductions apply only to passenger vehicles.
- VMT reductions are taken from the baseline discussed in Measure 1.
- Maximum VMT reductions are achieved by 2050 and half of the maximum reductions are achieved by 2030.
- Results in counties with partial bus service coverage were reduced 50% compared to counties with full coverage.
- Additional transit statistics were sourced from the Federal Highway Administration.[41]

Measure 3. Provide and promote new and expanded opportunities to reduce vehicle miles traveled through micromobility options and connected multimodal infrastructure.

This measure models resulting VMT and GHG emissions reduced if the Richmond MSA enhances its micromobility infrastructure by improving pedestrian networks, expanding bike networks, and implementing an electric bikeshare program throughout the MSA. The measure assumes these strategies only result in light-duty passenger vehicle VMT reduction. The potential VMT reduction due to each of these actions was calculated based on the methodology outlined in the *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity,* a document compiled for the

[41] U.S. Department of Transportation. National Household Travel Survey: 2017 Survey. Federal Highway Administration. n.d. https://nhts.ornl.gov/.

California Air Pollution Control Officers Association to provide methods for estimating GHG reductions resulting from various measures.[42]

Passenger vehicle VMT reduction due to micromobility enhancements was modeled for all counties in the MSA. The resulting passenger VMT reduction across the MSA is shown in the following table. Larger reductions are possible when this measure is paired with other items such as improved transit-oriented development, congestion and/or VMT pricing, encouragement of teleworking, and other disincentives for driving, which are not quantified as part of this PCAP measure and will be further reviewed as part of the CCAP process.

Strategy Name	2030 VMT Reduction	2050 VMT Reduction
Provide Pedestrian Network Improvement	-0.25%	-0.50%
Expand Bikeway Network	-0.0097%	-0.019%
Implement Electric Bikeshare Program	N/A	-0.0055%
Parking Pricing	-3.0%	-3.0%

Where calculation input data from specific plans were not available, conservative estimates were made for each micromobility strategy based on the maximum input value listed in the *Handbook*. The following additional key assumptions were made throughout the analysis:

- VMT reduction only applies to passenger vehicles.
- VMT reductions are taken from the baseline discussed in Measure 1.
- Maximum VMT reductions are assumed to be achieved in 2050. Half of maximum reductions are achieved by 2030, except for electric bikeshare which is assumed to be implemented after 2030, and parking pricing which is assumed to be fully implemented by 2030.
- Additional micromobility statistics were sourced from the Federal Highway Administration.[43]

Measure 4. Reduce GHG emissions from solid waste.

To estimate potential GHG reductions from Measure 4, a diversion rate was applied to the BAU projections for MSW tons buried in landfills. Starting from MSA current diversion rates of about 58% in 2019, the diversion rate was grown to 80% by 2050, in line with CVWMA's stated goal. This resulted in cumulative emissions reductions from the BAU of 2.29 $MMTCO_2e$ (million metric tons CO_2e) 2025–2030 and 24.64 $MMTCO_2e$ 2025–2050.

[42] California Air Pollution Control Officers Association. 2021. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. https://www.airquality.org/ClimateChange/Documents/Handbook%20Public%20Draft_2021-Aug.pdf
[43] U.S. Department of Transportation. National Household Travel Survey: 2017 Survey. Federal Highway Administration. n.d. https://nhts.ornl.gov/.

GHG Reduction Quantification Summary	Units	2019	2030	2050
Annual Measure Diversion Rate	%	58.4%	66.0%	80.0%
Total MSW Tons Created Annually	Tons	10,096,050	11,309,826	13,902,739
MSW Tons Buried After Diversion	Tons	4,203,322	3,840,476	2,780,548
Emissions Under Measure Scenario	MTCO2e	2,440,482	2,229,811	1,614,408
BAU Emissions	MTCO2e	2,440,482	2,733,884	3,360,660

Measure 5. Implement decarbonization strategies for municipal operations.

Since most localities in the MSA do not have GHG reduction goals in place for their operations, a target of reaching net zero emissions by 2050 was used to estimate the potential GHG reductions of fully implemented in the actions in Measure 5. This aligns with both the state goal of reaching economy-wide net zero emissions by 2050 (as set forth in the Virginia Clean Economy Act of 2020) and the City of Richmond's community-wide goal to achieve net zero GHG emissions by 2050. This resulted in cumulative emission reductions from the BAU of 0.42 $MMTCO_2e$ 2025–2030 and 7.29 $MMTCO_2e$ 2025–2050.

GHG Reduction Quantification Summary	Units	2019	2030	2050
GHG Reduction Goal Modeled	%	N/A	30%	100%
BAU Municipal Operation GHG Emissions	$MTCO_2e$	404,432	453,054	556,922
Measure Scenario GHG Emissions	$MTCO_2e$	404,432	317,138	0

Measure 6. Accelerate the Deployment of Energy Efficiency Solutions and Decarbonization of Residential and Commercial Buildings

This measure models GHG emission reductions achieved through building energy efficiency upgrades, replacement of fossil fuel-fired heating, hot water, and cooking equipment with heat pump and induction technologies, and reductions from achievement of increased distributed solar adoption.

Buildings Approach

Building energy use and building emission projections are based on energy consumption from electricity, natural gas, fuel oil, and propane in existing residential (single-family, multifamily, and mobile homes) and commercial buildings (office, food service, school, hotel, healthcare, retail, and warehouse). The base year and projections for energy consumption in existing buildings are built from the 2022 AEO, which represent projected energy user prior to the passage of the Inflation Reduction Act.[44] AEO data were scaled to the Richmond MSA counties by scaling AEO census level data with the ResStock and ComStock building models of North American building stock with county-level resolution.[45,46]

ICF's CO_2Sight™ platform and Distributed Energy Resources Planner (DER Planner) model were used to quantify the change in energy consumption from existing buildings under an

[44] "Annual Energy Outlook 2023 - U.S. Energy Information Administration (EIA)." March 16, 2023. https://www.eia.gov/outlooks/aeo/index.php.
[45] "ResStock Analysis Tool." n.d. Accessed February 19, 2024. https://www.nrel.gov/buildings/resstock.html.
[46] "ResStock Analysis Tool." n.d. Accessed February 19, 2024. https://www.nrel.gov/buildings/resstock.html.

accelerated electrification scenarios for heating, ventilation, and air conditioning (HVAC) as well as Water Heating and Cooking, and a High scenario for building envelope implementation. DER Planner is a bottom-up model that is built upon the best practice principles for potential modeling outlined by the National Action Plan for Energy Efficiency (NAPEE) in their Guide for Conducting Energy Efficiency Potential Studies.[47] DER Planner, informed by stock CO_2Sight measures data, has the capabilities to model various energy efficiency, electrification, and building envelope measures in selected building types. The model uses key inputs such as equipment stock, participation rate curves, and energy change per measure and estimates potential savings from applying efficient measures available for each building type and end-use. Given the efficient technologies available, this quantifies how much energy could be reduced. To compute total savings potential, the model runs all permutations combining savings per measure unit, expected measure penetration, and total number of measure units (or total eligible stock) by all adoption types (replace on burnout (ROB) and retrofit (RET)).[48]

Building characteristics and energy use data for modeling buildings under the selected scenario were derived from ResStock and ComStock datasets provided by the National Renewable Energy Laboratory (NREL). These datasets integrate large public and private data sources statistical sampling, detailed sub-hourly building simulations, and high-performance computing. By synthesizing multiple sources into a single resource, these data allow for a granular understanding of the housing and commercial stock and the impacts of building technologies in different communities and businesses. The ResStock and ComStock energy use data are calibrated to match the AEO dataset.

As an input into DER Planner, each measure has participation (or technology adoption curves) connected to them. A range of factors can impact whether new efficiency technologies are adopted. This approach builds from NREL's Electrification Future Study, from which many of the adoption curves are provided, and through the adoption curves accounts for changes in costs, supporting infrastructure, ownership and availability, health and sustainability (including policies) and other factors that could influence technology adoption.[49] Adoption curves are also provided from the implementation energy efficiency programs and informed by expert judgement. For ease of use, users can select prepopulated groupings of participation curves to match the types of energy change they want to model.

Key Assumptions

- Modeled high scenario for Building Envelope measures meaning high building envelope work and deep energy retrofits
- Modeling accelerated electrification scenarios for HVAC measures and Water Heating and Cooking measures meaning a large amount of electrification will occur
- BAU emissions factors (2019 eGRID held flat)

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[47] U.S EPA. "Guide for Conducting Energy Efficiency Potential Studies."2007. https://doi.org/10.2172/1219674.
[48] Measures' adoption type definitions: ROB or "replace on burnout" implies that the technology will be adopted when the previous technology needs to be replaced. RET or "retrofit" implies that the technology is adopted before the previous technology needs to be replaced.
[49] "Electrification Futures Study: A Technical Evaluation of the Impacts of an Electrified U.S. Energy System." n.d. Accessed February 19, 2024. https://www.nrel.gov/analysis/electrification-futures.html.

- Measure emissions factors (2019 eGRID changed based on 2023 AEO Reference Case)

Data Sources

- ComStock and ResStock data sets
- EPA's ENERGYSTAR Equipment performance thresholds
- Various state's Technical Reference Manual
- NREL's Electrification Future Study
- DOE's equipment purchasing profiles
- PNNL's Building Retuning materials
- EPA's GHG Emission Factors Hub
- Electric Grid Emission Factor Projections, AEO 2023
- EPA eGRID, 2019

Distributed Solar Approach

Emissions reductions from renewable energy were projected through the forecasted adoption of rooftop solar systems in the MSA. The total technical potential for rooftop solar was aggregated from Project Sunroof's estimates of the technical potential in each of the counties and cities in the MSA.[50] To determine an adoption rate, the most aggressive 2050 adoption scenario from NREL's Storage Futures Study (20%) was applied to the total technical potential.[51] For the MSA territory in Virginia, existing rooftop solar capacity assumptions were sourced from PJM's 2023 Load Forecast for the DOM zone and then grown to meet the assumed 2050 level.[52]

To calculate the kWh of solar output, the analysis used the capacity factor for residential solar from NREL's annual technology baseline corresponding to the geography of the MSA. The incremental growth in solar output from current levels, multiplied by grid emissions factors, resulted in the potential avoided emissions from rooftop solar.

Key Assumptions

- Constant technical potential per building over time
- Constant ratio of commercial to residential rooftop solar capacity
- No incremental rooftop PV installation beyond existing in BAU case
- Linear growth of PV installations between 2023 and 2050 in PCAP Policy Case
- BAU emissions factors (2019 eGRID held flat)
- PCAP Policy emission factors (2019 eGRID grown based on 2023 AEO Reference Case)

Data Sources

- Storage Futures Study: Distributed Solar and Storage Outlook: Methodology and Scenarios (2021), NREL
- 2023 Load Forecast, PJM (2023)
- Project Sunroof data explorer, (June 2019), Google
- Annual Technology Baseline, Residential PV (2023), NREL

[50] Google. "Project Sunroof". Accessed Feb 13, 2024. https://sunroof.withgoogle.com/
[51] NREL. "Storage Futures Study." https://www.nrel.gov/analysis/storage-futures.html
[52] https://www.pjm.com/-/media/library/reports-notices/load-forecast/2023-load-report.ashx

- Electric Grid Emission Factor Projections, AEO 2023 Reference Case
- EPA eGRID, 2019

Measure 7. Reduce emissions from port operations through the adoption of low-carbon fuels, electric equipment, and operational changes.

The GHG reduction calculations represented for ports target specific potential projects at select port facilities and locations. These include a set number of equipment and system upgrades and replacements for forklifts, vans, cruisers, shuttles, pickups, buses, and battery systems. As a state entity, the VPA will be implementing projects for its facilities across the state, not just for its facilities and operations within the boundary of the Richmond MSA. As such, both the Hampton Roads MSA and Virginia State PCAPs measures related to ports are complementary to this measure.

The project list for the Richmond port operations includes electrifying the following vehicles/equipment:

- 10 utility tractor rigs (UTRs)
- 6 top pick container handlers
- 9 pick-up trucks
- 1 specialty vehicle
- 2 mobile harbor cranes
- 5 light-duty, 2 medium-duty, and 1 heavy-duty forklift
- 5 Level 2, 28 Level 3, and 3 Level 4 EV charging stations
- 1 medium-sized battery storage system

To estimate the potential GHG emission reductions from **vehicle electrification**, EPA's GHG equivalency formula was used for passenger vehicles as well as port-wide average fleet fuel consumption to estimate annual CO_2e based on the amount of gasoline consumed. The EPA's GHG equivalency formula for passenger vehicles (using averages for VMT and MPG) based on CO_2e per gallon of gasoline shows:

8.89 × 10-3 metric tons CO_2/gallon gasoline × 10,746 VMT car/truck average × 1/22.9 miles per gallon car/truck average × 1 CO_2, CH_4, and N_2O/0.993 CO_2 = 4.20 metric tons CO_2e/vehicle /year

The Port's calculation utilized their fleet wide per vehicle fuel consumption average in place of the VMT*MPG numbers that the EPA's formula utilizes to generate average fuel consumption nationwide for passenger vehicles.

To estimate the potential GHG emission reductions from the **battery storage** system, the usage of the battery was estimated in terms of annual avoided grid electricity consumption. The emissions from that avoided electricity use were calculated using an emissions factor projection created using eGRID data and information on the local utility, Dominion Energy. The EPA eGRID region SRVC was used for a starting grid emissions factor. Dominion's Integrated Resource Plan and grid decarbonization target from the Virginia Clean Economy Act were then used to create an emissions factor projection for the region.

To estimate the potential GHG emission reductions from the **electrification of port equipment**, EPA's Diesel Emissions Quantifier tool was used to calculate CO_2 and NO_x, which were used to calculate CO_2e.[53] Assumed all equipment would be free of tailpipe emissions in 2040 according to the Port's net-zero goal of 2040. Fuel usage/usage hours as well as engine years and other inputs came from internal fleet data for Richmond and knowledge of normal use.

[53] https://cfpub.epa.gov/quantifier/index.cfm?action=user.account